

**ITEM #1111401A - LOOP VEHICLE DETECTOR****ITEM #1111451A - LOOP DETECTOR SAWCUT**

Replace Section 11.11, LOOP VEHICLE DETECTOR AND SAWCUT, with the following:

**11.11.01 – Description:**

1. Furnish and install a loop vehicle detector amplifier.
2. Sawcut pavement. Furnish and install loop detector wire in sawcut.

**11.11.02 – Materials:**

Article M.16.12

**M.16.12 - LOOP VEHICLE DETECTOR AND SAWCUT****1. Loop Vehicle Detector:**

- Comply with National Electrical Manufacturers Association (NEMA) standards, Section 6.5, Inductive Loop Detectors.
- Comply with the current CT DOT Functional Specifications for Traffic Control Equipment, Section 3 B, Loop Vehicle Detector with Delay/Extend Option.

**2. Sawcut:****(a) Wire in sawcut:**

- International Municipal Signal Association (IMSA) Specification 51-7, single conductor cross-linked polyethylene insulation inside polyethylene tube.
- # 14 AWG

**(b) Sealant:****(1) Polyester Resin Compound**

- Two part polyester which to cure, requires a liquid hardener.
- Use of a respirator not necessary when applied in an open-air environment.
- Cure time dependent on amount of hardener mixed.
- Flow characteristics to guarantee encapsulation of loop wires.
- Viscosity: 4000 CPS to 7000 CPS at 77 degrees Fahrenheit (25° C).
- Form a tack-free skin within 25 minutes and full-cure within 60 minutes at 77 degrees Fahrenheit (25° C).
- When cured, resist effects of weather, vehicular abrasion, motor oil, gasoline, antifreeze, brake fluid, de-icing chemicals, salt, acid, hydrocarbons, and normal roadway encounters.
- When cured, maintain physical characteristics throughout the ambient temperature ranges experienced within the State of Connecticut.
- When cured, bonds (adheres) to all types of road surfaces.
- Weight per Gallon (3.8 l): 11 lbs ±1 lb (5kg ± .45kg)

- Show no visible signs of shrinkage after curing.
- 12-month shelf life of unopened containers when stored under manufacturers specified conditions.
- Cured testing requirements:
  - Gel time at 77 degrees F (25° C): 15 - 20 minutes, ASTM C881, D-2471
  - Shore D Hardness at 24 hours: 55-78, ASTM D-2240
  - Tensile Strength: > 1000 psi (6895 kPa), ASTM D-638
  - Elongation: 18 - 20 %, ASTM D-638
  - Adhesion to steel: 700 - 900 psi (4826 - 6205 kPa), ASTM D-3163
  - Absorption of water, sodium chloride, oil, and gasoline: < 0.2%, ASTM D-570
- Include in the Certificate of Compliance:
  - Manufacturer's confirmation of the uncured and cured physical properties stated above.
  - Material Safety Data Sheet (MSDS) stating sealant may be applied without a respirator in an open-air environment.
- Designed to allow clean-up without the use of solvent that is harmful to the workers and the environment.

(2) Elastomeric Urethane Compound:

- One part urethane which to cure, does not require a reactor initiator, or a source of thermal energy prior to or during its installation.
- Use of a respirator not necessary when applied in an open-air environment.
- Cure only in the presence of moisture.
- Flow characteristics to guarantee encapsulation of loop wires.
- Viscosity such that it does not run out of the sawcut in sloped pavement during installation; 5000 CPS to 85,000 CPS.
- Form a tack-free skin within 24 hours and 0.125 inch (0.33mm) cure within 30 hours at 75 degrees Fahrenheit (24° C).
- When cured, resist effects of weather, vehicular abrasion, motor oil, gasoline, antifreeze, brake fluid, de-icing chemicals, salt, acid, hydrocarbons, and normal roadway encounters.
- When cured, maintain physical characteristics throughout the ambient temperature ranges experienced within the State of Connecticut.
- Show no visible signs of shrinkage after curing.
- Shelf life when stored under manufacturers specified conditions:
  - Caulk type cartridges: minimum 9 months
  - Five gallon containers: minimum 12 months
- Designed for application when the pavement surface temperature is between 40 and 100 degrees Fahrenheit (4° and 38° C).
- Uncured testing requirements:
  - Weight/Gallon: ASTM D-1875
  - Determination of Non-volatile Content: ASTM D-2834
  - Viscosity: ASTM D-1048B
  - Tack-free Time: ASTM D-1640
- Cured testing requirements:
  - Hardness: ASTM D-2240
  - Tensile Strength & Elongation: ASTM D-412A
- Include in the Certificate of Compliance:
  - Manufacturer's confirmation of the uncured and cured physical properties stated above.
  - Material Safety Data Sheet (MSDS) stating sealant may be applied without a respirator in an open air environment.

- Designed to allow clean-up without the use of solvent that is harmful to the workers and the environment.

### 3. Miscellaneous:

- (a) Liquidtight Flexible Nonmetallic Conduit
  - UL listed for direct burial
  - UL 1660
  - Smooth polyvinyl chloride inner surface
- (b) Water Resistant Pressure Type Wire Connector
  - UL listed for direct burial and wet locations
  - UL 486D

### 11.11.03 - Construction methods:

#### 1. Loop Vehicle Detector

- Shelf-mount the detector amplifier in the controller cabinet.
- Terminate the harness conductors with crimped spade connectors. Connect conductors to appropriate terminals, eg, black wire to 110vac, white wire to 110vac neutral.
- Tie loop harness and conductors to controller cabinet wiring harness. Leave enough slack in loop harness so that amplifier may be moved around on cabinet shelf;  $\pm 2$  feet (0.6 meter) slack.
- Attach a loop identification tag to the harness. Record pertinent detector information on the tag with indelible ink. See example below.
  - Loop No.: *D4*
  - Phase Call: *Phase 4*
  - Field Location: *Rt. 411(West St.)*
  - *Eastbound, Left Lane*
  - Detector No.: *4*
  - Cabinet Terminals: *234, 235*

#### 2. Loop Detector Sawcut

- Loop size, number of turns, and location is shown on the intersection plan.
- Do not cut through a patched trench, damaged or poor quality pavement without the approval of the Engineer.
- Wet-cut pavement with a power saw using a diamond blade  $\frac{3}{8}$  inch (9.5mm) wide. Dry-cut is not allowed.
- Ensure slot depth is between 1  $\frac{3}{4}$  inch to 2.0 inch (45mm to 50mm).
- Overlap corners to ensure full depth of cut.
- To prevent wire kinking and insulation damage, chamfer inside of corners that are  $\leq 120$  degrees.
- Clean all cutting residue and moisture from slot with oil-free compressed air. Ensure slot is dry before inserting wire and sealing sawcut.
- Cut home-run, from loop to curb or edge-of-road, as shown on the typical installation sheet.
- To prevent cross-talk and minimize electrical interference, twist home-run wires, from edge of road to handhole, with at least 5 turns per foot (16 turns per meter). Tape together twisted home-run wires at 2 foot (0.6 meter)  $\pm$  intervals.
- In new or resurfaced pavement, install loops in the wearing course. If the wearing course is not scheduled for immediate placement (within 24 hours) after the base course, provide temporary detection when directed by the Engineer. Temporary detection may be sawcut

loops, preformed loops, microwave sensor, video, or other method approved by the Engineer.

- Splice(s) not allowed anywhere in loop wire either in loop or in home-run.
- Ensure wires are held in place at bottom of slot by inserting at 2 foot (0.6 m) intervals, 1 inch sections of foam backer rod or wedges formed from 1 inch (25mm) sections of the polyethylene tubing. Loop detectors with wires that have floated to the top of the sealant will not be accepted.
- To create a uniform magnetic field in the detection zone, wind adjacent loops in opposite directions.
- Use **polyester compound** as the sealant unless another type is allowed by the Engineer.
- Mix hardening agent into polyester resin with a power mixer or in an application machine designed for this type of sealant in accordance with the manufacturer's instructions.
- Apply the loop sealant in accordance with the manufacturer's instructions and the typical installation sheet. Do not apply sealant when pavement temperature is outside the manufacturers recommended application range.
- Solder splice the loop wires to the lead-in cable and install water resistant connector as shown on the typical installation sheet.
- Test the loop circuit resistance, inductance, and amplifier power-interruption as shown on the typical installation sheet. Document all test results.

### 3. Damaged, Patched, or Excessively Worn Pavement

- Where the existing pavement is damaged, patched or excessively worn and is found to be not suitable for reliable loop detection, notify the Engineer.
- When directed by the Engineer, remove and replace an area of pavement to allow the proper installation of the loop.
- Remove a minimum of 3 inches (75mm) depth.
- Comply with the applicable construction methods of Section 2.02 Roadway Excavation, Formation Of Embankment and Disposal of Surplus Material, and Section 4.06 Bituminous Concrete, such as:
  - Cut Bituminous Concrete
  - Material for Tack Coat
  - Bituminous Concrete Class 1

### 4. Re-surface/Overlay Project

- Prior to disconnecting the existing loop confirm that the amplifier is operating properly and is programmed according to plan. Document loop operation. Report any discrepancies and malfunctions to Engineer.
- Remove all abandoned sawcut home-run wire from handhole.
- Sawcut new loop according to plan.
- Solder splice new loop wires to the existing lead-in cable and install new water resistant twist connectors as shown on the typical installation sheet. Do not re-use the removed connectors.
- Test the loop circuit resistance and inductance. Document results.
- Ensure the existing loop amplifier has re-tuned to the new loop and is operating according to plan.

**11.11.04 – Method of Measurement:**

1. Loop Vehicle Detector is measured by the number of installed, operating, tested, and accepted vehicle detector amplifiers of the type specified.
2. Loop Detector Sawcut is measured by the number of linear feet (meters) of installed, tested, operating, and accepted sawcut only where there is loop wire. Over-cuts at corners that do not contain wire are not measured.

**11.11.05 – Basis of Payment:**

1. Loop Vehicle Detector and Sawcut is paid at the contract unit price per linear foot (meter). The price includes the detector, sawcut, loop wire, sealant, liquidtight flexible nonmetallic conduit, duct seal, water resistant splice connectors, testing, incidental material, equipment, and labor.

<u>Pay Item</u>	<u>Pay Unit</u>
Loop Vehicle Detector and Sawcut	l.f. (m)

## **ITEM #1111420A – PIEZO CABLE SENSOR (TYPE 1)**

**DESCRIPTION:** Work under this item shall consist of furnishing and installing a piezo sensor of the type specified, all lead-in cable from the sensor to the traffic control cabinet, and all saw cut needed to install the piezo sensor and piezo sensor cable, where specified on the plans or directed by the Engineer.

**MATERIALS:** All materials must be compatible with the “Diamond Phoenix” Traffic Recorder and “Peek ADR” Traffic Recorder.

The piezo sensors shall operate within specification in both asphalt and portland cement concrete pavements, constructed on all commonly encountered sub-base materials and soil. The system is required to operate in through traffic lanes of interstate and principal highways covering the full range of traffic volumes and truck percentages to be found in the United States. The system shall function within specification over the temperature range -40 °F to 160 °F.

Piezo cable sensor type 1 shall be a Class I sensor approximately 11'6" in length with an output uniformity less than  $\pm 7\%$ . Sensor shall consist of a 16 gauge, flat, braided, silver plated, copper wire, a highly compressed piezoelectric copolymer, and a 0.016" thick brass outer sheath conforming to CDA-260 and ASTM B587-88. Sensor shall be approximately 0.260" wide x 0.063" thick and have a linear capacitance of 1.1 nF/ft,  $\pm 20\%$ . Insulation resistance shall be greater than 500 megohm, and piezoelectric coefficient shall be greater than or equal to 20 pC/N.

Each sensor shall be supplied with enough sensor cable to go from the piezo sensor to the cabinet unspliced. Sensor cable shall be RG 58 C/U type with a high density polyethylene outer jacket rated for direct burial and a nominal capacitance of 27 pF/ft.

Epoxy for piezo sensor installation shall be one of the following:

ECM P5G  
IRD AS-475  
IRD-Pat America PU200

Polyester resin compound for sealing sensor cable saw cut shall be:

- Two part polyester which to cure, requires a liquid hardener.
- Use of a respirator not necessary when applied in an open air environment.
- Cure time dependent on amount of hardener mixed.
- Flow characteristics to guarantee encapsulation of sensor cables.
- Viscosity: 4000 CPS to 7000 CPS at 77 degrees Fahrenheit.
- Form a tack-free skin within 25 minutes and full-cure within 60 minutes at 77 degrees Fahrenheit.

- When cured, resist effects of weather, vehicular abrasion, motor oil, gasoline, antifreeze, brake fluid, de-icing chemicals, salt, acid, hydrocarbons, and normal roadway encounters.
- When cured, maintain physical characteristics throughout the ambient temperature ranges experienced within the State of Connecticut.
- When cured, bonds (adheres) to all types of road surfaces.
- Weight per Gallon: 11 lbs ±1 lb
- Show no visible signs of shrinkage after curing.
- 12 month shelf life of unopened containers when stored under manufacturers specified conditions.
- Cured testing requirements:
  - Gel time at 77 degrees F: 15 – 20 minutes, ASTM C881, D-2471
  - Shore D Hardness at 24 hours: 55-78, ASTM D-2240
  - Tensile Strength: > 1000 psi, ASTM D-638
  - Elongation: 18 – 20 %, ASTM D-638
  - Adhesion to steel: 700 – 900 psi, ASTM D-3163
  - Absorption of water, sodium chloride, oil, and gasoline: < 0.2%, ASTM D-570
- Include in the Certificate of Compliance:
  - Manufacturer's confirmation of the uncured and cured physical properties stated above.
  - Material Safety Data Sheet (MSDS) stating sealant may be applied without a respirator in an open air environment.
- Designed to allow clean-up without the use of solvent that is harmful to the workers and the environment.

**CONSTRUCTION METHODS:** The Contractor performing the work shall have had previous experience installing piezo sensors. Experience shall be understood to mean the foreman/crew leader having installed piezo sensors of the type specified. Contractors not meeting the experience requirements shall receive training from the sensor manufacturer, or have a manufacturer's representative present for training and supervision during installation of the sensors at the first site. Documentation of experience or training shall be submitted to the Engineer for approval 30 days prior to the start of work.

The Contractor shall follow the manufacturer's recommended installation procedure. The Contractor shall submit installation procedure along with catalog cuts for approval. Outlined below is a sample of an acceptable installation procedure.

Work shall be organized so that roadway closings are kept at a minimum and as specified in Maintenance and Protection of Traffic.

Using the location shown on the plans and details, carefully mark out the piezo sensor slot perpendicular to the flow of traffic and the cable run on the roadway using crayons and pavement paint.

Cut the sensor slot  $\frac{3}{4}$ " wide ( $\pm 1/16$ ") and 1" minimum deep and approximately 6" longer than the sensor length (including lead attachment) using a  $\frac{3}{4}$ " wide diamond blade or blades ganged together to get a single  $\frac{3}{4}$ " wide cut. Drop blade an extra  $\frac{1}{2}$ " down on both ends. The slot shall be wet cut to minimize damage to the road.

Cut the sensor cable home run slot  $\frac{1}{4}$ " minimum wide and  $1\frac{3}{4}$ " – 2" deep. The slot shall be wet cut to minimize damage to the road. Cable lead-out shall be centered on the piezo sensor slot.

Chisel out any material in the center between the two sensor saw cuts.

Power wash and sweep all slots. All slots and the pavement 5" on all sides must be very clean.

Dry all slots with compressed air. All slots and the pavement 1' on all sides must be completely dry.

Place a strip of duct tape along the pavement  $\frac{1}{8}$ " from both sides of the slot for the full length of the slot.

Remove the sensor from the container, check for damage, visually inspect the sensor to ensure it is straight without any twists and curls and verify that the sensor cable is of sufficient length to reach the cabinet without splicing.

Test the sensor for capacitance, dissipation factor and resistance according to the manufacturer's directions. Capacitance and dissipation factor shall be within  $\pm 20\%$  of the enclosed data sheet. Resistance shall be greater than 20 megohm. Test results, serial number and location of sensor shall be recorded on data sheet and a copy left in the cabinet.

Lay the sensor on the tape next to the slot. Ensure that the sensor is straight and flat. From this point on, handle the sensor with latex gloves.

Clean the sensor with steel wool or emery pad and wipe down with alcohol and lint-free cloth.

Place the installation brackets on the sensor every 6" for the length of the sensor.

Bend the end of the sensor downward at a 30 degree angle. Bend the lead attachment end down at a 15 degree angle and then 15 degrees back up until level, forming a lazy Z.

Place the sensor in the slot with the top of the brass element  $\frac{3}{8}$ " below the road surface, and the top of the brackets  $\frac{1}{8}$ " below the road surface. The end of the sensor shall be at least 2" from the end of the slot, and the tip shall not touch the bottom of the slot. The lead attachment shall also not touch the bottom or sides of the slot. The brackets shall fit snugly against the sides of the slot.

Visually inspect the length of the sensor to ensure it is level and at uniform depth.

Route the piezo sensor cable through the home run slot. The sensor cable shall be protected by a PVC sleeve where it crosses a joint in or adjacent to pavement. Place backer rod under and over the sensor cable inside the slot 3" from the lead attachment to prevent the epoxy from running out into the home run slot.



Premix the epoxy for 2 minutes or until smooth using a low speed mixing drill (450 rpm) and a mixing paddle. Add the hardener to the epoxy and mix according to the manufacturer's instructions. Ensure the mixing paddle is not lifted out of the epoxy while the mixing head is spinning, which could trap excessive air in the material.

Immediately pour the epoxy into the slot using a small bead to facilitate the flow of the epoxy under the sensor, eliminating air pockets. Start at the end of the sensor and pour towards the lead attachment utilizing several passes to completely fill the slot full of epoxy.

Using a trowel or putty knife, lightly spread the epoxy smooth along the length of the slot, ensuring the epoxy does not have a trough on top. The epoxy should be slightly higher than the tape as the epoxy will shrink while curing.

Remove the tape on the sides of the sensor as soon as the epoxy begins to set.

Remove the backer rod from the slot and fill the home run slot with polyester compound. Polyester compound shall fully encapsulate the sensor cable, be flush with the road surface and provide a minimum cover of 1" between the top of the sensor cable and road surface.

Grind the top of the epoxy flat and even with the road surface using an angle grinder after the epoxy is fully cured.

Clean up the site. When the epoxy is fully cured, it may be opened to traffic. Time of cure should be specified by manufacturer and is dependent on the temperature. Failure to wait for the epoxy to fully cure may ruin the installation and cause it to fail prematurely.

After installation, the piezo sensor shall be tested a second time for capacitance, dissipation factor and resistance. In addition, the sensor shall be tested for voltage output using an oscilloscope by measuring the signal generated by vehicles of various size and weight driving over the sensor and applying an external pressure. An acceptable installation shall consist of the sensor having a capacitance and dissipation within  $\pm 20\%$  of the enclosed data sheet, a resistance greater than 20 megohm and a minimum voltage output of 100 mV for a light car. Test results shall be recorded on the enclosed data sheet and a copy left in the cabinet.

**METHOD OF MEASUREMENT:** Piezo sensors shall be measured for payment by the number of piezo sensors of the type specified, complete, operational, and accepted in place.

**BASIS OF PAYMENT:** This work will be paid for at the contract unit price each for "Piezo Cable Sensor (Type 1)" which price shall include the sensor, sensor cable, installation brackets, saw cut, epoxy, polyester compound, liquidtight flexible nonmetallic conduit, PVC sleeves, spade lugs, all materials, labor, tools, necessary fittings, required training and supervision by piezo manufacturer, testing, equipment, and work incidental thereto.

**ITEM #1105001A - 1 WAY, 1 SECTION SPAN WIRE TRAFFIC SIGNAL**

**ITEM #1105003A - 1 WAY, 3 SECTION SPAN WIRE TRAFFIC SIGNAL**

**ITEM #1105006A - 2 WAY, 1 SECTION SPAN WIRE TRAFFIC SIGNAL**

**ITEM #1105007A - 2 WAY, 3 SECTION SPAN WIRE TRAFFIC SIGNAL**

**ITEM #1105011A - 3 WAY, 3 SECTION SPAN WIRE TRAFFIC SIGNAL**

**ITEM #1105014A - 4 WAY, 1 SECTION SPAN WIRE TRAFFIC SIGNAL**

**ITEM #1105015A - 4 WAY, 3 SECTION SPAN WIRE TRAFFIC SIGNAL**

**ITEM #1105101A - 1 WAY, 1 SECTION MAST ARM TRAFFIC SIGNAL**

**ITEM #1105103A - 1 WAY, 3 SECTION MAST ARM TRAFFIC SIGNAL**

**ITEM #1105107A - 2 WAY, 3 SECTION MAST ARM TRAFFIC SIGNAL**

**ITEM #1105180A - 1 WAY, 1 SECTION BI-COLORED ARROW**

**ITEM #1105203A - 1 WAY, 3 SECTION POLE MOUNTED TRAFFIC SIGNAL**

**ITEM #1105303A - 1 WAY, 3 SECTION PEDESTAL MOUNTED TRAFFIC SIGNAL**

**ITEM #1105490A – 1 WAY, 1 SECTION TRAFFIC SIGNAL SIGN MOUNTED**

**Article 11.05.03 – Construction Methods:**

In the second paragraph, delete the last sentence (“A balance adjuster shall...”).

Add the following paragraphs:

Circular indications that have an identification mark (such as an arrow) on the top of the lens shall be installed with that mark at the 12 o'clock position.

**Article 11.05.05 – Basis of Payment:**

ITEM #1105001A, 1105003A, 1105006A, 1105007A,  
1105011A, 1105014A, 1105015A, 1105101A, 1105103A,  
1105107A, 1105180A, 1105203A, 1105303A, 1105490A

In the first sentence of the first paragraph, delete “balance adjuster,”.

**Form 817 -Article M.16.06 - Traffic Signals**

**Sub Article 3 - Housing:**

In the last sentence, between the words “housing” and “shall” add “and all internal hardware”.

Add the following after the last paragraph.

Each section of the housing shall be provided with a removable visor. The visor shall be the cap type, unless otherwise noted on the plan. The visor shall be a minimum .05 inch (.13 mm) thick. The visor shall be the twist on type and secured to the signal by four equidistant flat tabs screwed to the signal head.

**Sub Article 4 - Brackets:**

Add the following at the end of the last paragraph:

Backplates shall be 5” wide and louvered.

Install a 3” wide yellow retroreflective strip (Type IX sheeting) along the perimeter of the face of the backplate.

Replace the last paragraph with the following:

When indicated on the plans, a backplate of dimensions, as shown on the plans, constructed of 5052-H32 aluminum alloy sheet between 0.050-in to 0.065-in thickness meeting the requirements of ASTM B209 shall be attached to the signal head housing. The backplate shall be painted a flat black on both sides.

**Delete Sub Article 5 - Optical Unit and Sub Article 6 – Lamp Socket** and replace with the following:

Optical Unit, Light Emitting Diode:

**(a) General:**

Only Optical Units that meet the requirements contained herein supplied by the below manufacturers that have been tested by the Department’s Signal Lab will be accepted. Final approval for model numbers will be done at the time of the catalog cut submittals.

ITEM #1105001A, 1105003A, 1105006A, 1105007A,  
1105011A, 1105014A, 1105015A, 1105101A, 1105103A,  
1105107A, 1105180A, 1105203A, 1105303A, 1105490A

Duralight  
Trastar, Inc.  
860 N. Dorothy Dr., Suite 600  
Richardson, TX 75081

GE Lighting Solutions  
Corporate Headquarters  
1975 Noble Road Building 338E  
East Cleveland, OH 44112-6300

Dialight  
1501 Foute 34 South  
Farmingdale, NJ 07727

Leotek  
726 South Hillview Drive  
Milpitas, CA 95035

The materials for Light Emitting Diode (LED), Optical Unit, circular and arrow, shall conform to the following:

- The ITE Performance Specification for Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Circular Signal Supplement for circular indications dated June 27, 2005.
- The ITE Performance Specification for Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement for arrow indications dated July 1, 2007.

Section 4, Adjustable Traffic Signals and General Housing sections of the **Department of Transportation Functional Specifications for Traffic Control Equipment, current edition governs**. Where the Department of Transportation Functional Specifications conflict with this Special Provision or the 2005/2007 ITE Performance Specifications, this Special Provision and the 2005/2007 ITE Performance Specifications shall govern.

The Optical Unit shall have an Incandescent look and be made up of a smooth surfaced outer shell, multiple LED light sources, a filtered power supply and a back cover, assembled into a sealed unit. The Optical Unit shall be certified as meeting the 2005/2007 ITE Specifications by Intertek Testing Services, Inc. (ITSNA, formerly ETL) or another organization currently recognized by the Occupational Safety and Health Administration (OSHA) as a Nationally Recognized Testing Laboratory (NRTL.) The Optical Unit shall perform to the requirements of the ITE Specification for a minimum of 60 months.

A “Swing Test” will be performed by the Department to ensure no significant dimming or blanking occurs, until the lamp is obscured by the visor. All L.E.D Lamps will be subjected to further field testing for reliable operation.

The Arrow Optical Unit shall be “Omni-Directional” so that it may be oriented in a right, left or straight configuration without degradation of performance.

**(b) Electrical Requirement:**

ITEM #1105001A, 1105003A, 1105006A, 1105007A,  
1105011A, 1105014A, 1105015A, 1105101A, 1105103A,  
1105107A, 1105180A, 1105203A, 1105303A, 1105490A

**Operating voltage:**

80 to 135 Volts AC with cutoff voltage (no visible indication) below 35Volts AC.

**Power requirements:**

Circular Indications: 12", (300 mm) – no more than 16 Watts

Circular Indications: 8", (200mm) - no more than 16 Watts

Arrows Indications: 12", (300mm) - no more than 16 Watts

**Power Supply:**

Fused and filtered to provide excess current protection and over voltage protection from electrical surges and transient voltages.

**(c) Photometric Requirement:**

**Beam Color:**

Meet 2005/2007 ITE Specifications

**(d) Mechanical Requirements:**

**Diameter:**

The Circular Optical Unit shall fit into standard 12" (300mm) or 8" (200mm) housing.

The Arrow Optical Unit shall fit 12" (300mm) housings only.

**Enclosure:**

UV (Ultraviolet) stabilized polycarbonate back cover.

Clear lens cover for all Red, Yellow and Green Circular Optical Units.

For Arrow Optical Units the arrow indication segment of the lens shall be clear.

Enclosure sealed and waterproofed to eliminate dirt contamination and be suitable for installation in all weather conditions.

Clearly mark on the housing the following information:

- Manufacturer & model number
- Date of manufacture (must be within one year of installation)

The model number shall end with the number of LEDs used to comprise the unit as the last digits of the model number. Example, if the unit comprised of 3 LEDs and the model is x12y, then the new model number shall read x12y3.

**Operating temperature:**

Meet 2005/2007 ITE Specification

**Wiring:** L.E.D. lamps shall have **color coded 16 AWG wires** for identification of heads as follows:

RED L.E.D. Lamps	RED with WHITE neutral
YELLOW L.E.D. Lamps	YELLOW with WHITE neutral
GREEN L.E.D. Lamps	GREEN or Brown with WHITE neutral

ITEM #1105001A, 1105003A, 1105006A, 1105007A,  
1105011A, 1105014A, 1105015A, 1105101A, 1105103A,  
1105107A, 1105180A, 1105203A, 1105303A, 1105490A

RED L.E.D. ARROWS	RED/WHITE with WHITE neutral
YELLOW L.E.D. ARROWS	YELLOW/WHITE with WHITE neutral
GREEN L.E.D. ARROWS	GREEN/WHITE or BROWN/WHITE with WHITE neutral
GREEN/YELLOW L.E.D. ARROWS	GREEN/WHITE or BROWN/WHITE, YELLOW/WHITE, with WHITE neutral

Wires shall be terminated with a Block Spade, 6-8 stud/ 16-14 wire size.

All Circular Optical Units shall be supplied with a minimum 40" pigtail and all Arrow Optical Units Supplied with a minimum 60" pigtail.

**Sub Article 9 - Painting:**

**Third coat:**

Replace with the following:

The housing and all brackets and hardware shall be painted black by the manufacturer. The color shall be No. 17038, Federal Standard No. 595.

At intersections at Merritt Parkway interchanges, the housing and all brackets and hardware shall be painted dark green by the manufacturer. The color shall be No. 14056, Federal Standard No. 595.

The inside of the visors shall be flat black and shall meet Federal Specification TT-E-527.

The housing door and the outside of the visor shall be flat Black No. 37038, Federal Standard No. 595.

## **ITEM #1107007A - PEDESTRIAN PUSHBUTTON AND SIGN (PIEZO)**

### **Article M16.08 - Pedestrian Push Button:**

Delete the entire section and replace with the following:

#### **A. General**

- Size and force compliant with ADA, Section 14.2.5, Crossing Controls.
- Tamper-proof, and Vandal-proof, Weatherproof, Freeze-proof, Impact-resistant design and construction.
- Completely insulated to preclude electrical shock under any weather conditions.
- Wire entrance through the rear.
- Stainless steel mounting hardware.

#### **B. Actuation**

##### **1. Mechanical:**

- Single momentary contact switch with tactile feedback.
- Rated at 10 amps, 125 volts.
- Normally open, closed when actuated.

##### **2. Piezo:**

- Either non-movable or minimal movement (< 1/16" (1.6)) pressure activation.
- Audible confirmation beep to correspond with circuit closure.
- Minimum 100,000,000 actuations.

#### **C. Housing**

- Die cast aluminum meeting requirements of ASTM B85.
- Designed to attach 9" x 12" (230 x 300) four-hole advisory sign.
- Flat back to facilitate surface mount.
- Available hardware to either pedestal top-mount or pole side-mount on diameter range of 3½" (89) to 15" (380).
- Available extension bracket of a size indicated on the plan – 18" maximum.

#### **D. Finish**

- Method: Either

##### **1. Painted with 3 coats of infrared oven-baked paint before assembly.**

- Primer: Baked iron oxide which meets or exceeds FS TT-P-636.
- Second coat: Exterior-baking enamel, light gray, which meets or exceeds FS TT-E-527.
- Third coat: Exterior-baking enamel, which meets or exceeds FS TT-E-489.

##### **2. Electrostatic powder coated after chemically cleaned.**

- Color:

The housing and all brackets and hardware shall be black by the manufacturer. The color shall be No. 17038, Federal Standard No. 595.

At intersections at Merritt Parkway interchanges, the housing and all brackets and hardware shall be dark green by the manufacturer. The color shall be No. 14056, Federal Standard No. 595.

## **ITEM #1107011A - ACCESSIBLE PEDESTRIAN SIGNAL AND DETECTOR (TYPE A)**

### **Description:**

Furnish and install an Accessible Pedestrian Signal and Detector (APS&D). The APS&D provides audio and tactile information to augment the visual pedestrian signal.

Type A provides a low frequency percussive tone during the walk interval and is used where there is an exclusive pedestrian phase or  $\geq 10$  foot separation between APS&Ds.

### **Material:**

#### **A. General:**

- Conform to applicable sections of the current MUTCD Chapter 4E, Pedestrian Control Features as specified herein.
- All features fully operational when the traffic signal is in colors mode.
- All features non-operational when the traffic signal is in flash mode.
- Interchangeable with a non-accessible type pedestrian pushbutton with no modifications to the Controller Assembly (CA) or Controller Unit.
- Audible transducer integral with the APS&D housing, adjacent to the pushbutton.
- Operation programming method: Either or combination of:
  - Mechanically by dip switches or circuit board jumpers
  - Infrared remote-control hand-held device

#### **B. Electrical:**

- Metallic components either grounded or insulated to preclude an electrical hazard to pedestrians under all weather conditions.
- All features powered by the 110VAC Walk signal and the 110VAC Don't Walk signal so that additional conductors from the CA are not needed.

#### **C. Audible Pushbutton Locator Tone**

- Frequency: repeating tone at one (1) second intervals
- Tone duration:  $\leq 0.15$  seconds
- Volume:
  - Minimum setting of zero
  - Manually adjustable initial setting
  - Automatically adjusted after initial setting. Volume increased in response to a temporary increase in ambient noise and subsequently decreased with a decrease in ambient noise.
  - Maximum volume: 100 dBA which is the approximate sound pressure of a gasoline powered lawn mower nearby.
  - Automatic volume adjustment independent of other APS&Ds at the intersection.
  - May be disabled without affecting operation of other features.
- Silent only during walk interval. Active all other times.

#### **D. Vibrotactile Arrow Pushbutton**

- Pushbutton contained in a circular assembly which fits inside the housing and is attached to the housing with 4 screws.
- Actuation of pushbutton acknowledged by confirmation light.
- Actuation of pushbutton initiates speech message "Wait".
- ADA compliant: Size:  $\geq 2.0$ " (50) diameter, Actuation force:  $\leq 5$  ft-lb (22.2 N)



- Shape: Circular, raised slightly above housing so that it may be actuated with the back of a hand
- Tamper-proof, vandal-proof, weatherproof, freeze-proof, impact-resistant design and construction.
- Operation: Vibrates only during the walk interval (when the walk indication is displayed).
- Tactile Arrow:
  - Attached to surface of the button assembly by a tamperproof method.
  - Raised slightly above surface of pushbutton, minimum 0.125" (0.3)
  - Size: Length  $\geq$  1.5" (38), Height  $\geq$  1.0" (25)
  - Color: Sharp contrast to background color of pushbutton and housing

#### E. Audible Walk Interval

##### 1. General:

- Operation independent of other APS&Ds at intersection.
- Active only during the walk interval (when the walk indication is displayed).
- Volume:
  - Minimum setting of zero
  - Manually adjustable initial setting
  - Automatically adjusted after initial setting. Volume increased in response to a temporary increase in ambient noise and subsequently decreased with a decrease in ambient noise.
  - Automatic volume adjustment independent of other APS&Ds at the intersection.
  - Maximum volume: 100 dBA which is the approximate sound pressure of a gasoline powered lawn mower nearby.
- Duration:
  - Default method: Automatically set by the duration of the visual walk signal display.
  - When selected: Manually set when rest-in-walk is used for a concurrent pedestrian movement.
- Audible sounds that mimic any bird call are not allowed.

##### 2. Type A, Percussive Tone:

- Repeating tone at eight (8) to ten (10) ticks per second.
- Tone frequency: Multiple frequencies with a dominant component at 880 Hz which creates a "tick - tick - tick..." sound.

#### F. Pushbutton Housing/Sign Frame/Sign

- One piece die cast aluminum meeting requirements of ASTM B85.
- Sign frame designed to accept 9" x 15" (230 x 380) four-hole advisory sign.
- Flat back to facilitate surface mount.
- Available brackets to either pedestal top-mount or pole side-mount on pole diameter range of 3½" (89) to 15" (380).
- Available brackets to allow mounting two (2) APS&Ds to the same 3½" (89) pole, facing  $\geq$  60 degrees apart, at the same height.
- Available extension bracket of a size indicated on the plan – 18" maximum.
- Wire entrance through the rear.
- Stainless steel mounting hardware.
- Color: The color shall be black No. 17038, Federal Standard No. 595. At intersections at Merritt Parkway interchanges, all brackets and hardware shall be painted dark green by the manufacturer. The color shall be No. 14056, Federal Standard No. 595.
- Finish: Housing/Frame and all mounting brackets either:
  1. Painted with 3 coats of infrared oven-baked paint before assembly.

- Primer: Baked iron oxide which meets or exceeds FS TT-P-636.
- Second coat: Exterior-baking enamel, light gray, which meets or exceeds FS TT-E-527.
- Third coat: Exterior-baking enamel, which meets or exceeds FS TT-E-489.
- 2. Electrostatic powder coated after chemically cleaned.
- Sign: CT DOT Sign No. 31-0856

**Construction Methods:**

Install the APS&D according to the manufacturer’s instructions. Position the APS&D so the plane of the sign face is parallel to the crossing (sign is facing perpendicular) and the arrow is pointing in the same direction as the crossing, not necessarily at the ramp. Notify the Engineer if there is any discrepancy or ambiguity between the plans and field conditions that prevent placement of the APS&D as shown on the plan. Set the minimum sound levels of the locator tone and the audible walk indication when there is little or no ambient noise as in night time operation. Set the volume of audible walk indications and pushbutton locator tones to a maximum of 5dBA louder than ambient sound. The locator tone should be audible 6’ to 12’ (1.8 m to 3.6 m) from the pushbutton or to the building line, whichever is less. Confirm the volume of both audible walk indication and the locator tone increases with an increase in ambient sound and subsequently decreases when the ambient noise decreases.

If programming method is remote, by an infrared hand-held device, provide one device and operation manual for each intersection where APS&D is installed.

**Method of Measurement:**

This work is measured by the number of APS&Ds of the type specified, installed, tested, fully operational, and accepted.

**Basis of Payment:**

Payment for this work is based on the installation, inspection, successful completion of the 30 day test period, and final acceptance of the Accessible Pedestrian Signal and Detector of the type specified. Payment includes the sign, mounting brackets for adjacent buttons on the same structure, extension brackets, all necessary cable, all incidental materials, labor, tools, and equipment necessary to complete the installation. Payment also includes the warrantee, installation manual, and operation manual.

If programming method is remote by an infrared hand-held device, the total bid price of all APS&Ds includes one remote programming device and accompanying operation manual for each intersection where APS&D is installed.

Pay Item	Pay Unit
Accessible Pedestrian Signal and Detector (Type A)	Each

## **ITEM #1107007A - PEDESTRIAN PUSHBUTTON AND SIGN (PIEZO)**

### **Article M16.08 - Pedestrian Push Button:**

Delete the entire section and replace with the following:

#### **A. General**

- Size and force compliant with ADA, Section 14.2.5, Crossing Controls.
- Tamper-proof, and Vandal-proof, Weatherproof, Freeze-proof, Impact-resistant design and construction.
- Completely insulated to preclude electrical shock under any weather conditions.
- Wire entrance through the rear.
- Stainless steel mounting hardware.

#### **B. Actuation**

##### **1. Mechanical:**

- Single momentary contact switch with tactile feedback.
- Rated at 10 amps, 125 volts.
- Normally open, closed when actuated.

##### **2. Piezo:**

- Either non-movable or minimal movement ( $< 1/16''$  (1.6)) pressure activation.
- Audible confirmation beep to correspond with circuit closure.
- Minimum 100,000,000 actuations.

#### **C. Housing**

- Die cast aluminum meeting requirements of ASTM B85.
- Designed to attach 9" x 12" (230 x 300) four-hole advisory sign.
- Flat back to facilitate surface mount.
- Available hardware to either pedestal top-mount or pole side-mount on diameter range of 3½" (89) to 15" (380).
- Available extension bracket of a size indicated on the plan – 18" maximum.

#### **D. Finish**

- Method: Either

##### **1. Painted with 3 coats of infrared oven-baked paint before assembly.**

- Primer: Baked iron oxide which meets or exceeds FS TT-P-636.
- Second coat: Exterior-baking enamel, light gray, which meets or exceeds FS TT-E-527.
- Third coat: Exterior-baking enamel, which meets or exceeds FS TT-E-489.

##### **2. Electrostatic powder coated after chemically cleaned.**

- Color:

The housing and all brackets and hardware shall be black by the manufacturer. The color shall be No. 17038, Federal Standard No. 595.

At intersections at Merritt Parkway interchanges, the housing and all brackets and hardware shall be dark green by the manufacturer. The color shall be No. 14056, Federal Standard No. 595.

## **ITEM #1113506A - RELOCATE INTERCONNECT CABLE**

## **ITEM #1113XXXA – REPAIR AND REPLACE INTERCONNECT CABLE**

### **Description:**

Relocate: Relocate existing interconnect cable and closure as required to maintain traffic signal coordination during construction. Reinstall interconnect cable in permanent location after construction.

Repair and Replace: Repair and replace existing interconnect cable and closure as required to maintain traffic signal coordination during construction. Reinstall interconnect cable in permanent location after construction.

### **Materials:**

#### Interconnect Cable

- Solid conductor, shielded, twisted pair with 600 V polyethylene insulation and polyethylene jacket.

#### 12 Pair Figure 8, 6 Pair Figure 8

- Figure 8 type with 6650 lb. (29,600 N) test, integral messenger
- Conform in all respects to IMSA Specification 20-4.

#### 6 Pair, 12 Pair Non-figure 8

- Conform in all respects to IMSA Specification 20-2

#### Underground Splice Enclosure

- Designed for use in direct buried or underground duct system
- Re-enterable, designed for # 14 - # 16 AWG shielded communication cable
- Fillable with non-hardening encapsulating compound

Furnish to the Engineer a manufacturer warranty that the cable is resistant to damage and deterioration by sustained contact with greases and oil.

### **Construction Methods:**

Throughout the duration of construction, furnish, install, maintain, relocate, and remove the equipment necessary to maintain existing interconnect to adjacent signals.

Whenever it is necessary to disconnect the cable, notify the Department of Transportation, Traffic Signal Lab (phone 860 258-0347) if the system is State owned, or the municipal Legal Traffic Authority, if the system is Town owned. Provide 48 hours advance notice with the following information:

- Project Number
- Contractor and phone number
- Department of Transportation Inspector and phone number
- Intersection description of traffic signal on either side of the proposed disconnection point. Town, Route number, side street, and location number.

Reconnect the cable no less than 24 hours after disconnection. Notify the Traffic Signal Lab (State system) or The LTA (Town system) to verify communication has been reestablished.

### Aerial

The existing interconnect is Figure 8, Twisted Pair, Communication Cable, attached to utility poles and to "I" beams of overpass bridge structures.

If disconnection cannot be made at a closure where there is a full cable cut, install a Cable Closure (Type A), Item #1113398A. Cut the cable one conductor at a time to prevent shorting. Where additional cable is necessary to maintain communication, install it from closure to closure. Connect the new cable to the existing, color to color, on terminal blocks inside the closure. Splices outside the closure will not be allowed. Bond the strand and the shield at all new closures.

Keep utility representatives apprised of all work on utility poles. Attach all interconnect cable a minimum 12 inches (0.3 m) above the highest communication cable attachment (Frontier Communications [formerly AT&T] or Cable TV) and a minimum 40 inches (1 m) below the lowest power company attachment. Match the sag of the next lowest communication cable. Do not allow the interconnect cable to sag into, or come in contact with other cables.

### Underground

The existing interconnect is twisted pair communication cable in a rigid metal conduit system with concrete handholes spaced at regular intervals. The cable was initially installed continuous between traffic controllers with no splices.

If the existing interconnect cable is long enough to be reinstalled without a splice, disconnect it from the nearest controller cabinet. Pull it back to the nearest handhole beyond the area of construction. Relocate the handholes as required. Relocate and extend the existing RMC as required. Comply with Section 11.18 Removal and/or Relocation of Traffic Signal Equipment and the construction methods and typical installation illustrations of the pertinent items. New conduit may be installed and the existing abandoned if mutually agreed to by the Engineer and the Contractor. Clean the conduit. Re-install and reconnect the interconnect cable to the traffic controller or repair and replace interconnect cable as directed by the Engineer.

If the existing interconnect cable will be too short, replace the entire length of cable between controller cabinets. Splices will be allowed only with the approval of the Engineer.

When a splice is allowed, provide enough slack so the splice may be removed from the handhole. Connect all conductors color-to-color. Solder all connections. Install wire nuts. Connect the shields of all cables together. Confirm communication has been restored then protect the splice with a re-enterable splice enclosure. Fill enclosure with encapsulation compound as instructed by the splice enclosure manufacturer.

### **Method of Measurement:**

Relocate: This work will be measured as per hour when all relocation work is completed and the interconnect cable is in the permanent location and communication between the traffic controller and the Operations Center is reestablished.

Repair and Replace: This work shall be measure as actual hours of time and material when all repair and replacement work is completed and the interconnect cable communication between the traffic controller and the Operations Center is reestablished.

### **Basis of Payment:**

Relocate, & Repair: This work will be paid for at the contract unit price per actual hour to include material for "Relocate & Repair Interconnect Cable". The Replace work will be paid for at the contract unit price per linear foot for which all items bid shall include all materials, re-enterable splice enclosure, tools, equipment, labor and work incidental to relocate and reinstall the interconnect cable to a permanent condition. Additional necessary interconnect cable, cable closures conduit and handholes that will remain, as the permanent installation will be paid for under the appropriate item.

## **ITEM NO. 11112XXA – TEMPORARY DETECTION**

### **Description:**

Provide a Temporary Detection (TD) system at signalized intersections throughout the duration of construction, as noted on the contract plans or directed by the Engineer. TD is intended to provide an efficient traffic-responsive operation which will reduce unused time for motorists travelling through the intersection. A TD system shall consist of all material, such as pedestrian pushbutton, accessible pedestrian signal, conduit, handholes, cable, messenger, sawcut, loop amplifier, microwave detector, Video Image Detection System (VIDS), Self-Powered Vehicle Detector (SPVD), and any additional components needed to achieve an actuated traffic signal operation.

### **Materials:**

Material used for TD is either owned by the Contractor and in good working condition, or existing material that will be removed upon completion of the contract. Approval by the Engineer is needed prior to using existing material that will be incorporated into the permanent installation. New material that will become part of the permanent installation is not included or paid for under TD.

### **Construction Methods:**

The work for this item includes furnishing, installation, relocating, realigning, and maintaining the necessary detection systems as to provide vehicle and pedestrian detection during each phase of construction. If not shown on the plan, program the TD modes (pulse or presence) as the existing detectors or as directed by the Engineer. If the TD method (loops, SPVD, microwave, VIDS, pushbutton, or other) it may be the Contractor's choice. The method chosen for TD must be indicated on the TD Plan submission.

The traffic signal plan-of-record, if not in the controller cabinet will be provided upon request. Ensure the controller phase mode (recall, lock, non-lock) and phase timing are correct for the TD. Adjust these settings as needed or as directed by the Engineer.

At least 30 days prior to implementation of each phase of construction submit a TD proposal to the Engineer for approval. Submit the TD proposal at the same time as the Temporary Signalization plan. Indicate the following information for each intersection approach:

- Phase Mode
- Temporary Detection Method
- Area of Detection
- Detector Mode

Submit the proposed temporary phase timing settings and the TD installation schedule with the TD proposal. See the example below.

Example Proposed Temporary Detection and Timing

**Site 1**

Warren, Rt. 45 at Rt. 341, Location #149-201

Approach	Phase	Phase Mode	TD Method	Area of Detection	Det Mode
<i>Rt. 45 NB</i>	<i>2</i>	<i>Min Recall</i>	<i>VIDS</i>	<i>150' from Stop Bar</i>	<i>Pulse</i>
<i>Rt. 45 SB</i>	<i>2</i>	<i>Min Recall</i>	<i>SPVD</i>	<i>150' from Stop Bar</i>	<i>Pulse</i>
<i>Rt. 341</i>	<i>4</i>	<i>Lock</i>	<i>Microwave</i>	<i>30' from Stop Bar</i>	<i>Pulse</i>
<i>Rt. 341</i>	<i>4</i>	<i>Lock</i>	<i>Pushbutton</i>	<i>At SE &amp; SW corners</i>	<i>n/a</i>

Temporary Phase Timing Settings:

Phase	Min	Ped	Ped Clr	Ext	Max 1	Max2	Yel	Red
<i>2</i>	<i>20</i>	<i>0</i>	<i>0</i>	<i>6</i>	<i>45</i>	<i>60</i>	<i>4</i>	<i>1</i>
<i>4</i>	<i>14</i>	<i>7</i>	<i>9</i>	<i>3</i>	<i>27</i>	<i>35</i>	<i>3</i>	<i>1</i>

Scheduled TD: *July 4, 2011* **Site 2**

Scotland, Rt. 14 at Rt. 97, Location #123-201

Approach	Phase	Phase Mode	TD Method	Area of Detection	Det Mode
<i>Rt. 15 WB Left Turn</i>	<i>1</i>	<i>Non-Lock</i>	<i>VIDS</i>	<i>5' in front to 10' Behind Stop Bar</i>	<i>Presence</i>
<i>Rt. 14 EB</i>	<i>2</i>	<i>Min Recall</i>	<i>Existing Loop</i>	<i>150' from Stop Bar</i>	<i>Pulse</i>
<i>Ped Phase</i>	<i>3</i>	<i>Non-Lock</i>	<i>Pushbutton</i>	<i>At all corners</i>	<i>n/a</i>
<i>Rt. 14 WB</i>	<i>6</i>	<i>Min Recall</i>	<i>VIDS</i>	<i>150' from Stop Bar</i>	<i>Pulse</i>
<i>Rt. 97</i>	<i>4</i>	<i>Lock</i>	<i>Loop, Pre- formed</i>	<i>20' from Stop Bar</i>	<i>Pulse</i>

Temporary Phase Timing Settings:

Phase	Min	Ped	Ped Clr	Ext	Max 1	Max2	Yel	Red
<i>1</i>	<i>5</i>	<i>0</i>	<i>0</i>	<i>2</i>	<i>12</i>	<i>18</i>	<i>3</i>	<i>0</i>
<i>2 &amp; 6</i>	<i>24</i>	<i>0</i>	<i>4</i>	<i>4</i>	<i>26</i>	<i>36</i>	<i>4</i>	<i>1</i>
<i>3</i>	<i>16</i>	<i>7</i>	<i>9</i>	<i>0</i>	<i>16</i>	<i>16</i>	<i>4</i>	<i>1</i>
<i>4</i>	<i>14</i>	<i>7</i>	<i>9</i>	<i>3</i>	<i>27</i>	<i>35</i>	<i>3</i>	<i>1</i>

Scheduled TD: *July 4, 2011*

When at any time during construction the existing vehicle or pushbutton detection becomes damaged, removed, or disconnected, install TD to actuate the affected approaches. Install and make TD operational prior to removing existing detection. TD must be operational throughout all construction phases.

Provide a list of telephone numbers of personnel who will be responsible for the TD to the Engineer. If the TD malfunctions or is damaged, notify the Engineer and place the associated phase on max recall. Respond to TD malfunctions by having a qualified representative at the site within three (3) hours. Restore detection to the condition prior to the malfunction within twenty-four (24) hours.

If the Engineer determines that the nature of a malfunction requires immediate attention and the Contractor does not respond within three (3) hours following the initial contact, then an alternative maintenance service will be called to restore TD. Expenses incurred by the State for alternative service will be deducted from monies due to the Contractor with a minimum deduction of \$500.00 for each service call. The alternate maintenance service may be the traffic signal owner or another qualified Contractor.

TD shall be terminated when the detection is no longer required. This may be either when the temporary signal is taken out of service or when the permanent detectors are in place and fully operational.

Any material and equipment supplied by the Contractor specifically for TD shall remain the Contractor's property. Existing material not designated as scrap or salvage shall become the property of the Contractor. Return and deliver to the owner all existing equipment used as TD that is removed and designated as salvage.

**Method of Measurement:**

Temporary Detection must be set up, become fully operational, and will be paid complete after its need has been met and all temporary equipment is removed to the satisfaction of the Client Agency.

**Basis of Payment:**

This work will be paid at the contract per unit price to include materials for "Temporary Detection". The price includes furnishing, installing, relocating, realigning, maintaining, and removing, the necessary detection systems and all incidental material, labor, tools, and equipment. This price also includes any detector mode setting changes, timing or program modifications to the controller that are associated with TD. All Contractor supplied material that



will remain the Contractor's property will be included in the unit price for "Temporary Detection" Any items installed for TD that will become part of the permanent installation will not be paid for under this item but are paid for under the bid item for that work.

## **ITEM NO. 11180XXA – TEMPORARY SIGNALIZATION**

### **Description:**

Provide Temporary Signalization (TS) at the intersections shown on the plans or as directed by the Engineer.

1. Existing Signalized Intersection: Keep each traffic signal completely operational at all times during construction through the use of existing signal equipment, temporary signal equipment, new signal equipment, or any combination thereof once TS has started as noted in the section labeled Duration.

2. Unsignalized Intersection: Provide TS during construction activities and convert the temporary condition to a permanent traffic signal upon project completion. Furnish, install, maintain, and relocate equipment to provide a complete temporary traffic signal, including but not limited to the necessary support structures, electrical energy, vehicle and pedestrian indications, vehicle and pedestrian detection, pavement markings, and signing.

### **Materials:**

- Pertinent articles of the Standard Specifications
- Supplemental Specifications and Special Provisions contained in this contract

### **Construction Methods:**

#### *Preliminary Inspection*

In the presence of the Engineer and a representative from the DOT Electrical Maintenance Office (Town representative for a Town owned signal), inspect and document the existing traffic signal's physical and operational condition prior to Temporary Signalization. Include but do not limit the inspection to the following:

- Controller Assembly (CA)
  - Controller Unit (CU)
  - Detection Equipment
  - Pre-emption Equipment
  - Coordination Equipment
- Vehicle and Pedestrian Signals
- Vehicle and Pedestrian Detectors
- Emergency Vehicle Pre-emption System (EVPS) \*
- Interconnect Cable and Splice Enclosures
- Support Structures
- Handholes, Conduit and Cable

It may be necessary to repair or replace equipment that is missing, damaged, or malfunctioning. Develop a checklist of items for replacement or repair after the inspection. If authorized by the Engineer, this work will be considered "Extra Work" under Article 1.09.04.

\* At a State owned signal the EVPS equipment is usually owned by the municipality. It is recommended to apprise the municipality of the inspection schedule and results.

#### *TS Plan*

At least 30 days prior to implementation of each stage, submit a 1:40 (1:500 metric) scale TS plan for each location to the Engineer for review and comment. Include but do not limit the plan to the following:

- Survey Ties
- Dimensions of Lanes, Shoulders, and Islands
- Slope Limits
- Clearing and Grubbing Limits
- Signal Phasing and Timing
- Location of Signal Appurtenances such as Supports, Signal Heads, Pedestrian Push buttons, Pedestrian Signals
- Location of Signing and Pavement Markings (stop bars, lane lines, etc.)
- Location, method, and mode of Temporary Detection

Review of the TS plan does not relieve the Contractor of ensuring the TS meets the requirements of the MUTCD. A copy of the existing traffic signal plan for State-owned traffic signals is available from the Division of Traffic Engineering upon request. Request existing traffic signal plans for Town-owned traffic signals from the Town. Do not implement the TS plan until all review comments have been addressed.

#### Earthwork

Perform the necessary clearing and grubbing and the grading of slopes required for the installation, maintenance, and removal of the TS equipment. After TS terminates restore the affected area to the prior condition and to the satisfaction of the Engineer.

#### Maintenance and Protection of Traffic

Furnish, install, maintain, relocate, and remove signal-related signing (lane-use, signal ahead, NTOR, etc.) and pavement markings as needed. Install, relocate, and/or remove equipment in a manner to cause no hazard to pedestrians, traffic or property. Maintain traffic as specified in the Special Provisions “Prosecution and Progress” and “Maintenance and Protection of Traffic.”

#### Electrical Service and Telephone Service at Existing Signalized Intersections

If the electrical service or the telephone service source must be changed or relocated make all arrangements with the utility company and assume all charges. The party previously responsible for the monthly payment of service shall continue to be responsible during TS.

#### Electrical Service at Unsignalized Intersections

Assume all charges and make all arrangements with the power company, including service requests, scheduling, and monthly bills in accordance with Section 10.00.12 and Section 10.00.13 of the Standard Specifications,. A metered service is recommended where TS equipment will be removed when no longer needed.

#### Temporary Signalization

Furnish, install, maintain, relocate, and remove existing, temporary, and proposed traffic signal equipment and all necessary hardware; modify or furnish a new CA; reprogram the CU phasing and timing; as many times as necessary for each stage/phase of construction to maintain and protect traffic and pedestrian movements as shown on the plans or as directed by the Engineer.

Inspection

When requested by the Engineer, the TS will be subject to a field review by a representative of the Division of Traffic Engineering and/or the Town, which may generate additional comments requiring revisions to the temporary signal.

Detection

Provide vehicle detection on the existing, temporary, and/or new roadway alignment for all intersection approaches that have existing detection, that have detection in the final condition as shown on the signal plan, or as directed by the Engineer. Keep existing pedestrian pushbuttons accessible and operational at all times during TS. Temporary Detection is described and is paid for under Item # 11112XXA - Temporary Detection (Site No. X)

Emergency Vehicle Pre-emption System (EVPS)

Furnish, install, maintain, relocate, and remove the equipment necessary to keep the existing EVPS operational as shown on the plan. Do not disconnect or alter the EVPS without the knowledge and concurrence of the Engineer and the EVPS owner. Schedule all EVPS relocations so that the system is out of service only when the Contractor is actively working. Ensure EVPS is returned to service and is completely operational at the end of the work day. Keep the EVPS owner apprised of all changes to the EVPS.

Coordination

Furnish, install, maintain, relocate, and remove the equipment necessary to keep the intersection coordinated to adjacent signals as shown on the plan. Do not disconnect the interconnect without the approval of the Engineer.

- Closed Loop System: If it is necessary to disconnect the communication cable, notify the Engineer and the Bridgeport Operation Center (BOC) or the Newington Operation Center (NOC) prior to disconnect and also after it is reconnected.
- Time Base System: Program and synchronize all Time Clock/Time Base Coordination (TC/TBC) units as necessary.

Maintenance

Once TS is in effect, assume maintenance responsibilities of the entire installation in accordance with Section 1.07.12 of the Standard Specifications. Notify the Engineer for the project records the date that Temporary Signalization begins. Notify the following parties that maintenance responsibility has been transferred to the Contractor:

Signal Owner

CT DOT Electrical Maintenance Office or

Town Representative

Local Police Department

Provide the Engineer a list of telephone numbers of personnel who will be on-call during TS. Respond to traffic signal malfunctions by having a representative at the site within three hours from the initial contact. Within twenty-four (24) hours have the traffic signal operating according to plan.

If the Engineer determines that the nature of a malfunction requires immediate attention and/or the Contractor does not respond within three (3) hours, then an alternate maintenance service will be called to repair the signal. Expenses incurred by the alternate maintenance service for each call will be deducted from monies due to the Contractor with a minimum deduction of \$1,000. The alternate maintenance service may be the owner of the signal or another qualified electrical contractor.

Duration

Temporary Signalization shall commence when any existing signal equipment is disturbed, relocated, or altered based on the inspection checklist in any way for the TS.

For intersections with a State furnished controller, TS terminates when the inspection of the permanent signal is complete and operational and is accepted by the Engineer. For intersections with a Contractor furnished controller, Temporary Signalization terminates at the beginning of the 30 day test period for the permanent signal.

Ownership

Existing equipment, designated as salvage, remains the property of the owner. Salvable equipment will be removed and delivered to the owner upon completion of use. Temporary equipment supplied by the Contractor remains the Contractor's property unless noted otherwise.

**Method of Measurement:**

Temporary Signalization shall be contract installed unit price.

**Basis of Payment:**

This work shall be paid at the contract per unit price to include materials for "Temporary Signalization" for each site. This price includes the preliminary inspection, TS plan for each stage/phase, furnishing, installing, maintaining, relocating and revising traffic signal equipment, controller assembly modifications, controller unit program changes such as phasing and timing, removing existing, temporary, and proposed traffic signal equipment, arrangements with utility companies, towns or cities including the fees necessary for electric and telephone service, clearing and grubbing, grading, area restoration and all necessary hardware, materials, labor, and work incidental thereto.

All material and work for signing and pavement markings is paid for under the appropriate Contract items.

All Contractor supplied items that will remain the Contractor's property shall be included in the contract unit price for "Temporary Signalization."

Any items installed as part of the permanent installation are not paid for under this item but are paid for under the bid item for that work.

## **ITEM #1112284A — VEHICLE DETECTION MONITOR**

### **Description:**

Furnish and install a Vehicle Detection Monitor with stand in the Controller Cabinet.

### **Materials:**

All hardware shall be new, corrosion-resistant. All equipment shall be current production.

#### **Physical:**

- Compact and easily accessible stand-mounted LCD/ LED Flat Panel Display.
- Diagonal screen size minimum 10 inches and maximum 15 inches.
- Withstand temperatures ranging from -4 to 140°F (-20 to 60°C).
- Operating humidity: 10-90% non-condensing.

#### **Functional:**

- Compatible with Color or Monochrome Detection systems.
- Industrial-grade video panel.
- ANSI contrast ratio of 300:1 minimum.
- Minimum brightness level: 400 candelas per square meter (400 lux).
- Native resolutions: 1024 (horizontal) x 768 (vertical).
- Support both National Television Standards Committee (NTSC) and Phase Alternating Line (PAL) video formats with auto-sensing.
- Minimum viewing angle: 140 degrees horizontally, 120 degrees vertically.
- On-Screen Display (OSD) controls brightness, contrast, color as well as horizontal and vertical positioning.
- Compatible with video detection processor output. Use appropriate converters/ adapters if necessary.
- Operable on 110 VAC or 220 VAC, 50 or 60 Hz.
- FCC, Voluntary Control Council for Interference (VCCI), Electromagnetic Compatibility (EMC), Consumer Electronics (CE) approved, UL listed and Energy Star efficient.
- MTBF Rating: 50,000 hours minimum.

#### **Warranties and Guarantees:**

Provide warranties and guarantees to the **Department of Transportation Office of Maintenance** in accordance with Article 1.06.08 of the Standard Specifications. Warranties for all equipment furnished as part of this Contract are to cover a period of 24 months following successful completion of the entire intersection acceptance test.

#### **Method of Measurement:**

The Vehicle Detection Monitor will be measured for payment as the number of units furnished, installed, operational and accepted.

**Basis of Payment:**

This work will be paid at the Contract unit price for each accepted "Vehicle Detection Monitor," which price shall include the Vehicle Detection Monitor, stand, documentation, warranty, labor, tools and equipment incidental thereto.

Pay Item	Pay Unit
Vehicle Detection Monitor	EA.

## **ITEM #1112285A – THERMAL VIDEO DETECTOR ASSEMBLY**

### **Description:**

Furnish and install a Thermal Video Detector Assembly (TVDA) as shown on the plans or as directed by the Engineer.

### **Materials:**

All hardware shall be new, corrosion resistant. All equipment shall be current production.

### **Thermal Detector Assembly:**

#### **Thermal Imaging Sensor:**

- Sensor Type: Focal Plane Array (FPA), Uncooled Vanadium Oxide Microbolometer
- Fixed mount pan and tilt unit bracket.
- Thermal Sensitivity: <75mk, <50 mK f/1.0 or lower.
- Active picture elements (pixels): 320(H) x 240(V), minimum. 25 micron pixel pitch.
- Thermal Output: Analog NTSC equivalent.
- Output impedance: 75 Ohms nominal.
- Operating Temperature Range: -50°C to 75°C (-58°F to 167°F)
- Lens Selection: Based on recommendation of manufacturer for each detector installed, per outcome of Site Survey.

#### **Surge Protection**

A thermal surge suppressor(s) shall be available for installation inside the traffic signal controller cabinet. The suppressor shall provide coaxial cable connection points to a Thomas Research CCTV-SP-NI or approved equal transient suppresser for each image sensor.

- Peak Surge Current (8 x 20 us)      20KA
- Technology    Hybrid, Solid State
- Attenuation    0.1db @ 10Mhz
- Response Time      <1 nanosecond
- Protection    Line to Ground
- Shield to Ground    (isolated shield modules)
- Clamp Voltage      6 volts
- Connectors    BNC
- Impedance    75 Ohms
- Temperature    -40 to +85 degrees C
- Humidity      0-95% non-condensing
- Dimensions    4.5" x 1.5" x 1.25"
- UL Listed      UL 497B



**Detector Enclosure:**

- Tamper proof constructed of painted or powder coated aluminum of at least 0.06-inch (1.59-mm) thickness.
- Environmentally sealed housing. IP-66 Rating
- Adequate adjustable sunshield should be provided.
- Internal Heater, window defroster, and a thermostat to control both.
- The enclosure shall include grounding and surge protection.

**Documentation: (TVDA)**

Provide to the **Department of Transportation Office of Maintenance** three (3) copies of equipment manuals furnished by the manufacturer, which includes the following:

- Installation and operation procedures.
- Performance specifications (functions, electrical, mechanical and environmental) of the unit.
- Schematic diagrams.
- Pictorial of component layout on circuit board.
- List of replaceable parts including names of vendors for parts not identified by universal part numbers such as JEDEC/RETMA or EIA.
- Troubleshooting, diagnostic and maintenance procedures.

**Site Survey:**

Perform a site survey with the TVDA manufacturer representative at all TVDA locations prior to the installations of the TVDA equipment. The purpose of the survey is to optimize the performance from the TVDA equipment when it is installed and insure that it will meet the accuracy requirements specified previously. Submit the results of this survey to the Engineer in a report, which lists all TVDA locations with any recommended changes to camera locations, mounting adjustments, camera lens adjustments, and desired detection zone locations. This report shall be provided to the Engineer no later than the semi-final inspection.

**Warranties and Guarantees: (TVDA)**

Provide warranties and guarantees to the **Department of Transportation Office of Maintenance** in accordance with Article 1.06.08 of the Standard Specifications. Warranties for all equipment furnished as part of this Contract are to cover a period of 24 months following successful completion of the entire intersection acceptance test.

**Construction Methods:**

Install TVDA equipment in accordance with the manufacturer instructions and recommendations to achieve the detection zones as shown in the plans and accuracy as described in these specifications. Conduct the Site Survey as specified above. The location of the TVDA shown on the plan may be revised as a result of the Site Survey. Provide the Site

Survey report to the Engineer and review proposed TVDA relocations prior to installation of TVDA equipment.

**Method of Measurement:**

The Thermal Video Detector Assembly will be measured for payment as the number of detectors furnished, installed operational and accepted.

**Basis of Payment:**

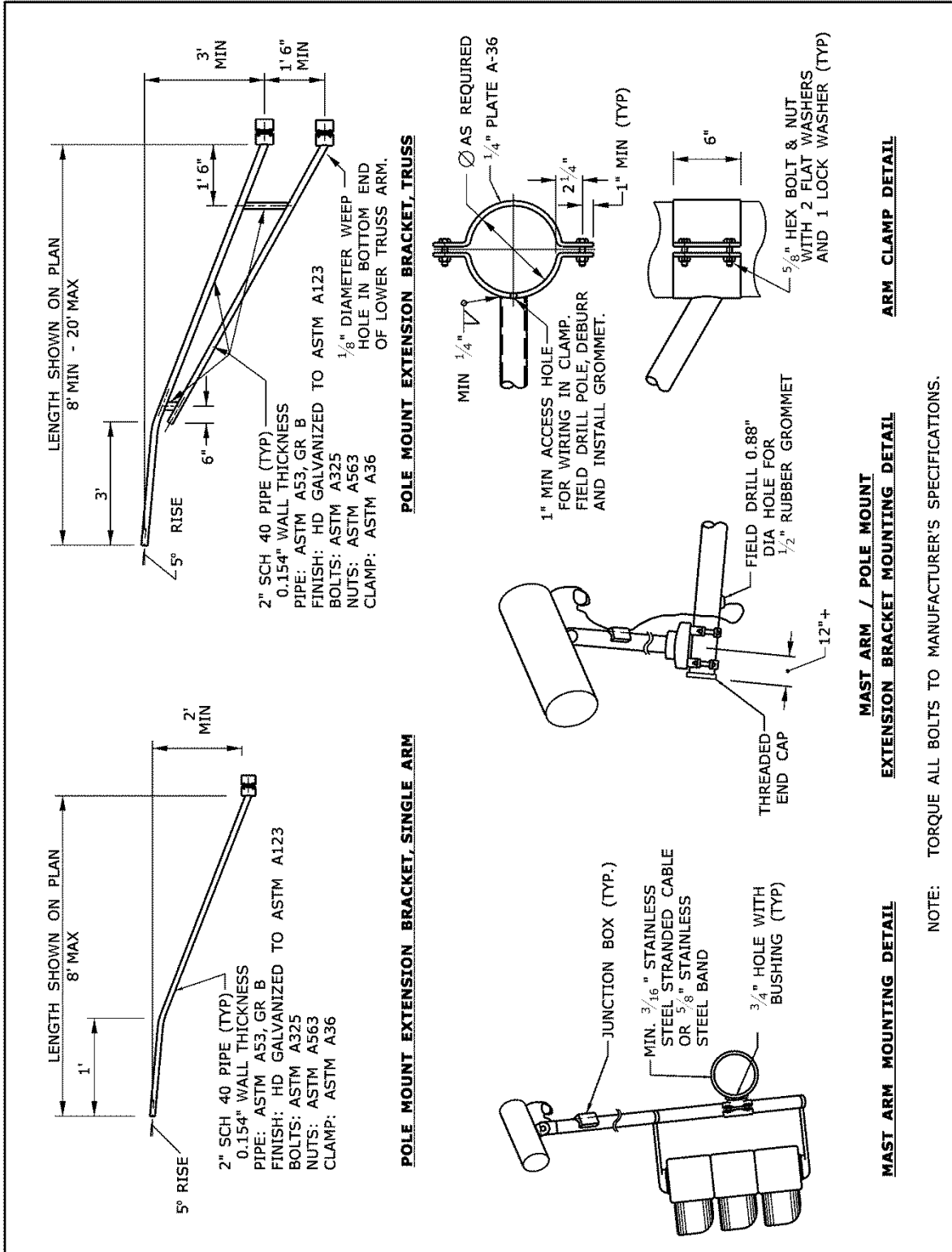
The unit bid price for Thermal Video Detector Assembly includes the detector, enclosure, surge protector, brackets used to attach the TVDA to a support structure or extension bracket, documentation, warrantee, labor, tools and equipment necessary to provide the specified video signal to the VDP.

Pay Item

Thermal Video Detector Assembly

Pay Unit

Ea.



**ITEM #1112286A – 360 DEGREE CAMERA ASSEMBLY**

**ITEM #1112287A – 360 DEGREE VIDEO DETECTION PROCESSOR**

**ITEM #1113725A – 23 AWG 4 TWISTED PAIR CATEGORY 6 CABLE**

**Description:**

Furnish and install a 360 Degree Video Image Detection System (360VIDS) as shown on the plans or as directed by the Engineer. The 360VIDS consists of a 360 Degree Camera Assembly (360CA), 360 Degree Video Detection Processor (360VDP) and 23 AWG 4 Twisted Pair Category 6 Cable.

**Materials:**

All hardware shall be new, corrosion resistant. All equipment shall be current production.

**360 Degree Camera Assembly:**

**Camera:**

- No-aim, no-focus camera
- Downward facing lens and camera shroud
- Single Power Over Ethernet (POE) connection for power and data collection.
- Color image camera with 360 degree point of view (POV)
- Active picture elements (pixels): 2560 (H) x 1920 (V), minimum.
- Signal to noise ratio : 55dB
- Heated camera
- IP addressable

**Camera Enclosure:**

- Tamper proof constructed of painted or powder coated aluminum of at least 0.25 inch (6.35-mm) thickness.
- IP66-rated camera housing.

**Camera Mounting Hardware:**

- Swivel bracket for dual plane adjustment for leveling
- Quick connect junction box
- Hybrid terminal junction box with surge.
- Astro-Brac banded bracket
- 34 inch to 78 inch 90 degree mounting arm pole.

**360 Degree Video Detection Processor:**

**Functional:**

- Connectivity: Local Area Network (LAN), Wide Area Network (WAN), Camera interfaces.
- NEMA TS1/ TS2, Type 170 and 2070 ATC compatible
- Four (4) USB 3.0 expansion ports.
- Front panel LED indicators displays calls and light states.
- Twenty-four (24) optically isolated I/O interface.
- Two (2) camera ports – Up to two (2) 360 Degree Camera Assembly; or one (1) 360 Degree Camera Assembly and four (4) IP video detection camera assembly or thermal detector assembly; or eight (8) IP video detection camera assembly or thermal detector assembly.
- Phase and detection display.
- Shall include at least a built-in 4g modem send be Wi-Fi capable
- Power – 110/220 VAC 50/60 Hz
- Omni-directional vehicle tracking
- Zone level visibility monitoring.
- Monitor phases and loops, generates calls to controllers.
- Environmental : -29F to +165F (-34C to +74C), 0-95% non-condensing
- Fail-safe in the event of loss of video from CA or loss of power to 360VDP.
- Shall be capable of configuring and adjusting the detection zone with the cabinet mounted VDM or remotely.
- Shall be activated collect and report traffic data such as turning movements/volume counts, vehicle classification, speed, and red/green occupancy.
- Shall be configured to transmit collected traffic data and alarm events from field devices to remote desktop pc.
- Shall be configured to sync with a cloud network resource to allow for data backup including signal performance metrics data such as the purdue coordination diagram.
- **Application Software:**
  - Shall be freely available for installation on any number of computers used to manage the 360VIDS.
  - Shall be capable of point and click zone drawing
  - Shall support the assignment of a detector output(s) to each zone. These assignments can be modified at any time through the software.
  - Shall have the ability to digitally flatten CA image
  - Shall feature the ability to mask objects that occlude the camera field of view and/or disrupt the camera automatic gain and exposure control.
  - Shall store detection zone data in non-volatile memory so that after recovery from power interruption, all parameters are returned to latest settings.
  - Shall have the ability to import and export program database to notebook PC or remote desktop PC. The program database shall also be allowed to be transferred via an external storage device.
  - Shall be capable of superimposing detection zone on real time video image from selected camera with time stamping capabilities.

- Shall be capable of monitoring real time video and adjusting zones in field or remotely while 360VDP is actuating the traffic controller.
- Shall provide visual confirmation of detection by highlighting detection zone symbols.
- Shall allow for remote display of site/camera status for all connected sites.
- Shall provide visual indication of the light state for each zone within the graphical user interface.
- Shall be capable of searching the network for other 360VDP.
- Shall be compatible with Windows operating system supported by the Department.
- Shall maintain a historical log of all configurations when site is modified
- Shall feature the ability to digitally pan, tilt, and zoom within the camera assembly's field of view without movement of the camera.
- Shall support quad view video monitoring.
- Shall be capable of syncing with a cloud network resource to allow for group site sharing of site program database information and historical traffic data report generation.
- Shall maintain a database of current and historical traffic data
- Shall allow users to create reports for turning movements/volume counts, vehicle classification, speed, red/green occupancy, and site alerts remotely via the software and online reports/performance measures via the web.
- Shall display data in a graph, chart, and table format.
- Shall display data in 15, 30, and 60-minute intervals.
- Shall provide a means by which alerts can be configured to be delivered to different individuals via email
- Report output formats shall include at minimum PDF, rich text format, and Microsoft Excel formats.

**Physical:**

- Either shelf mounted, stand alone design or modular card rack design.
- Aluminum card rack frame capable of accepting four (4) 360VDP modules.
- TS1 harness cable.
- Standard Ethernet and USB connectors for video input and video output.
- Female metal shell connector with latching clamp for NEMA TS 1 detector outputs and inputs.
- LED indications to monitor all detector outputs.
- Side or rear mounted connectors and controls are not allowed on stand alone units.
- NEMA FR-4 glass epoxy or equivalent circuit boards.

**Ethernet Repeater:**

- Utilize Ethernet repeater if CAT6 cable distance is over 328'.

**Ethernet Switch:**

- Power Over Ethernet (POE) switch

- Ports for up-to four (4) traditional or thermal cameras.
- Powder coated aluminum.
- Dual purpose LED port lights.
- RJ-45 CAT6 connectivity.
- Environmental: -29F to +165F (-34C to +74C).
- NEMA TS2 compliant.

#### **Video Encoder:**

- Power Over Ethernet (POE)
- Video: H.264 (MPEG-4 Part 10/AVC) Baseline and Main Profile
- Compression: Motion JPEG
- Resolutions: 176x120 to 720x576, 176x120 to 1536x1152 for quad view.
- Frame rate:
  - H.264: 25/30 (50/60 Hz) fps,
  - 15fps in quad view in full resolution,
  - Motion JPEG: 25/30 (50/60 Hz) fps,
  - 15fps in quad view in full resolution.
- Video Streaming: Multi-stream H.264 and Motion JPEG: One H.264 and one JPEG stream on each channel (8 streams in total) in full frame rate individually configured streams in max. resolution at 25/30 fps; more streams if identical or limited in frame rate/ resolution. Controllable frame rate and bandwidth; VBR/CBR H.264.
- Environmental: -40F to +167F (-40C to +75C), 10-95% non-condensing.
- NEMA TS2 compliant.

#### **Ethernet Protection Module:**

- Either shelf mounted or stand alone design.
- Protect 360CA, IP video detection camera assembly, thermal cameras and 360VDP in the event of a surge or lightning.

#### **Environmental:**

- Comply with NEMA TS 2, Section 2 requirements for Controller Assembly.
- Pass following NEMA TS 2 tests and applicable test procedures.
  - Vibration: Section 3.13.3, Section 3.13.8.
  - Shock: Section 3.13.4, Section 3.13.9.
  - Transients, Temperature, Voltage and Humidity: Section 3.13.7.
  - Power Interruption: Section 3.13.10.

#### **Peripherals:**

- Separable Keypad & Joystick or Computer Mouse including all necessary cables for connectivity to 360VDP.

#### **23 AWG 4 Twisted Pair Category 6 Cable:**

- Supply the 360CA power and return the video signal to the 360VDP.

- Outdoor Aerial CAT6 cable with UV insulation.
- Rated for 48VDC
- 250MHZ, shielded, gel-filled (flooded core) direct burial grade.
- Shall be equipped with a drain wire.
- Terminate with compatible connector.
- Polyethylene insulation.
- Shall be installed continuous between the 360CA and 360VDP.
- Cable shall be installed according to TIA/EIA-568-B.
- Other type cable may be substituted at the request of the 360VDP manufacturer.

#### **Documentation: (360VDP and 360CA)**

Provide to the **Department of Transportation Office of Maintenance** three (3) copies of equipment manuals furnished by the manufacturer, which includes the following:

- Installation and operation procedures.
- Performance specifications (functions, electrical, mechanical and environmental) of the unit.
- Schematic diagrams (point to point wiring).
- Pictorial of component layout on circuit board.
- List of replaceable parts including names of vendors for parts not identified by universal part numbers such as JEDEC/RETMA or EIA.
- Troubleshooting, diagnostic and maintenance procedures.
- Testing results of grounding, voltage, and cable length measurements as indicated on the installation best practice verification at the end of this document.

#### **Site Survey:**

Perform a site survey with the 360VDP manufacturer representative at all 360VIDS locations prior to installation. The purpose of the survey is to optimize the performance from the 360VIDS equipment when it is installed and insure that it will meet the accuracy requirements specified previously. Prior to installation, submit the results of this survey to the Engineer in a report, which lists all 360VIDS locations with any recommended changes to camera locations, mounting adjustments, camera lens adjustments, and desired detection zone locations.

#### **Warranties and Guarantees: (360VDP and 360CA)**

Provide warranties and guarantees to the **Department of Transportation Office of Maintenance** in accordance with Article 1.06.08 of the Standard Specifications. Warranties for all equipment furnished as part of this Contract are to cover a period of 36 months following successful completion of the entire intersection acceptance test.



### **Construction Methods:**

Install 360VIDS equipment in accordance with the manufacturer instructions. Detection zones shall be replicated as shown in the plans. The Contractor shall install vehicle counting zones for each lane as shown in the plans. The Contractor shall ensure the vehicle counting zones be accurate as possible. The Contractor shall contact the Engineer to confirm detection zones and vehicle counting zones. The Contractor shall refer to the "Installation Best Practices Guide" attached below to this specification. Note that all references to "Cat5e cable" in the attached "Installation Best Practices Guide" shall refer to "23 AWG 4 Twisted Pair Category 6 Cable" as specified above in this specification. The location of the 360CA shown on the plan may be revised as a result of the Site Survey. Peripherals are to be furnished and fully installed in an easily accessible position within the controller cabinet. Leave proper clearance(s) surrounding video monitor to allow for accessible connections and space to utilize surrounding equipment.

The Contractor shall forward the configuration file in electronic format to Mr. Don Assard at [Donald.Assard@ct.gov](mailto:Donald.Assard@ct.gov) or Mr. Mark Zampini at [Mark.Zampini@ct.gov](mailto:Mark.Zampini@ct.gov), immediately upon completion of configuration of the zones. The Contractor shall address any comments/corrections identified by the Traffic Signal Lab.

### **Method of Measurement:**

The 360 degree Camera Assembly will be measured for payment as the number of 360 degree cameras furnished, installed operational and accepted.

The 360 degree Video Detection Processor will be measured for payment as the number of units including all additional work and materials listed in Basis of Payment, furnished, installed, operational and accepted.

23 AWG 4 Twisted Pair Category 6 Cable will be measured for payment as linear feet (meters), furnished, installed and accepted.

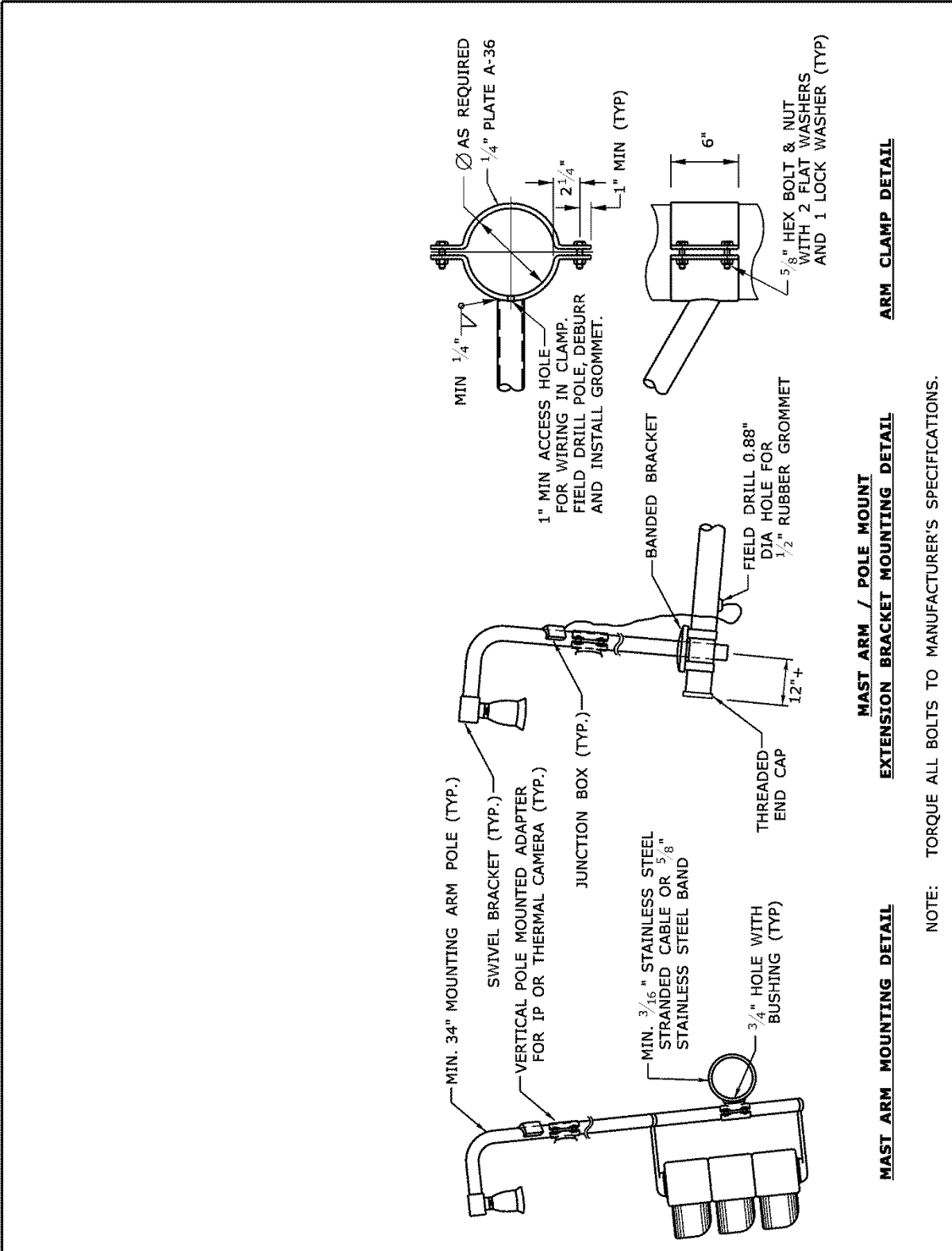
### **Basis of Payment:**

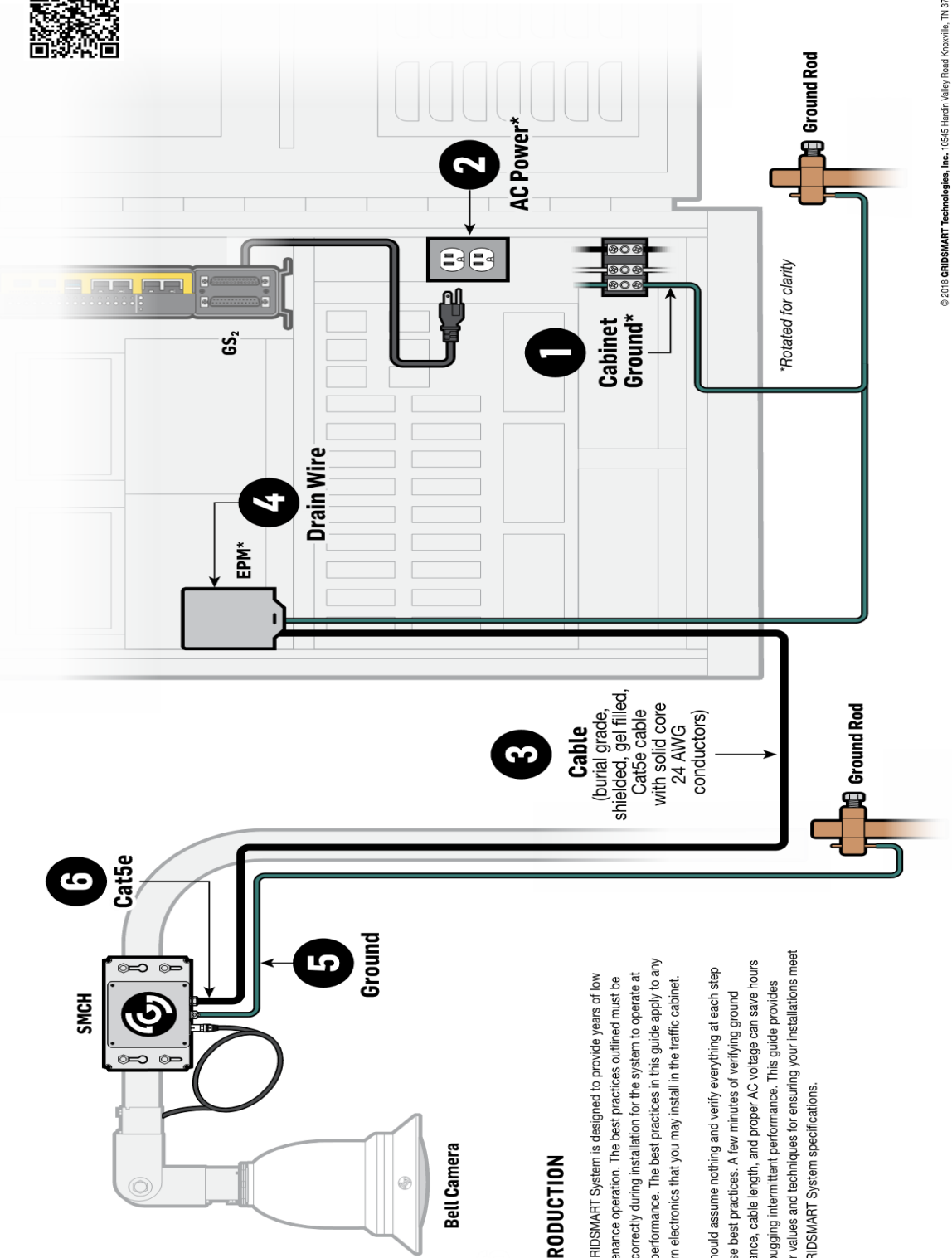
The unit bid price for 360 degree Camera Assembly includes the 360 degree camera, enclosure, brackets used to attach the 360CA to a support structure, documentation, warrantee, labor, tools and equipment necessary to provide the specified video signal to the 360VDP.

The unit bid price for 360 degree Video Detection Processor includes the manufacturers' site survey, unlimited number of any necessary 360VIDS configuration software and license, card rack frame, power supply, all miscellaneous hardware such as PC interface cable with connectors, necessary peripherals such as Ethernet repeater, Ethernet switch, video encoder, Ethernet protection module, documentation, warrantee, labor, tools and equipment necessary to make the 360VIDS fully operational.

The unit bid price for 23 AWG 4 Twisted Pair Category 6 Cable includes all connectors, labor, tools and equipment necessary to install the cable between the 360CA and the 360VDP.

<u>Pay Item</u>	<u>Pay Unit</u>
360 Degree Camera Assembly	Ea.
360 Degree Video Detection Processor	Ea.
23 AWG 4 Twisted Pair Category 6 Cable	LF (M)





**INTRODUCTION**

The GRIDSMART System is designed to provide years of low maintenance operation. The best practices outlined must be done correctly during installation for the system to operate at peak performance. The best practices in this guide apply to any modern electronics that you may install in the traffic cabinet.

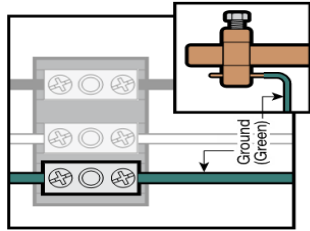
You should assume nothing and verify everything at each step in these best practices. A few minutes of verifying ground resistance, cable length, and proper AC voltage can save hours of debugging intermittent performance. This guide provides proper values and techniques for ensuring your installations meet the GRIDSMART System specifications.

## 1 CABINET GROUNDING

A proper cabinet ground helps mitigate interference from electrical noise at the intersection.

- The U.S. National Electrical Code (NEC) recommends a maximum of 25 ohms for touch safety and telecommunications; PLC industry standards require a maximum of 5.0 ohms for logic reference purposes.
- Use a clamp-on ground meter to verify the cabinet ground.
- GRIDSMART requires the Diligent Instruments DLG Di-120b Tester (<http://www.diligentinstruments.com/di-120.html>).

- If the ground reading is higher than the recommended NEC value, check the connection between the cabinet ground wire and the ground rod for corrosion; clean if corrosion is present. If you are in an area with poor grounds, you may need to add a ground rod to the grounding system to improve the ground.



DLG Di-120b Tester

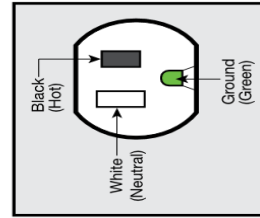


<b>SPECIFICATION:</b> 25 Ohms Max
<b>MEASURED:</b>

## 2 AC POWER

Plug the GRIDSMART Processor into an outlet on the filtered side of the cabinet power. Do not use GFCI type outlet.

- The outlet needs to be checked to verify that all three connections for the outlet are properly connected.
- Using a digital voltmeter (DVM), check the ac voltage from the line to the neutral and the line to ground. Both readings should be ~ 120/240VAC.



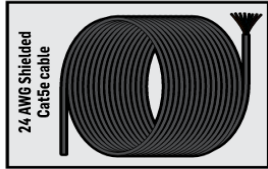
<b>SPECIFICATION:</b> HOT/NEU: 120/240VAC HOT/GND: 120/240VAC
<b>MEASURED:</b> HOT/NEU: HOT/GND:

## 3 CABLE TYPE & LENGTH

All GRIDSMART installations require burial grade, shielded, gel filled, Cat5e cable with solid core 24 AWG conductors. The shield will protect the data signals from radiated noise which is present in most intersections. LED streetlights have been found to be very noisy electrically and as more streetlights are switched to LED lights, the level of radiated noise will increase. The cable that GRIDSMART supplies and requires for all installations is Vertical Cable part #059-487/S/CMXF.

- The maximum length that a segment of Cat5e can be is 300 feet. If the distance from the EPM to the camera is more than 300 feet, a repeater (RBA) must be used.

- When determining length of the cable, a cable tester that measures the length of the cable is required. Do not rely on sight distance or "walking off" the distance.
- Many times, there are service loops in the pull boxes and at the base of the pole, which will not be accounted for when you do not use a meter for measuring the cable length. GRIDSMART recommends the Triplet Real World Certifier ([www.triplet.com/shop/real-world-certifier-rtc1000k/](http://www.triplet.com/shop/real-world-certifier-rtc1000k/)) for testing the cable. The tester will provide length measurements as well as cable quality measurements.



Triplet Real World Certifier



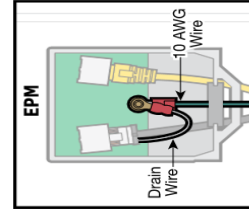
<b>SPECIFICATION:</b> Cable Length: 300 Ft Max Real World Certification: 100 MB Min Cable Type: Vertical Cable part #059-487/S/CMXF
<b>MEASURED:</b> Cable Length: Real World Certification: Cable Type:

## 4 CONNECT DRAIN WIRE

The drain wire for the shielded Cat5e cable must be connected to the ground post in the EPM (Ethernet Protection Module). A crimp lug should be attached to the end of drain wire to attach it to the ground post. The drain should only be connected at the EPM end of the cable.

- If you are using an RBA, the drain must be spliced so the drain is continuous from the junction box to the EPM. A 10 AWG Wire is required to connect the EPM ground post to the traffic cabinet ground rod.

- Using a digital voltmeter, you should measure 0 Ohms between the EPM Ground Post and the traffic cabinet ground rod.

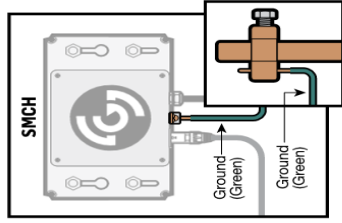


<b>SPECIFICATION:</b> 0 Ohms
<b>MEASURED:</b>

## 5 GROUND CONNECTIONS AT THE SMCH

The SMCH provides lightning protection for the camera.

- Use a 10-AWG wire to connect the SMCH ground lug to a well-grounded structure or a ground rod.
- Verify the resistance to ground of the structure utilizing the clamp on ground tester.

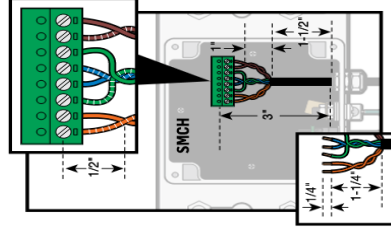


<b>SPECIFICATION:</b> 25 Ohms
<b>MEASURED:</b>

## 6 CAT5e AT SMCH

Proper terminal of the Cat5e to the SMCH Phoenix connector is required. Carefully implement the following requirements as shown.

- Remove no more than 1-1/2 inch of outer jacket from the end of the cable.
- No less than 1-1/2 inch of cable with outer jacket inside the SMCH.
- Pairs should be twisted as close as possible to the Phoenix connector.
- No more than 1/2 inch of untwisted conductors should be allowed. Strip 1/4 inch of the insulation from each conductor.



<b>Intersection:</b>
<b>Camera Serial Number:</b>
<b>GS: Processor Serial Number:</b>

## **ITEM #1112288A – IP VIDEO DETECTION CAMERA ASSEMBLY**

**Description:** Furnish and install an IP (Internet Protocol) Video Detection Camera Assembly (IPVDCA) as shown on the plans or as directed by the Engineer. The IPVDCA consists of an IP Video Detection Camera, lens, enclosure, mounting hardware and equipment necessary to provide the specified video signal to the video detection processor.

**Materials:** All hardware shall be new, corrosion resistant. All equipment shall be current production.

### **IP Video Detection Camera Assembly:**

#### **Camera:**

- Use appropriate CS-mount lens to provide adequate detection
- Single Power Over Ethernet (POE) connection for power and data collection
- Color image camera with 360 degree point of view (POV)
- Active picture elements (pixels): 2560 (H) x 1920 (V), minimum
- Heated camera
- IP addressable

#### **Camera Enclosure:**

- Tamper proof constructed of aluminum
- IP66-rated camera housing

#### **Camera Mounting Hardware:**

- Swivel bracket for dual plane adjustment for leveling
- Hybrid terminal junction box with surge
- Astro-Bracket banded bracket

#### **Environmental:**

- Comply with NEMA TS 2, Section 2 requirements for Controller Assembly
- Pass the following NEMA TS 2 tests and applicable test procedures
  - Vibration: Section 3.13.3, Section 3.13.8
  - Shock: Section 3.13.4, Section 3.13.9
  - Transients, Temperature, Voltage and Humidity: Section 3.13.7
  - Power Interruption: Section 3.13.10

### **Construction Methods:**

**Site Survey:** Perform a Site Survey with the IPVDCA manufacturer's representative for all IPVDCA locations prior to installation. The purpose of the Survey is to optimize the performance of the IPVDCA equipment when it is installed and ensure that it will meet the accuracy requirements specified. Prior to installation, submit the results of the Site Survey to the Engineer in a report which lists all IPVDCA locations with any recommended changes to camera locations, mounting adjustments, camera lens adjustments, and desired detection zone locations.

Install IPVDCA equipment in accordance with the manufacturer's instructions and the attached details to achieve the detection zones in the location(s) determined as a result of the Site Survey. Refer to the "Installation Best Practices Guide" attached below to this specification. Note that all

references to “Cat5e cable” in the attached “Installation Best Practices Guide” shall refer to “23 AWG 4 Twisted Pair Category 6 Cable” as specified in “Item #1113725A – 23 AWG 4 Twisted Pair Category 6 Cable.”

Documentation: (IPVDCA)

Provide to CTDOT Office of Maintenance three (3) copies of equipment manuals furnished by the manufacturer, including the following:

- Installation and operation procedures
- Performance specifications (functions, electrical, mechanical and environmental) of the unit
- Schematic diagrams (point to point wiring)
- Pictorial of component layout on circuit board
- List of replaceable parts including names of vendors for parts not identified by universal part numbers such as JEDEC/RETMA or EIA
- Troubleshooting, diagnostic and maintenance procedures

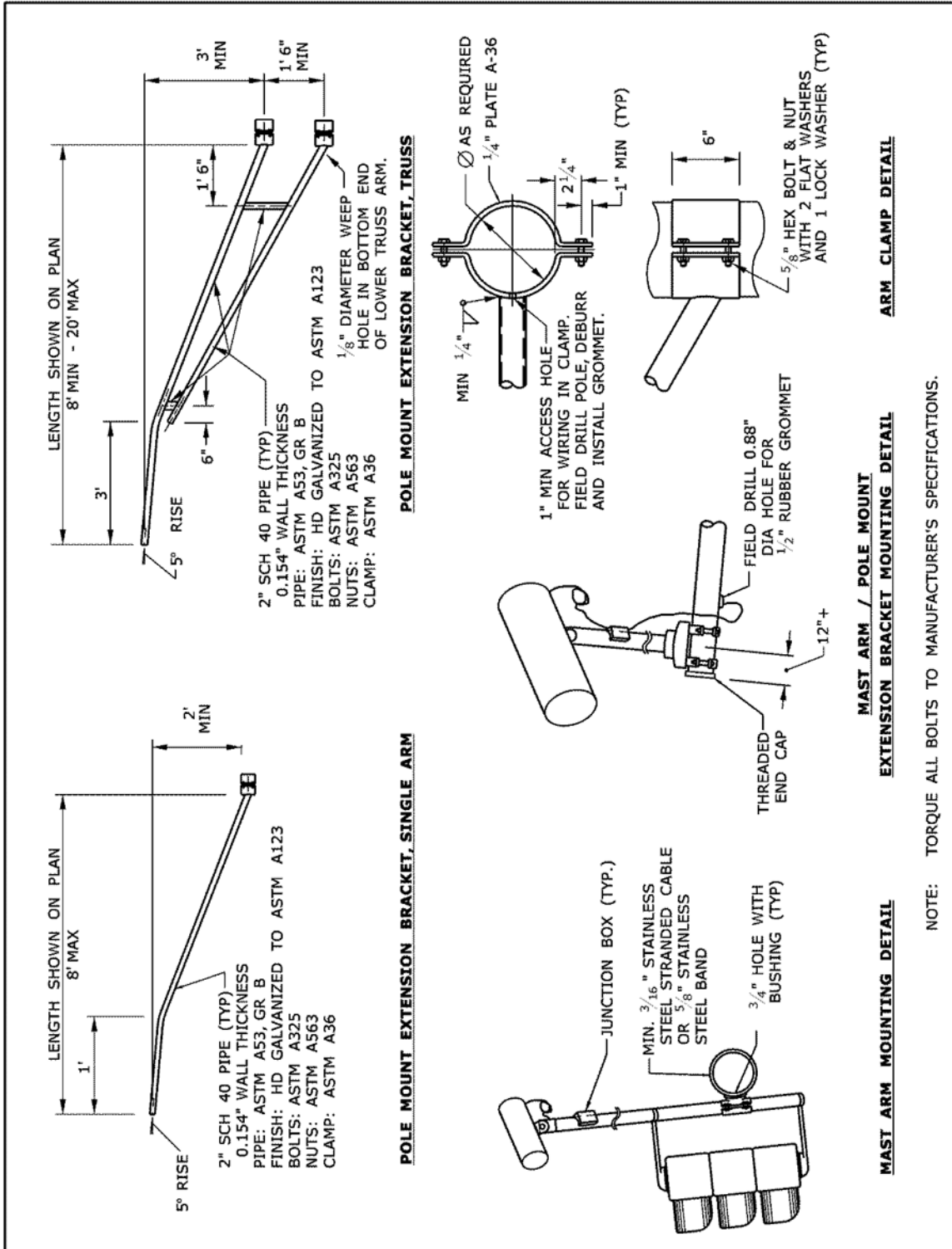
Warranties and Guarantees: (IPVDCA)

Provide warranties and guarantees to the CTDOT Office of Maintenance in accordance with Article 1.06.08 of the Standard Specifications. Warranties for all equipment furnished as part of this Contract are to cover a period of 36 months following successful completion of the entire intersection acceptance test.

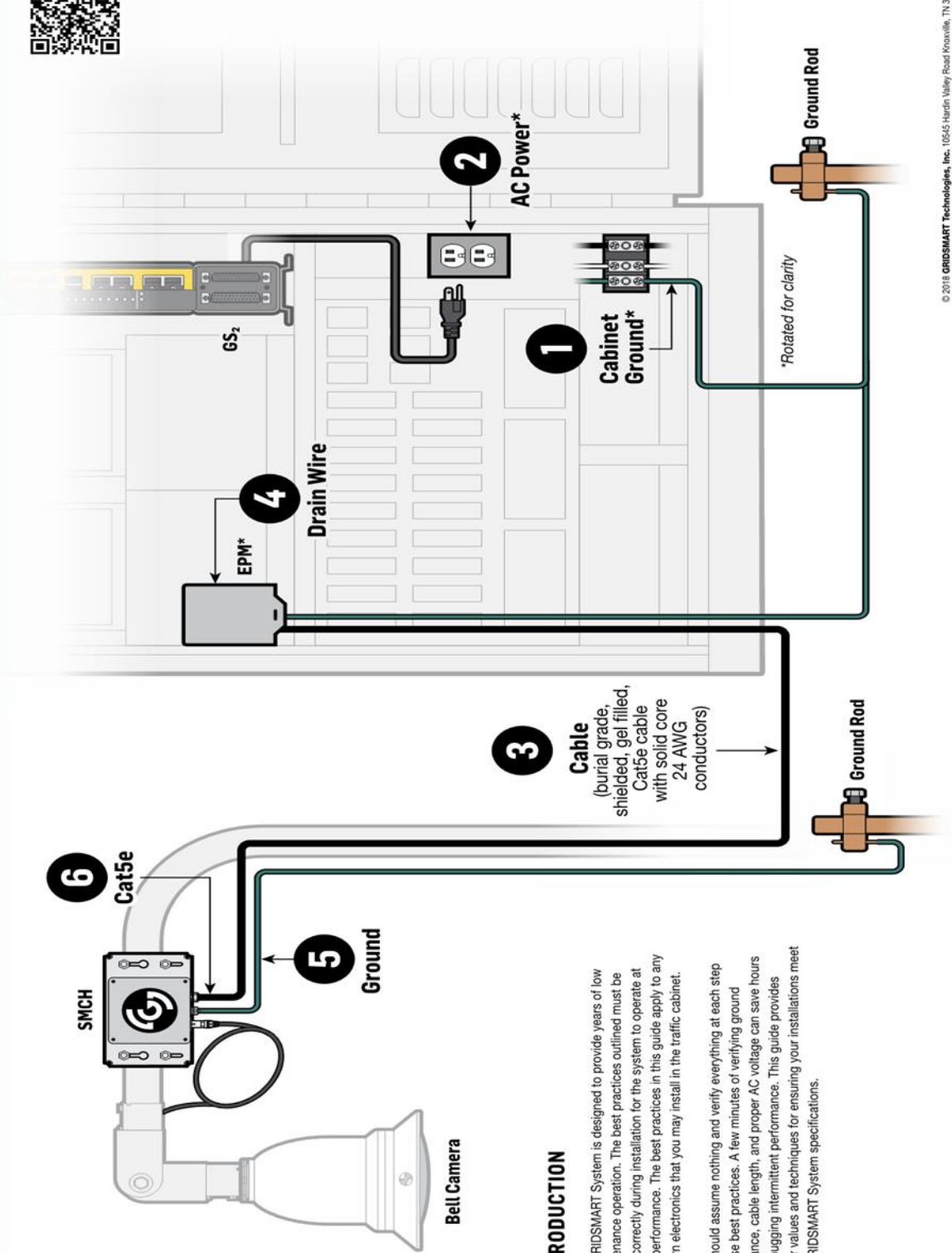
**Method of Measurement:** The IP Video Detection Camera Assembly will be measured for payment as the number of each assembly of IP video cameras, lenses, enclosures and mounting hardware furnished, installed, operational and accepted.

**Basis of Payment:** This item will be paid at the Contract unit price for each “IP Video Detection Camera Assembly” complete and accepted, which price shall include the Site Survey, IP video camera, lens, enclosure, brackets used to attach the IP video camera to a support structure or extension bracket, documentation, warrantee, labor, tools and equipment necessary to provide the specified video signal to the video detection processor.

Pay Item	Pay Unit
IP Video Detection Camera Assembly	ea.







**INTRODUCTION**

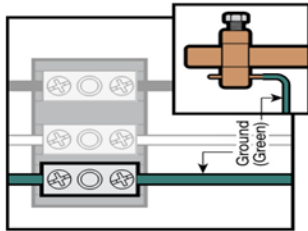
The GRIDSMART System is designed to provide years of low maintenance operation. The best practices outlined must be done correctly during installation for the system to operate at peak performance. The best practices in this guide apply to any modern electronics that you may install in the traffic cabinet.

You should assume nothing and verify everything at each step in these best practices. A few minutes of verifying ground resistance, cable length, and proper AC voltage can save hours of debugging intermittent performance. This guide provides proper values and techniques for ensuring your installations meet the GRIDSMART System specifications.

## 1 CABINET GROUNDING

A proper cabinet ground helps mitigate interference from electrical noise at the intersection.

- The U.S. National Electrical Code (NEC) recommends a maximum of 25 ohms for touch safety and telecommunications; PLC industry standards require a maximum of 5.0 ohms for logic reference purposes.
- Use a clamp-on ground meter to verify the cabinet ground.
- GRIDSMART requires the Diligent Instruments DLG Di-120b Tester (<http://www.diligentinstruments.com/di-120.html>).
- If the ground reading is higher than the recommended NEC value, check the connection between the cabinet ground wire and the ground rod for corrosion; clean if corrosion is present. If you are in an area with poor grounds, you may need to add a ground rod to the grounding system to improve the ground.



DLG Di-120b Tester

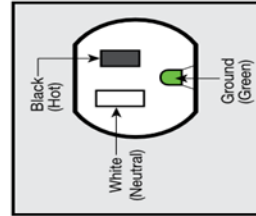


<b>SPECIFICATION:</b> 25 Ohms Max
<b>MEASURED:</b>

## 2 AC POWER

Plug the GRIDSMART Processor into an outlet on the filtered side of the cabinet power. Do not use GFCI type outlet.

- The outlet needs to be checked to verify that all three connections for the outlet are properly connected.
- Using a digital voltmeter (DVM), check the ac voltage from the line to the neutral and the line to ground. Both readings should be ~ 120/240VAC.



<b>SPECIFICATION:</b> HOT/NEU: 120/240VAC HOT/GND: 120/240VAC
<b>MEASURED:</b> HOT/NEU: HOT/GND:

## 3 CABLE TYPE & LENGTH

All GRIDSMART installations require burial grade, shielded, gel filled, Cat5e cable with solid core 24 AWG conductors. The shield will protect the data signals from radiated noise which is present in most intersections. LED streetlights have been found to be very noisy electrically and as more streetlights are switched to LED lights, the level of radiated noise will increase. The cable that GRIDSMART supplies and requires for all installations is Vertical Cable part #059-487/S/CMXF.

- The maximum length that a segment of Cat5e can be is 300 feet. If the distance from the EPM to the camera is more than 300 feet, a repeater (RBA) must be used.
- When determining length of the cable, a cable tester that measures the length of the cable is required. Do not rely on sight distance or "walking off" the distance.
- Many times, there are service loops in the pull boxes and at the base of the pole, which will not be accounted for when you do not use a meter for measuring the cable length. GRIDSMART recommends the Triplet Real World Certifier ([www.triplett.com/shop/real-world-certifier-rtc1000k/](http://www.triplett.com/shop/real-world-certifier-rtc1000k/)) for testing the cable. The tester will provide length measurements as well as cable quality measurements.



Triplet Real World Certifier

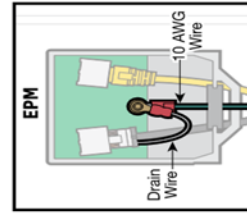


<b>SPECIFICATION:</b> Cable Length: 300 Ft. Max Real World Certification: 100 MB Min Cable Type: Vertical Cable part #059-487/S/CMXF
<b>MEASURED:</b> Cable Length: Real World Certification:

## 4 CONNECT DRAIN WIRE

The drain wire for the shielded Cat5e cable must be connected to the ground post in the EPM (Ethernet Protection Module). A crimp lug should be attached to the end of drain wire to attach it to the ground post. The drain should only be connected at the EPM end of the cable.

- If you are using an RBA, the drain must be spliced so the drain is continuous from the junction box to the EPM. A 10 AWG Wire is required to connect the EPM ground post to the traffic cabinet ground rod.
- Using a digital voltmeter, you should measure 0 Ohms between the EPM Ground Post and the traffic cabinet ground rod.

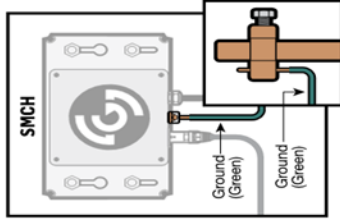


<b>SPECIFICATION:</b> 0 Ohms
<b>MEASURED:</b>

## 5 GROUND CONNECTIONS AT THE SMCH

The SMCH provides lightning protection for the camera.

- Use a 10-AWG wire to connect the SMCH ground lug to a well-grounded structure or a ground rod.
- Verify the resistance to ground of the structure utilizing the clamp on ground tester.

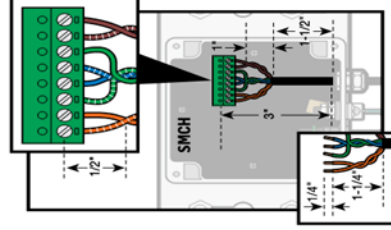


<b>SPECIFICATION:</b> 25 Ohms
<b>MEASURED:</b>

## 6 CAT5e AT SMCH

Proper terminal of the Cat5e to the SMCH Phoenix connector is required. Carefully implement the following requirements as shown.

- Remove no more than 1-1/2 inch of outer jacket from the end of the cable.
- No less than 1-1/2 inch of cable with outer jacket inside the SMCH.
- Pairs should be twisted as close as possible to the Phoenix connector.
- No more than 1/2 inch of untwisted conductors should be allowed. Strip 1/4 inch of the insulation from each conductor.



<b>Intersection:</b>
<b>Camera Serial Number:</b>
<b>GS: Processor Serial Number:</b>

## **ITEM #1108207A - INSTALL STATE FURNISHED TRAFFIC CONTROLLER AND CABINET**

### **Description:**

This item shall consist of installing a traffic controller cabinet, and related equipment, furnished by the State, Department of Transportation, on an existing, modified, or new foundation as indicated on the plans or as directed by the Engineer.

### **Material:**

All material for this work shall be furnished by the State except for miscellaneous electrical hardware, such as spade connectors, electrical tape, and cable ties required to complete the installation.

### **Construction Methods:**

The Contractor and the State shall arrange a schedule to pick up the traffic controller, cabinet, and related material from the Department of Transportation, Signal Lab, located at 280 West Street in Rocky Hill. Contact Mr. Don Assard at (860) 258-0346 or Mr. Mark Zampini at (860) 258-0349.

The Contractor shall sign a receipt, listing all material furnished by the State, for each location. All material provided by the State shall be transported, and stored if necessary, with care appropriate for microprocessor electronic equipment. It shall be the Contractors responsibility from the time of pick up until the new controller is in operation according to plan, to repair or replace any material damaged during delivery or during installation.

It shall be the responsibility of the Contractor to determine the function of existing traffic signal, pedestrian signal and detector cables, which will be reused, so that correct connection to the new controller may be completed.

The cabinet shall be installed on the foundation in accordance with the plans or as directed by the Engineer. Prior to connection of the field wires to the new controller cabinet, the Contractor shall perform the following tests:

1. Flash out all traffic and pedestrian signal field wires. This shall consist of momentarily connecting each to a 110 VAC fused source. This will ensure the signals are connected to the correct wires and there are no shorts in the field wiring.

2. Voltage test all input circuits. This shall consist of measuring all other field wires, such as vehicle detector, pedestrian pushbutton and pre-emption cables with a volt meter to ensure there is no voltage present which will damage the electronic devices.

Only then will existing and new signal wires and detector cables be connected, as indicated in the signal hook up chart provided with each cabinet.

When secondary service is initially applied to a State furnished controller cabinet, the controller unit, conflict monitor, coordination unit and other electronic equipment shall be unplugged. After the signals are flashing, the controller, conflict monitor and other equipment shall be connected, and the intersection placed in automatic operation.

**Method of Measurement:**

This work shall be measured for payment by the number of traffic controllers, cabinets and related equipment for each, picked up, installed, operating and accepted in place.

**Basis of Payment:**

This work will be paid for at the contract unit price each for "INSTALL STATE FURNISHED TRAFFIC CONTROLLER AND CABINET" complete in place, which shall include transportation from the pick-up source to the location, storage, all miscellaneous electrical hardware, tools and work incidental thereto.

Pay Items

Install State Furnished Traffic Controller and Cabinet

Pay Unit

Ea.