



**CONSTRUCTION SPECIFICATION FOR
TRAFFIC ACTUATION EQUIPMENT**

TABLE OF CONTENTS

623.01	SCOPE
623.02	REFERENCES
623.03	DEFINITIONS
623.04	DESIGN AND SUBMISSION REQUIREMENTS
623.05	MATERIALS
623.06	EQUIPMENT
623.07	CONSTRUCTION
623.08	QUALITY ASSURANCE
623.09	MEASUREMENT FOR PAYMENT
623.10	BASIS OF PAYMENT

623.01 SCOPE

This specification covers the requirements for the installation of vehicular and pedestrian traffic actuation equipment.

623.02 REFERENCES

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

Ontario Provincial Standard Specifications, Construction

OPSS 603	Underground Ducts
OPSS 604	Installation of Cables
OPSS 609	Grounding

Ontario Ministry of Transportation Publications

Ontario Traffic Manual

CSA Standards

B137.1-13	Polyethylene (PE) Pipe, Tubing, and Fittings for Cold-Water Pressure Services
C22.2 No. 38-14	Thermoset-Insulated Wires and Cables (Tri-National Standard, with UL 44 and ANCE NMX-J-451-2014)
C22.2 No. 197- M1983 (R2013)	PVC Insulating Tape
C22.2 No. 85-14	Rigid PVC Boxes and Fittings
C22.2 No. 211.2-06 (R2011)	Rigid PVC (Unplasticized) Conduit
C22.2 No. 227.1-06 (R2016)	Electrical Nonmetallic Tubing (Bi-National standard, with UL 1653)

International Municipal Signal Association Specification

IMSA No. 51-5, Loop Wire

Canadian and Provincial Statutes

Accessibility for Ontarians with Disabilities Act (AODA), 2005, - O. Reg. 413/12: Integrated Accessibility Standards

623.03 DEFINITIONS

For the purpose of this specification the following definitions apply:

Non-Intrusive Detection means the operation of an aerial sensor unit in detecting and registering the presence of a vehicle

Non-Intrusive Detection System means an assembly of interdependent components composed of one or more microwave, radar, video, or other aerial detectors; software, firmware and hardware for processing of the detector signal; and, power and communication links providing traffic actuation inputs to a traffic signal controller or similar device.

623.04 DESIGN AND SUBMISSION REQUIREMENTS

623.04.01 Submission Requirements

623.04.01.01 Documentation

Three (3) copies of service manuals for the following equipment shall be submitted to the Contract Administrator:

- a) Non-intrusive detection system equipment
- b) Accessible pedestrian signals.

The service manuals for the equipment shall be according to the manufacturer's specifications and the Contract Documents.

623.05 MATERIALS

623.05.01 Cables

Cables for loop detectors shall be #14 AWG type RWU 90, x-link - 40°C rated 1000 V stranded copper conductor according to CSA C22.2 No. 38.

Cables for loop detectors in tubing shall be #14 AWG THHN rated 600 V stranded copper conductor with polyethylene tube, according to IMSA No. 51-5.

623.05.02 Probe Detectors

Probe detectors shall be as specified in the Contract Documents.

623.05.03 Ducts and Fittings

Flexible polyethylene ducts and fittings shall be according to CSA B137.1, Series 75.

Rigid PVC conduits and fittings shall be according to CSA C22.2 No. 211.2.

Electrical non-metallic tubing and fittings shall be according to CSA C22.2 No. 227.1.

623.05.04 Electrical Insulating Tape

Electrical insulating tape shall be according to CSA C22.2 No. 197, rated for - 18°C to 105°C use, 600 V.

623.05.05 Pedestrian Pushbuttons and Signs

Pedestrian pushbuttons shall be as specified in the Contract Documents.

Pedestrian pushbutton signs shall be according to the Ontario Traffic Manual.

623.05.06 Solder

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

623.05.07 Sealant Compound

Sealant compound shall be of cold type or hot poured type.

623.05.08 Extra Low Voltage Splice Insulation Kit

Extra low voltage splice insulation kit shall be as specified in the Contract Documents.

623.05.09 Aerial Mounting Equipment

Fittings, accessories and hardware shall be as specified in the Contract Documents.

623.05.10 Junction Boxes and Fittings

Junction boxes and fittings shall be according to CSA C22.2 No. 85.

623.05.11 Prefabricated Detector Loops

Prefabricated detector loops shall be either prefabricated PVC detector loops or prefabricated heavy-duty rubber detector loops as specified in the Contract Documents.

623.05.11.01 Prefabricated PVC Detector Loops

Prefabricated PVC detector loops shall be constructed with rigid PVC conduit, filled with a flexible urethane. The corner of the loops shall be rounded to a radius of 100 mm with the same continued conduit without any visible malformation. A "T" type access conduit fitting shall complete the loops geometric form and allow for the junction lead-in conduit. The number of turns of the wires shall be as specified in the Contract Documents.

The wires in the prefabricated detector loop conduit shall come out of the "T" type fitting and be of adequate length to reach the traffic count station or the handholes without splices. After wiring, the end of the prefabricated PVC detector loop conduit shall be injected with malleable urethane. The number of turns per loop shall be as specified in the Contract Documents.

623.05.11.02 Prefabricated Heavy-Duty Detector Loops

Prefabricated heavy-duty rubber detector loops shall be constructed with 9 mm I.D. (17 mm O.D) reinforced rubber hose with a 1.72 MPa internal pressure rating. The hose for the loops shall be of one continuous piece. Hose "T" type connections constructed of high temperature rubber shall complete the loops geometric form and allow for the junction lead-in conduit. The ends of the "T" type access conduit fitting shall be of proper sizes to attach directly to the hose. The number of turns in the detector loop shall be as specified in the Contract Documents.

The wires used shall be No.16 THWN stranded copper. The wires shall come out of the "T" type fitting and be of adequate length to reach the traffic count station without any splice. The wires shall be twisted a minimum of ten turns per metre. After the insertion of the detector loop and lead-in wires, the hose shall be filled and sealed with a flexible sealant.

623.05.12 Traffic Count Station Type 1

623.05.12.01 Post

The post for the traffic count station type 1 shall be wooden; pressure treated and of the dimensions specified in the Contract Documents.

623.05.12.02 Terminal Electric Box

The terminal electric box (TEB) shall consist of a PVC electrical panel, conduit opening, and double-row barrier terminal block(s) with current capacity equal to the ampacity of #14 AWG stranded copper wire. The size and number of the terminal blocks and the size of the conduit opening shall suit the number of the detector loop cable leads.

The TEB for the traffic count station type 1 shall be constructed using a durable non-corrosive material, grey in colour, and shall be of the size specified in the Contract Documents.

The TEB shall have a cover of similar material or a piano hinge and hasp of similar non-corrosive material. The cover shall be attached to the TEB with four non-corrosive screws.

623.05.12.03 Assembly

The traffic count station Type 1 shall be completely assembled and installed as specified in the Contract Documents.

623.05.13 Traffic Count Station Type 2

623.05.13.01 Base

The base of the traffic count station type 2 shall be a pre-fabricated surface pin-lock base (SPLB). The base shall be constructed of a durable, non-corrosive material, which is black in colour. The dimension of the base diameter shall be smaller than the diameter of the electrical handhole cover over which the base shall be installed. The base shall be constructed in a way so that it can be attached to the electrical handhole, using non-corrosive replaceable fasteners.

623.05.13.02 Post

The post of the traffic count station type 2 shall be pre-fabricated, tubular in shape and made from a flexible, durable, non-discolouring white polypropylene. The post shall be strong enough to hold a terminal electric box. The post shall have two 75 mm wide strips of reflective high intensity amber sheeting, approximately 75 mm apart, located on its upper end. The post shall be of 914 mm in length and shall have a diameter, allowing the accommodation of the necessary number of detector loop cables.

The upper end of the post shall have an additionally installed 60 mm diameter PVC rigid reducer bushing, necessary for the installation of the terminal electric box on the post.

The lower end of the post shall be constructed in such a way that it can easily be mounted on the base (SPLB).

623.05.13.03 Terminal Electric Box

The TEB of the traffic count station type 2 shall be a PVC Rigid Conduit Access Fitting, Type LB ("L" shaped with back entry), constructed using a durable, UV and impact resistant, non-corrosive and non-metallic material, which is grey in colour.

The TEB shall have a cover of the same material and colour, and shall be fastened to the back of the box using two non-corrosive screws.

An ABS fitting cleanout adaptor with a plug having a minimum diameter of 25 mm shall be attached to the front of the TEB.

The bottom of the TEB shall be constructed in such a way, so that it can be mounted on the reducer bushing, already assembled together with the post.

623.05.13.04 Assembly

The traffic count station Type 2 shall be completely assembled with the parts listed above and installed as specified in the Contract Documents.

623.05.14 Accessible Pedestrian Signals

Accessible pedestrian signals (APS) shall meet the requirements of the Accessibility for Ontarians with Disabilities Act (AODA), Ontario Regulation 413/12 as specified in the Contract Documents.

Accessible pedestrian signals shall consist of all material required for the operation of the APS, including but not limited to, all APS displays, pushbuttons, hardware, software, firmware, housings, wiring, and all setup hardware and software required to set up and configure the APS.

Accessible pedestrian signals shall have a locator tone that is distinct from a walk indicator tone. The accessible pedestrian signals shall include both audible and vibro-tactile walk indicators.

The APS shall include both manual and automatic activation features.

The pushbutton locating tone shall be repeated every 1 second and each tone shall be less than 0.15 seconds in duration. The locator tone must be audible up to but not beyond 3.7 m from the pushbutton. The APS shall automatically adjust the locating tone to maintain the tone at 2 to 5 dB over the ambient noise level.

The industry standard “cuckoo” sound shall be used for the north-south direction of travel, and the “Canadian APS melody” sound shall be used for the east-west direction of travel. Where two APS assemblies are installed at the same corner, they must be a minimum of 3000 mm apart. If the separation of 3000 mm cannot be achieved due to site constraints, each APS assembly at that particular corner must play a verbal announcement stating which crossing is active. Each verbal announcement shall be as specified in the Contract Documents.

623.05.15 Non-Intrusive Detection System

The non-intrusive detection system equipment shall be according to the requirements as specified in the Contract Documents.

All hardware and software, including but not limited to all connecting cables, mounting brackets, detector port hubs, interface panels, cabinet wiring harnesses, processor units, set-up hardware, testing hardware, and firmware, shall be according to the non-intrusive detection system manufacturer’s specifications and the Contract Documents.

623.06 EQUIPMENT

623.06.01 Slot-cutting Equipment

Slot-cutting equipment shall include a minimum 18 hp engine and a minimum 250 mm diameter diamond tooth blade adjustable between 20 mm and 100 mm depth of cut.

623.07 CONSTRUCTION

623.07.01 Loop Detectors

623.07.01.01 Layout

Loops detectors shall be laid out on the pavement accurate to the dimensions specified in the Contract Documents. Slot cutting lines shall be marked with non-permanent materials. Saw cutting of slots shall not begin until the loop layout has been inspected by the Contract Administrator.

Locations where the layout of a loop crosses a major pavement crack, butt, expansion joint or transition area shall be reported to the Contract Administrator. In such instances, the treatment for crossing the pavement irregularity shall be as specified in the Contract Documents; or, at the discretion of the Contract Administrator, the loop shall be re-marked into 2 separate loops, each beginning approximately 300 mm away from the irregularity.

623.07.01.02 Saw Cutting

Saw cutting of loop slots in pavement shall be in straight lines with slot depths and widths as specified in the Contract Documents. Corner cutting for slots shall be extended only far enough past each corner point to obtain the full depth of the slot. Slot crossing of pavement irregularities shall be constructed using additional widths and depths of slots as specified in the Contract Documents.

Where specified in the Contract Documents, saw cut marks shall be made on the curbs to indicate location of the loop.

623.07.01.03 Slot Preparation

Upon completion of saw cutting, the slot shall be cleaned with a pressurized water stream and dried by means of compressed air forced through a nozzle at a minimum pressure of 300 kPa. The air shall be heated to a maximum of 160 °C where required to remove excess moisture.

The corners of all slots shall be rounded using hand tools. All slots and corners shall be examined for protrusions of sharp stone aggregates or debris which may damage cable. Any such protrusions or debris shall be removed. Final slot preparation shall be done immediately prior to the installation of cable.

623.07.01.04 Flexible Duct Installation

A hole shall be drilled through the pavement to accommodate a flexible duct at the location specified in the Contract Documents.

All work for flexible duct installation, including earth excavation, backfill, removal and restoration, shall be according to OPSS 603.

623.07.01.05 Loop Cable

The loop shall be installed with the size, winding direction, configurations, number of turns and type of cables as specified in the Contract Documents.

The loop cable end which progresses clockwise shall be marked at the splice point with two bands of electrical insulating tape.

Cable in slots shall be firmly and carefully tamped in place using a blunt instrument on each successive turn of cable. To prevent floating, cables shall be held in place using 25 mm lengths of foam backer rod at 600 mm centres.

Where cables are installed in slots crossing pavement irregularities, all cables shall be installed through split neoprene tubing.

Loop cables between the loop and the splice point, including those in the slot, shall be twisted together to form a consistent lay of 10 turns per metre. The entire loop and lead cable system shall be formed of a continuous and unspliced length of cable.

Each loop cable and extra low voltage cable shall be identified with a vinyl sleeve wire marker in the splice point as shown on the Contract Drawings.

623.07.01.06 Sealant

All sealing compounds shall be installed in slots as protection for detector loop cables according to the manufacturer's instructions and recommendations for the type of installation (e.g. installation in top course versus installation in binder course).

The sealing compound shall be allowed to set prior to allowing vehicles to cross over the loop. Cement dust may be added to tacky sealant where necessary. Spilled detector loop sealant or other excess loop sealant on the road surface that is not within the detector loop slot shall be removed from the road surface.

a) Cold Type

Cold pumped sealant shall be installed using a pressure pump or cartridge gun.

b) Cold Type Single Component Polyurethane

Cold pumped single component polyurethane sealant shall be installed using a pressure pump or cartridge gun. Single component polyurethane sealant shall not be used when detector loops are to be installed in the binder course pavement prior to placement of the top course of pavement over the loops.

"Summer Grade" cold pumped single component polyurethane sealant shall not be used at ambient temperatures less than 20 °C.

"Winter Grade" cold pumped single component polyurethane sealant shall not be used at ambient temperatures less than 0 °C.

c) Hot-Poured Type

Hot poured sealant shall not be used when detector loops are to be installed in the binder course pavement prior to placement of the top course of pavement over the loops.

Hot poured sealant shall not be used when the ambient temperature is greater than 0 °C or less than minus 18 °C.

623.07.01.07 Splicing

Splices of cables shall be made only at the designated splice point. Cables shall be stripped of approximately 12 mm of insulation, twisted together with a minimum of four turns and soldered to produce a bonded connection with a maximum resistance of 0.1 Ohm.

Splices shall be insulated with four half-laps of electrical insulating tape and encased in a resin splice with the splices positioned to obtain a minimum coverage of 6 mm of resin around each splice. The black conductor of the extra low voltage cable shall be connected to the clockwise winding lead cable as specified in the Loop Cable clause.

The metallic shield of cables shall be cut off cleanly and left unconnected in the resin splice.

623.07.02 Probe Detectors

Slot preparation, flexible duct installation and splicing for probe detectors shall be as specified in the Loop Detectors subsection.

623.07.02.01 Aerial Installation

Probe detectors, cables, equipment and fittings, hardware, PVC junction boxes, and accessories necessary for the mounting of equipment on aerial messenger cable system shall be installed as specified in the Contract Documents. All compression nuts, locknuts and fitting hardware shall be securely tightened to prevent shifting of equipment by wind.

623.07.02.02 Underpavement Installation

Probe detectors shall be installed in holes vertically, according to the manufacturer's instructions.

Cable in slots shall be firmly and carefully tamped in place using a blunt instrument on each successive turn of cable. To prevent floating, cables shall be held in place using 25 mm lengths of foam backer rod at 600 mm centres.

Where cables are installed in slots crossing pavement irregularities, they shall be installed through split neoprene tubing.

623.07.02.03 Saw Cutting and Drilling

Saw cutting of slots in pavement shall be in straight lines with slot depths and widths as specified in the Contract Documents. Slot crossing of pavement irregularities shall be constructed using additional widths and depths of slots as specified in the Contract Documents.

Holes for probe detectors shall be 25 mm diameter at a depth of 460 mm below grade and in line with the saw cut slot.

623.07.02.04 Bedding and Sealant

Clean and dry silica sand shall be used as bedding for probe detectors. Sealant shall then be applied to the upper portion of the hole. Cold pumped sealant compound shall be installed using a pressure pump or cartridge gun according to the manufacturer's instructions.

The sealant compound shall be allowed to set according to the manufacturer's instruction prior to allowing vehicles to cross the probe detectors. Cement dust may be added to tacky sealant where necessary.

623.07.03 Pedestrian Pushbuttons

623.07.03.01 Installation

Pedestrian pushbuttons and signs shall be mounted on the side of the pole such that the pedestrian signal pushbutton sign arrow indicates the proper direction for which roadway crossing is required.

Pedestrian pushbuttons shall be installed with stainless steel self-tapping screws or stainless steel straps. A wiring aperture shall be drilled in metal poles and fitted with a rubber gromet or a rigid conduit shall be installed on poles, for wiring access.

Pushbuttons for metal poles shall be installed with an integral sign frame or separately mounted with stainless steel straps or screws where specified in the Contract Documents.

623.07.04 Prefabricated Loops

623.07.04.01 Installation

Prefabricated loops shall be installed as specified in the Contract Documents and as described below.

Prefabricated detector loops shall be accurately laid out to the dimensions specified in the Contract Documents when covered by paving materials.

Prefabricated PVC detector loops shall be installed for burial in granular base, for saw cut installation in subsurface pavement course, open-graded drainage layer, or for embedding in concrete.

Heavy-duty rubber detector loops shall be installed for saw cut installation in subsurface pavement course, open-graded drainage layer, or for embedding in concrete.

When installed in concrete with rebar, prefabricated detector loops shall be mounted a minimum 50 mm above the rebar grid and as specified in the Contract Documents.

Any extra length of wiring of the prefabricated detector loop shall be coiled in the electrical handhole.

623.07.04.02 Flexible Duct Installation

Flexible duct installation, including earth excavation, backfill, removal and restoration, shall be according to OPSS 603.

623.07.05 Traffic Count Station Installation

The work for traffic count station shall include the installation of traffic count station, regardless of type.

The traffic count station and all associated equipment shall be installed as specified in the Contract Documents.

623.07.06 Accessible Pedestrian Signals

The installation of APS shall meet the requirements of the AODA Ontario Regulation 413/12 and shall be installed according to the manufacturer's recommendations and the Contract Documents.

Accessible pedestrian signal pushbuttons shall be installed within 1,500 mm of the edge of the curb, and shall be mounted at a maximum of 1,100 mm above ground level as specified in the Contract Documents.

Accessible pedestrian signals shall have tactile arrows that align with the direction of crossing.

623.07.07 Non-Intrusive Detection System

Detectors shall be installed at locations and mounting heights specified in the Contract Documents and according to the manufacturer's guidelines. The detectors shall be oriented and configured for operation according to the manufacturer's specifications and the Contract Documents.

Wiring and cabling shall be installed according to OPSS 604 and shall run continuously from source to destination. Splicing of wires and cables shall not be permitted.

All cabling and equipment required to transmit, receive, and process non-intrusive detection signals shall be installed according to the manufacturer's specifications and the Contract Documents.

Anti-seize compound shall be applied to the mounting bracket.

Drip loops and expansion loops shall be formed at each pole or conduit entry and held free of the pole or of other cables or connections.

Cable shall be protected with rigid PVC conduit where slack lengths of more than 450 mm are externally exposed.

Setup equipment shall be ruggedized and shall have 1 serial port, 1 USB port, 1 ethernet port, and a daylight-readable display. The setup equipment shall include a ruggedized notebook or equivalent device. The setup equipment shall operate correctly in ambient temperatures from 5 to 35 °C.

Metal detector housings shall be connected to the pole ground connector, or the system ground wire in surface mounted PVC junction boxes. All grounding work shall be according to OPSS 609.

For installation on metal poles, wiring apertures shall be drilled as required. The apertures shall be located clear of the vertical seam and overlapping sections of sectional steel poles. Apertures shall be deburred and painted with grey zinc rich paint. Rubber grommets shall be installed after the paint has dried.

623.07.08 Quality Control

623.07.08.01 Pre-installation Testing and Inspection

Prior to installation, an inspection of the following shall be conducted to ensure they are according to the Contract Documents:

- a) Detection devices and connection components
- b) Prefabricated detector loops and components
- c) Traffic count stations

The Contractor shall ensure that the temperature is within allowable limits prior to saw cutting and ensure that any dampness or precipitation can be successfully blown out of saw cut slots prior to beginning installation.

Prior to the overlaying of asphalt, detector loop wiring shall be tested for continuity, for leakage to ground and for inductance. Resistance to ground shall be 10 megohm or greater. Inductance shall be within 25% of the value indicated in the Contract Documents using a 100 kHz signal at 5V. Any prefabricated detector loop not passing these tests shall be replaced.

Prior to installation of probe detectors, the coil resistance shall be tested and shall be within 25% of the manufacturer's rated resistance. For multiple installations of probe detectors, the set shall be tested for total resistance value. Any detector not passing the foregoing tests shall not be used.

623.07.08.01.01 Accessible Pedestrian Signals

Actuation devices and connection components shall have been inspected prior to installation to ensure that they meet the requirements of Ontario Regulation 413/12 of the AODA and the Contract Documents.

623.07.08.01.02 Non-Intrusive Detection System Equipment

Non-intrusive detection system equipment shall be tested and inspected prior to installation to verify that it performs according to the manufacturer's specifications and the Contract Documents.

623.07.08.02 Proof of Performance Testing and Inspection

The Work shall be inspected and tested to ensure that all components are according to the requirements of the Contract Documents.

When the installation of traffic signals is included in the contract, all auxiliary components such as sensor units shall be tested to ensure they are in working order without activating the traffic signals for public display.

The testing and inspection results shall be documented in a report and submitted to the Contract Administrator.

623.07.08.02.01 Detector Loops

Loop wiring shall be tested for continuity, leakage to the ground and for inductance as follows:

- a) Prior to sealing slots.
- b) At the controller cabinet upon the completion of splices, installation of extra low voltage cable, sealing of slots and backfilling of trenches.

Testing requirements shall be the same as specified in the Pre-installation Testing and Inspection clause. Any loop not passing these tests shall be replaced.

Loops to be replaced shall be re-cut in cut in the original slot with new wiring and sealant installed and retested.

623.07.08.02.02 Probe Detectors

Probe detectors shall be tested at the splice point for coil resistance and leakage to the ground prior to sealing all slots and holes. Testing requirements shall be the same as specified in the Pre-installation Testing and Inspection clause.

For aerial installations, the coil resistance shall be tested at the controller cabinet upon the completion of splices to extra low voltage cables.

623.07.08.02.03 Pedestrian Pushbuttons

Upon completion of the installation of pedestrian pushbuttons, the APS system shall be tested at the controller cabinet.

623.07.08.02.04 Prefabricated Detector Loops

Loop wiring shall be tested for continuity, leakage to the ground and for inductance as follows:

- a) After covering with paving materials.
- b) At the controller cabinet or the traffic count station upon the completion of splices, installation of extra low voltage cable, sealing of slots and backfilling of trenches.

Resistance to ground shall be 10 megohm or greater. Inductance shall be within 25% of the value indicated in the Contract Documents.

623.07.08.02.05 Traffic Count Station

Upon completion of the installation of the traffic count station and the connection to the loops, the APS system shall be tested for its wiring continuity, leakage to ground and inductance, as specified in the Prefabricated Detector Loops clause.

623.07.08.02.06 Accessible Pedestrian Signals

The installed APS shall be inspected and tested to confirm that they meet the requirements of Ontario Regulation 413/12 of the AODA and the Contract Documents. The APS shall be tested according to the manufacturer's recommendations.

623.07.08.02.07 Non-Intrusive Detection System

Each non-intrusive detection system shall be inspected and tested to verify that it performs according to the manufacturer's specifications and the Contract Documents. In particular, and without limiting the foregoing, the Contractor shall ensure that all components are installed, tested, and proven to work as indicated in the Contract Documents, and that all cables are energized and in working order.

623.07.08.03 Testing and Training for Non-Intrusive Detection System "Switch On"

A new non-intrusive detection system at a location not previously equipped with a non-intrusive detection system, or a new non-intrusive detection system to replace an existing detection system, shall be switched on for operation according to the following requirements:

- a) The Contract Administrator shall be given a minimum of 3 Business Days' notice of when the new detection system will be installed or switched over, and shall reconfirm that the work will be done as scheduled 24 hours prior to doing the work.
- b) The Contractor shall provide training from the manufacturer to ministry staff, up to a maximum of six (6) persons, on the following topics:
 - i. Overview of the non-intrusive detection system
 - ii. Hardware and software operation
 - iii. Field setup procedures (detection zones setup)
 - iv. Configuration procedures and techniques
 - v. Operation and maintenance of the detection system
- c) The training shall include hand-outs and reference material for each participant.
- d) Training shall be completed on or before the detection system is installed and operational.
- e) The setup equipment shall be handed over to the MTO electrical coordinator responsible for the maintenance of the non-intrusive detection system equipment, at the time of training.
- f) All repairs or replacement of defective components shall be complete prior to activation.
- g) Non-intrusive detection system "Switch On" for operation shall not be permitted on Fridays, Saturdays, Sundays, Mondays, or statutory holidays.
- h) Traffic shall be under police supervision during this operation.

The Contract Administrator may witness any test performed and may make random inspections of the work.

The accessible pedestrian signals shall be tested in the presence of the Contract Administrator and the ministry's electrical coordinator.

The Contract Administrator may provide direction for the aiming of non-intrusive detectors or the adjustment of the non-intrusive detection system.

623.08 **QUALITY ASSURANCE**

623.08.01 **General**

The Contractor shall give the Contract Administrator 24 hours notice of when final tests are to be performed. The final tests shall be done after all work is completed.

The Contract Administrator shall witness all final tests. All test results shall be submitted to the Contract Administrator.

The accessible pedestrian signals shall be tested in the presence of the Contract Administrator and the ministry's electrical coordinator.

The Contract Administrator and the ministry's electrical coordinator may witness any testing performed and may make random inspections of the work.

The Contract Administrator may provide direction for the aiming of non-intrusive detectors or the adjustment of the non-intrusive detection system.

The Contract Administrator may witness any test and may make random inspections of the work.

623.08.02 **Loop Detectors**

Prior to sealing slots, loop wiring shall be tested for continuity, for leakage to ground and for inductance. Resistance to ground shall be 10 mega ohm or greater. Inductance shall be within 25% of the value indicated in the contract using a 100 kHz signal at 5V.

Upon completion of splices, installation of extra low voltage cable, sealing of slots and backfilling of trenches, the foregoing tests shall be repeated at the controller cabinet.

Any loop detector required to be replaced shall be re-cut in the original slot with new wiring and sealant installed. All such loops shall be tested to conform to the foregoing requirements.

623.08.03 **Probe Detectors**

Prior to installation of probe detectors, the coil resistance shall be tested and shall be within 25% of the manufacturer's rated resistance. For multiple installations of probe detectors, the set shall be tested for total resistance value. Any detector not passing the foregoing tests shall not be used.

623.08.03.01 **Aerial Installation**

Upon completion of splices, installation of extra low voltage cable, the coil resistance shall be tested at the controller cabinet.

623.08.03.02 **Underpavement Installation**

Prior to sealing of slots and holes for probe detectors, the coil resistance shall be tested at the splice point. The probe detectors shall also be tested for leakage to ground at the splice point.

623.08.04 **Pedestrian Pushbuttons**

Upon completion of the installation of the pedestrian pushbuttons, the system shall be tested at the controller cabinet.

623.09 MEASUREMENT FOR PAYMENT

623.09.01 Actual Measurement

- 623.09.01.01**
- Loop Detectors**
- Loop Detectors (Temporary)**
- Probe Detectors**
- Probe Detectors (Temporary)**
- Pedestrian Pushbuttons**
- Pedestrian Pushbuttons (Temporary)**
- Prefabricated Detector Loops**
- Traffic Count Station**

For measurement purposes, a count shall be made of the number of loops, detectors, pushbuttons and traffic count stations installed.

- 623.09.01.02**
- Accessible Pedestrian Signals**
- Accessible Pedestrian Signals (Temporary)**
- Non-Intrusive Detection Systems**
- Non-Intrusive Detection Systems (Temporary)**

For measurement purposes, a count shall be made of the number of intersections where accessible pedestrian signals and non-intrusive detection systems are installed. Each intersection shall be counted only once, regardless of the number of times all or part of the accessible pedestrian signals or non-intrusive detection systems are relocated.

623.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

623.10 BASIS OF PAYMENT

- 623.10.01**
- Loop Detectors - Item**
- Loop Detectors (Temporary) – Item**
- Probe Detectors - Item**
- Probe Detectors (Temporary) - Item**
- Pedestrian Pushbuttons – Item**
- Pedestrian Pushbuttons (Temporary) - Item**
- Prefabricated Detector Loops - Item**
- Traffic Count Station - Item**
- Accessible Pedestrian Signals – Item**
- Accessible Pedestrian Signals (Temporary) - Item**
- Non-Intrusive Detection Systems – Item**
- Non-Intrusive Detection Systems (Temporary) – Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Materials required to do the work, including, but not limited to, installation, removal, salvage, relocation, reinstallation, rearrangement, and recalibration of all equipment system components.

Payment for loop detectors that were to be constructed as a single loop but constructed as two loops due to pavement irregularities, as directed by the Contract Administrator, shall be made at the Contract price plus 20%.