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**Part 1      General**

**1.1            DESCRIPTION OF WORK**

- .1      The work shall consist of the construction of electrical work as shown in the Plans and as described in the Specifications.

**1.2            STANDARDS**

The following organizations publish standards which have been referred to in this Section:

- .1      Manitoba Electrical Code
- .2      Canadian Electrical Code
- .3      Canadian Standards Association (CSA International)  
178 Rexdale Boulevard,  
Etobicoke, ON M9W 1R3
- .4      Manitoba Hydro  
820 Taylor Ave.  
Winnipeg MB

The Standards referred to shall be the most recent edition.

**1.3            REFERENCED STANDARD DETAILS**

- .1      SD-37 Buried Cable Detail

**1.4            QUALITY ASSURANCE**

**.1            QUALIFICATIONS**

All electrical work shall be performed by journeymen electricians who hold a valid licence as issued by the Province of Manitoba. Electronic service technicians provided by the manufacturer, supplier or their agent(s) shall be utilized in wiring and calibration of specialized electronic equipment

**.2            TESTING**

The Contractor shall test the operation of the completed electrical works for direct inspection by the Engineer

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## **1.5 STORAGE AND HANDLING**

- .1 All products associated with the construction of the electrical work shall be stored and handled in accordance with the requirements of CSA International or the recommendations of the manufacturer, or as directed by the Engineer.

## **1.6 INSPECTION**

- .1 Inspection of the work described in this Section shall be performed by the Engineer or his authorized representative and certified by Manitoba Hydro.

## **1.7 SCOPE OF WORK**

- .1 The Contractor shall include the furnishing of labour, new material, equipment and services necessary for and incidental to the complete installation of the electrical work as shown on the Plans and as hereinafter specified.
- .2 The specifications shall be considered an integral part of the Plans which accompany them. Neither the Plans nor the specifications shall be used alone, and all services, materials or apparatus, etc., omitted from one but mentioned, shown or reasonably implied in the other shall be considered as properly and sufficiently specified and shall therefore be supplied and installed by the Contractor.
- .3 Unless otherwise specified in this section of the specifications, the Contractor shall supply and install all devices required for the complete system, and for its operation to the complete satisfaction of the Engineer.

## **1.8 CODES AND REGULATIONS**

- .1 The entire electrical installation shall comply with the Canadian Electrical Code and with all Provincial, Municipal, CSA International, and Manitoba Hydro, Codes and Regulations.
- .2 Where there is a conflict on the Plans or with the specifications, the above noted Codes, Laws, Rules, Regulations and Ordinances shall govern.
- .3 The Contractor shall coordinate and obtain from Manitoba Hydro all necessary permits and pay all fees.
- .4 Upon completion and before final payment is made, the Contractor shall present to the Engineer a “certificate of approval” or “acceptance” for all electrical work from all applicable inspection authorities and Manitoba Hydro.

## **1.9 SITE VISIT**

- .1 The Contractor shall examine the site and local conditions affecting the work under this Contract. He shall also carefully examine the structural, mechanical

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and architectural drawings to be certain that the electrical work can be satisfactorily carried out without changes to the building or site as shown on these Plans, and before commencing the work, he shall examine the work of the other trades and report at once any defect or interference affecting the work of this section or the guarantee of same.

- .2 No extra compensation will be allowed the Contractor due to his failure to make this examination.

## **1.10 WORK OF OTHER TRADES**

- .1 The Contractor shall refer to Mechanical, Structural and Architectural Plans and specifications for electrical work in connection herewith. Where such work is included in this section of the specifications, the Contractor shall install such equipment, etc., as specified and in accordance with the approved shop drawings.

## **1.11 GUARANTEE**

- .1 The Contractor shall guarantee the satisfactory operation of all work and apparatus included and installed under this section of the specifications. The Contractor shall replace forthwith, at no additional cost to the Owner, any part which may fail or prove defective within a period after the final acceptance of the complete installation as per Section GC: 12 provided that such failure is not due to ordinary wear and tear. No certificate given, payment or partial use of the equipment by the Owner shall be construed as acceptance of defective work. This guarantee shall not act as a waiver of any specified guarantee for any greater length of time.

## **1.12 ADDITIONS TO OR DELETIONS FROM WORK**

- .1 Should the Owner or Engineer desire to make changes whereby certain work is deleted, or added, the Contractor shall submit an itemized cost estimate to the Engineer.

## **1.13 ALTERNATE MATERIALS**

- .1 The Contractor's application for approval of alternate materials or methods which may be substituted for those specified, must be submitted to the Engineer not later than five (5) working days before the tender closes as per Instruction to Bidders.

## **Part 2 Products**

### **2.1 IDENTIFICATION LABELS**

- .1 The Contractor shall affix lettering on all electrical equipment.

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- .2 The identification shall be by means of approved lamacoid plastic markers (self adhesive), installed on each switch, switch unit, panelboard, switchboard, motor starter, contactor, etc.
- .3 The descriptive lamacoid designations shall be in accordance with that shown on the Plans, e.g. Panel 'A', Motor 'M1' etc. Minimum size of markers shall be 12 x 65 mm except service entrance equipment which shall not be less than 38 x 65 mm. Markers shall be black with white letters except fire alarm, emergency and warning shall be red with white letters

## 2.2 CONDUCTORS

- .1 Wire and cable shall be rated and installed where indicated on the Plans and as specified, and shall not be installed at a temperature that will cause breakdown to the insulation. Unless otherwise noted, the minimum wire size for lighting branch circuits and remote control wiring, convenience and special outlets, motors, etc., shall be AWG sizes of conductors. Where reference is made in the code to AWG size, this shall mean the copper AWG size, unless otherwise specified.
- .2 Wire installed in conduit feeders to all panelboards, shall be Type R90 copper.
  - .1 Types of wire shall be rated at 600 volts or less at 90°C, with solid or stranded insulated copper conductor.
  - .2 The basic colour coding for branch circuit wiring and feeder conductors and cables shall comply with the Electrical Code.

## 2.3 OUTLET BOXES

- .1 Unless otherwise specifically specified, outlet boxes for the various types of outlets shall be corrosion resistant (PVC) as hereinafter described:
  - .1 SURFACE MOUNTED OUTLETS (interior):

Surface mounted outlet boxes shall be of the PVC construction type and boxes for outlets other than lighting fixture outlets shall be equipped with suitable cover plates to accommodate the specified switch, convenience receptacle, etc. Outlets installed at sink shall be GFIC weatherproof.
  - .2 SURFACE MOUNTED OUTLETS (exterior):

All exterior outlet boxes shall be weatherproof of the types shown or noted on the Plans and be complete with weatherproof covers.
  - .3 Outlets in hazardous areas shall meet Electrical Code requirements.

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## .2 INSTALLATION

- .1 Approved fixture studs shall be installed at all outlet boxes or where lighting fixtures are specified. All boxes shall be rigidly attached to the building structure in an approved manner. Refer to clause 3.12 “Mounting Heights” for specified mounting heights.
- .2 Where blank coverplates are installed on outlet boxes, they shall match the outlet boxes

## 2.4 MOTORS

- .1 The Motor Schedule if included in the specifications identifies the motors. Motors are designated indicating electric characteristics, approximate location and brief description of unit. They are as accurate as possible but are supplied for convenience only. For listing of motors refer to “Motor Schedule”.
- .2 Refer to clause 3.11 “Installation and Wiring of Controls”.
- .3 Where indicated to operate with Variable Frequency Drives, motors shall be rated for use with the Variable Frequency Drives.
- .4 Provide motor starting switches and disconnect switches as required.

## 2.5 MOTOR CONTROL

- .1 All motor starters and controls shall be of the same manufacturer. Approved motor control manufacturers can be found in the Listing of Approved Products or as otherwise approved by the Engineer.
- .2 Starters and control type designations shall be as described below. Starters shall be supplied in conformance with the appropriate description and shall be complete with control accessories. Remote control devices shall be supplied in accordance with the designations and any further relevant requirements noted on the Plans and in the specifications.
  - .1 **STARTER TYPE “A”**

Manual motor starting switch, full voltage, shall be rated in horsepower and voltage not less than the motor controlled and not less than 125% of the nameplate amperes and shall be supplied complete with necessary number of poles and approved overload protective devices. External reset facility shall be provided, complete with pilot light.
  - .2 **STARTER TYPE “B”**

Magnetic motor starter, full voltage, non-reversing, shall be rated in horsepower, amperes and voltage not less than the nameplate ampere rating of the motor controlled and shall be supplied complete with the necessary number of poles, auxiliary contacts and the approved overload

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relays. An external mounted reset button shall be provided, and pilot light. Include 120 volt control transformer as required.

.3 STARTER TYPE “C”

Magnetic combination starter, circuit breaker type full voltage, non-reversing, shall be rated in horsepower, amperes and voltage of not less than the nameplate rating of the motor controlled complete with the necessary number of poles, necessary auxiliary switches and approved overload relays. An externally mounted breaker operating handle shall be provided on a hinged door interlocking with the door such that the door may not be opened unless the breaker is open. Provision shall be made to lock the handle in either “OFF” position or “ON” position. An externally operated cover mounted reset button shall be supplied, as well as 120 volt control transformer, fixed as required.

.4 VARIABLE FREQUENCY DRIVE

Variable frequency drive shall convert the input AC main power to an adjustable frequency and voltage. Input power section shall have an internal 5% line reactor and an external 5% line reactor that maintains the electrical approval of the system. The line reactor should provide a minimum of 5% impedance based on the drive operating at its continuous output current rating. The input power section shall convert fixed voltage and frequency, AC line power to fixed DC voltage. The DC voltage shall be filtered. The output power section shall change fixed DC voltage to adjustable frequency AC voltage. The AC Drive’s output shall be connected to an output load reactor for distances shorter than 30 m, or dv/dt filter for distances longer than 30 m. Variable frequency drive shall be sized to operate a variable torque load and the motor speed range shall be from a minimum of 1.0 Hertz to a maximum speed of 60 Hertz.

.3 The following designations describe control devices either mounted in the starter or remote as indicated in the “Motor Schedule”.

.1 TYPE “DD”

start-stop pushbutton station complete with pilot light, momentary contact type on starter box.

.2 TYPE “EE”

hand-off-automatic selector switch and pilot light. Switch shall maintain position as selected.

## 2.6 MOTOR FEEDERS

.1 Feeders shall be installed where indicated on the Plans and schedules. Installation shall comply in every respect with the Canadian Electrical Code and Province of Manitoba rules, regulations and codes.

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## **2.7 FUSES**

- .1 All fused type switches mentioned in the specifications or shown on the Plans shall be installed complete with fuses of the type required. All fuses shall be non-renewable type as recommended by Code.

## **2.8 PUSHBUTTON STATIONS**

- .1 Pushbutton stations shall be flush or surface type as required. One selected type shall be used throughout and stations shall be supplied complete with pilot lights where shown on the Plans.

## **2.9 TIME SWITCHES**

- .1 Where shown on the Plans, supply, install, wire and connect all time switches. Time switches shall be of the type and rating as required.

## **2.10 PANELBOARDS**

- .1 Panelboards shall consist of cabinet, trim, removable interior, and door cover finished with concealed hinges and flush chrome plate lock and snap catch. All locks shall be keyed alike.
- .2 The cabinet shall be constructed of heavy gauge sheet steel, with interior provided with adequate wiring space for the conductors involved.
- .3 Flush mounted cabinets shall not exceed 120 mm in depth unless otherwise specified or indicated on the Plans.
- .4 On the inside of each panelboard there shall be provided a typewritten directory indicating the specific use of each individual circuit breaker. The directory shall be mounted in a metal holder complete with clear plastic cover. Consecutive numbering strips shall be supplied on the panelboard.
- .5 The circuit breaker supplying branch circuits of systems equipment, emergency lighting units and trace heating shall be equipped with circuit breaker stays.
- .6 Each panelboard shall be identified in compliance with clause 2.1, "Identification Labels". The location of the labels shall be to the satisfaction of the Engineer.
- .7 Panelboards shall be mounted as per the most current edition of the Electrical Code.
- .8 Panelboards shall employ moulded case type circuit breakers.
- .9 Refer to Panelboard Schedule where shown on the Plans.
- .10 All breakers shall be standard full width breakers unless otherwise noted.
- .11 Fillers shall be provided in all panelboard spaces not occupied by breakers.

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- .12 All panelboards shall be of the same manufacturer for the entire project.

## **2.11 LIGHTING FIXTURES**

- .1 The Contractor shall supply and install where shown on the Plans, and as specified, the lighting fixtures complete with all glass, suspension devices, lamps and tubes and other attachments as hereinafter described or required to give the best possible appearance and installation.
- .2 The lighting fixtures are identified on the Plans by means of alphabetical type designations or are described as a certain type. Lamps shall be of a colour and type selected by the Engineer. Approved fixed backplate supports shall be installed where electrical discharge fixtures are specified.
- .3 Fixtures are described and catalogue numbers mentioned for the purpose of establishing a standard of quality which shall be adhered to.
- .4 The Engineer reserves the right to make a choice among fixtures or substitutes of equal value and/or to adopt any other fixtures subject to an adjustment of cost to the Contractor. This right shall be reserved at all times up to the termination of the Contract.
- .5 All fixtures shall carry the approval of CSA International and/or the approval of the Inspection Authority having jurisdiction.
- .6 Where, in the opinion of the Engineer, the appearance of the fluorescent fixture is affected by the colour of the lampholder, the Engineer reserves the right to require "white" lampholders.
- .7 Interior LED vapour tight light fixtures shall be surface mounted sealed and gasketed luminaires for wet locations with 120/277V, 5000K and 24000 lumens.
- .8 Exterior LED light shall be wall mounted 15W, 120/277V, 3000K, 1725 lumen and suitable for ambient temperature range from -40°C to +40°C.
- .9 All fluorescent lamps shall be high efficiency energy saving type, 2800 lumens after 100 hours.
- .10 All incandescent lamps shall be of the extended service type, rated 130 volts.

## **2.12 WIRING DEVICES**

- .1 Wiring devices are described and catalogue numbers mentioned for the purpose of establishing a standard of quality which shall be adhered to.
- .2 Wiring devices shall be premium quality, specification grade, and heavy duty construction rated as indicated.
- .3 Wiring devices shall be matching colour with PVC coverplates.

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- .4 Wall Switches:
  - .1 Single pole toggle, 15 ampere, 120V AC rated.
- .5 Convenience Receptacles:
  - .1 Specification grade, 15 ampere, 120V AC rated 'U' ground receptacle with break-off feature for split circuit application.
- .6 Outdoor Receptacles:
  - .1 Duplex type, 15 ampere, 120V AC rated 'U' ground duplex receptacle complete with weatherproof cover, attached to outlet box at all four corners. All outdoor receptacles shall be of GFI type or protected by GFI circuit breaker.

## **2.13 LIGHTING FIXTURE SCHEDULE**

- .1 TYPE "A"  
Interior LED vapour tight light fixtures shall be surface mounted sealed and gasketed luminaires for wet locations with 120/277V, 5000K and 24000 lumens.
- .2 TYPE "B"  
Exterior LED light shall be wall mounted 15W, 120/277V, 3000K, 1725 lumen and suitable for ambient temperature range from -40°C to +40°C.

## **2.14 MOTOR PANEL**

- .1 Motor panel shall be as indicated on the Plans, complete with all the relays, contacts, pilot lights, etc., to provide operation as detailed. The panel shall be approved by Manitoba Hydro.
- .2 Motor panel shall be complete with all items indicated on the Plans and shall be complete with the following:
  - .1 EEMAC 12 Enclosure.
  - .2 Hinged lockable door. Door to contain pilot lights, pushbuttons, etc.
  - .3 Backboard.
  - .4 Terminal strips (identified) for all wiring.
  - .5 Extra flexible wire to door components.
  - .6 Identification labels on all components - interior and exterior.
  - .7 All necessary approved components.
  - .8 All Electrical Drawings shall be stored in "Clear Panel" drawers in electrical panel.

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## **2.15 MOTOR CONTROLS**

- .1 Motor starters shall be combination starters as indicated on the Plans, and shall be complete with:
  - .1 Circuit breaker
  - .2 Magnetic starter
  - .3 Elapsed time meter as shown
  - .4 Auxiliary contacts as required
  - .5 Control transformer
  - .6 Identification
  - .7 Overloads in all phases
- .2 Refer to “Motor Schedule” on Plans for motor ratings.

## **2.16 LIQUID LEVEL CONTROL PANEL**

- .1 The Liquid Level shall be included in the motor control panel, complete with all the relays, pilot lights, etc., to provide operation as detailed in Section 00 10 01, Special Provisions, or as shown on the Plans.

## **Part 3 Execution**

### **3.1 RESPONSIBILITY**

- .1 The Contractor shall be responsible for any damage caused to the Owner by the Contractor improperly carrying out any work under this Contract.
- .2 The Contractor shall provide and install all fittings, sleeves and appurtenances, where required, prior to the placement of concrete or similar work. Should there be any cutting and repairing of unfinished or finished work required, it shall be carried out by the appropriate sub-trade. Before being undertaken such work shall be laid out for the Engineer’s approval.
- .3 The work shall be arranged in co-operation with other trades in such a manner as to not interfere with other work being carried on. In such places where other pipes or ducts must be installed along with conduits, the work shall be co-ordinated to achieve the best possible arrangement.
- .4 Excavation and backfilling where required shall be the responsibility of the Contractor and in accordance with Clause 3.15 of this section.
- .5 The Contractor shall protect finished and unfinished work from damage due to his operations. Floors and other work shall be covered with tarpaulins if necessary. All damage to floor surfaces resulting from the Contractor's construction

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operation shall be repaired without expense to the Owner and to the satisfaction of the Engineer.

- .6 If power tools are used to cut conduit necessitating the use of cutting oil, metal drip pans shall be used to protect floors and concrete slabs. Pans shall be emptied regularly.
- .7 Tools, surplus and waste material shall be removed and the premises left in a clean and satisfactory condition after completion of the electrical work.

### **3.2 WORKMANSHIP**

- .1 The Contractor shall execute all work in a first class and workman like manner. All supports, hangers and securing devices shall be solid and shall be installed neatly in appearance and shall be arranged for simplicity of installation, accessibility and efficiency.
- .2 Panelboards and other cabinets, as well as switch boxes, etc., shall be rigidly attached to the structure by means of lag bolts, or other approved means of support.

### **3.3 TESTING**

- .1 The entire electrical installation shall be tested when completed to ensure that the system is free from short circuits and ground faults. The insulation resistance shall be in compliance with the latest edition of the Canadian and/or Manitoba Electrical Code. If this insulation resistance test is less than required by the Code, the defective circuits or equipment shall be replaced.
- .2 At completion of the installation, voltage tests shall be conducted in the presence of the Engineer or his authorized representative and transformer taps adjusted or other corrective measures shall be carried out as designated by the Engineer or his representative.
- .3 The Contractor shall measure the phase current to all panelboards with normal loads operating at time of acceptance and adjust branch circuit connections as required to obtain the best balance of current between phases and record all changes.
- .4 The Contractor shall fill out a "Motor Data Sheet" for each single phase and 3-phase motor.

### **3.4 GROUNDING AND BONDING**

- .1 The Contractor shall supply and install a bare copper stranded grounding conductor. The conductor shall be connected in an approved manner to the main distribution and other service switches including the service neutral conductor in

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full compliance with the Code ground regulations, Section 10 Canadian Electrical Code. Grounding conductors shall be protected where exposed to mechanical injury by approved methods. All service and other equipment requiring grounding by the Electrical Codes shall be grounded. The grounding system shall be so arranged that under operating conditions, no excessive amount of current will flow in any grounding conductor.

### **3.5 OPERATION AND MAINTENANCE**

- .1 The Contractor shall supply three (3) copies of the manufacturer's instructions to the Engineer for each piece of major equipment apparatus as per GC 4.52. Instructions shall be complete for installation, operation and maintenance and shall include the names of spare parts, suppliers and their addresses. The Engineer shall designate which equipment shall require this information.

### **3.6 TEMPORARY LIGHTING AND POWER**

- .1 All temporary light, power and costs of installation shall be paid by the Contractor.

### **3.7 RIGHT TO CHANGE LOCATIONS**

- .1 The right to change locations of outlets, switches, etc., to within 3.0 m of points shown is reserved by the Engineer provided that such change is requested prior to roughing-in. These changes do not include major items such as panelboards, motor control centres, etc.

### **3.8 SHOP DRAWINGS**

- .1 The Contractor shall submit all required shop drawings in accordance with these requirements.
- .2 All major equipment such as main distribution, sub-distribution, transformers, lighting fixtures, etc., as well as auxiliary systems and their associated devices shall be submitted for approval on Equipment Shop Drawings, drawn to a scale approved by the Engineer. Submit shop drawings as per GC 4.42.
- .3 The Contract Plans shall be considered as diagrammatic, since the actual locations of the runs of conduit, ducts, cables, etc., and locations of the specified and/or required pull boxes shall be installed as required by the Canadian and/or Manitoba Electrical Code so as to give the best possible layout.
- .4 The Contract Plans do not show all the structural details and any information involving accurate dimensions shall be taken from the figured dimensions on the Plans or by measurements at the site. The Contractor shall make, without

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additional charge, any necessary changes or additions to the runs to accommodate any existing and proposed structural conditions.

- .5 As the work progresses, and before installing fixtures and other fittings and equipment which may interfere with the treatment or use of the installation, the Contractor shall consult with the Engineer and obtain instructions for the exact locations of such equipment.
- .6 The Plans indicate the general locations and route to be followed by the conduit and ducts which are to be installed under this Contract. Where the required conduits, ducts and boxes are not shown on the Plans, or only diagrammatically, they shall be installed in such a way as to conserve the maximum head room. Maximum head room above the floor shall be maintained under all suspended conduit, ducts, etc., unless otherwise shown on the Plans or approved by the Engineer. Conduits shall not be installed directly on floor.

### **3.9 WIRING METHOD**

- .1 Unless otherwise specified, shown on the Plans, or required by the Electrical Code, all systems shall be wired in rigid PVC conduit.
- .2 Wiring shall be surface mounted unless otherwise indicated in the specifications or shown on the Plans. All devices shall be surface mounted type except where shown otherwise. Where surface mounting is not possible, wires and cables shall be installed in conduit and neatly supported by channel and/or backboard support system to nearest overhead cable tray, or as otherwise approved by Engineer.
- .3 12.5 mm conduit is the minimum acceptable and shall not be reduced without the approval of the Engineer.
- .4 Joints in feeders shall be kept to a minimum. Where joints are required, they shall be made with solderless connector, "Marretts" or approved equal.
- .5 Couplings, terminal adapters, female adapters shall be of the PVC type or equal. PVC fittings shall be installed in all areas.
- .6 Outlet, junction and pull boxes shall be PVC rigidly supported, CSA International approved and of the size shown on the Plans and/or as otherwise required by the Electrical Code. Vertical runs of conduit shall be equipped with pull boxes containing approved wire strain supports at intervals as required by Code.
- .7 Wire or cable shall not be pulled into conduit until rough building operations are complete. When pulling conductors into conduit, lubricant which is harmful to the conduit or to the insulation of the conductors shall not be used. Contractor shall pull wire or cable through conduit at a velocity that does not damage the exterior of wire or cable due to friction or any other means.

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- .8 Conduit shall be laid out so as to avoid interference with other work. Conduits shall be at least 150 mm clear of all flues, steam pipes, etc.
- .9 Where runs are exposed on the surface, conduit shall be supported at intervals not exceeding 1.5 m and shall be run on the square, parallel with the building structure, beams, etc. Where conduits are run in close proximity with other conduits, they shall be grouped and installed in a neat and workman like manner, properly supported with approved hangers, securely anchored. Maximum headroom shall be maintained at all times.
- .10 Conduit ends shall be cut square to ensure that conduits butt in couplings and other fittings. Conduits shall be free of dents and bruises and shall be installed with long bends. Unless otherwise designated, junction boxes shall be installed in those runs where more than four bends are necessary and pull boxes shall be installed where conduit exceeds 18.0 m in length.
- .11 Branch circuit wiring shall be installed as shown on the Plans and in full compliance with Electrical Code regulations.
- .12 Liquid-tight flexible connections shall be provided to all motors and miscellaneous equipment.

### **3.10 EXPANSION JOINTS**

- .1 All conduits entering outlet boxes and devices that are located in walls subject to movement shall be terminated by means of liquid-tight flexible conduit, approximately 450 mm in length between the PVC conduit and the outlet box or device which is being supplied.
- .2 All conduits, bus duct, wireways, etc., passing through or across expansion joints in the building shall be installed along with the use of approved expansion fittings.

### **3.11 INSTALLATION AND WIRING OF CONTROLS**

- .1 All motor starting switches and controls shall be supplied, installed, wired and connected under this section unless otherwise specified in the Mechanical Section. This shall also include the supply and installation of required auxiliary contacts, relays, and fire alarm shut-down of mechanical equipment, etc.
- .2 Reference shall be made to Mechanical Plans and Specifications for specific details of electrical work to be done in connection with mechanical control equipment and control wiring.
- .3 The Contractor shall install, wire and connect all remote mechanical equipment controls and devices in the building which require electrical connections, unless otherwise stated in Mechanical Specifications.

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### **3.12 MOUNTING HEIGHTS**

- .1 Devices shall be installed at the following heights:
  - .1 Wall switches – 1370 mm
  - .2 Convenience Receptacles - 990 mm
  - .3 Wall Thermostats - 1450 mm
  - .4 Counter Outlets - 200 mm above counter top

### **3.13 MECHANICAL EQUIPMENT**

- .1 References shall be made to the specifications as well as to the Plans.
- .2 All indicated line and control voltage wiring and control equipment shall be supplied and connected.
- .3 All electrically operated mechanical equipment shall be wired, connected and grounded in an approved manner.
- .4 Prior to final connections all electrical characteristics shall be checked and verified and all adjustments made for approved and fully operative installations

### **3.14 PLYWOOD MOUNTING BOARDS**

- .1 Surface wall mounted panelboards and other electrical equipment shall be installed on plywood mounting boards. The mounting boards shall be sized to suit the equipment.
- .2 Plywood mounting boards shall consist of 20 mm fir plywood fastened securely to the wall.
- .3 Plywood mounting boards, strapping and trim shall be treated with wood preservative prior to installation and painted with one coat of primer and two coats of grey enamel ASA61. Painting shall be completed before any electrical equipment is mounted on the plywood.

### **3.15 TRENCHING AND BACKFILLING**

- .1 All trenching and backfilling as necessary for installation of underground cables, etc., shall be the responsibility of the Contractor.
- .2 Underground installation includes but is not limited to control and power conductors.
- .3 Trenching shall be approximately 1000 mm in depth, trenching width to suit proper installation.

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- .4 Backfill for trenches for all direct buried cables, ducts, conduits, etc., unless otherwise specified by the Engineer, shall consist of fine sand (minimum 150 mm below and above cables etc.) firmly compacted. Backfill finishing material shall be as indicated on the Plans or as specified by the Engineer.
- .5 All direct buried cables, ducts, etc., crossing over each other or over/under other types of underground service shall be encased in wood planks.
- .6 Frozen earth, large lumps or boulders shall not be used for backfill material.
- .7 Treated wood planks shall be provided over all buried cables, etc., and under existing or future roads and sidewalks, when installed in an open trench.
- .8 Sleeves shall be provided under all parking, concrete and traffic areas.

### **3.16 ELECTRICAL HEATING**

- .1 Electric space heating equipment where shown on the Plans shall be supplied and installed together with the associated control apparatus as specifically described. A completely operable electric heating system shall be provided as specified, and shown on the Plans and as satisfactory to the Engineer

### **3.17 SERVICE AND MAIN DISTRIBUTION SYSTEM**

- .1 The distribution system shall be fully operative and shall be supplied, installed, wired and connected complete from the service point through to the final outlets to provide an approved installation complete with all necessary equipment, devices, wiring materials, etc.

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