TS 809
TRAFFIC SIGNAL CONTROLLERS

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1.0 Scope

This specification covers the requirements for the installation of traffic signal controllers and associated components.

2.0 References

This specification refers to the following standards, specifications or publications:

Toronto Transportation:

TS 803	Ducts
TS 806	Power Supply Equipment
TS 810	Traffic Actuation Equipment
TS 813	Grounding
TS 815	Removals

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

3.0 Definitions

For the purpose of this specification the following definitions apply:

'AC+': 120V AC, 60 Hz power bus

'AC-': 120 V AC, 60 Hz neutral bus, grounded at power source.

'LED': Light Emitting Diode

'MS': Military Specification

'PROM': Programmable Read Only Memory

'RAM': Random Access Memory

Conflict Monitor: means a device for detecting and interrupting conflicts in the traffic signal output circuits.

Controller: means a complete traffic signal control equipment package including cabinet, controller unit and all associated power control, actuation or interconnection devices.

Controller Cabinet: means an outdoor enclosure used for the housing of the controller unit and all associated power, control, activation or interconnection devices.

Controller Unit: means that portion of the controller assembly devoted to the selection and timing of traffic movements.

Detection: means the operation of a detector sensor unit in registering the presence or passage of a vehicle or pedestrian.

Hold: means a command to the controller unit which causes it to retain the existing traffic signal phase.

Interconnection: means the system of cables and devices which operate traffic signal controllers at consecutive intersections in a fixed or preprogrammed timing sequence.

Interval: means the part or parts of the signal cycle during which signal indications do not change.

Interval Advance: means an external command to service the next sequential interval.

Interval Sequence: means the order of appearance of signal indications during successive intervals.

Interval Sequence Chart: means a chart designating the order in which the signal phases occur and the associated display for each interval.

Microprocessor: means a small, self-contained limited capability computer with the central processing unit on a single chip.
Module: means a piece of equipment which is designed such that functional sections plug in and are readily exchanged with similar units.

Motherboard: means a printed circuit connector interface board with no active or passive components.

Phase Sequence: means a predetermined order in which the phases occur.

Phase Skip: means a controller function used to provide omission of a phase in the absence of actuations on that phase.

Pre-emption: means the transfer of the normal control of signals to a special control mode which may be required by railroad trains at crossings, emergency vehicles, mass transit vehicles, or other special needs.

Vehicle Extension: means the time in seconds added to the green interval to permit additional green time upon actuation by a vehicle approaching the intersection.

4.0 Construction and Materials

4.1 Controller Supplied by Toronto Transportation

Where Toronto Transportation supplies the controller, the controller shall be picked up and transported as specified in the contract. The Contractor shall ensure that all components are safely connected, secured or packaged prior to transporting the controller.

Toronto Transportation guarantees to the Contractor that the controller and all associated equipment are free of any defects.

4.2 Timing of Work

The controller shall be energized within 48 hours of shipment from the place of storage or as specified in contract.

4.3 Controller Cabinet

4.3.1 Base Mounted Controller Cabinet

The cabinet shall be installed complete with all hardware and accessories.

4.3.2 Power Connection

The low voltage feeder cables shall be connected to the controller cabinet breaker.

4.3.3 Equipment Ground

The cabinet ground wire shall be connected to the controller cabinet ground bus. Connections shall conform to TS 806 and TS 813 and the manufacturer's drawings or instructions.

4.4 Installation of Controller Equipment

4.4.1 Wiring and Connections

All connections to terminal boards or screw type equipment terminals shall be made with insulated fork tongue compression connectors only, when using stranded cable. All wiring to bulkhead connectors on equipment housings shall be made with MS bayonet type connectors in conformance with the contract or in the manufacturer's drawings.

All connector joints for use with extra low voltage systems shall be soldered, with the joint metals preheated to the flow temperature of the solder.

Traffic signal cables shall be connected to the terminal board address as assigned on the contract drawings. The controller output circuit assigned shall match the proper traffic signal cable circuit. The traffic signal cable neutral(s) shall be securely connected to the AC-terminal in the cabinet.

Extra-low voltage cables and interconnection cables shall have the outer jacket removed to expose approximately 150mm of the shielding and/or drain wire. The shielding or drain wire for all cables serving a similar function shall be twisted together and soldered.

Upon completion of wiring and connections, all incoming cables shall be bundled and held in place with nylon cable ties.

Unused conductors shall be terminated with insulated wing nut vibration proof spring connectors, leaving sufficient cable to reach terminal boards.

Incoming cables shall be identified as follows:

1. Extra-low voltage cable shall be identified with PVC sleeve wire markers having the same number as the traffic phase served.

2. Traffic signal cable shall be identified with PVC sleeve wire markers placed over the outer multi conductor cable, naming the corner of the intersection that the cable is routed towards such as "northeast", "southwest", etc.

3. Interconnection cable shall be identified similar to traffic signal cable, naming the direction that the cable is routed towards such as "north", "south", etc.

Rigid PVC conduits and fittings shall conform to CSA C22.2 No. 211.2-M1984 (R2003).

Single conductor low voltage cables shall be stranded copper type TWH conforming to CAN/CSA-C22.2 No. 75-03.

Wire connectors shall be of the fork tongue compression type for terminal connections or the insulated wing nut vibration proof spring type for wire to wire connections and shall conform to CSA C22.2 No. 65-03 - M88.

Electrical insulating tape shall be rated for 600 V at -18°C to 90°C working temperature and conform to CSA C22.2 No. 197-M1983 (R2003).

Ground wire and connectors shall conform to TS 813.

Solder shall be 60/40 tin/lead mix resin core type.

4.4.5 Controller Security

The controller cabinet shall be kept locked except when access is required to carry out the work of the contract. Upon completion of the work the controller keys supplied by Toronto Transportation shall be surrendered to the Contact Administrator.

4.5 Quality Control

4.5.1 Pre-Shipping Shop Tests

4.5.1.1 General

These tests are required prior to transporting the controller to the contract site. Where the Toronto Transportation supplies the controller, the tests will be carried out by the Toronto Transportation in conformance to sub-section 4.1.

4.5.1.2 Cabinet Assembly and Components

A visual check shall be made to ensure that all components necessary to the complete controller are present and that all pre-assembled equipment is securely mounted and connected.

4.5.1.3 Circuit Output

The output terminal board voltage shall be tested for 108 V minimum output from load switches and for proper terminal assignment conforming to the manufacturer's wiring diagram.

4.5.1.4 Interval Sequence

With the proper programming for the intersection in operation, but with modified timing values suitable to test conditions, the controller unit shall be cycled through all phases for a minimum of six hours. Controller output shall be tested to ensure that the proper phases and phase intervals appear in the correct sequence by use of a 120 V test board with lamps or by use of 24 V test board with LED or other appropriate indicators wired to the input side of the load switches. Test results are to be confirmed a minimum of six times.

4.5.1.5 Actuation

With an appropriate test board, the effect of detection devices and pedestrian pushbuttons in entering a call to the controller unit shall be tested. All modes of detector sensor unit program and vehicle extension calls shall be tested. Tests shall confirm that all calls are registered, activated and are associated with the correct traffic phase.

4.5.1.6 Conflict Monitor

The conflict monitor shall be tested by removal of the monitor programming card or by methods recommended in the manufacturer's literature. Diode breakouts in the monitor card shall conform to the signal operation required. All flash and reset functions shall be tested.

4.5.1.7 Flasher

The output of flasher units and flash transfer relays shall be tested for proper functioning over a two hour period.

4.5.1.8 Programming

With actual phase timing for the intersection operational, the controller programming or cam breakouts shall be tested to ensure that the intended operation is accomplished. This test is to include all possible combinations of actuation and recall settings together with any special features such as advance green, pre-emption or co-ordination.

4.5.1.9 Manual Control

The manual over-ride controls shall be tested for proper operation under all possible switching combinations.

4.5.2 Field Tests

4.5.2.1 General

These tests are required upon installation of the controller. The controller shall be allowed to operate functionally only after all testing has been completed and all components are operational.

4.5.2.2 Signal Cable

All traffic signal cable circuits shall be tested disconnected, for continuity and the absence of short circuits, as determined by an ohmmeter test.

4.5.2.3 120 V Test

The operation of all signal head lamps and the absence of short circuits shall be tested by progressively connecting each active signal cable conductor to the AC+ bus through a temporary 10A fuse bypassing the load switches.

4.5.2.4 Interval Sequence

With the proper programming and timing functions in operation, the controller shall be cycled through all phases for a minimum of 24 hours with all signal circuits off.

4.5.2.5 Actuation

All calls shall be observed to be registered and activated. Actuation equipment shall be tested in conformance to TS 810.

4.6 Controller Modifications

This work shall include any modification to actuation equipment in conformance to TS 810 and any removal and salvage or disposal of components in conformance to TS 815.

4.7 Work by Others

The following work will be done by others:

1. Programming of microprocessor and conflict monitor PROM.

2. Programming of microprocessor RAM.

3. Setting of all timing controls, switches or programming controls.

4. Provision of an interval sequence chart for cam breakouts.

5. Energization upon the initial opening to traffic.

5.0 Measurement for Payment

5.1 Individual Item Method

5.1.1 Actual Measurement

Where the contract includes tender items using the Individual Item Method, measurement will be made of each controller.

5.1.2 Plan Quantity Measurement

Measurement will be by Plan Quantity as may be revised by Adjusted Plan Quantity, when designated in the Contract. Such measurement will be based on the units indicated in the clauses under 5.1.1, Actual Measurement.

6.0 Basis of Payment

6.1 All Inclusive Price Method

6.1.1 Traffic Signal Controllers - Item

Payment at the contract price for the above tender item shall be full compensation for all labour, equipment and materials to do the work including earth excavation, backfill and compaction, installation of controllers and components, conduit and fittings, wiring and connections and all controller modifications, testing, hardware and accessories.

6.2 Individual Item Method

6.2.1 Traffic Signal Controllers - Item

Payment at the contract price for the above tender item(s) shall be full compensation for all labour, equipment and materials to do the work associated with each type of installation including installation of controller and components, and all testing hardware and accessories.

6.2.2 Traffic Signal Controller Modifications (Applicable Intersection Location) - Item

Payment at the contract price for the above tender shall be full compensation for all labour, equipment and materials required to modify traffic signal controllers, and such work shall include the removal, salvage, installation, relocations, rearrangement repair or replacement of components.