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1.0 Scope

The specification covers the requirements for the supply and delivery of the 36-circuit traffic signal controller cabinet assemblies in accordance with City of Toronto requirements and standards, and as shown in Toronto Transportation Drawings TTD 809.020, TTD 809.021, TTD 809.022, TTD 809.023, TTD 809.025 and TTD 809.027.

2.0 Reference

All materials and equipment shall be of the best quality and latest design and used for their intended purpose. They shall conform to the most recent standards, specifications or publications. See below.

Toronto Transportation

- TTS 809.100
- TTD 809.020
- TTD 809.021
- TTD 809.022
- TTD 809.023
- TTD 809.025
- TTD 809.027

Others:

CSA C22.2 No. 65-03 - M88 Wire Connectors.
CAN/CSA-C22.2 No. 75-03 Thermoplastic Insulated Wires & Cables.
CSA C22.2 No. 211.2-M1984 (R2003) - Rigid PVC (Unplasticized) Conduit.
CSA C22.2 No. 197-M1983 (R2003) - PVC Insulating Tape
NEMA Standard No.: TS 1-1989 and all revisions.

3.0 Definitions

The terminology used in this specification reflect definitions as defined in following documents:

- Toronto Transportation - TTS 809.100; and
- NEMA Standard No.: TS 1-1989 - Section 1.

For the purpose of this specification any reference to “NEMA Standards” shall refer to the NEMA Standard No.: TS 1-1989 and all revisions.

4.0 Design Requirements

No component shall be of such design, fabrication, nomenclature, or other identification as to preclude the purchase of said component from a wholesale electronics distributor or from the component manufacturer, except as noted.

To the highest practicable degree, the unit shall be engineered for simplicity and ease of operation and maintenance.

All electronic equipment shall be solid state and constructed in accordance with the latest technology. Use of electrical-mechanical devices will require the final approval of the Commissioner.

5.0 Materials

5.1 General

All cabinet brackets, mountings, bands, bolts, nuts, washers and other fittings or accessories shall be of aluminum or stainless steel.

Each complete controller assembly shall be supplied with all necessary components, accessories, wiring, etc., to provide for fully actuated operation and shall include :

a) Conflict Monitor;
b) Load Switches
c) Flashers
d) Cabinet Assembly;
e) Cabinet Power Supply
f) Flash Transfer Relays.

Each cabinet assembly shall support Ontario Fast Flash for flashing advanced green indications. The cabinet assembly shall be configured to NEMA Standards in one of two possible configurations: either a four- (4) phase unit, or an eight- (8) phase unit. The configuration and number of the assembly units shall be indicated on the tender form upon ordering. However, the supplier shall the wire each assembly to support the maximum phase assignment as shown below regardless of the composition of the tender:

Phase 1 & 5	Main Street Left Turn Movements
Phase 2 & 6	Main Street
Phase 3 & 7	Side Street Left Turn Movements
Phase 4 & 8	Side Street

In addition, the terminal facilities shall be wired to allow future modification of the assembly from a four-phase to an eight-phase configuration (this includes detector and output assignments).

6.0 Construction and Materials

6.1 Load Switches

Signal load switches must meet or exceed NEMA Standards.

Twelve (12) load switches shall be supplied with each cabinet.

6.2 Conflict Monitor Unit

The Conflict monitor unit must meet or exceed NEMA-TS-1 specification operational standards, and should meet the physical standards.

Each cabinet must be supplied with a Liquid Crystal Display conflict monitor unit, and be able to:

a) Monitor Ontario Fast Flash;

b) Detect and respond to improper and conflicting signals, and improper operating voltages in a controller assembly.

A twelve (12) channel conflict monitor shall be provided with dual ring controller timers. Each channel shall have four (4) independent inputs. When a conflict is detected, the conflict monitor shall place the controller in the emergency flash mode, and apply 'stop timing' to the controller.

Through software, the monitor shall be capable of detecting conflicting indications of Ontario Fast Flash green (having a flash rate from 120 fpm up to 180 fpm (±10 percent) on one (1) channel against an Ontario Fast Flash green on a conflicting channel. The conflict monitor shall be equipped with a real time clock to mark the time and date of each fault occurrence.

Prior to the acquisition of conflict monitor units, the final approval of the Commissioner is required, which may require that the supplier provide a sample for testing and evaluation.

Cabinet supplier shall provide a test report for each conflict monitor unit.

6.3 Flasher Units

Flasher units for emergency flash must meet or exceed NEMA Standard TS 1-1989 - Section 8.

Each cabinet shall be provided with a solid state 20 ampere flasher mechanism arranged to provide, with equal duration, one on and one off period per second (60 flashes per minute). The flasher shall be so mounted and connected that it remains in place and in operation while the rest of the controller timing unit is removed from the cabinet.

The flasher shall be supplied complete with all necessary switches and control relays. When selected for operation, the flasher shall provide a direct connection between the power supply circuit breaker terminals and selected signal terminals while at the same time, the power supply from whatever source to all other signal terminals shall be disconnected. The signal terminals to be supplied with power through the flasher shall be easily selectable and readily changeable at any time.

6.4 Flash Transfer Relays

Four flash transfer relay sockets and heavy-duty relays shall be provided for the configuration of each controller back panel, as per NEMA Standard TS 1-1989 - Section 10.3.4.1.

The coil of the flash transfer relay(s) shall be de-energized for flashing operation.

Relay Mounting is described in Transportation Drawing TTD 809.023.

6.5 Cabinet Assembly

The sturdy weatherproof base mounted controller cabinet shall be supplied in a state ready for field installation to meet or exceed NEMA Standards.

The controller cabinet shall consist of:

a) A NEMA Standard, Size 5 – Type M base mounted unit, with police door compartment and a shelf as shown in Toronto Transportation Drawing TTD 809.021;

b) A base extension unit with communication terminal compartment as shown in Toronto Transportation Drawing TTD 809.027;

c) Bell Terminal Housings will be supplied in accordance with the City of Toronto's requirement in order to interface to Bell Canada communication lines

6.5.1 Enclosure

The overall M type cabinet enclosure comprise main cabinet plus base extension unit which shall be bolted together with stainless steel hardware. One piece 3mm neoprene gasket shall be provided between them.

The cabinet enclosure shall be provided with a two-position doorstop rail with a stop wheel to enable the main cabinet door to be securely held open at increments of 90º and 120º.

The entire perimeter of each door opening on the cabinet shall have a 17 mm flange to act as a rain gutter when any of the cabinet doors are open.

An internal ground base flanged lip of 70-mm width shall be incorporated around the entire inside bottom edge perimeter. This flange must allow the enclosure to sit flat against the aluminum controller cabinet base unit that it will be mounted upon.

Cabinet must meet the following requirements:

a) Be constructed of 3.2 mm thick, Type 5052-H32, sheet aluminum, all welded construction. All welds shall be continuous in all seams;

b) Incorporate a 25 mm slope towards the rear of the top of the cabinet, to prevent rain accumulation;

c) Have a smooth exterior, with rounded corners and be neat in design and appearance;

d) The interior and exterior of the enclosure, main door, police door, shelf and base extension unit shall be thoroughly cleaned and degreased, primed with zinc chromatic based rust inhibiting primer coat and finished with 2 mils (tolerance +10%, -0%) of baked enamel powder paint, colour "Muncell Grey" (ASA 61 or ASA 70) or city-approved equivalent.

e) Provide a one-piece closed cell neoprene gasket, adhesive on one side, 10 mm thick, 75 mm wide, 3 meters long to install between the concrete pad and the bottom of the cabinet base extension unit.

f) Exterior surface of the cabinet shall be free of any labels and writings;

g) All doors shall close and secure tightly with a closed cell neoprene gasket, providing a weatherproof seal.

h) Load switch panel, controller interface panel, field distribution panel, test panel and power supply panel shall be painted white on front, with all labels silk-screened in black as per Toronto Transportation drawings TTD 809.020, TTD 809.022, TTD 809.023 and TTD 809.025.

Overall dimensions of the M type cabinet unit enclosure without the base extension unit shall be:

Height = 1380mm;
Width = 760mm;
Depth = 430 mm.

Dimensions of the main cabinet door opening shall be:

Height = 1080 mm;
Width = 695 mm.

The actual size shall be dependent on the supplier's equipment but must conform to the minimum standards and construction as shown in Toronto Transportation Drawings TTD 809.021.

The tolerance levels of these dimensions are:

Height = ± 25 mm;
Width = ± 15 mm;
Depth = ± 15 mm.

The enclosure shall also be incorporated with adjustable double wall or track mount type construction providing discrete horizontal adjustability of the rails. Twelve pre-punched false rails shall be supplied per cabinet. These rails are to be mounted with eight on the back and two on each side of the cabinet.

An easily adjustable. cabinet shelf 270 mm deep x 710 mm wide shall be mounted inside the cabinet. The location of the shelf is shown in Transportation drawing TTD 809.021.

The inside of the top of the cabinet shall be lined with Styrofoam, shall have silver foil at top and bottom with a minimum thickness of 25 mm, or an acceptable equivalent material with the same insulation capabilities.

A normally closed spring loaded alarm switch shall be provided on the main cabinet. The alarm switch shall be located at the top right hand portion main enclosure.

There shall be an aluminium base-plate included in the base of the main enclosure. This plate shall have a thickness of 2.5 mm, and shall have the dimensions that are indicated in Toronto Transportation Drawing TTD 809.027. All points within the base-plate where there is a possibility of cable contact shall have plastic shields and grommets appropriately in place to prevent wear and damage to cabling.

An aluminum or stainless steel bracket for the telephone connector shall be provided inside the distribution compartment. Male telephone jack shall be mountable on this bracket and shall be able to be connected to Bell terminal block inside the communication compartment section.

6.5.1.1 Door - Main

Dimensions of the main door shall be:

Height = 1130 mm;
Width = 760 mm.

The main door shall be mounted to its cabinet section with 5 mm diameter stainless steel piano hinge that cannot be accessed or tampered from outside the cabinet.

The main enclosure door shall incorporate the following:

a) A lock mechanism with a three point latching mechanism with nylon rollers at top and bottom and an outside door handle of stainless steel with a 12.7-mm shank, and a Corbin dead bolt solid brass pin tumbler type lock with two brass 5R3575-GR Keyway.

6.5.1.2 b) Provisions for padlocking the door shut shall be supplied.

6.5.1.2 Police Door Compartment

The police door compartment shall be located in the centre of the door approximately 135mm from the top of the door. Dimensions of police door compartment shall be:

Height = 150mm;
Width = 340mm.
Depth = 55 mm

The police door compartment shall incorporate:

a) An inside mounted stainless steel piano hinge with 2.5 mm diameter hinge pin. The hinge pin shall not be accessible from the outside of the cabinet.

b) A lock mechanism with a Corbin #035759 solid brass treasury type lock supplied with two brass skeleton keys with a minimum overall length of 60 mm.

The police door shall provide access to the following designated switches and indicators, identified with silk-screened labels on the police door compartment panel:

- SIGNALS ON/OFF to apply EXTERNAL START to the timer in the OFF position
- AUTO/FLASH to apply EXTERNAL START to the timer in the FLASH position
- AUTO/MANUAL
- MANUAL PUSHBUTTON
- H.O.L (Hold-On-Line) INDICATOR LIGHT marked "COMPUTER" that indicates computer operation

The wiring configuration must be as per Toronto Transportation Drawing TTD 809.020, relating to the police door compartment panel.

6.5.1.3 Test Panel

The test panel shall be mounted on the inside area of the main door as shown in Toronto Transportation Drawing TTD 809.021 and wired as per Toronto Transportation Drawing TTD 809.020.

The test panel shall include:

a) Twelve (12) momentary test switches inside the cabinet, to simulate eight (8) vehicle and four (4) pedestrian detector inputs directly to the controller.

b) One toggle switch to control STOP TIMING to the timer.

c) One toggle switch that places the controller into emergency flash condition without activating any inputs such as EXTERNAL START or STOP TIME to the timer.

d) Indicator light marked "COMPUTER" that indicates computer operation.

Please refer to Toronto Transportation Drawing TTD 809.022 for panel layout detail, and TTD 809.021 for panel location.

6.5.1.4 Ventilation-Main Door

Vent openings allowing air to enter the cabinet must be in the main door. There shall be a total of 24 vent openings spaced equally within three columns and eight rows within an area 200 mm high and 400 mm wide. The vent area shall be centred within the door 120 mm from the bottom.

These vents must be backed with an easily removable metal non-corrosive, vermin / insect proof, washable, permanent filter screening or city approved equivalent, 244 mm high x 410 mm wide x 22 mm thick, for summer; or

Aluminium vent cover, 244 mm high x 410 mm wide x 3.2mm thick, for winter.

6.5.2 Base Extension Unit

The base extension unit shall have the same external width and depth dimensions as the cabinet enclosure.

The actual size shall be dependent on the supplier's equipment but must conform to the minimum standards and constructed as shown in TTD 809.027.

Dimensions of the base extension unit shall be as follows:

Height = 457 mm;
Width = 760 mm;
Depth = 430 mm.

The base extension unit shall be incorporated with a two piece, sheet aluminum construction and fabricated with:

a) A communication terminal block compartment with closure door in the front face panel.

b) A 70-mm wide flanged lip around the entire inside top and bottom edge perimeter on the internal area base.

c) A 70-mm wide overlap flange lip on ends of the front corners.

The top and bottom flange must allow the enclosure to sit flat against the aluminium controller cabinet and the concrete pad to which the cabinet extension base unit will be mounted upon. Four slotted mounting holes shall be installed in the base flange, one in the centre of each side of the cabinet.

6.5.1.3.1 6.5.2.1 **Communication Terminal Block Compartment**

The communication terminal block compartment and its door shall be centred within the face of the base extension unit.

Dimensions of this communication terminal block compartment shall be:

Height = 290 mm;
Width = 510 mm;
Depth = 150 mm.

The communication terminal block compartment shall incorporate:

a) An external mounted stainless steel piano hinge with 2.5 mm diameter hinge pin. The hinge pin shall not be accessible from the outside of the cabinet.

b) A construction that is secured by a "Bell" 1/4"-20 hex head 1.5" long silicon bronze bolt with 1/4" long shoulder reduced to 3/16" diameter. The door shall be drilled and tapped for

1/4"-20 bolt. The bolt shall be recessed 25mm deep from the door surface. Please refer to Drawing TTD 809.027;

c) A ground terminal and a 35 x 67.5 punch out (future provision for a duplex outlet) shall be provided in the communication terminal block .

6.5.2.2 Ventilation-Base Extension Unit

Both sides of the base extension unit shall have vents as shown in Drawing TTD 809.027 to provide ventilation.

There shall be a total of 18 vent openings spaced equally within three columns and six rows on each side.

These vents must be backed with an easily removable metal non-corrosive, vermin / insect proof, washable, permanent filter screening or city approved equivalent, 244 mm high x 390 mm wide x 22 mm thick, for summer; or

Aluminum vent cover, 244 mm high x390 mm wide x 3.2mm thick, for winter.

6.5.3 Weatherproof Clear Pouch

Each cabinet shall be supplied with a seal-able, fell-coat, heavy duty weatherproof clear pouch, minimum dimensions of 350 mm W x 440 mm H, with a zipper on the short end. The pouch shall be mounted on the inside of the door below the police door compartment to store the diagrams and manuals. The long side of the pouch shall be on top and the zipper to the right towards the open side of the door and not interfering with the switches or filters when mounted.

6.5.4 Load Switch Panel

At least one point of mechanical support shall be provided to each load switch, at a point approximately two-thirds of the distance from the connector end as per Section 10.2.4 of the NEMA-TS-1 specification. This panel assembly shall be capable of supporting twelve (12) load switches within the cabinet.

A stainless steel hinge shall be mounted at the bottom centre of this panel for maintenance purposes.

Load switch socket shall comply with NEMA TS1 specifications; properly done soldered or crimped connections are acceptable.

The load switch panel shall be wired as per Toronto Transportation drawings TTD 809.020 and equipped as shown in TTD 809.023. The output circuits on load switch panel shall be terminated on a Phoenix barrier type terminal block assembly, Model #5509658 or a city-approved equivalent.

6.5.5 Controller Interface Panel

The Controller Interface Panel shall be wired as per Drawing TTD 809.020. This panel shall utilize terminal strips as shown in TTD 809.023.

An insulated cover shall be mounted on 'F' block terminals 25 to 31 of the controller interface panel for electrical safety. The panel shall be provided with supporting flange at each side.

6.5.6 Circuit Wiring

The controller cabinet shall be wired as per Toronto Transportation Drawing TTD 809.020.

Cabinet wiring shall be routed into and out of the terminal blocks so that each circuit, including all functional points on the connectors of the controller unit, is accessible for connection to external equipment, and so that cabinet wiring changes can be readily made.

As a minimum requirement, all functions represented in Toronto Transportation Drawing TTD 809.020 shall be accessible on the terminal blocks. These include:

a) All signal phase and overlap circuits at both the 24 VDC levels and 120 VAC levels;
b) All co-ordination circuits;
c) All computer control circuits;
d) All signal sequence selection circuits;
e) All controller status circuits;
f) All intersection flash circuits;
g) All vehicle and pedestrian detection input circuits;
h) All pre-emption circuits;
i) Miscellaneous circuits including conflict monitor output, reset, and manual control circuits.

All wires shall be properly terminated with no unused wires hidden within a harness or cable run. Each wire within harnesses shall be hot stamped with the wire's identification.

All cabinet wire for DC signals shall be a minimum of #22 AWG or larger copper stranded wire, and all cabinet wire for 115 Volt AC signals shall be a minimum of #16 AWG or larger copper stranded wire.

The wires shall be sized as per the ampacity ratings in the following table and shall meet the Military 16878 type, BN wire specification:

Ampacity Rating	Gauge Wire Size AWG
2	22
4	20
5	18
10	16
15	14
20	12
30	10
50	8
70	6

All primary feed wiring shall be #8 AWG while all ground wiring shall be #6 AWG or larger copper wire. No more than three connections shall be made at any screw terminal.

All terminals shall be identified as per Toronto Transportation Drawing TTD 809.020, and cross references relating the cabinet terminals to the total system, both within the controller and external to the controller, shall be indicated on the cabinet drawing. Two single drawings depicting this must be supplied per cabinet. Terminals shall be easily accessible from the front opening of the cabinet and shall be designed to allow connections to be made.

All connectors (sockets or plugs) to the controller unit and conflict monitor shall meet or exceed NEMA TS1 specifications and all wires to connector pins shall be soldered

6.5.7 Power Supply Panel

The cabinet shall include a power distribution module to control and distribute uniform, clean power from a 120 VAC, single phase, 60 Hz external source.

The Power Supply Panel shall be equipped with:

a) Circuit Breakers
b) Grounding System
c) Neutral Bus
d) Ground Bus
e) Signal Power Bus Terminal
f) Convenience Outlet
g) Mercury Contactor
h) Line Filters
i) Surge Protector
j) Power Connection Block

Please refer to Toronto Transportation Drawing TTD 809.022 for detail.

The circuit breakers shall be mounted for side access as shown in the drawing. Duplex outlet, toggle switch for DDAU power on/off (15A) and fuse unit with 4A fuse installed shall be located on the front of the power supply panel. An insulated cover shall be provided on the side opening to prevent accidental contact to live 120 volts AC circuits.

6.5.7.1 Circuit Breakers

Two single pole moulded case circuit breakers of 10KA-interrupt rating, 120VAC, surface mounted type, model Square D-QOU or a City-approved equivalent, shall be provided to protect the inside circuitry of the cabinet. The main breaker shall protect the main circuit, which powers all control modules and traffic signals, and shall be calibrated for 40 amperes. The auxiliary breakers shall protect the ground fault interrupter and be calibrated for 15 amperes.

6.5.7.2 Grounding System

A grounding system shall be provided in the cabinet that divides it into three separate and distinct circuits. Each of these shall be connected together at a single point where both the AC neutral and earth ground enter the cabinet.

6.5.7.3 Neutral Bus

The neutral bus terminal strip(s) within the cabinet are used to terminate all of the neutral conductors and shall be insulated from the cabinet.

The neutral bus shall be a solid, seventeen (17) position copper terminal bus strip, Model # ILSCO D-167-14 or city-approved equivalent, located in close proximity to the power service entering the cabinet. Subsidiary neutral bus terminal strips may be located as necessary in the cabinet for use with control equipment.

6.5.7.4 Ground Bus

The ground bus terminal strips within the power supply shall be directly connected to the cabinet shell and the earth. The ground bus shall be a solid, seven (7) position copper terminal bus strip model #ILSCO D-167-8, located on the power supply module entering the cabinet. This ground shall be connected to the cabinet shell in a manner that minimizes the length of the conducting path.

The chassis ground connection to each unit in the cabinet shall be run separately and directly to this terminal strip or to a subsidiary ground bus strip(s). The RFI filter, breaker, and all surge protection devices shall be connected to the ground bus.

In addition, a braided ground strap should be provided between the cabinet shell and the main door. The wire material shall be braided #6 copper, with a green coloured insulator.

6.5.7.5 Signal Power Bus Terminal

The signal power bus terminal shall be connected to the incoming AC+ through a signal bus 60-ampere mercury contactor, a radio interference suppresser, and a circuit breaker. The signal bus mercury contactor shall be energized to provide power to the signal power bus (PB) on load switch panel. The current rating of the signal bus mercury contactor shall be at least 75% of the current rating of the main circuit breaker.

6.5.7.6 Convenience Outlet

Each cabinet shall be provided with a 120 VAC G.F.I. duplex receptacle, three (3) prong, NEMA Type 5–15R.

6.5.7.7 Mercury Contactor

Each cabinet shall be provided with a 60-ampere mercury contactor, Durakool Model 1060APS-120VAC.

6.5.7.8 Line Filter

Each cabinet shall be provided with a 60-ampere line filter, which attenuates the signals in both directions, EDCO line filter INXT120NL000-1.

6.5.7.9 Surge Protector

Each cabinet shall be provided with one (1) surge protector which shall be designed and arranged to prevent damage to, or improper operation of the equipment in the event of lightning strikes on, or

power surges from the power lines, interconnects cables, etc. The protector shall be EDCO Model # SHP 300-10 Surge suppresser protection device.

6.5.7.10 Power Connection Block

A Phoenix terminal block assembly, model # 5503337 or city-approved equivalent shall be provided as shown in Toronto Transportation Drawings TTD 809.022 and wired as per TTD 809.020.

6.5.8 Field Distribution Panel

The bottom part of this panel shall be elevated 30 degree to the front as shown in Drawing TTD 809.025R4. Octal round relay sockets shall be an OMRON PF083A-E or equivalent, and the 14-pin square relay socket shall be an OMRON PYF14A or equivalent. Wire connections to all relay sockets shall be terminated using copper lugs.

The field distribution panel shall be wired as per Toronto Transportation Drawing TTD 809.020.

DDAU harness shall be wired from the field distribution panel as per Drawing TTD 809.020. DDAU harness shall be:

a) 6 foot length harness with BN (Military 16878) 22AWG black wires;

b) hot stamped every 6 inches for DDAU wire identifications as per Toronto Transportation drawing TTD 809.020;

c) provided with 3/4 inches size (min 0.5 to max 1.25 inches) expandable braided polyester sleeving 1.5 foot length from the connector end;

d) One DB 37 pin socket connector, non-corrosive metal, to mate with a 37 pin male connector AMP 206816-2-7732 or city approved equivalent;

e) Included with a two pair stranded shielded telephone cable, CSA CMG FT-4, 24AWG, wired from the 37 pin DDAU connector to a circular stainless steel four contact connector WPI 91-MCF.

Provide a two pair stranded shielded telephone cable, CSA CMG FT-4, 24AWG from a bracket mounted 91-MCM male connector with a sufficient length for connection to the Bell protector terminal located inside the communication terminal block compartment.

The circuits shall be terminated on Phoenix barrier type terminal block assemblies, Model # 5510210 and # 5509632. Please refer to Toronto Transportation Drawing TTD 809.025 for detail.

6.5.8.1 Specifications for Inter- connection / Terminal Block Devices

This section describes the requirements applicable to all electrical, electronic and communications systems for inter-connection/terminal block devices as provided for in this contract.

6.5.8.1.1 Applicability

All inter-connection/terminal block devices shall be installed in enclosures/panels.

Inter-connection/terminal block devices shall be DIN-rail mountable onto standard 35mm flat (symmetrical) DIN rails.

All inter-connection/terminal block devices shall meet or exceed the appropriate safety agencies to appropriate standards (i.e. C.S.A. standard C22.2 No. 158-1987 and E.C.N. 584A).

6.5.8.1.2 Performance Criteria

The inter-connection/terminal block devices shall provide a low ohmic/resistance (0.3 milliohm or less). They should also be gas-tight, providing a long lasting reliable connection which will maintain the gas-tight connection over time, and when subjected to vibration or shock.

The inter-connection/terminal block devices shall be constructed so that once installed/mounted onto the DIN rail, they cannot be pulled or knocked off because of: accidental force, purposeful force, vibration, or shock. The mounting foot of these devices shall incorporate a feature or mechanism that enables them to be removed from the DIN rail with the use of an appropriate flat blade screwdriver.

All screws and terminals shall be directly accessible from the main door and not mounted upside down.

6.5.8.2 Connection Means

All wire connection means shall be by cage clamp terminal block design and must be able to allow copper conductors to be connected without being treated (i.e. ferrules or special treatment of conductors). Special treatment includes soldering, the use of cable shoes or any type of ring terminal or bending of eyes, or any other custom process or equipment.

The cage clamp terminal block design shall incorporate an automatic progressive locking action, which generates an increasing thread friction or braking force through the elastic deformation of the clamping part. This shall be achieved by mere finger-tightening of the screw via an appropriate screwdriver, i.e. 5 up to 14.2 inch lbs. depending on the size of inter-connection/terminal block device. The active parts of the cage clamp terminal shall work with elasticity so that even repeated tightening and loosening shall not cause the screw locking to slacken.

The cage clamp terminal block design shall have a minimum reverse spring tension of 30 N to eliminate loose wire connections caused by wire deformation. In this way, a reliable gas-tight connection shall be maintained.

The cage clamp terminal block design shall have corrosion proof metal parts. They are to be constructed of copper alloys that are resistant to stress corrosion cracking, which can arise under unfavourable conditions such as dampness, frequent temperature fluctuations, or tensile stress in atmospheres containing ammonia. The copper alloy components of the cage clamp are to be subjected to thermal after-treatment, which ensures the resistance to stress corrosion cracking. The use of only copper alloys in the components of the cage clamp shall ensure low temperature rise due to high electrical conductivity, which shall also decrease electrical losses on low voltage and current

levels. Additionally, a low ohmic resistance and gas-tight connection shall be maintained since there shall be practically no relative thermal expansion between the conductor and the cage clamp.

The cage clamp copper alloy components' surfaces shall be protected by a galvanic nickel or tin plating which will effectively resist and prevent corrosion and its consequences, i.e. unreliable electrical connections and/or jammed screws. The use of such cage clamp copper alloy components will prevent electrolytic corrosion, which occurs in the presence of moisture between the copper conductor and the cage clamp when steel cage clamp components are used.

The cage clamp shall be so constructed with flat surfaces, which clamp the conductor so as to ensure that even the thinnest/smallest wires can be clamped properly with a gas-tight connection maintained.

The flat surfaces (minimum of one) that clamp the conductor shall incorporate transverse grooves to ensure that the oxide film on the conductor is broken, as well as providing a low ohmic resistance connection without wrenching, thereby ensuring good electrical contact conditions.

The insulation housing of the inter-connection/terminal block devices shall incorporate an enclosed (on both sides) tunnelled wire entry thereby ensuring all strands of standard conductors are guided into the cage clamp and thus eliminating the possibility of conductor strands of adjacent terminals shorting together.

All wiring points and connections shall be "touch safe". This means that no live voltages can make contact with an operator's finger, and no contact can be made with live voltage connections even when bridging accessories are incorporated.

6.5.8.3 Types of Inter-Connection/Terminal Block Devices

6.5.8.3.1 Single Level Device

All single level inter-connection/terminal block devices designed to accept up to a #10 AWG size conductor shall be C.S.A. certified for 600 Volt, 40 ampere and a wire range of #28 AWG to 10 AWG.

All single level inter-connection/terminal block devices designed to accept up to a #8 AWG size conductor shall be C.S.A. certified for 600 Volt, 55 ampere and a wire range of #26 AWG to 8 AWG.

A surge suppressor (city approved Wieland WT/WEG-HSP-001ATC) shall be mounted on the 'N' terminal block as per drawing TTD 809.025.

6.5.8.3.2 Double Level Devices

Double level inter-connection/terminal block devices accepting a component holder shall be C.S.A. certified for 300 Volt, 15 ampere and a wire range of 28 AWG to 12 AWG. These double level devices are to be located in Terminal strip M, positions 11 to 28 as per Toronto Transportation Drawing TTD 809.025.

6.5.8.4 Manufacturer Qualifications

The inter-connection / terminal block devices shall be manufactured by a company normally engaged in the manufacture, testing and design of such products.

The manufacturer shall offer factory repair service for all pre-assembled rail assemblies manufactured by the company sold under single part numbers.

The accepted manufacturer of inter-connection / terminal block devices is:

Phoenix Contact Ltd.,
235 Watline Avenue,
Mississauga, Ontario
L4Z IP3
1-800 890-2820.

6.5.8.5 6.5.8.5 Warranty

Inter-connection/terminal block devices shall be free from defects in material and workmanship under normal use and service for a period of one year from shipment.

6.6 Drawings

The following drawings shall be supplied:

a) Two (2) sets of cabinet wiring, schematic, and connection diagrams for each cabinet ordered.

b) These drawings shall be complete, up-to-date, and correctly labelled.

7.0 QUALITY ASSURANCE

7.1 Inspection

The Supplier shall notify the Engineer of the date that the fabrication of the unit will commence.

The Engineer shall have free access to the site of manufacture of the unit while work on the unit is being performed for the purpose of inspecting and examining plant records and certificates, the materials used, the process of fabricating the unit, and to make any tests that may be considered necessary.

The Supplier shall notify the Engineer when the unit is ready for inspection.

All work is subject to an inspection by the Engineer prior to shipment.

8.0 PURCHASE OF MATERIALS

8.1 Technical Information to be supplied to Bidder

The following technical information shall be supplied to the bidder:

a) Controller Assembly Configuration (Type 1).
b) Phase Operation (4 to 8 Phase).
c) Miscellaneous Options.

8.2 Technical Information to be provided in Quotation

Each bidder shall submit with their quotation four (4) copies of the following information to the Engineer for preliminary approval:

a) Outline specifications, including sketches showing the layout, the bill of material, weights, and dimensions; and

b) Wiring diagram.

8.3 Shop Drawings

Within thirty (30) calendar days of receipt of a purchase order to supply the equipment specified herein the Supplier shall submit four (4) copies of the following information to the Engineer for each cabinet ordered:

a) Detailed dimensioned layout shop drawings, including plans, elevations, sections and details to show enclosure, structural details, equipment layout and mounting arrangements, anchor bolt locations and exact weight.

b) Detailed bill of materials.

c) Wiring diagram.

d) Details of warning signs and equipment nameplates.

The Supplier shall submit four (4) copies of shop drawings for review by the Engineer. Upon approval, three (3) copies of the drawings shall be returned with "Permission to Construct" stamp to the Supplier. In a case of non-acceptance, one (1) copy of the drawings shall be marked, outlining the unacceptable conditions and returned to the Supplier for corrections and re- submission.

Once fabrication of the equipment has commenced, materials and dimensions shown on the final shop drawings shall not be changed without approval of the Engineer. In the event of changes, resubmission of four (4) copies of revised shop drawings showing any changes from the final drawings will be required.

8.4 Packaging

Each delivered item shall be individually packaged in its own shipping container and shall be complete and ready for testing.

Each shipping container shall identify, on the top left corner, the following information as applicable:

- Equipment Description
- Contract Number
- Manufacture
- Serial Number
- Date of Shipment
- Packing List

The Supplier shall advise the Engineer of their intent to deliver three (3) days prior to the shipping date.

8.5 Measurement and Payment

Measurement and payment for the Controller Cabinet Assembly is per unit, as specified in the purchase order.

9.0 APPROVALS

The cabinet shall be approved for its intended purpose by a recognized safety authority, such as the Canadian Standards Association or the Electrical Safety Authority.