

**1. Intelligent Transportation Systems  
(ITS) Control of Materials.**

**Section 106.2 – Supply Source and Quality**

Is modified by the addition of the following:

A portion of equipment to be installed by the contractor will be furnished by the department. This state-furnished equipment includes the following:

<b>State-furnished Items</b>
Dome Camera
Fiber Optic Cable Outdoor Plant 6-CT
Camera Wall Mount Assembly
Fiber Optic Termination Panel 12-Count
Ethernet Video CODEC
ITS Field Cabinet
Ethernet Switch

Pick-up small state-furnished equipment, such as communications devices, cameras, and controllers from the department Statewide Traffic Operations Center (STOC), 433 W. St. Paul Ave., Milwaukee, WI 53203 at a mutually agreed upon time during normal State office hours.. Contact Don Schell at (414) 227-2148 to coordinate pick-up of equipment.

Large state-furnished equipment, such as camera poles will be delivered by the supplier to a contractor controlled site within Racine or Kenosha County. Delivery will not necessarily be in a “just in time” manner. Store the equipment until field installation. Provide location details and a contact for delivery coordination upon contract Notice to Proceed.

**2. Intelligent Transportation System -  
General.**

**A Description**

The work herein is included in the contract items for furnishing and installing elements for an Intelligent Transportation System (ITS) in or along the existing roadway as shown on the plans.

Unusual aspects of this project include:

- The project includes working on cables and equipment that are carrying data between roadside equipment and the WisDOT Traffic Operations Center (TOC). This work must be done in a way that minimizes communication outages for the existing equipment.

- Some of the equipment to be installed will be furnished by the department. Make a reasonable effort to discover defects in that equipment prior to installing it.

### **A.1 Surge Protection**

Equip every ungrounded conductor wire entering or leaving any equipment cabinet or camera housing with a surge protector. For purposes of this section, multiple cabinets on a single pole or foundation are considered a single cabinet.

## **B Materials**

### **B.1 General**

All equipment and component parts furnished shall be new and have high quality workmanship. All controls, indicators, and connectors shall be clearly and permanently labeled in a manner approved by the engineer. All equipment of each type shall be identical.

All electrical equipment shall conform to the standards and requirements of the Wisconsin Electrical Code, the National Electrical Manufacturers Association (NEMA), National Electric Safety Council (NESC), Underwriter's Laboratory Inc. (UL) or the Electronic Industries Association (EIA), when applicable. All materials and workmanship shall conform to the requirements of the National Electrical Code (NEC), Rural Electrification Administration (REA), Standards of the American Society for Testing and Materials (ASTM), American Association of State Highway and Transportation Officials (AASHTO), requirements of the plans, these Technical Special Provisions, the standard specifications, and to any other codes, standards, or ordinances that may apply. All system wiring, conduit, grounding hardware and circuit breakers shall be in conformance with the National Electrical Code. Whenever reference is made to any of the standards mentioned, the reference shall be considered to mean the code, ordinance, or standard that is in effect at the time of the bid advertisement.

### **B.2 Outdoor Equipment**

All conductive connectors, pins (except pins connected by soldering), and socket contacts shall be gold plated. Acrylic conformal coating shall protect each circuit board side that has conductive traces. Except for integrated circuits containing custom firmware, all components shall be soldered to the printed circuit board.

To prevent galvanic corrosion, all connections between dissimilar metals shall incorporate a means of keeping moisture out of the connection. Where the connection need not conduct electricity, interpose a non-absorbing, inert material or washer between the dissimilar metals. Use nonconductive liners and washers to insulate fasteners from dissimilar metals. Where the connection must conduct electricity, use a conductive sealant between the dissimilar metals. Alternatively, use an insulating gasket and a bond wire connecting the two metal parts.

### **B.3 Custom Equipment**

Equipment that is not part of the manufacturer's standard product line, or that is made or modified specifically for this project, shall conform to the following requirements:

Where practical, electronics shall be modular plug-in assemblies to facilitate maintenance. Such assemblies shall be keyed to prevent incorrect insertion of modules into sockets.

All components shall be available from multiple manufacturers as part of the manufacturers' standard product lines. All must be clearly labeled with the value, part number, tolerance, or other information sufficient to enable a technician to order an exact replacement part.

Lamps used for indicator purposes shall be light-emitting diodes.

The printed circuit boards shall be composed of "two-ounce" copper on 1/16" thick fiberglass epoxy or equivalent type construction. Holes that carry electrical connections from one side of the boards to the other shall be completely plated through. Multilayer printed circuit boards shall not be used. The name or reference number used for the board in the drawings and maintenance manuals supplied to the department shall be permanently affixed to each board.

All components shall be mounted so that the identifying markings are visible without moving or removing any part, if practical.

#### **B.4 Environmental Conditions**

Equipment shall continue to operate as specified under the following ranges of environmental conditions, except as noted in the specifications for individual pieces of equipment.

- **Vibration and Shock:** Camera assemblies, vehicle detectors, detection classification sensors, and any other equipment mounted atop poles or on structures shall not be impaired by the continuous vibration caused by winds (up to 90 mph with a 30 percent gust factor) and traffic.
- **Duty Cycle: Continuous.**
- **Electromagnetic Radiation:** The equipment shall not be impaired by ambient electrical or magnetic fields, such as those caused by power lines, transformers, and motors. The equipment shall not radiate signals that adversely affect other equipment.
- **Electrical Power:**
  1. Operating power: The equipment shall operate on 120 volts, 60 Hz, single-phase unless otherwise specified. It shall conform to its specified performance requirements when the input voltage varies from 89 to 135 volts and the frequency varies  $\pm 3$  Hz.
  2. High frequency interference: The equipment operation shall be unaffected by power supply voltage spikes of up to 150 volts in amplitude and ten microseconds duration.
  3. Line voltage transients: The equipment operation shall be unaffected by voltage transients of plus or minus 20 percent of nominal line voltage for a maximum duration of 50 milliseconds. Equipment in the field shall meet the power service

transient requirements of NEMA Standard TS-2 when connected to the surge protectors in the cabinets.

- **Temperature and Humidity:**

1. **Field equipment:** Equipment in the field shall meet the temperature and humidity requirements of NEMA Standard TS-2. Liquid crystal displays shall be undamaged by temperatures as high as 165 degrees F, and shall produce a usable display at temperatures up to 120 degrees F.
2. **Equipment in Controlled Environments** shall operate normally at any combination of temperatures between 50 degrees F and 100 degrees F, and humidity's between 5 percent and 90 percent, non-condensing, and with a temperature gradient of 9 degrees F per hour.

### **B.5 Patch Cables and Wiring**

All cables and wiring between devices installed in a single cabinet, or in separate cabinets sharing a single concrete base, will be considered incidental to the installation of the devices and no separate payment will be made for them. It is anticipated that this will include fiber optic patch cables between termination panels and Ethernet switches, 10 / 100 MBPS Ethernet cables, RS-232 cables between individual devices and terminal servers, and power cables between individual devices and power sources within the cabinets.

### **B.6 Surge Protection**

**Low-voltage signal pairs** shall be protected by two-stage, plug-in surge protectors and shall be installed on both ends of camera control cables. The protectors shall meet or exceed the following minimum requirements:

- The protectors shall suppress a peak surge current of up to 10K amps.
- The protectors shall have a response time less than one nanosecond.
- The protector shall clamp the voltage between the two wires at a voltage that is no more than twice the peak signal voltage, and clamp the voltage between each wire and ground at 50 volts.
- The first stage of protection shall be a three-element gas discharge tube, and the second stage shall consist of silicon clamping devices.
- The protector shall also contain a resettable fuse (PTC) to protect against excessive current.
- There shall be no more than two pairs per protector.
- It shall be possible to replace the protector without using tools.

**Loop detector cables and cables carrying power to camera assemblies** shall be protected at the cabinet by grounded metal oxide varistors of appropriate voltages. The varistors must be at least 0.8 inch in diameter.

**Coaxial cables** carrying video signals shall be protected at each end by suppressors designed for baseband CCTV signals. The suppressors shall conform to the following:

- Surge: 18,000 amps with an 8 x 20 microsecond waveform
- Turn-on time: 4ns for 2 kV/ns
- VSWR: 1.1:1 or less

- Insertion loss: 0.3 dB or less
- Frequency range: DC to 30 MHz
- BNC connectors
- Operating voltage: 1.5 volts
- Impedance: 75 ohms

## **C Construction**

### **C.1 Communication Vaults**

All openings in communication vaults must be cored or blocked out at time of fabrication, or cored at time of placement. Where multi-cell or standard nonmetallic conduit is terminated at manholes, the coring or boxout shall be no larger than 6 inches in diameter or 6 inches square respectively for each conduit. Where multi-cell, directional bore or nonmetallic conduit special is terminated at manholes, a boxout of no more than 14 inches by 6 inches high by 3 inches deep positioned at 90 degrees will be allowed.

### **C.2 Thread Protection**

Rust, corrosion, and anti-seize protection shall be provided at all thread assemblies of metallic parts by coating (non-spray) the mating surfaces with an approved compound. Failure to use an approved compound will result in no payment for the items to which coating was to have been applied.

### **C.3 Cable Installation**

When new cables are to be installed into conduits containing existing cables, remove the existing cables and reinstall the existing cables simultaneously with the new cables. Take every precaution necessary to protect the existing cables. In the event of avoidable damage to the existing cables, replace all damaged cables, in-kind, at no additional expense to the department. When cables are pulled into conduit, use a cable pulling lubricant approved by the cable manufacturer. Submit documentation supporting manufacturer approval of the lubricant to the engineer.

When cables are installed in conduit before the proper installation of bushings or bell ends on the conduit or without the use of cable lubricant, the cables will be paid at 50 percent of the contract unit price if testing shows no damage to the cables. Replace all cables which testing shows to be damaged at no cost to the department.

### **C.4 Wiring**

Every conductor, except a conductor contained entirely within a single piece of equipment, must terminate either in a connector or on a terminal block. Provide and install the connectors and terminal blocks where needed, without separate payment. Approved splice kits shall be used instead of connectors and terminal blocks for underground power cable splices.

Permanently label and key connectors to preclude improper connection. The labeling method(s) must be approved by the engineer prior to use.

Terminal blocks must be affixed to panels that permanently identify the block and what wire connects to each terminal. This may be accomplished by silk screening or by installing a laminated printed card under the terminal block, with the labels on portions of the card that extend beyond the block. Installation of terminal blocks by drilling holes in the exterior wall of the cabinet is not acceptable.

Use barriers to protect personnel from accidental contact with all dangerous voltages.

Do not install conductors carrying AC power in the same wiring harness as conductors carrying control or communication signals.

Arrange wiring, including fiber optic pigtails, so that any removable assembly can be removed without disturbing wiring that is not associated with the assembly being removed.

Communication and control cables may not be spliced underground, except where indicated on the plans.

Cables in the Traffic Operations Center or in communication hubs, that are not contained within a single cabinet, shall have at least 10 feet of slack.

### **C.5 System Operations**

If the contractor's operations interrupt Intelligent Transportation Systems (ITS) service, notify the engineer immediately and restore service within 24 hours. Repair all damaged facilities to the condition existing before the interruption. If service is not restored within 24 hours, the department may restore service to any operating device and deduct restoration costs from payments due the contractor.

### **C.6 Surge Protection**

Arrange the equipment and cabinet wiring to minimize the distance between each conductor's point of entry and its protector. Locate the protector as far as possible from electronic equipment. All wiring between the surge protectors and the point of entry shall be free from sharp bends.

### **D Measurement**

No separate measurement will be made for the work described in this article.

### **E Payment**

No separate payment will be made for the work described in this article. All work described in this article shall be included under the ITS items in the contract.

## **3. Intelligent Transportation Systems - Conduit.**

**Add the following to subsection 671.2:**  
**671.2.5 Locate Wire**

Furnish and install a No. 14 AWG stranded copper wire for future locate purposes through each conduit run. Connect the locate wire by the use of a wire nut at each pull box, manhole, or other access point. Alternatively, use a single wire through the access points. All material furnished under this item shall meet the requirements of section 655 of the standard specifications.

**4. Install Conduit Into Existing Item,  
Item SPV.0060.205.**

**A Description**

This special provision describes installing proposed conduit into an existing manhole, pull box, junction box, or other structure.

**B Materials**

Conduit, as provided and paid for under other items in this contract. Backfill material, topsoil, fertilizer, seed, and mulch conforming to the requirements of pertinent provisions of the standard specifications.

**C Construction**

Carefully expose the outside of the existing structure without disturbing any existing conduits or cabling.

Drill the appropriate sized hole for the entering conduit at a location within the structure that will not disturb the existing cabling and will not hinder the installation of new cabling within the installed conduit.

Fill any void area between the drilled hole and conduit with an engineer-approved filling material to protect against conduit movement and entry of fill material into the structure.

Carefully tamp backfill into place.

**D Measurement**

The department will measure Installing Conduit Into Existing Item by the unit, acceptably installed. Up to five conduits entering a structure per entry point into the existing structure will be considered a single unit. Conduits in excess of five, or conduits entering at significantly different entry points into the existing pull box, manhole, or junction box will constitute multiple units.

**E Payment**

The department will pay for the measured quantity at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.205	Install Conduit Into Existing Item	Each

Payment is full compensation for drilling holes; furnishing and installing all materials, including bricks, and coarse aggregate; for excavation, bedding and backfilling, including

any sand or other required materials; furnishing and placing topsoil, fertilizer, seed, and mulch in disturbed areas; for disposal of surplus materials; for making inspections; and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work

**5. Ground Rod, Item SPV.0060.206.**

**A Description**

This special provision describes installing a ground rod and ground wire.

**B Materials**

Ground rod shall be copper clad steel with cladding 13 mils thick. The minimum diameter is 5/8-inch and the minimum length is eight feet. Ground wire shall be AWG # 6 bare, solid copper.

**C Construction**

Use exothermic welding to connect the ground wire to the rod. Install the rod vertically, or as close to vertical as conditions permit. Select locations with moist soil, if available. Place the rod at least six feet from all other ground rods.

**D Measurement**

The department will measure Ground Rod by the unit, acceptably installed.

**E Payment**

The department will pay for the measured quantity at the contract unit price each under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.206	Ground Rod	Each

Payment is full compensation for installation of the ground rod and ground wire; welding and connections at both ends of the ground wire; and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

**6. 2-Circuit Electrical Service Meter  
Breaker Pedestal, Item SPV.0060.207.**

**A Description**

This special provision describes furnishing and installing a 2-circuit electrical service meter breaker pedestal and all associated construction and restoration.

**B Materials**

Provide an approved meter breaker pedestal, conduit fittings, and two 50 amp circuit breakers (22,000 AIC or larger as required by power companies), and connections and all necessary conductors and equipment required by the State of Wisconsin Electrical Code and the utility for a service connection.



The meter breaker pedestal must be approved by both the department and the power utility, WE Energies.

Topsoil, seed, fertilizer, and mulch conforming to the requirements of sections 625, 627, 629, and 630 of the standard specifications.

Metallic conduit conforming to the requirements of section 652 of the standard specifications.

### **C Construction**

Coordinate a 100 amp, 120/240 volt, single phase, three wire underground electrical service lateral to be furnished and installed by the local utility at the meter located in a meter breaker pedestal mounted as shown in the plans, or as required by the local power company and approved by the engineer. Notify the engineer when the cabinet assembly is ready for connection to the power mains. The department will pay power company installation and energy costs.

Install the electrical service in accordance to power company requirements and in accordance to the department's "The Policy For The Accommodation of Utilities Within Highway Right-of-way". Furnish the power company with a wiring affidavit, certifying that the service has been installed in accordance to the State of Wisconsin Electrical Code.

Fill and grade the service trench and replace topsoil that may have become lost or contaminated with other materials. Fertilize, mulch, and seed all areas within the highway right-of-way that have been disturbed by the power company and by the installation of the meter breaker pedestal.

Use a bare, solid AWG # 6 copper wire to connect the meter socket to one or more ground rods. Use a device that measures resistance to ground using the three-point fall -of-potential method to ensure that the resistance from the meter socket to earth ground does not exceed 2 ohms. Add more ground rods if necessary to achieve this requirement. If the meter is within ten feet of the cabinet it is supplying, then the same ground rods can serve both the meter breaker pedestal and the cabinet. Otherwise, the ground rods for the meter breaker pedestal shall be separate from the ground rod(s) for the equipment cabinet.

### **D Measurement**

The department will measure 2 Circuit Electrical Service Meter Breaker Pedestal by the unit acceptably installed.

### **E Payment**

The department will pay for the measured quantity at the contract unit price under the following item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.207	2-Circuit Electrical Service Meter Breaker Pedestal	Each

Payment is full compensation for furnishing and installing the breaker pedestal, circuit breakers, riser conduit and fittings, wiring, and connections; for notifying and coordinating with the power company; for furnishing and placing topsoil, fertilizer, seed, and mulch; and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

**7. Install Ethernet Video CODEC,  
SPV.0060.208.**

**A Description**

This special provision describes installing a state-furnished Ethernet video CODEC.

**B Materials**

Ethernet video CODECs will be furnished by the department.

Provide all necessary cables between the video CODEC and Ethernet switch, or other device.

**C Construction**

Install the Ethernet video CODEC in a new or existing field cabinet. Connect it to devices as shown on the plans, or as directed by the engineer.

**D Measurement**

The department will measure Install Ethernet Video CODEC by the unit, installed in accordance with the contract, tested and accepted.

**E Payment**

The department will pay for the measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.208	Install Ethernet Video CODEC	Each

Payment is full compensation for installation of the Ethernet Video CODEC and connections; for testing; and for furnishing all labor, tools, equipment, transportation, and incidentals necessary to complete the work.

**8. Install ITS Field Cabinet, Item  
SPV.0060.209.**

**A Description**

This special provision describes installing a state-furnished ITS field cabinet.

**B Materials**

Field cabinets furnished by the department will be a McCain Model 334 controller cabinets.

Provide all necessary miscellaneous mounting hardware and internal power cables. Bolts to anchor the cabinet to the concrete base will be state-furnished with the field cabinet.

**C Construction**

Install the field cabinet on a new concrete base. Make all power connections to the cabinet, isolating the neutral bus from the cabinet and equipment ground.

Effectively ground all cable grounding shields and any spare or unused conductors in the field cabinet to the equipment grounding terminal strip.

**D Measurement**

The department will measure Install ITS Field Cabinet by the unit, acceptably installed.

**E Payment**

The department will pay for the measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	Unit
SPV.0060.209	Install ITS Field Cabinet	Each

Payment is full compensation for installation of the field cabinet; and for furnishing all labor, tools, equipment, transportation, and incidentals necessary to complete the work.

**9. Install Ethernet Switch, Item  
SPV.0060.210.**

**A Description**

This special provision describes installing a state-furnished Ethernet switch, and providing all necessary associated wiring.

**B Materials**

Ethernet switches will be furnished by the department.

Provide all necessary cables between the Ethernet switch and terminal server or other device.

**C Construction**

Install the Ethernet switch in a new or existing field cabinet. Connect it to devices as shown on the plans, or as directed by the engineer.

**D Measurement**

The department will measure Install Ethernet Switch by the unit, installed in accordance with the contract, tested, and accepted.

**E Payment**

The department will pay for the measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
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SPV.0060.210

Install Ethernet Switch

Each

Payment is full compensation for installation of the Ethernet switch; furnishing all necessary incidental hardware; making all necessary connections; and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.