SECTION 660
VEHICLE DETECTION SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Description

1. Furnish and install vehicle detection system in accordance with the Contract Documents. Use only vehicle detection systems that meet the requirements of this Specification and are listed on the FDOT's Approved Products List (APL) and the Department's Traffic Signals and Signs Division's Qualified Products List (TSSQPL).

B. Method of Measurement

1. Furnish and Install:

a. Inductive Loops

1) The Contract unit price for each Inductive Loop Detector furnished and installed at the traffic signal cabinet includes all labor, equipment, testing and configuration necessary for a complete and accepted installation.

2) The Contract unit price for each Loop Assembly, furnished and installed, will include all equipment, labor, equipment, and materials necessary for a complete and accepted installation of the entire loop assembly as specified in the Contract Documents including the shielded lead-in cable into the traffic signal cabinet, proper termination, and testing.

b. Microwave Vehicle Detection System

1) The Contract unit price for Microwave Vehicle Detection System (MVDS), Cabinet Equipment, furnished and installed, includes all materials, tools, labor, equipment, approved mounts and hardware, operational software packages and firmware, supplies, support, testing, calibration, personnel training, shop drawings, warranty documentation, and incidentals necessary to complete the MVDS installation at each traffic signal cabinet location.

2) The Contract unit price for Microwave Vehicle Detection System (MVDS), Above Ground Equipment, furnished and installed, includes all materials, tools, labor, equipment, approved mounts and hardware, routing of cables and wiring properly terminating inside the traffic signal cabinet, operational software packages and firmware, supplies, support, testing, calibration, personnel training, shop drawings, warranty documentation, and incidentals necessary to complete the above ground MVDS work for each intersection approach.

c. Video Vehicle Detection System

1) The Contract unit price for Video Vehicle Detection System (VVDS), Cabinet Equipment, furnished and installed, includes all materials, tools, labor, equipment, approved mounts and hardware, operational software packages and firmware, supplies, support, testing, calibration, personnel training, shop drawings, warranty documentation, and incidentals necessary to complete the VVDS installation at each traffic signal cabinet location.

2) The Contract unit price for Video Vehicle Detection System (VVDS), Above Ground Equipment, furnished and installed, includes all materials, tools, labor, equipment, approved mounts and hardware, routing of cables and wiring properly terminating inside the traffic signal cabinet, operational software packages and firmware, supplies, support, testing, calibration, personnel training, shop drawings, warranty documentation, and incidentals necessary to complete the above ground VVDS work for each camera.

d. Wireless Magnetometer Detection System

1) The Contract unit price for a Wireless Magnetometer Detection System (WMDS), Cabinet Equipment, furnished and installed, will include furnishing, placement, and testing of all materials and equipment, and for all tools, labor, equipment, hardware, operational software packages and firmware, supplies, support, personnel training, shop drawings, warranty documentation, and incidentals necessary to complete the work at each interection.

2) The Contract unit price for a Wireless Magnetometer Detection System (WMDS), Above Ground Equipment, furnished and installed, includes all materials, tools, labor, equipment, approved mounts and hardware, routing of cables and wiring properly terminating inside the traffic signal cabinet, operational software packages and firmware, supplies, support, testing, calibration, personnel training, shop drawings, warranty documentation, and incidentals necessary to complete the above ground WMDS work for each intersection.

3) Separate payment will be made for each magnetometer in-road device furnished and installed in conjunction with the WMDS installation, pursuant to the Contract Documents, and approved locations depicted on the Plans.

e. Automatic Vehicle Identification

1) The Contract unit price for a complete Automatic Vehicle Identification (AVI) detection system, furnished and installed, will include furnishing, placement, and testing of all materials and equipment, and for all tools, labor, equipment, hardware, operational software packages and firmware, supplies, support, personnel training, shop drawings, warranty documentation, and incidentals necessary to complete the work at each location.

C. Basis of Payment

1. Price and Payment under the applicable pay item below will be full compensation for all work specified in this Section.

2. Payment will be made under (Pay Items Numbers for Department Contracts to be determined by the Contracts and Specifications Section):

Item No.	Description	Unit
660-1-109C	Inductive Loop Detector, F&I	EA
660-2-106	Loop Assembly, F&I, Type F	AS
660-2-106M	Loop Assembly, F&I, Type F Modified (Bicycle)	AS
660-3-11	Vehicle Detection System- Microwave, F&I Cabinet Equipment	EA
660-3-12	Vehicle Detection System- Microwave, F&I Above Ground Equipment	EA
660-4-11	Vehicle Detection System- Video, F&I Cabinet	EA

	Equipment	
660-4-12	Vehicle Detection System- Video, F&I Above Ground Equipment	EA
660-5-11	Vehicle Detection System- Wireless Magnetometer, F&I, Cabinet Equipment	EA
660-5-12	Vehicle Detection System- Wireless Magnetometer, F&I, Above Ground Equipment	EA
660-5-13	Vehicle Detection System- Wireless Magnetometer, F&I, In-Road Electronics	EA
660-6-120	Vehicle Detection System- Avi, Bluetooth, F&I, Complete System	EA

1.02 SYSTEM DESCRIPTION

A. Classification of Types

1. Functional Types

   a. Vehicle Presence Detection System: Vehicle presence detectors produce a corresponding output any time that a vehicle occupies the physical or virtual area of the detector.

   b. Traffic Data Detection System: Traffic data detectors provide presence, volume, occupancy, and speed data for the lanes they are configured to monitor.

   c. Probe Data Detection System: Probe data detection systems provide speed data and travel times for a road segment. Probe data detectors use automatic vehicle identification (AVI) technologies to establish a unique identifier for each vehicle they detect. This identifier is then transmitted to a central site where it can be matched to past or future detections of the same vehicle at different detector locations.

2. Technology Types

   a. Inductive Loop Detection System: An inductive loop detection system uses a minimum of one inductive loop and loop detector. The system operates by energizing and monitoring wire embedded in the road surface to detect vehicle presence and provide an output to traffic controllers or other devices that can generate volume, occupancy, and speed data (detection output).

   b. Video Vehicle Detection System (VVDS): A VVDS uses one or more cameras and video analytics hardware and software to detect vehicle presence, provides a detection output, and generates volume, occupancy, and speed data.

   c. Microwave Vehicle Detection System (MVDS): A MVDS transmits, receives, and analyzes a FCC-certified, low-power microwave radar signal to detect vehicle presence, provide a detection output, and generate volume, occupancy, and speed data.

   d. Wireless Magnetometer Detection System (WMDS): A WMDS uses one or more battery-powered wireless sensors embedded in the road surface, which communicates data by radio to a roadside receiver. Wireless magnetometer systems detect vehicle presence and provide a detection output to traffic controllers or other devices that can generate volume, occupancy, and speed data.

   e. Automatic Vehicle Identification (AVI): AVI detection systems use one or more different methods to collect information that can be used to establish a unique

identifier for each vehicle detected and the time and location that the vehicle was detected. AVI detection systems collect data using probe detectors that utilize radio-frequency identification (RFID), optical character recognition, magnetic signature analysis, laser profiling, Bluetooth®, or other technologies to establish vehicle identifier, time, and location.

B. Design Requirements

1. Provide stop bar detection in all lanes to provide a detection system that is capable of supporting a fully-actuated intersection and meet the requirements of the standard details for vehicle detection of the Miami-Dade County Traffic Control Equipment Standards and Specifications.
2. Use Inductive Loop Detection System technology type unless an alternate technology described herein is demonstrated by the Engineer of Record to be more suitable and reliable for the intersection under design. Written Department approval is required for use of detection technologies other than inductive loops.
3. Vehicle Detection Zones.
    a. In addition to the Stop Bar Detection required by the standard details, the Department may approve the following general detection zones for use in a signal plan design where appropriate due to site-specific operational requirements:
        1) Queue Detection: Used on protected/permissive left turn lanes in addition to stop bar detection. Leading edge is placed at 50 feet from the Stop Bar.
        2) Long-Loop-Occupancy Detection: Used in each through lanes on very low-speed (25 mi/h or less) approaches for signal green time extension. Provided by increasing the length of the Stop Bar inductive loop detection to 50 feet from the Stop Bar.
        3) Multiple-Point Detection: Used on through lanes to ameliorate dilemma zone problems through the strategic placement of multiple sensors at high-speed (greater than 40 mi/h) approaches to intersections controlled by actuated controllers. Design based on guidance provided in Chapter 4, of the FHWA Traffic Detector Handbook: Third Edition—Volume I Inductive-loop detector placement in multiple-point detection systems used to ameliorate effects of dilemma zones.

1.03 WARRANTY

A. Ensure that vehicle detection and data collection systems have a manufacturer's warranty covering defects for a minimum of 5 years from the date of final acceptance by Engineer in accordance with the Contract Documents and Section 600. Ensure the warranty includes providing replacements, within 10 calendar days of notification, for defective parts and equipment during the warranty period at no cost to the County.

PART 2 PRODUCTS

2.01 INDUCTIVE LOOP DETECTION SYSTEM

A. Materials.

1. Use inductive loop detectors and loop sealant currently listed on the FDOT's APL and the Department's TSSQPL.

2. Inductive Loop Detector Units: Ensure loop detector units meet the requirements of NEMA TS-2-2016.

3. Loop Wire:

   a. Use No. 14 AWG stranded copper wire with Type XHHW cross-linked polyethylene insulation and an additional outer sleeve composed of polyvinylchloride or polyethylene insulation that meets the requirements of International Municipal Signal Association (IMSA) 51-7.

   b. The wire must have surface-printed information indicating the manufacturer ID and its NRTL listing (UL, CSA, etc.), the maximum rated voltage, AWG size, the proper type letter or letters for the type of wire or the IMSA specification number every 2 feet or less.

4. Shielded Lead-in Cable: Use No. 14 AWG two conductor, stranded copper wire with shield and polyethylene insulation, meeting the requirements for IMSA 50-2.

5. Splicing Material:

   a. Use rosin-core solder for soldered splices.

   b. Butt-end connectors must be non-insulated Panduit Part Number BS14, BS10; Ideal Model Number TV16X, TV12X; Thomas and Betts Catalog Number BB-2, CC-2 or Engineer approved equivalent.

   c. Insulated tubing used to cover splice must be heat-shrinkable, cross-linked polyolefin with a silicon sealant inside the tubing and an insulation rating of at least 600 V. Outer tubing must be dual/multiple wall type.

   d. Splicing tape must be self-fusing silicone rubber.

6. Loop Sealant:

   a. Ensure that loop sealant:

      1) Is manufactured for traffic loop embedding in both asphalt and concrete pavement.

      2) Consists of multi-component systems having simple mix ratios of 1:1 or 2:1 or are supplied in pre-measured containers in which all contents of both packages are to be mixed.

      3) Is self-leveling when applied.

      4) Does not run out of unlevel slots as tested for viscosity using ASTM D562 at 77°F.

      5) Is tack free within a maximum of 2 hours from time of application and when cured as tested for tack free time using ASTM C679 at 77°F.

      6) Securely adheres to concrete and asphalt when installed in a 3/8 inch by 3 inch saw cut, cured for 2 weeks at 77°F as tested for adhesion using visual inspection.

      7) Shows no visible signs of shrinkage after curing when installed in a 3/8 inch by 3 inch saw cut, cured for 2 weeks at 77°F as tested for shrinkage using a dimensional measurement.

      8) Resists weather, oils, gasoline, antifreeze, and brake fluid as tested for absorption using ASTM D570 for water, No. 3 oil, gasoline, antifreeze, and brake fluid for 24 hours.

      9) Resists penetration of foreign materials as tested for durometer hardness using ASTM D2240 Shore A for 24 hours.

10) Resists cracking caused by expansion and contraction due to temperature changes as tested for tensile strength and elongation using ASTM D412.

11) Does not become brittle with age or temperature extremes as tested for weight loss, cracking, and chalking using ASTM C1246.

12) Has a minimum shelf life of 1 year in undamaged containers when stored per manufacturer recommendations.

2.02 VIDEO VEHICLE DETECTION SYSTEM (VVDS)

A. Configuration and Management:

1. Ensure that the VVDS:
   a. Is provided with software that allows local and remote configuration and monitoring.
   b. Can display detection zones and detection activations overlaid on live video inputs.
   c. Allows a user to edit previously defined configuration parameters, including size, placement, and sensitivity of detection zones.
   d. Retains its programming in nonvolatile memory.
2. Ensure that the detection system configuration data can be saved to a computer and restored from a saved file. Ensure that all communication addresses are user programmable.
3. Ensure that the detection system software offers an open Application Programming Interface (API) and software development kit available to the Department at no cost for integration with third party software and systems.

B. Detection Camera: Provide a camera that is furnished or approved by the video detection system manufacturer.

C. Machine Vision Processor: Ensure the VVDS includes a machine vision processor that allows video analysis, presence detection, data collection, and interfaces for inputs and outputs as well as storage and reporting of collected vehicle detection data.

D. Video Inputs and Outputs: Ensure that analog video inputs and outputs utilize BNC connectors.

E. Solid State Detection Outputs: Ensure outputs meet the requirements of NEMA TS2-2016, 6.5.2.26.

F. Electrical Requirements: Ensure the system operates using a nominal input voltage of 120 volts of alternating current (V_{AC}). Ensure that the system will operate with an input voltage ranging from 89 to 135 V_{AC}. If a system device requires operating voltages other than 120 V_{AC}, supply a voltage converter.

2.03 MICROWAVE VEHICLE DETECTION SYSTEM (MVDS)

A. Ensure that MVDS used for stop bar intersection presence detection can detect vehicles throughout a minimum detection range of 6-140 feet from the sensor and are capable of detecting up to 10 lanes of traffic.

B. Ensure that MVDS used for dilemma zone protection can detect vehicles throughout a minimum detection range of 50-600 feet from the sensor; can report the speed, range, and estimated time of arrival at the stop bar of each vehicle detected; and can provide contact closure outputs when a vehicle meeting user-defined alert criteria is detected.

C. Ensure that sidefire MVDS sensors used for data collection have a minimum 200-foot range and the capability to detect 8 lanes of traffic.

D. Configuration and Management:

1. Ensure that the MVDS is provided with software that allows local and remote configuration and monitoring. Ensure that the system software can display detection zones and detection activations in a graphical format.
2. Ensure that the MVDS allows a user to edit previously defined configuration parameters, including size, placement, and sensitivity of detection zones.
3. Ensure that the MVDS retains its programming in nonvolatile memory. Ensure that the detection system configuration data can be saved to a computer and restored from a saved file. Ensure that all communication addresses are user programmable.
4. Ensure that the detection system software offers an open API and software development kit available to the Department at no cost for integration with third party software and systems.

E. Solid State Detection Outputs: Ensure outputs meet the requirements of NEMA TS2-2016, 6.5.2.26.

F. Electrical Requirements: Ensure the microwave detector will operate with a nominal input voltage of 12 V_{DC}. Ensure the microwave detector will operate with an input voltage ranging from 89 to 135 V_{AC}. If any system device requires operating voltages other than 120 V_{AC}, supply a voltage converter.

G. Ensure that the detector is FCC-certified and that the FCC identification number is displayed on an external label. Ensure that the detector transmits within a frequency band of 10.525 gigahertz, plus or minus 25 megahertz, or another FCC-approved spectral band.

2.04 WIRELESS MAGNETOMETER DETECTION SYSTEM (WMDS)

A. Configuration and Management:

1. Ensure that the detection system is provided with software that allows local and remote configuration and monitoring.
2. Ensure that the WMDS allows a user to edit previously defined configuration parameters.
3. Ensure that the WMDS retains its programming in nonvolatile memory. Ensure that the detection system configuration data can be saved to a computer and restored from a saved file. Ensure that all communication addresses are user programmable.
4. Ensure that the detection system software offers an open API and software development kit available to the Department at no cost for integration with third party software and systems.

B. Solid State Detection Outputs: Ensure outputs meet the requirements of NEMA TS2-2016, 6.5.2.26.

C. Electrical Requirements: Ensure the detection system will operate with an input voltage ranging from 89 to 135 V_{AC}. If any system device requires operating voltages other than 120 V_{AC}, supply a voltage converter.

2.05 AUTOMATIC VEHICLE IDENTIFICATION (AVI) DETECTION SYSTEM

A. Configuration and Management: Ensure that the detection system is provided with software that allows local and remote configuration and monitoring.

B. Probe Detector Requirements:

1. Transponder Readers: Ensure transponder readers are compatible with multiple tag protocols, including Allegro and the protocol defined in ISO18000-6B.
2. Bluetooth Readers: Ensure that Bluetooth readers will operate using solar power and cellular communications. Ensure that Bluetooth readers will operate using power over Ethernet. Ensure that Bluetooth readers will operate with a nominal input voltage of 12 V_{DC}.
3. License Plate Readers: License plate readers must not require the use of visible strobes or other visible supplemental lighting.

C. Electrical Requirements: Ensure the detection system will operate with an input voltage ranging from 89 to 135 V_{AC}. If any system device requires operating voltages other than 120 V_{AC}, supply a voltage converter.

2.06 COMMUNICATIONS

A. Communication requirements for VVDS, MVDS, WMDS and AVI:

1. Ensure that the VVDS includes a minimum of one Ethernet communications interface. Ensure that components of the MVDS, WMDS and AVI detection system (such as sensors, controllers, and processing hardware) include a minimum of one serial or Ethernet communications interface.
2. Ensure serial interfaces and connectors conform to applicable Telecommunications Industry Association (TIA) standards. Ensure that serial ports support data rates up to 115200 bps; error detection utilizing parity bits (i.e., none, even, and odd); and stop bits (1 or 2). MVDS sensors must a serial interface that supports RS-232 and RS-485.
3. Ensure that wired Ethernet interfaces provide a 10/100 Base TX connection. Verify that all unshielded twisted pair/shielded twisted pair network cables and connectors comply with TIA-568.
4. Ensure wireless communications are secure and that wireless devices are Federal Communications Commission (FCC) certified. Ensure that the FCC identification number is displayed on an external label and that all detection system devices operate within their FCC frequency allocation.
5. Ensure cellular communications devices are compatible with the 4G system and cellular carrier used by the agency responsible for system operation and maintenance.
6. Ensure the system can be remotely configured and monitored via one or more communications interface

2.07 MECHANICAL REQUIREMENTS FOR ALL DETECTORS

A. Ensure that all parts are made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal.

B. Ensure that all fasteners exposed to the elements are Type 304 or 316 passivated stainless steel.

2.08 ENVIRONMENTAL REQUIREMENTS FOR ALL DETECTORS

A. Meet the environmental requirements of NEMA TS-2-2016.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation Requirements for all detectors:

1. Install, configure, and demonstrate a fully functional vehicle detection system, as shown in the plans. Connect all field equipment to the existing communication network, and provide all materials specified in the Contract Documents. Install all equipment according to the manufacturer's recommendations and these Specifications.
2. Mount above-ground detectors on existing poles or sign structures, or on new poles, as shown in the Plans. Furnish all equipment with the appropriate power and communication cables. Install the power cable and the communication cables according to the manufacturer's recommendation. Ensure that the cables comply with NEC sizing requirements and meet all other applicable standards, specifications, and local code requirements.
3. Do not install communication cables in the same conduit or pull boxes as power cables carrying voltage greater than 24 V_{DC}/V_{AC} or current in excess of 1.5 amps.
4. Cut cabinet wiring to the proper length. Do not double back wire to take up slack. Neatly lace wires into cables with nylon lacing or plastic straps. Secure cables with clamps and provide service loops at all connections.
5. In the event that power to the vehicle detection system or a subcomponent thereof is interrupted, ensure that the equipment automatically recovers after power is restored. Ensure that all programmable system settings return to their previous configurations and the system resumes proper operation.

B. Inductive Loop Detector Installation:

1. Except as otherwise specified herein, install vehicle loops in accordance with the manufacturer's instructions, standard details for vehicle detection of the Miami-Dade County Traffic Control Equipment Standards and Specifications, and the Plans.
2. Unless otherwise specified in the Plans, stop bar loops in vehicular travel lanes must be thirty feet long Type F loops. Where specified in the Plans, a modified 3' x 20' Type F loop may be installed in dedicated bicycle lanes.
3. The leading edge of a loop cannot extend more than ten feet past the stop line.
4. The saw cut may not encroach into the crosswalk.
5. Inductive Loop-Detector Units: Adjust the operating frequency of each detector unit, if required, to prevent crosstalk of the units.
6. Saw Cuts:

a. Saws must be equipped with a depth gauge to assist in maintaining proper depth and a horizontal guide to assure alignment.

b. Use a chalk line or equivalent method to outline the perimeter of the loop on the pavement and routes for lead-in cables. Do not allow the saw cut in the pavement to deviate by more than 1 inch from the chalked line.

c. Ensure that all saw cuts are free of any dust, dirt or other debris and completely dry prior to the installation of the loop wire, loop wire twisted pair lead or lead-in cable. Use compressed air to thoroughly dry the sawed slot.

d. Make saw cuts in accordance with standard details for vehicle detection of the Miami-Dade County Traffic Control Equipment Standards and Specifications unless otherwise stipulated in the Contract Documents.

e. Ensure that the top conductor of the loop wire or lead-in cable is a minimum of 2 inch below the final surface of the roadway.

7. Loop Wire:

a. Ensure that the first turn of the loop wire is placed in the bottom of the saw cut, with each subsequent turn placed on top of the preceding turn. Push the loop wire to the bottom of the saw cut with a non-metallic tool which will not damage the insulation.

b. Label the loop wires in the pull box with waterproof tags and identify the start (S), finish (F) lead and the loop number.

c. Use alternate polarity on adjacent loops.

d. Hold the loop in place with strips of rubber, neoprene, flexible tubing, or foam backer rod as approved by Engineer. Ensure that the backer rod material is non-metallic, is placed in the saw slot using segments 1 to 2 inches long, spaced 12 inches apart, and that the distance from the top of the hold down material to the final surface of the roadway is not less than 1.5 inches.

8. Loop Wire Twisted Pair Lead:

a. Create a loop wire twisted pair lead by twisting the loop wire pair a minimum of 10 turns per foot to form a loop wire twisted pair lead from the edge of the loop to the pull box located adjacent to the roadway. Place only one loop wire twisted pair lead in a saw cut. Ensure that the distance between a twisted loop wire pair lead within the roadway is a minimum of 6 inches from any other twisted loop wire pair lead or loop, until they are within 1 foot of the edge of pavement or curb, at which point they may be placed closer together.

b. Hold the loop wire twisted pair lead in place with strips of rubber, neoprene, flexible tubing, or foam backer rod as approved by Engineer. Ensure that the backer rod material is non-metallic, is placed in the saw slot using segments 1 to 2 inches long, spaced 24 inches apart, and that the distance from the top of the hold down material to the final surface of the roadway is not less than 1.5 inches.

c. Provide a minimum of 3 feet of twisted loop wire pair lead in the pull box located adjacent to the roadway. Do not route twisted loop wire pair lead directly through conduits to the cabinet, unless otherwise shown in the Plans.

9. Splicing:

a. Splices must be made by crimping and soldering. Splice lead-in cable to the loop wire in accordance with these Specifications.

b. Perform the splicing in a pull box located off the roadway, not in the roadway itself. Splices must be made on the same day wires are installed unless the ends of the wires are sealed with Scotchkote to keep water out of the insulating jacket.

c. Strip insulation of loop wires and lead-in cable as necessary. Clip one of the loop wires 3 inches shorter than other and clip the non-corresponding lead-in cable wire accordingly in order to stagger the splices.

d. Splice the black conductor of the lead-in cable to the finish (F) “lead” of the loop.

e. Crimp the appropriate wires with a non-insulated butt connector using a pressure crimping tool that provides a uniform 360-degree crimp. Insulate each wire splice separately using cross-linked polyolefin tubing.

f. Insulate the total splice using dual/multiple wall cross-linked polyolefin tubing.

g. Ensure that the ends of the cable jackets, twisted pair and lead-in, are encased in the loop splice material.

h. Ensure that each loop has an individual return to the cabinet and series splicing is performed on a separate terminal block in the cabinet.

10. Terminations:

a. Using insulated terminal lugs, terminate lead-in cables or twisted pair loop wire on a terminal strip which is located in the controller or detector cabinet.

b. Use a calibrated ratchet type crimping tool to attach the lugs to the conductors of the lead-in cable or twisted loop wire.

11. Loop Sealant:

a. Prepare the loop sealant in accordance with the manufacturer’s instructions.

b. Using a manufacturer approved applicator or dispenser, apply only sufficient sealant to completely fill the saw cut without overfilling

c. Remove excess material from pavement.

d. Ensure that the loop sealant has cured completely before allowing vehicular traffic to travel over the sealant.

12. Loop Assembly Identification: Identify and tag each loop assembly in the controller or detector cabinet by lane and movement number.

C. Video Detector Installation:

1. Install cameras and configure detection zones and settings in accordance with the Contract Documents, standard details for vehicle detection of the Miami-Dade County Traffic Control Equipment Standards and Specifications, manufacturer’s recommendations, and as directed by Engineer.

2. Submit configuration settings (including, but not limited to detector names, communication settings, and output assignments) and configuration file backups to Engineer.

3. Submit a graphical depiction of each camera site, its pole location, mounting height, the ratio of distance away from the camera versus the mounting height, the camera’s mounting type (i.e., pole or structure), camera aiming procedures, and the placement of the proposed detection zone for each lane.

4. Do not use coaxial cable runs in excess of 500 feet. Mount and aim cameras in a manner that eliminates as much environmentally generated glare as possible.

5. For systems where composite cables are used, Power over Ethernet (PoE) injectors are required for cable runs longer than 330 ft .

D. Microwave Detector Installation:

1. Install detector and configure detection zones and settings in accordance with the Contract Documents, manufacturer’s recommendations, and as directed by Engineer.

2. Submit configuration settings (including, but not limited to detector names, communication settings, and output assignments) and configuration file backups to Engineer.

E. Wireless Magnetometer Installation:

1. Install in accordance with the Contract Documents, manufacturer's recommendations, and as directed by Engineer.
2. Ensure that materials used for the installation of magnetometers in the road surface have cured completely before allowing vehicular traffic to travel over them.

F. AVI Detection System Installation:

1. Install in accordance with the Contract Documents, manufacturer's recommendations, and as directed by Engineer.

3.02 INDUCTIVE LOOP PERFORMANCE REQUIREMENTS

A. Obtain latest Department's Loop Assembly Test Form from Engineer. Tests must be performed and the form completed and signed by a Contractor representative that is IMSA Traffic Signal Level II certified. Deliver the completed original to Engineer prior to Engineer's inspection and place a copy in the controller cabinet.

B. Measure loop inductance, series resistance, insulation resistance, and quality factor. Take measurements both at the junction box (loop including twisted pair lead-in) and the Cabinet (loop and shielded lead-in cable). Measurements at the junction box must be taken before and after the loop wires are sealed in the pavement.

C. Test Equipment. Conduct tests using one or more loop tester devices capable of measuring continuity, inductance in microhenrys (μH), integrity of the wire insulation in mega-ohms (MΩ), loop wire resistance in ohms (Ω), and the Loop Quality Factor (Q).

D. Inductive Loop Tester:

1. Measure inductance.
2. Measure series resistance.
3. Measure Loop Quality Factor.

E. High voltage resistance tester:

1. Measure and record the insulation resistance (leakage to ground) of each loop assembly. Use a 500 VDC insulation megger to measure the resistance. Reference all measurements to a good earth ground (ground rod, metallic water pipe, etc.). Disconnect the transient suppression devices from the loop assemblies before taking any measurements.

F. Acceptable test results.

1. Inductance (L): The inductance reading on the loop tester is within 10 percent of the Department's calculated value.
2. Series resistance (R): Less than or equal to 10 Ω at the Controller.
3. Loop Quality Factor (Q): Greater than 5.
4. Insulation Resistance: Greater than 100 MΩ.

G. Corrective Actions:

1. Perform, at no additional cost to the Department and to the satisfaction of Engineer, all corrective actions necessary to obtain acceptable test results, as stipulated in the preceding Subarticle, and meet all requirements of these Specifications.
2. If the series resistance of a loop assembly is greater than 10 Ω, inspect the loop assembly to find the cause of the excessive resistance. Correct the cause of the excessive resistance at no additional cost to the Department.
3. If the insulation resistance is less than or equal to 100 MΩ, determine if the lead-in cable or the loop wire is causing the problem, and replace the defective cable or loop wire at no additional cost to the Department.

H. Turn On Requirements. Connect the loop assemblies to the appropriate inductive loop vehicle detectors and tune the detectors in accordance with the manufacturer's instructions. Separate the operating frequencies of vehicle detectors, in adjacent lanes, by at least 2 kHz.

3.03 VEHICLE PRESENCE DETECTOR PERFORMANCE REQUIREMENTS

A. Vehicle Presence Detection System Field Acceptance Testing:

1. Ensure presence detectors provide a minimum detection accuracy of 98%. Ensure presence detectors meet the requirements for modes of operation in NEMA TS2-2016, 6.5.2.17.
2. Verify detection accuracy at installed field sites using a reduced method to that described in FDOT Specification Section 660-2.2 (Vehicle Presence Detection Performance Requirements). Compare sample data collected from the detection system with ground truth data collected by human observation. For site acceptance tests, collect samples and ground truth data for each site for a minimum of five minutes during a peak period and five minutes during an off-peak period. For presence detection at intersections, ensure there are a minimum of three detections for each signal phase. Perform site acceptance tests in the presence of Engineer.

3.04 TRAFFIC DATA DETECTOR PERFORMANCE REQUIREMENTS:

A. Traffic Data Detection System Field Acceptance Testing:

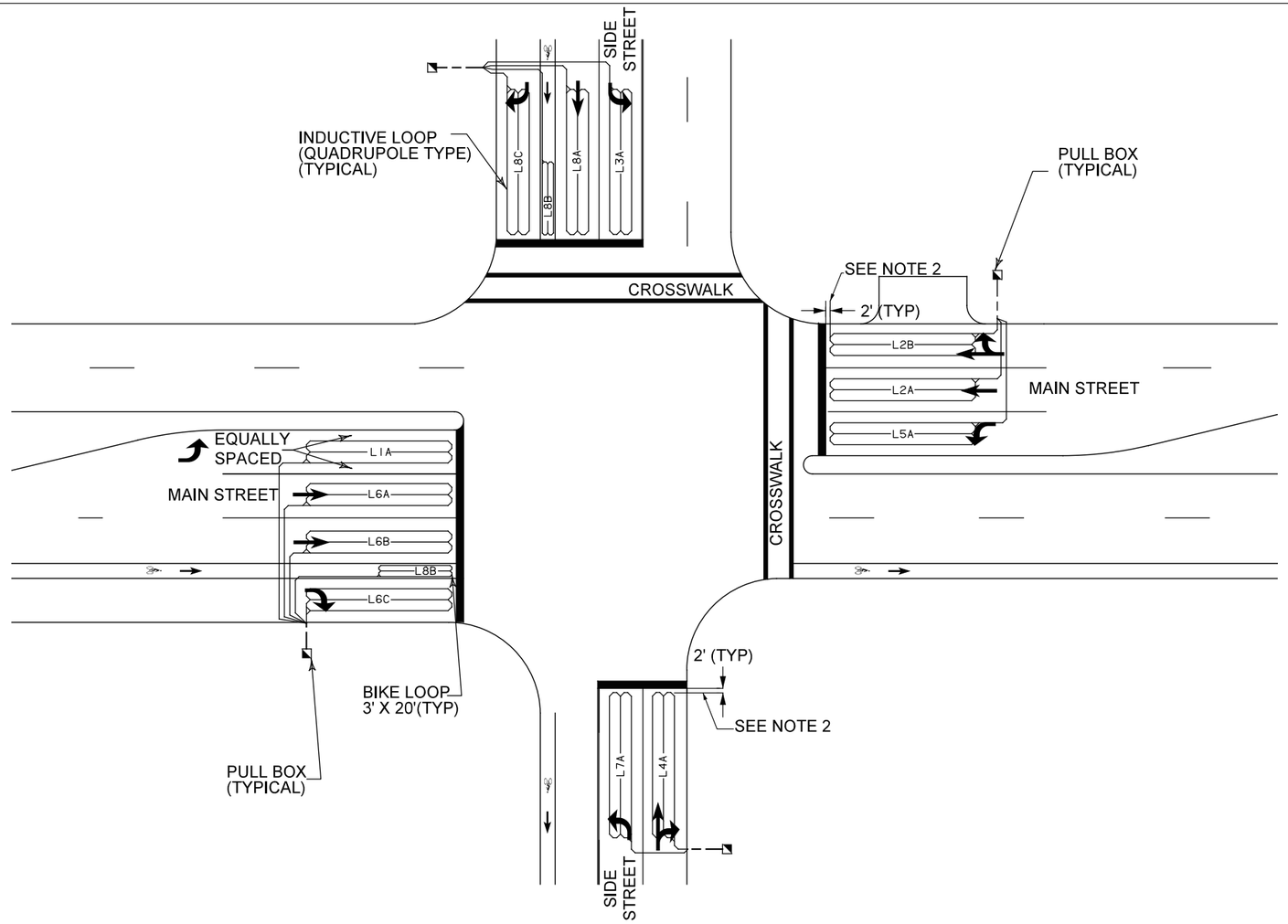
1. Vehicle detection system must be capable of meeting the minimum total roadway segment accuracy levels of 95% for volume, 90% for occupancy, and 90% for speed for all lanes, up to the maximum number of lanes that the device can monitor as specified by the manufacturer.
2. Verify detection accuracy at installed field sites using a reduced method to that described in FDOT Specification Section 660-2.3 (Traffic Data Detection System Performance Requirements). Compare sample data collected from the detection system with ground truth data collected by human observation. For site acceptance tests, collect samples and ground truth data for each site for a minimum of five minutes during a peak period and five minutes during an off-peak period. Perform site acceptance tests in the presence of the Engineer.

3.05 AVI DETECTION SYSTEM PERFORMANCE REQUIREMENTS:

A. AVI detectors must meet the performance requirements described in FDOT Specification Section 660-2.4 (Probe Data Detection Performance Requirements).

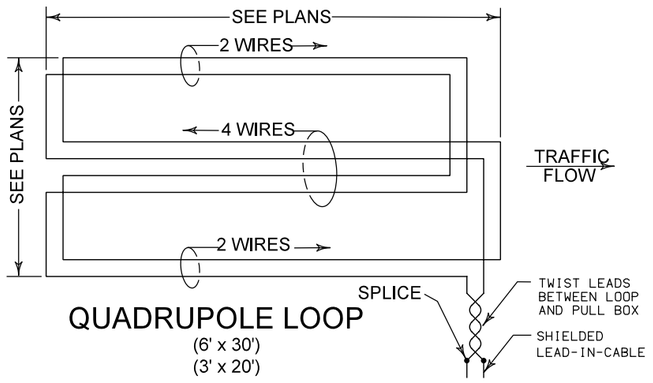
B. Calculation of AVI Detection System Speed and Travel Time Accuracy: Calculate speed and travel time accuracy by comparing the speeds and travel times reported by the system against ground truth collected through human observation or another method approved by Engineer.

END OF SECTION 660



TYPICAL INDUCTIVE LOOP PLACEMENT

NOT TO SCALE

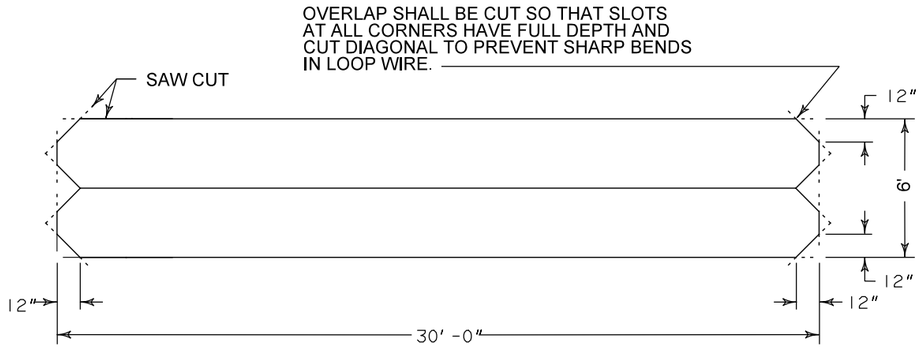


QUADRUPOLE LOOP

(6' x 30')
(3' x 20')

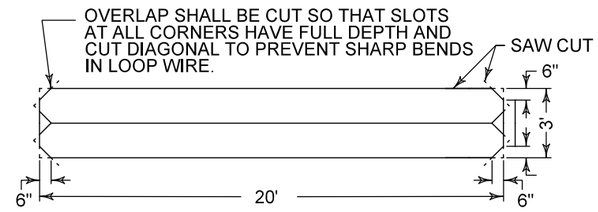
TYPICAL DETECTOR LOOP WIRE CONFIGURATION

NOT TO SCALE



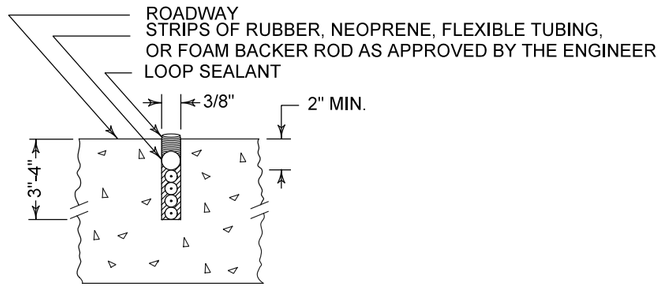
TYPICAL "TYPE F" VEHICLE INDUCTIVE LOOP

NOT TO SCALE



TYPICAL "TYPE F" MODIFIED BICYCLE INDUCTIVE LOOP

NOT TO SCALE

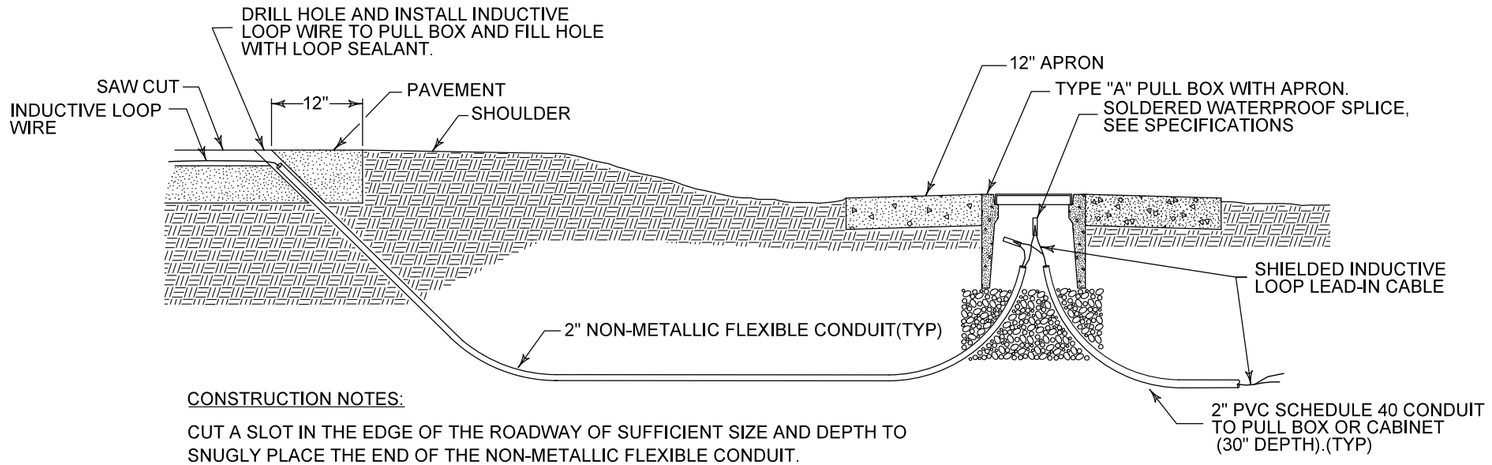


LOOP SECTION

NOT TO SCALE

TYPICAL SAW CUT DETAIL

LATEST REVISION	DESCRIPTION:	TRAFFIC CONTROL EQUIPMENT STANDARDS AND SPECIFICATIONS	MIAMI-DADE	DTPW TRAFFIC SIGNALS AND SIGNS DIVISION 7100 NW 36th STREET MIAMI, FLORIDA 33166 305.592.3580		NAME	DATE	TYPICAL INDUCTIVE LOOP INSTALLATION DETAILS (N.T.S.)	SHEET NO.
03/27/17					DRAWN BY	TRAVIS BREWER	09-29-16		1 of 2
					CHECKED BY	NAHUM FERNANDEZ	03-22-17		
					APPROVED BY: FRANK AIRA, P.E.				

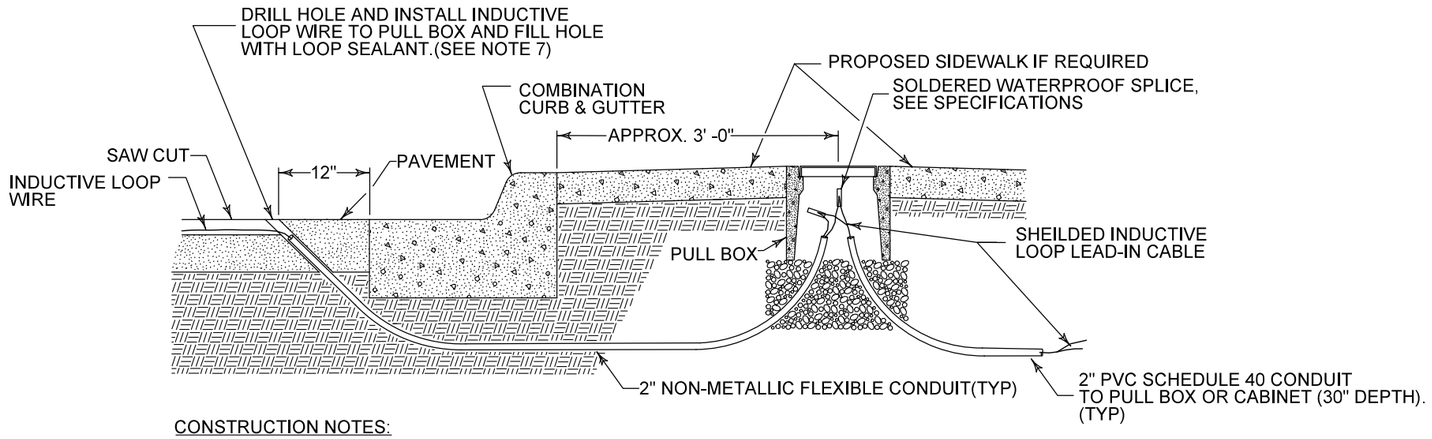


CONSTRUCTION NOTES:

CUT A SLOT IN THE EDGE OF THE ROADWAY OF SUFFICIENT SIZE AND DEPTH TO SNUGLY PLACE THE END OF THE NON-METALLIC FLEXIBLE CONDUIT.
THE END OF THE CONDUIT SHALL BE AT LEAST 12" INTO THE ROADWAY AND 3" BELOW THE TOP OF THE ROADWAY SURFACE. THE DEPARTURE ANGLE OF THE CONDUIT FROM THE ROADWAY SHALL BE 30 TO 45 DEGREES.

TYPICAL SECTION VIEW OF INDUCTIVE LOOP WIRE THROUGH PAVEMENT TO PULL BOX.

NOT TO SCALE



CONSTRUCTION NOTES:

DRILL A HOLE 1/2" TO 1" LARGER IN DIAMETER THAN THE FLEXIBLE CONDUIT TO BE USED THROUGH THE ROADWAY ASPHALT (OR CONCRETE) SURFACE AND BASE AT AN APPROPIATE ANGLE TO INTERCEPT THE TRENCH OR PULL BOX HOLE. PLACE A PREDETERMINED LENGTH OF NON-METALLIC FLEXIBLE CONDUIT IN THE HOLE AND DRIVE THE CONDUIT INTO THE TRENCH OR HOLE. THE TOP OF THE CONDUIT SHALL BE APPROXIMATELY 3" BELOW THE ROADWAY SURFACE. FILL THE HOLE WITH LOOP SEALANT TO THE LEVEL OF THE ROADWAY SURFACE. A NONMETALLIC MATERIAL SHOULD BE USED TO PREVENT EXCESSIVE LOOP SEALANT FROM ENTERING THE NON-METALLIC FLEXIBLE CONDUIT.

TYPICAL SECTION VIEW OF INDUCTIVE LOOP WIRE THROUGH CURB TO PULL BOX.

NOT TO SCALE

GENERAL NOTES:

1. MEET THE REQUIREMENTS OF MIAMI-DADE COUNTY TRAFFIC CONTROL EQUIPMENT STANDARDS AND SPECIFICATIONS SECTION 660 (VEHICLE DETECTION SYSTEMS).

2. THE STANDARD PLACEMENT OF THE LEADING EDGE OF TYPE F LOOP IS TWO FEET BEFORE THE STOP BAR BUT MAY EXTEND A MAXIMUM OF 10 FEET PAST THE STOP BAR TO MEET SITE-SPECIFIC ENGINEERING REQUIREMENTS. EACH INTERSECTION MUST BE INDIVIDUALLY DESIGNED AND IF THE AFOREMENTIONED MODIFICATION IS REQUIRED IT MUST BE NOTED OR DETAILED IN THE PLANS.UNDER NO CIRCUMSTANCES MAY THE LOOP OR SAW-CUT ENCROACH INTO A CROSSWALK.

3. IF THE LOOP LEAD-IN IS 75' OR LESS FROM THE EDGE OF THE LOOP DETECTOR TO CONTROLLER CABINET, CONTINUE THE TWISTED PAIR TO THE CABINET. IF THE LOOP LEAD-IN IS GREATER THAN 75' CONTINUE THE TWISTED PAIR TO THE SPECIFIED PULL BOX, SPLICE TO SHIELDED LEAD-IN WIRE AND CONTINUE TO THE CONTROLLER CABINET.

4. THE WIDTH OF ALL SAW CUTS SHALL BE SUFFICIENT TO ALLOW UNFORCED PLACEMENT OF LOOP WIRES OR LEAD-IN CABLES INTO THE SAW CUT. THE DEPTH OF ALL SAW CUTS, EXCEPT ACROSS EXPANSION JOINTS SHALL BE STANDARD 3 INCHES WITH A MAXIMUM OF 4 INCHES.

5. LOOP LEAD-IN WIRES MUST NOT BE INSTALLED IN THE SAME PULL BOX WITH SIGNAL POWER CABLES.

6. THE MINIMUM DISTANCE BETWEEN THE TWISTED PAIRS OF LOOP LEAD-IN WIRE IS 6 INCH FROM THE LOOP TO 12 INCH FROM THE PAVEMENT EDGE OR CURB.

7. THE MAXIMUM AREA OF ASPHALT TO BE DISTURBED SHALL BE 4"X 4". THIS AREA SHALL BE RESTORED AS DIRECTED BY THE ENGINEER.

8. LOOP LEAD-IN WIRES MUST BE 6 INCHES APART WHERE THERE ARE MULTIPLE LOOPS.

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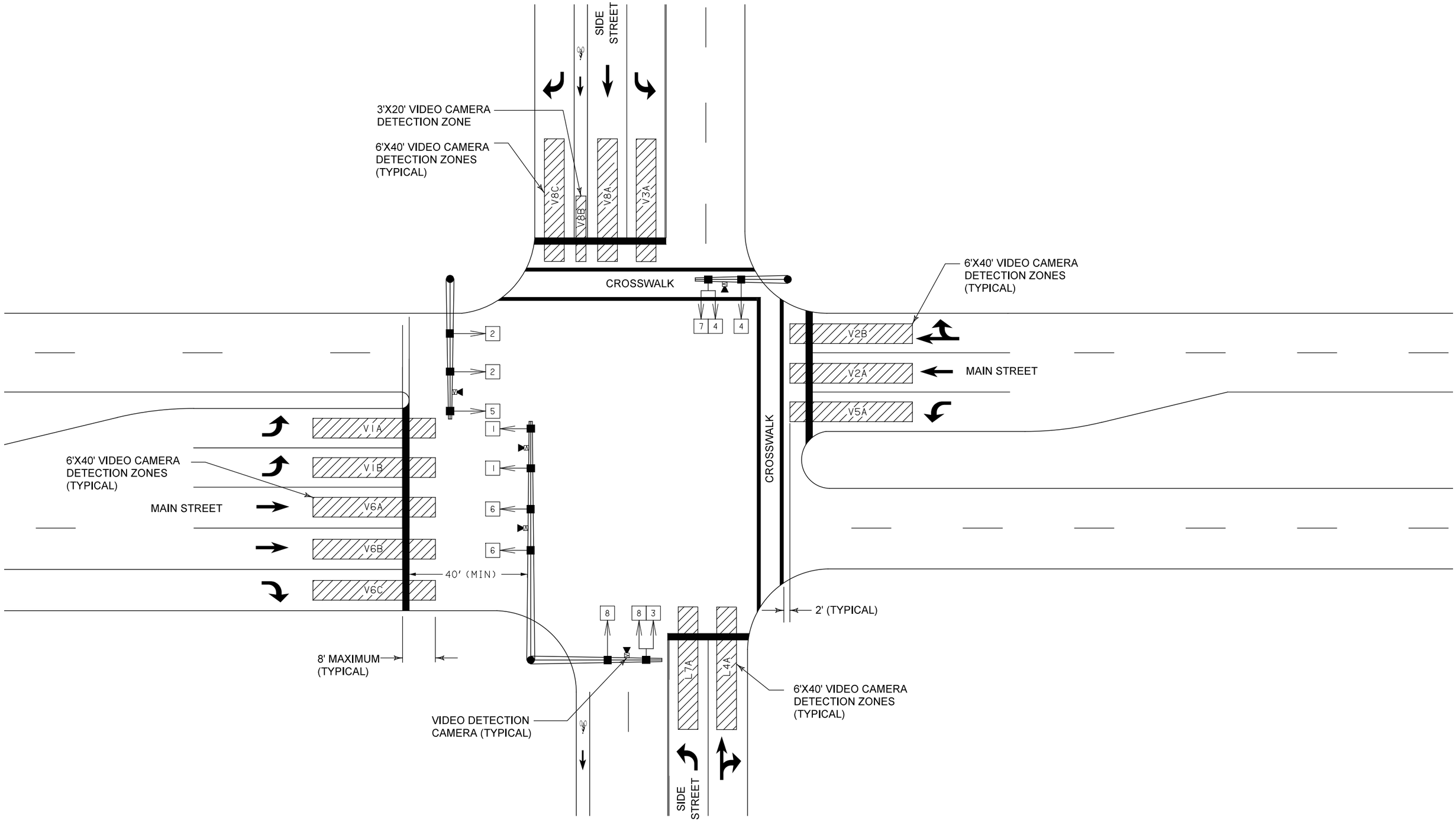
					CHECKED BY	NAHUM FERNANDEZ	03-22-17		
					APPROVED BY: FRANK AIRA, P.E.				

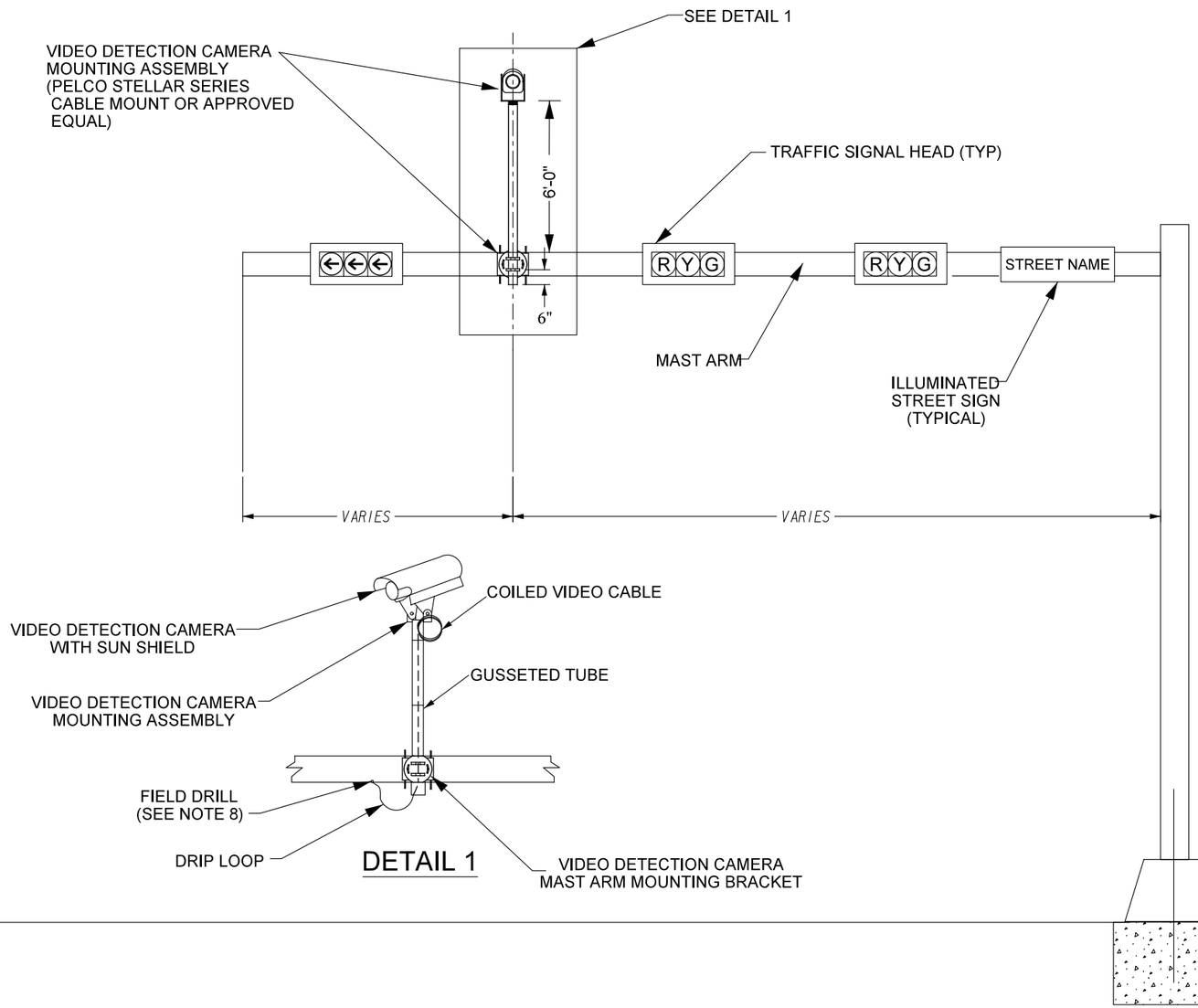
TYPICAL VIDEO DETECTION CAMERA LOCATION DETAIL



LATEST REVISION	DESCRIPTION:					
03/27/17		TRAFFIC CONTROL EQUIPMENT STANDARDS AND SPECIFICATIONS	MIAMI-DADE	DTPW TRAFFIC SIGNALS AND SIGNS DIVISION 7100 NW 36th STREET MIAMI, FLORIDA 33166 305.592.3580	NAME / DATE DRAWN BY: TRAVIS BREWER 09-29-16 CHECKED BY: NAHUM FERNANDEZ 03-22-17 APPROVED BY: FRANK AIRA, P.E.	VIDEO VEHICLE DETECTION DETAILS (N.T.S.)

SHEET NO. 1 of 2

TYPICAL MAST ARM VIDEO DETECTOR MOUNTING DETAILS



DETAIL 1

GENERAL NOTES:

1. MEET THE REQUIREMENTS OF MIAMI-DADE COUNTY TRAFFIC CONTROL EQUIPMENT STANDARDS AND SPECIFICATIONS SECTION 660 (VEHICLE DETECTION SYSTEMS). EACH INTERSECTION MUST BE INDIVIDUALLY DESIGNED TO INCLUDE SITE-SPECIFIC EQUIPMENT PLACEMENT REQUIREMENTS AND DETECTION ZONE REQUIREMENTS.
2. REFER TO FDOT'S APPROVED PRODUCT LIST (APL) AND THE MIAMI-DADE COUNTY TRAFFIC SIGNALS AND SIGNS DIVISION'S QUALIFIED PRODUCT LIST FOR VIDEO DETECTOR SYSTEMS AND MOUNTING HARDWARE APPROVED FOR USE IN MIAMI-DADE COUNTY SUBMIT SHOP DRAWINGS FOR APPROVAL BEFORE INSTALLATION.
3. TYPICAL INSTALLATION WILL REQUIRE ONE CAMERA PLACED ON THE LANE LINE BETWEEN THE INBOARD THROUGH LANE AND LEFT TURN LANE.
4. APPROACHES WITH MORE THAN FOUR LANES REQUIRE TWO CAMERAS PER APPROACH. COUNT BICYCLE LANES AS HALF A LANE. WHEN USING TWO CAMERAS, PLACE ONE BETWEEN THE LEFT LANES AND THE OTHER IN A POSITION THAT CENTERS THE CAMERA TO COVER ALL THE THROUGH LANES. THE CAMERA MUST BE ORIENTED SO THAT THE STOP BAR IS PARALLEL WITH THE BOTTOM OF THE IMAGE.
5. WHEN PROPOSED VIDEO DETECTION CAMERAS ARE LOCATED AT A HORIZONTAL DISTANCE FROM 40 TO 100 FEET FROM THE STOP BAR AND NUMBER OF APPROACH LANE EXCEED THREE (OR 33 FEET TOTAL WIDTH), INDIVIDUAL VIDEO CAMERAS MUST BE INSTALLED FOR EACH CONTROLLER TIMING FUNCTION.
6. CHECK FOR ANYTHING THAT MIGHT BLOCK THE FIELD OF VIEW OR IMPACT VEHICLE TRACKING SUCH AS TREES, OVERHEAD WIRES, AND COMMERCIAL LIGHT SOURCES
7. REVIEW THE PLACEMENT OF THE VIDEO IMAGE DETECTION DEVICES AND COORDINATE WITH THE ENGINEER OF RECORD TO CONFIRM THE MOST OPTIMAL LOCATION FOR THE INSTALLATION OF THE VIDEO IMAGE DETECTION DEVICES IN ORDER TO MEET THE PERFORMANCE REQUIREMENTS OF THE TECHNICAL SPECIFICATIONS OF AN APPROVED PRODUCT.
8. CONCEAL CAMERA CABLE(S) THROUGH THE MOUNT'S GUSSETED TUBE AND NEATLY PLACE DRIP LOOP INTO THE MAST ARM MINIMIZING EXPOSED CABLE(S). WIRE ACCESS HOLE MUST NOT EXCEED ONE INCH IN DIAMETER AND MUST INCLUDE A RUBBER GROMMET. DRILL HOLE AS TO NOT DAMAGE EXISTING SIGNAL CABLES. UTILIZE EXISTING ACCESS WHEREVER POSSIBLE.
9. MEET ALL GROUNDING AND SURGE PROTECTIVE DEVICE (SPD) REQUIREMENTS OF SECTION 620 OF THE FDOT STANDARD SPECIFICATIONS.
10. MAKE THE VIDEO DETECTION SYSTEM OPERATIONAL IMMEDIATELY UPON INSTALLATION, REMOVING THE ASSOCIATED MINOR MOVEMENTS FROM RECALL
11. ZOOM AND FOCUS THE CAMERA TO INCLUDE ALL TRAVEL LANES REQUIRING DETECTION. HORIZON MUST NOT BE VISIBLE IN THE IMAGE.
12. ALL OSHA CLEARANCE REQUIREMENTS FOR MAINTAINING SAFE DISTANCES TO OVERHEAD ELECTRIC FACILITIES WHILE PERFORMING CAMERA MAINTENANCE SHALL BE ACHIEVED BY CORRECT CAMERA PLACEMENT.LOCATE AND ANGLE CAMERAS TAKING INTO CONSIDERATION ITS RELATION TO THE RISING AND SETTING SUN TO BEST AVOID "SUNBURST" AND "WHITEOUT" EFFECTS DEMONSTRATED ON WET ROADWAYS.
13. ALL EXTERIOR VIDEO CABLE FITTINGS SHALL HAVE A WATER AND WEATHER-PROOF BOOT.
14. CAMERA TERMINALS THAT REQUIRE CABLE SPLICING IN THE FIELD MUST BE MADE WITH MECHANIC CONNECTORS OR TERMINAL LUGS NO ELECTRICAL WIRE NUTS WILL BE ALLOWED AS A MEANS OF TERMINATION.
15. SIGNAL CONTRACTOR IS RESPONSIBLE FOR INITIAL DETECTION ZONE SET-UP. COORDINATE WITH MIAMI-DADE COUNTY PRIOR TO SET-UP.
16. VIDEO DETECTION SET-UP WILL BE SUCH THAT NO FALSE OR DROPPED CALLS ARE OBSERVED.
17. DETECTION ZONE OUTPUT MUST BE PROGRAMMED TO CALL APPROPRIATE TIMING PHASES ASSIGNED TO CAMERA APPROACH. ONE VIDEO PROCESSOR CARD PER CAMERA. ONE DETECTION ZONE PER LANE ON APPROACH.
18. ALL MINIMUM REQUIREMENTS LISTED ABOVE MUST BE DEMONSTRATED PRIOR TO FINAL ACCEPTANCE OF ANY VIDEO DETECTION SYSTEM INSTALLATION.

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					CHECKED BY	NAHUM FERNANDEZ	03-22-17		
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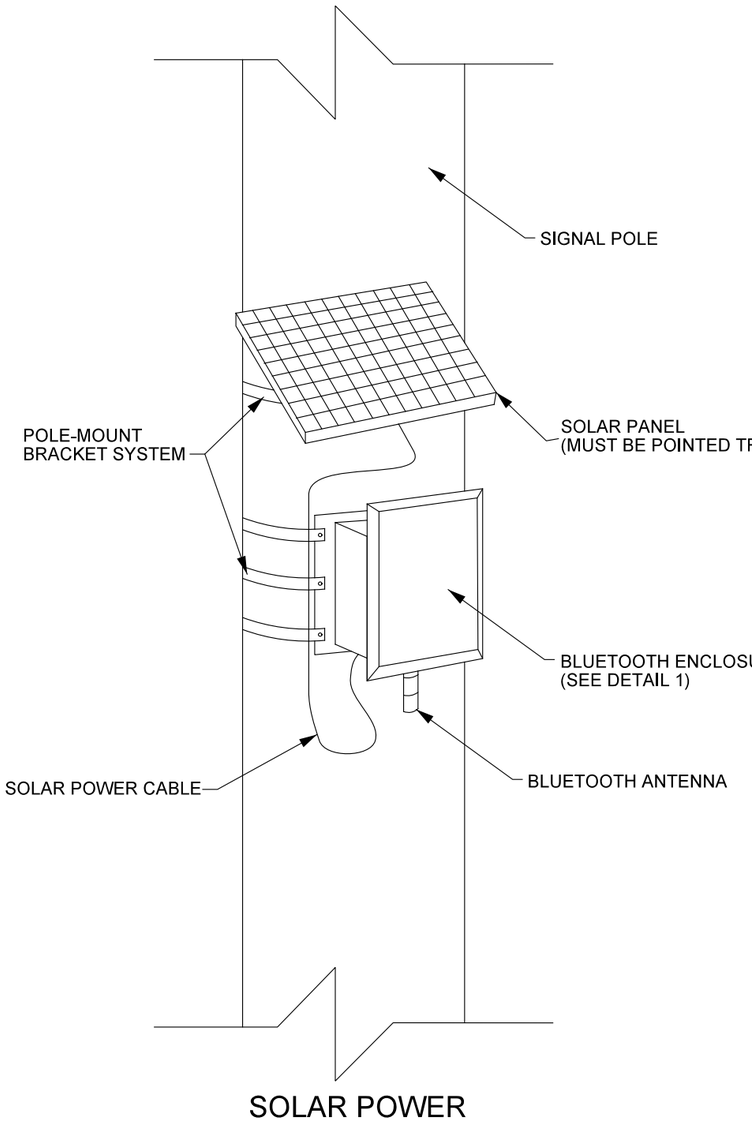
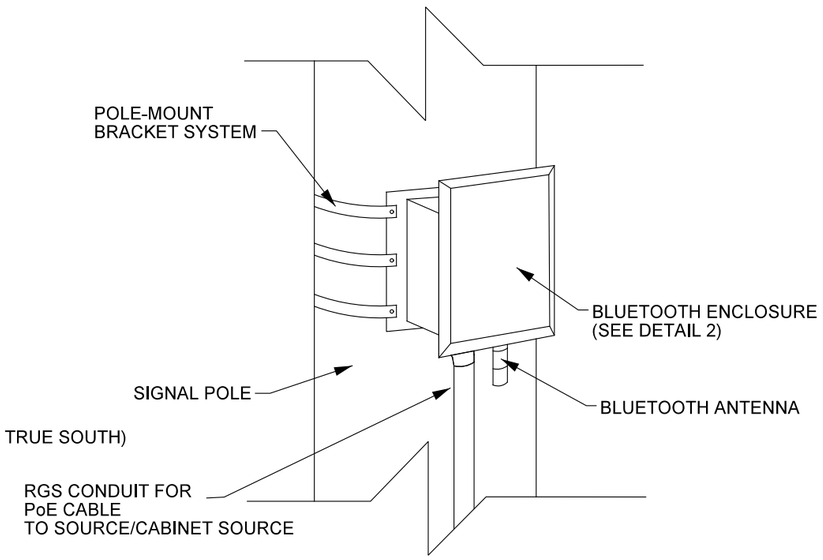
TYPICAL AUTOMATIC VEHICLE INDENTIFICATION (BLUETOOTH) MOUNTING DETAILS



SOLAR POWER



POWER OVER ETHERNET
(PoE)

GENERAL NOTES:

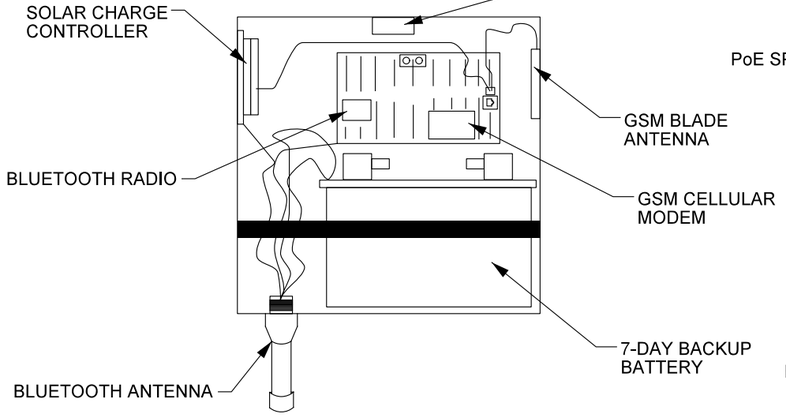
1. MEET THE REQUIREMENTS OF MIAMI-DADE TRAFFIC CONTROL EQUIPMENT STANDARDS AND SPECIFICATIONS SECTION 660 (VEHICLE DETECTION SYSTEM)

2. THE CONTRACTOR SHALL REFER TO THE FDOT'S APPROVED PRODUCT LIST (APL) AND THE MIAMI-DADE COUNTY QUALIFIED PRODUCT LIST SECTION 660 FOR AUTOMATIC VEHICLE IDENTIFICATION AND ALL MOUNTING HARDWARE APPROVED FOR USE IN MIAMI-DADE COUNTY AND SUBMIT SHOP DRAWINGS FOR APPROVAL BEFORE INSTALLATION. DRAWINGS MUST DEPICT THE APPROVED SOURCE/CABINET SOURCE FOR PoE.

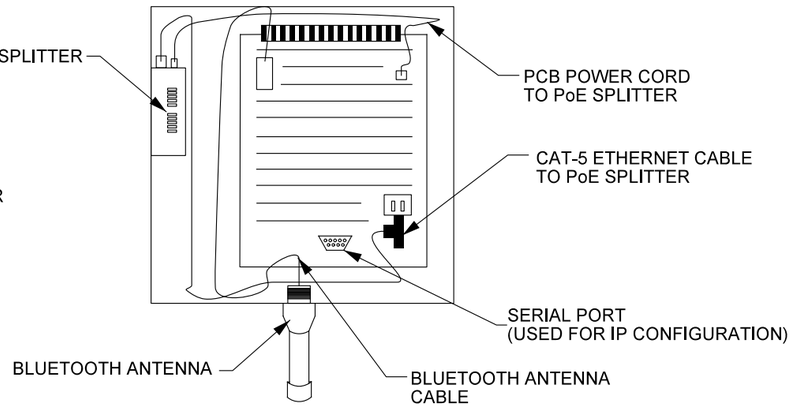
3. IT IS THE CONTRACTOR'S RESPONSIBILITY TO REVIEW THE PLACEMENT OF THE AUTOMATIC VEHICLE IDENTIFICATION (BLUETOOTH) DEVICES AND COORDINATE WITH THE ENGINEER OF RECORD TO DETERMINE THE MOST OPTIMAL LOCATION FOR THE INSTALLATION OF THE REQUIREMENTS OF THE TECHNICAL SPECIFICATIONS OF AN APPROVED PRODUCT.

4. THE AUTOMATIC VEHICLE INDENTIFCATION (BLUETOOTH) DEVICE SHOULD BE PLACED 12' ABOVE GROUND LEVEL.

DETAIL 1 (TYP)



DETAIL 2 (TYP)



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