SUPPLEMENTAL SPECIFICATIONS

603 GENERAL REQUIREMENTS FOR TRAFFIC CONTROL SIGNALS AND DEVICES.

(REV 1-14-14) (FA 1-22-14) (7-14)

SECTION 603 is deleted and the following substituted:

SECTION 603
GENERAL REQUIREMENTS FOR TRAFFIC CONTROL SIGNALS AND DEVICES

603-1 Description.

The provisions contained in this Section include general requirements for all traffic control signals and devices.

603-2 Equipment and Materials.

603-2.1 General: Only use traffic control signals and devices meeting the requirements of the Minimum Specifications for Traffic Control Signals and Devices (MSTCSD), the Contract, and are listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their products for the APL must submit an application in accordance with Section 6.

Only use new equipment and materials, except as specified in the Contract.

603-2.2 Exceptions: The Department may grant exceptions to the requirements of 603-2.1 by permit to evaluate new technology or for other circumstances that are found to be in the public interest.

603-2.3 Uniformity: Only use compatible units of any one item of equipment, such as signal heads, detectors, controllers, cabinets, poles, signal system or interconnection equipment, etc.

603-2.4 Hardware and Fittings Used for Installation: Ensure that all assembly hardware, including nuts, bolts, external screws and locking washers less than 5/8 inch in diameter, are Type 304 or 316 passivated stainless steel. Use stainless steel bolts, screws and studs meeting the requirements of ASTM F593. Use nuts meeting the requirements of ASTM F594. Ensure all assembly hardware greater than or equal to 5/8 inch in diameter is galvanized. Use bolts, studs, and threaded rod meeting the requirements of ASTM A307. Use structural bolts meeting the requirements of ASTM A325.

Use high-strength steel anchor bolts and U-bolts, having a minimum yield strength of 55,000 psi and a minimum ultimate strength of 90,000 psi.

603-2.5 Galvanizing: Meet the requirements of Section 962 when galvanizing for fittings and appurtenances for all structural steel (including steel poles).

603-2.6 Environmental Specifications: Ensure system electronics intended for installation outdoors or within a roadside cabinet satisfactorily performs all required functions during and after being subjected to the environmental testing described in National Electrical Manufacturers Association (NEMA) TS2, 2.2.7, 2.2.8, and 2.2.9.

603-3 Definitions.

Traffic Control Signals and Devices: Any signal or device; manually, electrically or mechanically operated, by which traffic is alternately directed to stop and permitted to proceed or controlled in any manner. Traffic control signals and devices regulate, warn, or guide traffic on, over or adjacent to a street, highway, pedestrian facility, or bikeway by authority of a public agency having jurisdiction. Traffic control signals and devices include, but are not limited to, controller assemblies (controller cabinets and their contents); signal heads including their hanging or mounting devices; vehicle detection systems (loops, sealant, amplifier, lead-in wire, or cable); pedestrian detection systems (push button, push button housing, lead-in wires, and signal); motorist information systems, video equipment, network devices, dynamic message signs, highway advisory radios, cameras, vehicle detection systems, and other equipment used within a traffic control system.

Minimum Specifications for Traffic Control Signals and Devices (MSTCSD): The minimum specifications used for the evaluation, certification, and approval of official traffic control signals and devices and ancillary devices for use on the streets and highways of Florida. The specifications are available on the Traffic Engineering and Operations web site.

603-4 Systems Approval Requirement.

The Engineer will review and approve any system design plan of traffic control signals and devices, that is controlled or operated from a remote location by computers or similar devices, and which affects the movement of traffic on any portion of the State Highway System, prior to installation.

603-5 Submittal Data Requirements.

Prior to the installation of equipment and within 30 days after the preconstruction conference, submit a listing of all traffic control signals, devices, and hardware with APL approval numbers to the Engineer for approval on Form 750-010-02, Submittal Data - Traffic Control Equipment. Alternate or modified forms are unacceptable. Provide a separate form for each cabinet location. For non-structural equipment or materials that do not have a APL approval number, submit one copy of the manufacturer's descriptive literature and technical data fully describing the equipment to the Engineer for approval. The Engineer will submit forms received from the Contractor to the District Traffic Operations Engineer for concurrence.

Develop shop drawings for all structural support materials and other special designs, such as non-electrical, non-mechanical, or other fabricated items, which may not be specifically detailed in the Plans. Have the Specialty Engineer approve all shop drawings. Do not submit shop drawings for those items that have been previously evaluated and approved.

Provide a complete operable signal installation as specified in the Contract regardless of any failure of the Department to discover or note any unsatisfactory material.

603-6 Documentation for Electronic Equipment.

Prior to final acceptance, furnish the Engineer with two copies of the following documentary items obtained from the manufacturer for the electronic equipment listed below:

1. Operation Manual
2. Troubleshooting and Service Manual
3. Assembly and installation instructions
4. Pictorial layout of components and schematics for circuit boards
5. Parts list
6. Diagram of the field installation wiring (not applicable to the detectors)
7. Warranty information

Furnish documentary items for the following equipment:

1. Controllers
2. Vehicle detectors
3. Load switches
4. Flasher units
5. Preemption units
6. Conflict monitors
7. Special sequence relays
8. Cameras
9. Dynamic message signs
10. Highway advisory radios
11. Road weather information systems
12. Any other equipment which has a logic, timing, or communications function
13. Other equipment specified in the Contract Documents

603-7 Department-Furnished Equipment Installed By Contractor.

Where the Contract includes installation of Department-furnished equipment, the Department will turn over such equipment to the Contractor when the construction progress allows or as designated in the Contract. The Department will test and certify the equipment to be in proper condition and ready to use and will bear the costs of correcting any defects in the equipment prior to pick-up by the Contractor. The Engineer will coordinate the pick-up and installation of the equipment. Maintain the equipment in proper operational condition after pick-up at no cost to the Department, until either final acceptance or the equipment is returned to the Department.

620 TRAFFIC CONTROL SIGNAL AND DEVICE INSTALLATION GROUNDING.

(REV 1-30-14) (FA 2-4-14) (7-14)

SECTION 620 is deleted and the following substituted:

SECTION 620
GROUNDING AND LIGHTNING PROTECTION

620-1 Description.

Furnish and install grounding and lightning protection to provide personnel and equipment protection against faults, surge currents and lightning transients. Provide a grounding and lightning protection system in accordance with the details shown in the Design Standards unless otherwise shown on the plans.

620-2 Materials.

620-2.1 Ground Rods: Use UL listed ground rods made of copper-clad steel with a nominal diameter of 5/8 inches. Ground rod sections must be a minimum of eight feet in length and manufactured for the sole purpose of providing electrical grounding.

620-2.2 Ground Rod Assembly: Provide a ground rod assembly consisting of one or more ground rods coupled together, such that the total length of the assembly is a minimum of 20 feet, driven into the earth at a single point, without disrupting the electrical continuity of the assembly.

620-2.3 Ground Rod Array: Provide ground rod arrays, as required, consisting of two or more ground rod assemblies, bonded together and spaced a minimum of 40 feet apart.

620-2.4 Grounding Conductors: Use solid copper insulated (green) conductor for electrical or lightning protection ground from the system ground bus or barrier plates to the ground rod assembly. Size equipment grounding conductors according to NEC Section 250.122. Size grounding electrode conductors according to NEC Section 250.66.

620-2.5 Exothermic Grounding Bond: Make all connections to the ground rod assemblies using exothermic welds.

620-2.6 Air Terminals: Use UL listed air terminals.

620-2.7 Surge Protective Devices: Provide surge protective devices (SPDs) to protect electronics from lightning, transient voltage surges, and induced current.

Install SPDs on all power, data, video and any other conductive circuit. SPD requirements for lighting must meet the minimum requirements of Section 992 and the Design Standards. SPDs for traffic control devices, including ITS equipment, must be listed on the Department's Approved Product List (APL).

Provide primary and secondary surge protection on AC power at traffic control device field sites.

620-2.7.1 SPD for 120V or 120/240V Power: Install a SPD at the utility disconnect to the cabinet. Ensure that the SPD at the utility disconnect includes L-N, L-G, and N-G protection and has a maximum surge current rating of 50 kA per phase or greater. Verify that the SPD has been labeled to indicate that the unit is UL 1449, Third Edition listed.

Ensure an SPD is provided where the supply circuit enters the cabinet. Locate the SPD on the load side of the main disconnect and ahead of any and all electronic devices and connected in parallel with the AC supply. Ensure that the SPD in the cabinet includes L-N, L-G, and N-G protection and has a maximum surge current rating of 50 kA per phase or greater. Verify that the SPD has been labeled to indicate that the unit is UL 1449, Third Edition listed.

Ensure that the SPD has a visual indication system that monitors the weakest link in each mode and shows normal operation or failure status and also provides one set of normally open (NO)/normally closed (NC) Form C contacts for remote alarm monitoring. The enclosure for a SPD shall have a NEMA 4 rating.

620-2.7.2 SPD at Point of Use: Install a SPD at the point the ITS devices receive 120 volt power and connected in series with the circuits. Ensure that these devices comply with the minimum functional requirements shown in Table 1. Ensure that the units are rated at 15 or 20 amps load and are configured with receptacles.

Ensure that these units have internal fuse protection and provide common mode (L+N-G) protection.

620-2.7.3 SPD for Low-Voltage Power, Control, Data and Signal Systems: Install a specialized SPD on all conductive circuits including, but not limited to, data communication cables, coaxial video cables, and low-voltage power cables. Ensure that these devices comply with the minimum functional requirements shown in Table 1 for all available modes (i.e. power L-N, N-G; L-G, data and signal center pin-to-shield, L-L, L-G, and shield-G where appropriate).

Table 1

SPD Minimum Requirements

Circuit Description	Clamping Voltage	Data Rate	Surge Capacity	Maximum Let-Through Voltage
12 VDC	15-20 V	N/A	5kA per mode (8x20 µs)	<150 Vpk
24 VAC	30-55 V	N/A	5kA per mode (8x20 µs)	<175 Vpk
48 VDC	60-85 V	N/A	5kA per mode (8x20 µs)	<200 Vpk
120 VAC at POU	150-200 V	N/A	20kA per mode (8x20 µs)	<550 Vpk
Coaxial Composite Video	4-8 V	N/A	10kA per mode (8x20 µs)	<65 Vpk (8x20 µs/1.2x50µs; 6kV, 3kA)
RS422/RS485	8-15 V	Up to 10 Mbps	10kA per mode (8x20 µs)	<30 Vpk

Table 1				
SPD Minimum Requirements				
Circuit Description	Clamping Voltage	Data Rate	Surge Capacity	Maximum Let-Through Voltage
T1	13-30 V	Up to 10 Mbps	10kA per mode (8x20 µs)	<30 Vpk
Ethernet Data	7-12 V	Up to 1 Gbps	1kA per mode (10x1000 µs)	<30 Vpk
POE	60-70 V	Up to 1 Gbps	5kA per mode (8x20 µs	<200Vpk (100kHz 0.5µs; 6kV, 500A)

Ensure that SPDs are listed and meet the requirements of UL 497B or UL 497C, as applicable.

620-2.7.4 Mechanical Specifications: Ensure equipment is permanently marked with manufacturer name or trademark, part number, and date of manufacture or serial number.

All parts must be made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal.

620-2.7.5 Environmental Specifications: Ensure that SPDs operate properly during and after being subjected to the temperature and humidity test described in NEMA TS 2, Section 2.2.7, and the vibration and shock tests described in NEMA TS 2, Sections 2.2.8., and 2.2.9.

620-2.7.6 Manufacturer's Warranty: Ensure that the SPD has a manufacturer's warranty covering failures for a minimum of 10 years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608.

The term "failure" for warranty replacement is defined as follows:

Parallel-connected, power-rated SPD units are considered in failure mode when any of the visual indicators shows failure mode when power is applied to the terminals at the unit's rated voltage, or the properly functioning over-current protective device will not reset after tripping.

Series-connected, low-voltage power, data, or signal units are considered in the failure mode when an open circuit condition is created and no data/signal will pass through the SPD device or a signal lead is permanently connected to ground.

In the event that the SPD, including any component of the unit, should fail during the warranty period, the entire SPD shall be replaced by the manufacturer at no cost to the Department or maintaining agency.

620-3 Installation.

620-3.1 General: Construct a single-point grounding system. Install the primary ground rod assembly in an electrical pull box so that the top four inches are accessible for inspection, resistance testing, and maintenance. The primary ground rod assembly and electrical pull box shall be installed between 12 inches to 36 inches from the element being grounded. The top of all other ground rod assemblies connected to the primary

ground rod assembly in an array must be buried a minimum of 18 inches below grade. Direct bury grounding conductors used to connect ground rod assemblies a minimum of 18 inches below finished grade.

Bond all ground rod assemblies and ground rod arrays together with solid bare tinned copper wire unless otherwise shown on the plans. Install grounding conductors in a straight path.

Make all bonds between ground wires and ground rod assemblies and ground rod arrays with an exothermic bond with the following exception: do not exothermically bond sections of ground rods to create the ground rod assembly and do not exothermically bond connections within a cabinet. Apply an anti-oxidant compound to all mechanical connections.

Connect primary surge protection for power at the service entrance or main disconnect. Connect secondary surge protection at point of use, unless otherwise shown in the plans.

Ensure that lightning protection systems conform to the requirements of the National Fire Protection Association (NFPA) Code NFPA 780, Standard for the Installation of Lightning Protection Systems. Install SPDs that have an operating voltage appropriate for the characteristics of the circuits they protect.

620-3.2 Minimum Grounding Resistance: Obtain a resistance to ground of 5 ohms or less for the following elements. Install multiple ground rod assemblies totaling a maximum length of up to 80 feet, as required to achieve minimum grounding resistance.

a. Power service for traffic control devices
b. Signal and ITS cabinets
c. ITS Poles/Structures with electronic equipment
d. DMS and DMS structures
e. Equipment Shelters and fencing
f. Communication Towers

Install a single ground rod assembly for these elements.

a. Conventional lighting
b. External lighting for signs
c. Signal cable & span wire
d. Aerial interconnect messenger wire
e. Pedestals for pedestrian signals
f. Pull boxes with metal covers when 120V (or greater) AC power is present
g. Splice vaults with wire grounding units

Install a minimum of one primary ground rod assembly. If a grounding and lightning protection system using a single ground rod assembly does not achieve the required resistance to ground, extend the length of the ground rod assembly an additional 20 feet or install an additional ground rod assembly 40 feet away and connect it to the main ground rod assembly to create a ground rod array. Continue installing ground rod assemblies connected in an array until the required resistance is obtained or until the maximum required total length of ground rod is installed.

Grounding systems formed from horizontally constructed conductive radials are permitted if site conditions prohibit the use of vertically driven rods as

permitted by the NEC Article 250.53(G). A grounding system consisting of the maximum total length of ground rod required is acceptable in cases where soil conditions prevent the grounding system from achieving the required resistance to ground. Submit the site resistance measurement to the Engineer.

620-3.3 Grounding Traffic Control Systems at Signalized Intersections: Ensure that all separately grounded elements at an intersection (signal cabinet, power service, mast arms or strain poles, etc.) are bonded together to form an intersection grounding network array.

For traffic signal poles, including pedestals for pedestrian signals, accommodate the ground connection from signal heads and electrically powered signs through span wires to the ground rod assembly or array located at the pole base in accordance with the details in the Design Standards.

For span wire assemblies, use the span wire to connect the ground rod assemblies or arrays of the poles. Do not use guy wires for grounding purposes, however bond any guy wire to the span wire as part of the intersection grounding network.

620-3.4 Grounding Traffic Control Systems on Highways: Install the primary ground rod assembly at the base of the traffic control device supporting structure. Bond all metal components of the system (such as cabinets, steel poles, and concrete pole grounding wire) to the grounding system using a mechanical connection on the equipment side and an exothermically welded connection at the down cable. Do not use split bolts for grounding system connections.

Connect all ground rod assemblies and any associated grounded electrical system within a 100 foot radius (but not beyond the edge of the roadway) of the primary ground rod assembly. Connect the primary ground rod assembly to a single point main grounding bar inside the equipment cabinet or mount it to the base of the traffic control device supporting structure unless otherwise shown on the plans.

Place multiple ground rod assemblies, as required, in a ground rod array as depicted in the Design Standards unless otherwise shown on the Plans. If a required array cannot be placed in the right of way, submit an alternate placement detail for approval.

620-3.5 Grounding Highway Lighting Systems: Ground each metal light pole.

For poles on bridge structures, bring the grounding conductors out to a pull box at each end of the structure and connect them to driven ground rods 20 feet in length.

Ground all high mast poles in accordance with the details for grounding in the Design Standards, Index No. 17502.

620-3.6 Grounding Equipment Shelters: Install all grounds for the equipment shelter on the side of the building that utilities, communication cables, and fiber enter. Connect all earth grounds to this point, including the grounding system for SPDs. Make all connections to SPDs according to the manufacturer's recommendations.

Ensure that communication cables, AC power, emergency generator, and equipment frames are connected by the shortest practical route to the grounding system. Protect the lead lengths from each device to the SPD.

Use compression type connection for all interior connections to bond grounding conductors to equipment in the shelter. For connections to bus bars, use mechanical connections having two bolts on a double-lug connector. Install star washers, or another means that accommodates the fasteners used and achieves reliable electrical

connections that will not deteriorate. Crimp and solder all wires connected to lugs or clamps. Verify electrical continuity of all connections. Remove all non-conducting surface coatings before each connection is made.

Ensure that ground conductors are downward coursing, vertical, and as short and straight as possible. Ensure that the minimum bending radius for interior equipment shelter grounds is eight inches. Avoid sharp bends and multiple bends in grounding conductors.

620-3.6.1 Interior Grounding: Install a No. 2 AWG solid bare copper wire approximately one foot below the ceiling on each wall and mount it using insulated standoffs. Ensure that the wire encircles the equipment room, forming a ring or continuous loop. Mechanically connect the cable trays to the interior perimeter ground using stranded copper wires with green insulation and bolted terminal connectors at the cable tray ends. Make all points where cable tray sections meet electrically continuous by use of a short jumper wire with terminals attached at each end.

Directly bond all other metallic objects, such as door frames and doors, air conditioners, alarm systems, wall-mounted communication equipment, etc., to the closest interior perimeter ground with the shortest possible stranded copper wire with green insulation. Bond the door to the doorframe using flexible welding cable.

620-3.6.2 Exterior Grounding: Install an exterior grounding system consisting of multiple ground rod assemblies around the exterior perimeter of the equipment shelter. Place the ground rod assemblies a minimum of two feet from the building foundation in a suitable access point. Bond the following items to the shelter's grounding system:

1. Metal building parts such as downspouts and siding.
2. Ground rods provided by power or telephone utilities for grounding of AC power or surge protection devices, as permitted by local codes.
3. Shelter support skids, bases, or foundations, if applicable.
4. Any metal object larger than four square feet.
5. External metal fencing.

620-3.6.3 Punch Block SPD Grounding: Ground Type 66 punchdown blocks in accordance with the manufacturer's recommendations and mechanically connect them to the shelter's interior perimeter ground.

620-3.6.4. Equipment Shelter Fence Grounding: Ensure that the metal Type B fence is grounded to fence perimeter grounding conductors consisting of No. 2 AWG solid bare tinned copper wires that encircle the entire compound to achieve required resistance to ground required in 620-3.2.

Exothermically bond any splices in the grounding conductors. Bury the fence perimeter grounding conductor a minimum of 2.5 feet below finished grade. Bond all fence posts to the fence perimeter ground wire using No. 2 AWG solid bare tinned copper wire. Bond the gate and gatepost together with a flexible ground, such as welding cable wires. Ground the gatepost to the fence perimeter ground wire using No. 2 AWG solid bare tinned copper wire. Exothermically bond all connections to the fence perimeter ground wire.

Connect the fence's top rail to each corner post and in the middle of each side. Ground the fence fabric with No. 2 AWG solid bare tinned copper wire connected to the fence posts. Connect the fence perimeter wires to the ground rod

assemblies of the equipment shelter's ground system with No. 2 AWG solid bare tinned copper wire, as shown in the plans.

Ensure that all ground leads are No. 2 AWG solid bare tinned copper wires for all above- and underground grounding wire installations. Ensure that all exothermic bonds are appropriate for the application. Do not use welding or other forms of bonding without prior written approval.

620-4 Ground Resistance Testing and Inspection.

620-4.1 Testing: Measure the ground resistance with an instrument designed specifically to measure and document earth/ground resistance, soil resistivity, and current flow. Conduct the test by using the fall-of-potential method as described in the Institute of Electronic and Electrical Engineers (IEEE) Standard 81.If fall-of-potential tests cannot be performed, it is acceptable to measure resistance at each accessible ground rod using a clamp-on ground resistance tester. Provide the Engineer with written, certified test results for each testing location. Illegible hand-written results are not acceptable. Provide the following information on the test results:

1. The formal name or ID for the location where the test was performed
2. The GPS latitude and longitude for the location where the test was performed
3. The date on which the test was performed
4. The make and model number, serial number, and last date of calibration (by an independent testing facility within the previous 12 months) for the grounding resistance testing device used
5. Contact information (including name, signature, and employer name) for each person conducting, witnessing, or certifying the test
6. Description of the local environmental and soil conditions at the time of testing
7. A rough sketch of the site grounding system; along with the corresponding measured data points
8. Page numbering showing the current page number and total page count (e.g., Page 1 of 3)

620-4.2 Inspection: Do not backfill below-grade grounding installations and grounding connections until inspected and approved. The Engineer will inspect the installation for proper connection types, tightness, workmanship, and conformance to plans. Replace any exothermic bonds that are deemed unsatisfactory with new exothermic bonds. Repair or replace any mechanical connections that are deemed unsatisfactory. Measure the resistance at each accessible ground rod using a clamp-on earth tester. The measurement at any individual rod is the cumulative resistance of all rods in a parallel circuit.

For grounding system inspections, notify the Engineer at least five days prior to completion of the installation. Record all test results in a standardized format approved by the Engineer prior to testing. All recorded test report data shall be dated, witnessed, and signed by at least one representative of the Department and the Contractor. Remedy all deficiencies at no cost to the Department.

620-5 Basis of Payment.

The work specified in this Section will not be paid for directly, but will be considered as incidental work.

632 SIGNAL CABLE.

(REV 2-6-14) (FA 2-18-14) (7-14)

ARTICLE 632-2 is deleted and the following substituted:

632-2 Materials.

Use only new materials meeting the requirements of this Section.

632-2.1 Signal Cable: Use either polyethylene insulated, polyvinyl chloride jacketed signal cable conforming to the requirements of the International Municipal Signal Association, Inc. (IMSA) Specification No. 19-1 or polyethylene insulated, polyethylene jacketed signal cable conforming to the requirements of IMSA Specification No. 20-1. Use signal cable conductors of stranded copper, No. 14 AWG or larger.

632-2.2 Cable Support Wire: Provide utilities grade zinc-coated support wire meeting the requirements of ASTM A475, whether separate or integral to signal cable, having a minimum nominal diameter of 1/4 inches.

632-2.3 Cable Attachment Hardware: Ensure that all bolts and nuts less than 5/8 inch in diameter are passivated stainless steel, Type 316 or Type 304 and meet the requirements of ASTM F593 and ASTM F594 for corrosion resistance. Ensure that all bolts and nuts 5/8 inch and over in diameter are galvanized and meet the requirements of ASTM A307. Use attachment hardware with sufficient tensile strength for the application. Use stainless steel lashing wire, galvanized or stainless steel lashing rod, cable rings or self-locking cable ties of UV stabilized black plastic having a minimum tensile strength of 100 pounds.

633 COMMUNICATION CABLE.

(REV 11-18-13) (FA 2-18-14) (7-14)

SUBARTICLES 633-2.3 AND 633-2.4 are deleted and the following substituted:

633-2.3 Cable Support Wire: Meet the requirements of 632-2.2.

633-2.4 Cable Attachment Hardware: Meet the requirements of 632-2.3.

634 SPAN WIRE ASSEMBLY.
(REV 11-18-13) (FA 2-18-14) (7-14)

ARTICLE 634-2 is expanded by the following:

634-2.5 Cable Attachment Hardware: Meet the requirements of 632-2.3.

635 PULL, SPLICE, AND JUNCTION BOXES.
(REV 11-21-13) (FA 2-4-14) (7-14)

SUBARTICLE 635-3.2 is deleted and the following substituted:

635-3.2 Pull and Splice Boxes: Install pull and splice boxes in accordance with the Design Standards, Index No. 17700. Ensure pull and splice boxes are sized for the amount of cable to be placed inside. Ensure that the pull or splice box cover is flush with the concrete apron or sidewalk. Do not install pull or splice boxes in roadways, driveways, parking areas, ditches or public sidewalk curb ramps. Avoid placing pull and splice boxes in low-lying locations with poor drainage. Ensure that pull and splice boxes house fiber optic cable without subjecting the cable to a bend radius less than 14 times the diameter of the cable.

635-3.2.1 Placement and Spacing: Place pull and splice boxes as shown in the Plans and at the following locations, unless directed otherwise by the Engineer:

1. At all major fiber optic cable and conduit junctions.
2. Approximately every 2,500 feet for fiber optic cable applications in rural areas with any continuous section of straight conduit if no fiber optic cable splice is required.
3. At a maximum of 1,760 feet for fiber optic cable applications in metropolitan areas.
4. At each end of a tunnel, and on each side of a river or lake crossing.
5. On each side of an aboveground conduit installation, such as an attachment to a bridge or wall.
6. At all turns in the conduit system.
7. Near the base of a service pole or communication cabinet to provide:
    a. A transition point between the fiber optic conduits extending from the fiber backbone and the conduit feeding the communication cabinet.
    b. An assist point for the installation of fiber optic drop cable.
    c. Storage of slack fiber optic drop cable.

635-3.2.2 Electronic Box Marker: Equip all pull and splice boxes buried below finish grade with an electronic box marker inside the pull or splice box to mark the location. Ensure that the electronic box marker is a device specifically manufactured to electronically mark and locate underground facilities. Ensure that the electronic box marker includes circuitry and an antenna encased in a waterproof polyethylene shell.

Ensure that the outer shell is impervious to minerals, chemicals, and temperature extremes normally found in underground plant environments. Ensure that the electronic box marker does not require any batteries or active components to operate. Ensure that electronic box markers used to mark fiber optic cable and general telecom applications are orange in color and operate at 101.4 kHz. Ensure that the electronic box marker's passive circuits produce an RF field when excited by a marker locator to direct the locator to the marker's position. Ensure that the electronic box marker has a minimum operating range of 5 feet from the marker locator.

671 TRAFFIC CONTROLLERS.
(REV 11-25-13) (FA 1-22-14) (7-14)

SECTION 671 is deleted and the following substituted:

SECTION 671
TRAFFIC CONTROLLERS

671-1 Description.

Furnish and install a NEMA Model 170, Model 2070, or ATC controller unit as shown in the Plans. Meet the requirements of Section 603.

671-2 Materials.

Use traffic controllers listed on the Department's Approved Product List (APL). Ensure equipment is permanently marked with the manufacturer's name or trademark, part number, and serial number.

Controllers must meet the following applicable industry standards:

NEMA TS1 Controller	NEMA TS-1-1989
NEMA TS2 Controller	NEMA TS-2-2003
Model 170 Controller	CALTRANS TEES, 2009
Model 2070 Controller	CALTRANS TEES, 2009
ATC Controller	AASHTO/ITE/NEMA ATC 5.2b

All controllers must provide functionality that meets or exceeds operational characteristics, including NTCIP support, as described in NEMA TS-2-2003.

671-3 Method of Measurement.

No separate payment will be made for the controller; payment is included with the Traffic Controller Assembly.