

## ORIGINATION FORM

### THE INFORMATION BELOW IS TO BE PROVIDED BY THE ORIGINATOR

(The person who receives or originates the issue and needs to forward the issue for action.)

Modify Specification \_\_\_\_\_.  
Section/File number

New Section 785 \_\_\_\_\_.  
Section number

**Subject:** Intelligent Transportation Systems – Infrastructure

**Origination date:** 10-21-05

**Originator:** Gene Glotzbach

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**Problem statement:** Standard Specifications are needed for the Intelligent Transportation System components.

**Information source:** FDOT ITS Section

**Background data:** To bring consistency to construction of ITS deployments statewide and provide for approval of components to be list on the APL.

#### **Recommended**

**Usage Note:** Use on all ITS projects.

#### **Desired implementation**

**date:** Beginning with the July 2006 letting.



*Florida Department of Transportation*

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GOVERNOR

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DENVER J. STUTLER, JR.  
SECRETARY

**MEMORANDUM**

**DATE:** November 17, 2005  
**TO:** Specification Review Distribution List  
**FROM:** Duane F. Brautigam, P.E., State Specifications Engineer  
**SUBJECT:** **Proposed Specifications Change: 7850000 Intelligent Transportation Systems – Infrastructure**

In accordance with Specification Development Procedures, we are sending you a copy of a proposed specification for Intelligent Transportation Systems Infrastructure.

This change was proposed by Gene Glotzbach of the Traffic Operations Office to develop Standard Specifications for the Intelligent Transportation System components.

Please share this proposal with others within your responsibility. Review comments are due within four weeks and should be sent to Mail Station 75 or to my attention via e-mail at SP965DB or duane.brautigam@dot.state.fl.us. Comments received after December 15, 2005 may not be considered. Your input is encouraged.

DFB/ft

Attachment

COMMENTS:

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Submitted by:

Phone #:

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**INTELLIGENT TRANSPORTATION SYSTEMS – INFRASTRUCTURE  
(REV 10-21-05)**

PAGE 766. The following new Section is added after Section 715:

**SECTION 785  
INTELLIGENT TRANSPORTATION SYSTEMS  
INFRASTRUCTURE**

**785-1 Grounding and Transient Voltage Surge Suppression.**

**785-1.1 Description:** Furnish and install grounding and transient voltage surge suppression for all intelligent transportation system (ITS) devices installed in the field or in remote locations to protect this equipment from lightning, transient voltage surges, and induced current.

**785-1.2 Materials:** Refer to Section 620 as a guide for compliance with the grounding portion of this specification.

Install a transient voltage surge suppressor (TVSS) both ahead of and behind the ITS device electronics.

**785-1.3 Installation Requirements.**

**785-1.3.1 General:** Achieve a resistance to ground measurement of 5 ohms ( $\Omega$ ) or less between the grounding electrode and the soil by using multiple electrodes, and if necessary, soil preparation that includes a grounding augmentation fill. References for this section include, but are not limited to, UL467, UL497A, and NEC. Ensure that lightning protection systems conform to the requirements of NFPA 780, Standard for the Installation of Lightning Protection Systems.

**785-1.3.2 Grounding Specifications:** Use a grounding electrode system (i.e., multiple electrodes as required to achieve a resistance to ground measurement of 5  $\Omega$  or less) as shown in the plans and approved by the Engineer. Ensure that ground rods are listed according to UL requirements as detailed in the standard UL 467, Grounding and Bonding Equipment. Use electrodes that are copper clad or solid copper. Make all connections to the grounding electrode using exothermic welds.

Connect all grounding points related to the ITS device and its subsystems, and any grounded electrical system within a 100-foot radius (but not beyond the edge of the roadway) of the structural base of the ITS device, to a single point main grounding electrode, sometimes referred to as the ground window, which shall be driven a maximum of 3 feet [0.91 m] from the structural base of the ITS device. Provide for each grounding electrode an interfacing hemisphere, which is an imaginary cylinder with a diameter and depth equal to the length of the electrode. Therefore, install a 20-foot [6-m] grounding electrode a minimum of 40 feet [12 m] away from any additional grounding electrodes and/or ground-mounted devices.

Install a minimum of one grounding radiant, plus additional radiants in a “Y” configuration as required to achieve a resistance to ground of 5  $\Omega$  or less, at each ITS device structure. In the event that the “Y” configuration cannot be placed in the right-of-way, change the 120-degree spacing of the radiants to make the grounding array fit in the space available, provided that the sphere of influence radius is maintained.

Install the grounding radiants using one main 20-foot [6-m] grounding rod located at the structural base of the ITS device and attached to three additional 20-foot [6-m] radiant grounding rods placed a minimum of 40 feet [12 m] away from the main grounding rod. Bond the ITS device structure’s equipment directly to the main grounding rod using an exothermic weld. Ensure that all grounding rod attachments use a minimum #2 tin-plated bare copper wire that is exothermically welded at all connection points.

Bond all metal components of the ITS device subsystem, such as the cabinets, to the grounding system with a grounding cable that uses a mechanical connection on the equipment side and an exothermically welded connection at the down cable

**785-1.3.3 Use of Grounding Augmentation Fill:** For each grounding rod, dig a minimum 12-inch diameter hole 12 feet deep using an augured shaft. Backfill the holes with grounding augmentation fill per the manufacturer’s installation requirements. Insert 20-foot-long ground rods driven into the center of the shaft.

Install radial conductors in the center of a one-foot by one-foot trench backfilled with coke breeze material. Cover the top of the coke breeze trench with one foot of native soil. Neither charcoal nor petroleum-based coke breeze may be substituted for coke breeze from coal in coke ovens. Increase the shaft diameters and depth as required to meet the 5 Ω or less specification. Increase the rod length and volume of coke breeze as required to meet the specification.

With the Engineer’s approval, use such alternative fills as engineered soils treated with moisture-absorbing materials such as bentonite, conductive cement, or homogenous clays in combination with native soils. Ensure that the grounding augmentation fill is environmentally safe and stable. Refer to the table below for materials and their characteristics.

<b>Table 3.1 – Characteristics of Grounding Augmentation Fills</b>		
<b>Material</b>	<b>Characteristics</b>	<b>Effect</b>
Bentonite	Highly variable in volume and resistivity with respect to soil moisture.	2.5 ohm-meters
Clay-based material	High capability to retain moisture.	0.3 to 0.8 ohm-meters
Coke breeze	Carbon-based backfill material. Environmentally safe and not moisture dependent.	0.1 to 0.5 ohm-meters
Conductive cement	Retains moisture once hardened. Resists leaching from soil.	0.2 ohm-meters

**785-1.3.4 Ground Resistance Testing and Certification:** Measure the ground resistance with an instrument designed specifically to measure and document earth/ground resistance, soil resistance, and current flow. Conduct the test by using the Fall-of-Potential method as described in the IEEE Standard 142-1991. Provide the Engineer with written test results for each testing location prior to backfilling the grounding electrode. Include in the test results the instrument model and date of calibration for the device used in the testing, the local environmental conditions at the time of testing, and a full Fall-of-Potential graph. Certify and sign the test results submitted.

**785-1.3.5 Air Terminals:** Ensure that air terminal lightning protection devices consist of either a hemispherical array type of dissipating air terminal or a single lightning rod constructed of a material compatible with the structure. Ensure that the air terminal extends at least 2 feet [0.61 m] above the object or area it is to protect and is mounted at the top of the pole or structure in such a way as to allow for an exothermic weld connection to the grounding down cable. Ensure that all ITS devices attached to structures having air terminals are within the zone of protection determined by the 150-foot radius rolling sphere model described in NFPA 780.

Provide additional air-terminals, static wires, and conductors as required by the manufacturer of large equipment such as DMS units that may require more than one terminal to protect the structure and equipment. Use air terminals that are UL listed according to the UL 96A standard and that are suitable for use in a UL master label lightning protection system.

**785-1.4 Transient Voltage Surge Suppression Devices**

**785-1.4.1 General:** Provide all ITS field installation sites with both primary and secondary surge protection on the AC power. Connect the primary surge protection at the service entrance or main disconnect. Connect the secondary surge protection on the power distribution to the equipment.

**785-1.4.2 TVSS Device at Power Entry Point:** Install a TVSS at the closest termination/disconnection point where the 120-volt (V) supply circuit enters the ITS device cabinet. Locate the TVSS on the load side of the service disconnect and ahead of any and all ITS electronic devices. Configure the TVSS to operate at 120 V single phase (i.e., two wires) or 120/240 V single phase (i.e., three wires) as required to match the supply circuit configuration. Verify that the TVSS has been labeled to indicate that the unit is UL listed and meets the requirements of UL 1449, Second Edition. Install a TVSS that complies with the requirements as detailed in Section 2.2.7 of the NEMA LS 1 standard.

Ensure that the TVSS for the ITS device's power source has an operating voltage of 120 V single phase and a maximum continuous operating voltage of 150 V single phase. The TVSS shall be rated at a minimum of 150 kiloamps (kA) per phase. The results of testing this device for maximum let-through voltage using the IEEE C62.41.2-2002 Category C3 and B3/C1 waveforms shall be submitted for approval and for equal comparison the following special test conditions shall be adopted: Apply the transient at the 90-degree phase angle, measured at a lead length of 6 inches [152.4 millimeters (mm)] outside of the device enclosure. The maximum ANSI/IEEE let-through voltage shall be 1000 V line to neutral, when measured according to the IEEE C62.41.2-2002 Category C3 at 20 kilovolts (kV) 1.2 by 50 microseconds ( $\mu$ s)/10 kA 8 by 20  $\mu$ s waveform; and 500 V line to neutral for the Category B3/C1 at 6 kV 1.2 by 50  $\mu$ s/3 kA, 8 by 20  $\mu$ s waveform..

Ensure that the suppression device is a hybrid, multi-staged device with 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 dry contacts to export this status information to other monitoring systems.

**785-1.4.3 TVSS Device at Point of Use:** Install a TVSS at the point the ITS devices receive 120 V power. Ensure that the units are rated at 15 or 20 amps (A), as required, and configured for hardwiring or receptacles to meet the ITS device requirements. Receptacle configuration units may be grouped as long as all listing and performance requirements can be met. Verify that the TVSS has been labeled to indicate that the unit is UL listed and meets the requirements of UL 1449, Second Edition. Install a TVSS that complies with the requirements of Section 2.2.7 of the NEMA LS 1 standard.

Ensure that the TVSS for the ITS device's point of use has an operating voltage of 120 V single phase and a maximum continuous operating voltage of 150 V single phase. Ensure that the TVSS is rated at a minimum of 20 kiloamps (kA) per phase. The results of testing this device for maximum let-through voltage using the IEEE C62.41.2-2002 Category A1 waveform shall be submitted for approval and for equal comparison the following special test conditions shall be adopted: The transient shall be applied at the 270-degree phase angle and measured at a lead length of 6 inches [152.4 millimeters (mm)] outside of the device enclosure. The maximum allowable let-through voltages for the A1 waveform is 45 V line to neutral mode, 60 V line to ground mode, and 35 V neutral to ground mode.

Ensure that the suppression device is a hybrid, multi-staged device with 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 dry contacts to export this status information to other monitoring systems. Ensure that these units have internal fuse protection and provide both normal mode (L-N) and common mode (L+N-G) protection.

**785-1.4.4 TVSS Device for Low-Voltage Power, Control, Data and Signal Systems:** Install a specialized TVSS at the supply and line sides of all low-voltage connections to the ITS device and its operating subsystems. These connections shall include, but are not limited to, Category 5 data cables, coaxial video cables, twisted pair video cables, and low-voltage control cables that comply with Electronic Industries Alliance (EIA) requirements as detailed in the EIA-232/422/485 standards. Ensure that these devices are of hybrid multi-staged design with maximum let-through voltage as shown in the

accompanying table. Testing shall be for all available modes (i.e. power L-L, L-G; data and signal center pin-to-shield, L-L, L-G, and shield-G where appropriate).

<b>Table 4.1 – Values for Low-Voltage Circuits</b>				
<b>Circuit Description</b>	<b>Continuous Current</b>	<b>Frequency/ Bandwidth/ Data Rate</b>	<b>Surge Capacity</b>	<b>Let-Through Voltage (All voltages are measured from zero)</b>
Coaxial Video	Up to 300 mA	Up to 1.5 GHz Up to 150 Mbps	10,000 amps per mode(8x20 μs)	<100 Vpk (IEEE Cat B3/C1 6 kV / 3 kA)
Power and Control Up to 12 V	Up to 30 A	Up to 60 Hz (sensitive loads)	5,000 amps per mode(8x20 μs)	<150 Vpk (IEEE Cat B3/C1 6 kV / 3 kA) <50 Vpk (IEEE Cat A1 Ringwave 2 kV)
Power and Control Up to 24 V	Up to 30 A	Up to 60 Hz (sensitive loads)	5,000 amps per mode(8x20 μs)	<175 Vpk (IEEE Cat B3/C1 6 kV / 3 kA) <50 Vpk (IEEE Cat A1 Ringwave 2 kV)
Power and Control Up to 48 V	Up to 30 A	Up to 60 Hz (sensitive loads)	5,000 amps per mode(8x20 μs)	<200 Vpk (IEEE Cat B3/C1 6 kV / 3 kA) <50 Vpk (IEEE Cat A1 Ringwave 2 kV)
Power and Control Up to 120 VAC	Up to 30 A	Up to 60 Hz (sensitive loads)	20,000 amps per mode(8x20 μs)	<550 Vpk (IEEE Cat B3/C1 6 kV / 3 kA) <50 Vpk (IEEE Cat A1 Ringwave 2 kV)
RS422 Up to 12 V	Up to 500 mA	Up to 100 MHz Up to 10 Mbps	10,000 amps per mode(8x20 μs)	<30 Vpk (IEEE Cat B3/C1 6 kV / 3 kA)
RS485 Up to 12 V	Up to 500 mA	Up to 100 MHz Up to 10 Mbps	10,000 amps per mode(8x20 μs)	<30 Vpk (IEEE Cat B3/C1 6 kV / 3 kA)
T1 Up to 7.5 V	Up to 500 mA	Up to 100 MHz Up to 10 Mbps	10,000 amps per mode(8x20 μs)	<20 Vpk (IEEE Cat B3/C1 6 kV / 3 kA)
Cat 5 Up to 12 V	Up to 500 mA	Up to 100 Mbps	3,000 Watts per mode(10x1000 μs)	<30 Vpk (10 x 1000 μs)

Install a TVSS that has an operating voltage matching the characteristics of the device, such as 24 volts of direct current (VDC) and less than 5 VDC for data and video functions. Ensure that these specialized TVSS are UL 497B or UL 497C listed, as applicable.

## **785-2 Pole and Lowering Device.**

**785-2.1 Description:** Furnish and install a steel or concrete pole, with or without a lowering device, as shown in the plans. Consider the lowering device and pole as two interdependent components of a single unit, and provide them together to ensure compatibility of the pole and lowering device.

### **785-2.2 Materials.**

**785-2.2.1 Pole:** Use a pole as shown in the plans that meets the requirements of either Section 641 for prestressed concrete poles or Section 649 for steel poles.

Use a pole that is equipped with a handhole of sufficient size to provide access to the pole interior and for temporarily securing and operating the lowering tool. Ensure that the pole-top tenon is rotatable.

**785-2.2.2 Lowering Device:** Use a lowering device as shown in the plans. Ensure that the lowering device provides the electrical connections between the control cabinet and the equipment installed on the lowering device without reducing the function or effectiveness of the equipment installed on the lowering device or degrading the overall system in any way. Ensure that the only cable in motion when operating the lowering device is the stainless steel lowering cable contained within the pole. Ensure that all other cables remain stable and secure during lowering and raising operations.

Ensure that the lowering device includes a disconnect unit for electrically connecting the equipment installed on the lowering device's equipment connection box to the power, data, and video cables (as applicable); a divided support arm, a pole adapter for the assembly's attachment to the rotatable pole-top tenon, and a pole-top junction box, as shown in the plans.

Ensure that all of the lowering device's external components are made of corrosion-resistant materials that are powder-coated, galvanized, or otherwise protected from the environment by industry-accepted coatings that withstand exposure to a corrosive environment.

**785-2.2.2.1 Equipment Connection Box:** Provide an equipment connection box for connecting the CCTV camera or other ITS device to the lowering device. Ensure that the equipment connection box is watertight and able to seal the interior from moisture and dust.

**785-2.2.2.2 Disconnect Unit:** Ensure that the disconnect unit has a minimum load capacity of 200 pounds [90.7 kilograms (kg)] with a 4:1 safety factor. Ensure that the fixed and movable components of the disconnect unit have a locking mechanism between them. Provide a minimum of two mechanical latches for the movable assembly and, when latched, ensure that all weight is removed from the lowering cable. Ensure that the fixed unit has a heavy-duty cast tracking guide and a means to allow latching in the same position each time.

Ensure that the disconnect unit is capable of securely holding the lowering device and the equipment installed on the lowering device. Use interface and locking components that are stainless steel or aluminum.

**785-2.2.2.2.1 Disconnect Unit Housing:** Ensure that the disconnect unit housing is watertight with a gasket provided to seal the interior from dust and moisture.

**785-2.2.2.2.2 Connector Block:** Provide a connector block as shown in the plans and directed by the Engineer. Provide modular, self-aligning and self-adjusting female and male socket contact halves in the connector block. Provide a minimum of 9 and a maximum of 20 contacts with at least 2 spare contacts. Provide contact connections between the fixed and movable lowering device components that are capable of passing EIA-232, EIA-422, EIA-485, and Ethernet data signals and 1 volt peak to peak (V<sub>p-p</sub>) video signals, as well as 120 VAC, 9-24 VAC, and 9-24 VDC power. Ensure that lowering device connections are capable of carrying the signals, voltages, and current required by the device(s) connected to them under full load conditions.

Ensure that the connector block conforms to one of the two options described below:

**Option 1 – Light-Duty Connector:** Provide plastic female and male halves of the connector block that houses the connector pins.

Provide corrosion-resistant stainless steel hardware. Ensure that all contacts and connectors are self-aligning and self-adjusting mechanical systems. Provide a spring-assisted contact assembly to maintain constant pressure on the contacts when the device is in the latched position.

Because there are no individual gaskets on the top and bottom connectors, ensure that a gold or silver lining is provided in the interior to prevent degradation of the connectors due to moisture.

**Option 2 – Heavy-Duty Connector:** Ensure that the female socket contacts and the male contact halves of the connector block are made of molded synthetic rubber

or molded chlorosulfonated polyethylene, or approved equal. Provide connector pins made of brass- or gold-plated nickel, or gold-plated copper.

Ensure that the current-carrying male and female contacts are a minimum of 0.102 inch [2.6 mm] in diameter. Provide two male contacts that are longer than the other contacts to mate first and break last, providing optimum grounding performance.

Provide cored holes in the rubber to create moisture-tight seals when mated with the male connector. Permanently mold the wire leads from both the male and female contacts in a body of chlorosulfonated polyethylene, or an approved equal. Provide current-carrying wires and signal wires of American Wire Gauge (AWG) #18/1 jacketed wire.

Ensure that the contacts are self-wiping with a shoulder at the base of each male contact so that it is recessed in the female block, thereby giving each contact a rain-tight seal when mated.

**785-2.2.3 Lowering Tool:** Provide a metal-frame lowering tool with winch assembly and a cable with a combined weight less than 35 pounds; a quick release cable connector, and an adjustable safety clutch. Ensure that the lowering tool can be powered using a half-inch chuck, variable-speed reversible industrial-duty drill to match the manufacturer-recommended revolutions per minute, or supply a drill motor for the lowering tool as shown in the plans. Provide an electrically powered drill unit.

Ensure that the lowering tool supports itself and the load. Ensure that the lowering tool is equipped with a positive braking mechanism to secure the cable reel during raising and lowering operations, and to prevent freewheeling.

Use a lowering tool equipped with gearing that reduces the manual effort required to operate the lifting handle to raise and lower a capacity load. Provide the lowering tool with an adapter for operating the lowering device with the portable half-inch chuck drill using a clutch mechanism.

Ensure that the lowering tool is manufactured of durable, corrosion-resistant materials that are powder-coated, galvanized, or otherwise protected from the environment by industry-accepted coatings that withstand exposure to a corrosive environment.

Provide a minimum of one lowering tool plus any additional tools as required in the plans. Upon a project's final acceptance, deliver the lowering tool to the Department.

**785-2.2.4 Lowering Cable:** Provide a lowering cable with a minimum diameter of 0.125 inch [3.2 mm]. Construct it of stainless steel aircraft cable with a minimum breaking strength of 1,740 pounds [789.3 kg], and with 7 strands of 19-gauge wire each. Ensure that the prefabricated components for the lift unit support system preclude the lifting cable from contacting the power or video cables.

**785-2.2.5 Wiring:** Ensure that all wiring meets the equipment manufacturers' recommendations for each device connected on the pole, at the lowering device, and in the field cabinet.

**785-2.2.6 External-mount Lowering System Enclosure for Mounting to Existing Structures:** Furnish and install an external-mount lowering system enclosure for mounting to existing structures, as shown in the plans. Ensure that the system includes external conduit, cabling, and upper mounting box that is able to accept the respective (i.e., general/light or heavy-duty) lowering device. Ensure that the system includes a winch assembly permanently housed in a corrosion-resistant lower lockable box with gaskets, as shown in the plans. Provide all necessary mounting hardware for the upper and lower box, conduits, standoffs, and conduit mounts required for a complete and functional system.

### **785-2.3 Installation Requirements.**

Ensure that the divided support arm and receiver brackets self-align the contact unit with the pole centerline during installation, and that the contact unit cannot twist under high wind conditions. Supply internal conduit in the pole for the power and video cabling if required by the Engineer.

Ensure all pulleys installed for the lowering device and portable lowering tool have sealed, self-lubricated bearings, oil-tight bronze bearings, or sintered bronze bushings.

Ensure that the poles and their foundations conform to the requirements of the PPM and Indexes 17723 and 17725 of the Design Standards, and with the AASHTO LTS-4 standard with current addenda. Use Volume 1, Chapter 29, Table 29.1, Design Wind Speeds, of the PPM to compute the wind

loads. Provide shop drawings that specify the overturning moment or ground line moment detail for the pole structure and all necessary design features.

### **785-3 Warranty Provision.**

**785-3.1 General:** Ensure that the balance of the manufacturer's warranty is transferable from the Contractor to the Department upon the expiration of the Contractor's one-year warranty period covering materials and workmanship, as detailed in Section 611-5.2.

**785-3.2 Poles and Lowering Devices:** Ensure that the poles and the lowering devices furnished, assembled, fabricated, or installed are warranted by the manufacturers against defects in materials or workmanship for a period of no less than three years from the date of final acceptance.

**785-3.3 Transient Voltage Surge Suppressors:** The TVSS manufacturer shall warranty the TVSS against any failures caused by electrical events, including direct lightning strikes, for a period of not less than 10 years or the TVSS device manufacturer's standard warranty period, whichever is greater.

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

Parallel-connected, power-rated TVSS units are considered in failure mode when any of the indicating lamps 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 TVSS device.

In the event that the TVSS, including any component of the unit, should fail during the warranty period, the entire TVSS shall be replaced by the manufacturer at no charge to the Department. Costs relating to the removal of the TVSS, shipping and handling, and the reinstallation of the TVSS shall be paid by the Department.

### **784-4 Method of Measurement**

**784-4.1 General:** Poles, with or without the lowering devices, and the grounding and TVSS shall be measured for payment in accordance with the following tasks.

The work specified for grounding and transient voltage surge suppression will not be paid for directly, but will be considered incidental to the installation of ITS devices and systems.

**784-4.2 Furnish and Install:** The Contract unit price per device furnished and installed, will include furnishing, placement, and testing of all equipment and materials, and for all tools, labor, hardware, operational software package(s) and firmware(s), supplies, support, personnel training, shop drawings, documentation, and incidentals necessary to complete the work.

Except in the case of a retrofit, the work specified for furnishing and installing a lowering device will not be paid for directly, but will be considered incidental to the installation of a steel or concrete pole.

**784-4.3 Furnish:** The Contract unit price per device furnished, will include all equipment specified in the Contract Documents, plus all shipping and handling costs involved in delivery as specified in the Contract Documents.

Except in the case of a retrofit, the work specified for furnishing a lowering device will not be paid for directly, but will be considered incidental to the installation of a steel or concrete pole.

**784-4.4 Install:** The Contract unit price per device, installed, will include placement and testing of all equipment and materials, and for all tools, labor, hardware, operational software package(s) and firmware(s), supplies, support, personnel training, shop drawings, documentation, and incidentals necessary to complete the work. The Engineer will supply the equipment specified in the Contract Documents.

Except in the case of a retrofit, the work specified for installing a lowering device will not be paid for directly, but will be considered incidental to the installation of a steel or concrete pole.

### **785-5 Basis of Payment.**

7850000

ITS Jobs

Prices and payments will be full compensation for all work specified in this Section. Payment will be made under:

Item No. 785-2-	ITS Pole and Lowering Device – each.
Item No. 2785-2-	ITS Pole and Lowering Device – each.