Illinois Department of Transportation
2300 South Dirksen Parkway / Springfield, Illinois / 62764

November 8, 2023

SUBJECT FAU Route 1340 (Touhy Ave)
FAI Route 94 (I-94/Edens Expressway)
Project NHPP-1LU7(347)
Section 2019-197-B
Cook County
Contract No. 62K70
Item No. 22, November 17, 2023 Letting
Addendum A

NOTICE TO PROSPECTIVE BIDDERS:

Attached is an addendum to the plans or proposal. This addendum involves revised and/or added material.

1. Revised the Schedule of Prices
2. Revised pages iii & iv of the Table of Contents to the Special Provisions
3. Revised pages 3, 8 &152 of the Special Provisions
4. Added pages 257-291 to the Special Provisions
5. Revised sheets 1, 2, 4-25, 28, 37, 39, 44-50, 52, 53, 56-58, 75, 88, 87 & 132 of the Plans
6. Added sheets 124A-124T & 201A to the Plans

Prime contractors must utilize the enclosed material when preparing their bid and must include any changes to the Schedule of Prices in their bid.

Very truly yours,

Jack A. Elston, P.E.
Bureau Chief, Design and Environment

MTS

Stage 1

Oakton Street

STAGE / LOCATION	TYPE	DESCRIPTION	RESPONSIBLE AGENCY	DURATION OF TIME
No conflicts anticipated				

I-94

STAGE / LOCATION	TYPE	DESCRIPTION	RESPONSIBLE AGENCY	DURATION OF TIME
No conflicts anticipated				

Stage 2

Oakton Street

STAGE / LOCATION	TYPE	DESCRIPTION	RESPONSIBLE AGENCY	DURATION OF TIME
No conflicts anticipated				

I-94

STAGE / LOCATION	TYPE	DESCRIPTION	RESPONSIBLE AGENCY	DURATION OF TIME
No conflicts anticipated				

Stage 3

Oakton Street

STAGE / LOCATION	TYPE	DESCRIPTION	RESPONSIBLE AGENCY	DURATION OF TIME
Gross Point Road Sta. 50+40, 35' RT Sta. 51+75, 35' RT Sta. 53+15, 35' RT Central Avenue Sta. 101+05, 20'RT	ComEd Pole	Remove Poles at these stations and associated electric lines.	ComEd	12 Working Days

Pre-Stage: ___0_____ Days Total Installation
Stage 1: ____0____ Days Total Installation
Stage 2: ____0____ Days Total Installation
Stage 3: ___12___ Days Total Installation

Revised 11/8/2023

Xing Gross Point Sta. 29+27 Gross Point Road Sta. 29+27, 17' RT to 30+97, 17' RT			

The following contact information is what was used during the preparation of the plans as provided by the owner of the facility.

Agency/Company Responsible to Resolve Conflict	Name of contact	Phone	E-mail address
AT&T	Jamie Gwin	630-573-5423	Jg8128@att.com
Comcast	Bob Schulter	224-229-5861	Bob_Schulter@comcast.com
ComEd	Axl Davis	773-236-7288	Axl.Davis@comed.com
Crown Castle	Mike Kyriazakos	847-370-7617	Michael.Kyriazakos@crowncastle.com
Nicor	Frank Tanzillo	815-261-9418	ftanzil@southernco.com
Village of Morton Grove	Chris Tomich	847-470-5235	ctomich@mortongroveil.gov

The above represents the best information available to the Department and is included for the convenience of the bidder. The days required for conflict resolution should be considered in the bid as this information has also been factored into the timeline identified for the project when setting the completion date. The applicable portions of the Standard Specifications for Road and Bridge Construction shall apply.

Estimated duration of time provided above for the first conflicts identified will begin on the date of the executed contract regardless of the status of the utility relocations. The responsible agencies will be working toward resolving subsequent conflicts in conjunction with contractor activities in the number of days noted.

The estimated relocation duration must be part of the progress schedule submitted by the contractor. A utility kickoff meeting will be scheduled between the Department, the Department's contractor and the utility companies when necessary. The Department's contractor is responsible for contacting J.U.L.I.E. prior to all excavation work.

Revised 11/8/2023

The contractor shall not damage the existing structures adjacent to the staircase. Any damage to the structures shall be repaired by the Contractor at no additional cost to the Department.

Foundations should be completely removed. Backfill shall be completed in accordance with Article 502.10 and Section 205 of the Standard Specifications for Road and Bridge Construction, latest edition.

Method of Measurement. The work shall be measured by the contract lump sum for STAIRCASE REMOVAL as indicated on the Plans and specified herein.

Basis of Payment. This work will be paid for at the lump sum contract unit price for STAIRCASE REMOVAL, which price shall include removal of stairs, platforms, railings and all foundations as needed for the proposed work.

CONCRETE STRUCTURE (SPECIAL)

Description.

This work shall consist of furnishing all material, equipment, and labor to construct new cast-in-place concrete stairs. It shall include excavation, CA-6 granular subbase, compaction, Portland Cement Concrete, epoxy coated reinforcement bars, and other appurtenances, as shown on the plans, as herein specified, and as directed by the Engineer. s

Materials.

Portland Cement Concrete shall be Class SI in conformance with Article 1020 of the Standard Specifications.

Epoxy Coated Reinforcement Bars shall be in conformance with Article 1006.10 of the Standard Specifications.

Structure excavation and backfill shall be in conformance with Article 502 of the Standard Specifications.

Preformed Expansion Joint Filler shall be in conformance with Article 1051 of the Standard Specifications.

CA-6 subbase shall be in conformance with Article 1004.04 of the Standard Specifications.

Construction Requirements.

The work shall be in compliance with Article 503 of the Standard Specifications, including formwork, placing and consolidating, joints, foundations and footings, surface finish, curing and with the following additions:

Exposed corners of concrete shall be chamfered ¾ inch.

Stair noses shall be rounded with a maximum radius of ½ inch.

Stair treads and landings shall be finished with a non-slip broom finish.

Stair treads and landings shall be sloped for drainage at a maximum slope of ¼ inch per foot.

Compact subgrade and CA-6 subbase to an allowable bearing pressure of 3,000 PSF.

Method of Measurement.

This work will be measured for payment on a Lump Sum basis.

Basis of Payment.

This work will be paid for at the contract Lump Sum Price for CONCRETE STRUCTURE (SPECIAL). All work associated with the concrete stairs as shown on the plans and as described herein shall be included for payment. All incidental work and any additional work necessary to complete the task and as directed by the Engineer shall be included in the Lump Sum Price.

Revised 11/8/2023

REMOVE AND REINSTALL FIBER OPTIC CABLE IN CONDUIT

Description This work shall consist of removing an existing fiber optic cable from a conduit then reinstalling it in a new conduit or existing conduit as per plans. The conduit shall be cleaned and swabbed prior to the reinstalling of the cable.

Method of Measurement Removal and removal and installation of existing fiber optic cable will be measured for payment in place in feet. If two or more cables in a conduit are to be removed, or removed and installed, each cable will be measured for payment separately.

Basis of Payment This work will be paid for at the contract unit price per foot for REMOVE AND REINSTALL FIBER OPTIC CABLE IN CONDUIT as shown on the plans. Payment shall not be made until the cable is installed, spliced and tested in compliance with the FIBER OPTIC CABLE special provisions.

INTERCEPT EXISTING CONDUIT

Description. This work shall consist of intercepting an existing underground conduit and rerouting into and out of a hand hole or communication vault.

Materials
Materials shall conform to Article 810.02

Construction Requirements
Installation The contractor shall reroute and extend the conduit as needed to allow conductors to pass through hand hole or vault. New conduit and fittings that match existing conduit shall be added as needed to allow conductors to pass through the hand hole or vault. The existing cable shall be removed prior to rerouting the conduit.

Method of Measurement
This work will be measured for payment per each hole that is drilled in an existing junction box.

Basis of Payment
This work will be paid for at the contract unit price each for INTERCEPT EXISTING CONDUIT which will be payment in full for performing the work described herein.

Added 11/8/2023

MAINTAINING ITS DURING CONSTRUCTION

Description.
Intelligent Transportation Systems (ITS) references IDOT traffic surveillance infrastructure. These elements include, but are not limited to, the following: induction loops, ramp meters, closed circuit television cameras, dynamic message signs, highway advisory radios, Radar Vehicle Sensing Devices (RVSDs), wireless vehicle detection devices, copper and fiber optic communication cables, power cables, cabinets, and communication equipment.

General Requirements.
Effective the date the Contractor's activities (ITS or otherwise) begin at the job site, the Contractor shall be responsible for the proper operation and maintenance of ITS elements that are part of, or that may be affected by, the work until final acceptance by the Engineer or as otherwise determined by the Engineer. Before performing any excavation, removal, or installation work (ITS or otherwise) at the site, the Contractor shall initiate a request for a maintenance transfer and preconstruction inspection to be held in the presence of the Engineer and a representative of the party or parties responsible for maintenance of any ITS systems that may be affected by the work. This includes co-ordination with adjacent projects that may have an effect on the ITS infrastructure. The request for the maintenance preconstruction inspection shall be made no less than seven (7) calendar days prior to the desired inspection date.

Existing ITS elements, when depicted on the plans, are intended only to indicate the general equipment installation of the systems involved and shall not be construed as an exact representation of the field conditions. It remains the Contractor's responsibility to visit the site to confirm and ascertain the exact condition and location of the ITS components and systems to be maintained and installed. Existing ITS components shall be defined as any ITS component or device in service at the time of the commencement of construction activities. The contract drawings indicate the general extent of any existing ITS elements, but whether indicated or not, it remains the Contractor's responsibility to ascertain the extent of effort required for compliance with these specifications, and failure to do so will not be justification for extra payment or reduced responsibilities. Maintaining ITS During Construction - It is the Contractor’s responsibility to maintain vehicle detection, which includes speed and volume data, in all lanes within the construction limits for this project, on all roadway segments and ramps that will be open to traffic. Where the existing detection cannot be maintained, the Contractor shall provide a temporary detection system, approved by IDOT, at no additional cost to the contract. The Contractor's responsibility shall include protection or removal and storage of any ITS/Communication cabinets and protecting in place any cables, conduits and ITS devices in or adjacent to the work zone. This work may also include the abandonment of the existing device and communication pathway and the installation of a temporary device such as a RVSD with a wireless communication. This work shall also include the relocation and adjustment of RVSD and wireless detection devices as necessary in coordination with construction staging. It is the Contractor’s responsibility to maintain closed circuit television cameras including associated fiber optic communications and power. The Contractor is responsible for the disconnection, rerouting, and reconnection of all fiber and copper communication cables currently located in existing conduits as indicated in the plans.

Added 11/8/2023

The disconnection and reconnection must be made at an existing splice point or communication cabinet where a connection is made, or as otherwise indicated in the plans. The existing communication and infrastructure must be properly maintained for the duration of construction activities and the Contractor must coordinate the disconnection and reconnection activities with the Engineer. All work required to maintain, relocate or provide temporary ITS infrastructure as depicted in the plans or otherwise necessary and as provided for in this special provision shall be paid for under the Maintaining ITS During Construction pay item. No component items germane to this work shall be paid for separately.

Once construction activities are complete, all temporary equipment installed will become the property of the Department and shall remain in place, except where a proposed location has been identified in the plans. All final locations and installations of ITS devices, communication cabinets, junction boxes, conduit, fiber optic, copper cable, wireless equipment and associated infrastructure shall be protected, secured and have the Engineer's approval. Proper documentation, to include latitude and longitude for all equipment locations and communication pathway must be turned over to the Department. The proposed plan for this work must be presented to the Engineer for approval prior to the commencement of the work.

Method of Measurement.
The contractor shall demonstrate to the satisfaction of the Engineer that the ITS components, devices and infrastructure have been properly installed, protected and maintained and that the appropriate data is being transmitted to the Traffic Management Center prior to submitting a pay request. In order for final payment to be released the contractor must demonstrate that the equipment is working as intended following inspection by the Engineer. Failure to do so will be grounds for denying the pay request.

Basis of Payment.
Maintaining ITS During Construction and Rerouting ITS Communication shall be paid for at the contract unit price per calendar month (Cal Mo) for MAINTAINING ITS DURING CONSTRUCTION, which shall include all work as described herein.

FIBER OPTIC SPLICE

Effective: June 1, 2014
Description. The Contractor will splice optical fibers from different cable sheaths and protect them with a splice closure at the locations shown on the Plans. Fiber splicing consists of in-line fusion splices for all fibers described in the cable plan at the particular location.

Two splices are identified. A mainline splice includes all fibers in the cable sheath. In a lateral splice, the buffer tubes in the mainline cable are dressed out and those fibers identified on the plans are accessed in and spliced to lateral cables.

Added 11/8/2023

Materials.

Splice Closures. Splice Closures shall be designed for use under the most severe conditions such as moisture, vibration, impact, cable stress and flex temperature extremes as demonstrated by successfully passing the factory test procedures and minimum specifications listed below:

Physical Requirements. The closures shall provide ingress for up to four cables in a butt configuration. The closure shall prevent the intrusion of water without the use of encapsulates.

The closure shall be capable of accommodating splice organizer trays that accept mechanical, or fusion splices. The splice closure shall have provisions for storing fiber splices in an orderly manner, mountings for splice organizer assemblies, and space for excess or un-spliced fiber. Splice organizers shall be re-enterable. The splice case shall be UL rated.

Closure re-entry and subsequent reassembly shall not require specialized tools or equipment. Further, these operations shall not require the use of additional parts.

The splice closure shall have provisions for controlling the bend radius of individual fibers to a minimum of 38 mm (1.5 in.).

Factory Testing.

Compression Test. The closure shall not deform more than 10% in its largest cross-sectional dimension when subjected to a uniformly distributed load of 1335 N at temperatures of –18 and 38 degrees Celsius (0 and 100 degrees Fahrenheit). The test shall be performed after stabilizing at the required temperature for a minimum of two hours. It shall consist of placing an assembled closure between two flat parallel surfaces, with the longest closure dimension parallel to the surfaces. The weight shall be placed on the upper surface for a minimum of 15 minutes. The measurement shall then be taken with weight in place.

Impact Test. The assembled closure shall be capable of withstanding an impact of 28 N-M at temperatures of –18 and 38 degrees Celsius (0 and 100 degrees Fahrenheit). The test shall be performed after stabilizing the closure at the required temperature for a minimum of 2 hours. The test fixture shall consist of 9 kg (20 lb) cylindrical steel impacting head with a 50 mm (2 in.) spherical radius at the point where it contacts the closure. It shall be dropped from a height of 305 mm (12 in.). The closure shall not exhibit any cracks or fractures to the housing that would preclude it from passing the water immersion test. There shall be no permanent deformation to the original diameter or characteristic vertical dimension by more than 5%.

Cable Gripping and Sealing Testing. The cable gripping and sealing hardware shall not cause an increase in fiber attenuation in excess of 0.05 dB/fiber @ 1550 nm when attached to the cables and the closure assembly. The test shall consist of measurements from six fibers, one from each buffer tube or channel, or randomly selected in the case of a single fiber bundle. The measurements shall be taken from the test fibers before and after assembly to determine the effects of the cable gripping and sealing hardware on the optical transmission of the fibers.

Added 11/8/2023

Vibration Test. The splice organizers shall securely hold the fiber splices and store the excess fiber. The fiber splice organizers and splice retaining hardware shall be tested per EIA Standard FOTP-II, Test Condition 1. The individual fibers shall not show an increase in attenuation in excess of 0.1 dB/fiber.

Water Immersion Test. The closure shall be capable of preventing a 3 m (10 ft) water head from intruding into the splice compartment for a period of 7 days. Testing of the splice closure is to be accomplished by the placing of the closure into a pressure vessel and filling the vessel with tap water to cover the closure. Apply continuous pressure to the vessel to maintain a hydrostatic head equivalent 3 m (10 ft) on the closure and cable. This process shall be continued for 30 days. Remove the closure and open to check for the presence of water. Any intrusion of water in the compartment containing the splices constitutes a failure.

Certification. It is the responsibility of the Contractor to insure that either the manufacturer, or an independent testing laboratory has performed all of the above tests, and the appropriate documentation has been submitted to the Department. Manufacturer certification is required for the model(s) of closure supplied. It is not necessary to subject each supplied closure to the actual tests described herein.

CONSTRUCTION REQUIREMENTS

The closure shall be installed according to the manufacturer's recommended guidelines. For mainline splices, the cables shall be fusion spliced. 45 days prior to start of the fiber optic cabling installation, the Contractor shall submit the proposed locations of the mainline splice points for review by the Department.

The Contractor shall prepare the cables and fibers in accordance with the closure and cable manufacturers' installation practices. A copy of these practices shall be provided to the Engineer 21 days prior to splicing operations.

Using a fusion splicer, the Contractor shall optimize the alignment of the fibers and fuse them together. The Contractor shall recoat the fused fibers and install mechanical protection over them.

Upon completing all splicing operations for a cable span, the Contractor shall measure the mean bi-directional loss at each splice using an Optical Time Domain Reflectometer. This loss shall not exceed 0.1 dB.

The Contractor shall measure the end-to-end attenuation of each fiber, from connector to connector, using an optical power meter and source. This loss shall be measured at from both directions and shall not exceed 0.5 dB per installed kilometer of single mode cable. Measurements shall be made at both 1300 and 1550 nm for single mode cable. For multimode cable, power meter measurements shall be made at 850 and 1300 nm. The end-to-end attenuation shall not exceed 3.8 dB/installed kilometers at 850nm or 1.8 dB per installed kilometer at 1300nm for multimode fibers.

Added 11/8/2023

As directed by the Engineer, the Contractor at no additional cost to the Department shall replace any cable splice not satisfying the required objectives.

The Contractor shall secure the Splice Closure to the side of the splice facility using cable support brackets. All cables shall be properly dressed and secured to rails or racks within the manhole. No cables or enclosures will be permitted to lie on the floor of the splice facility. Cables that are spliced inside a building will be secured to the equipment racks or walls as appropriate and indicated on the Plans.

Method of Measurement. Fiber optic splice of the type specified will be measured as each, completely installed and tested with all necessary splices completed within the enclosure, and the enclosure secured to the wall of the splice facility.

Basis of Payment. This item shall be paid at the contract unit price each for **FIBER OPTIC SPLICE, LATERAL** or **FIBER OPTIC SPLICE, MAINLINE** of the type specified, which shall be payment in full for the work, complete, as specified herein.

FIBER OPTIC CABLE, MICRO, SINGLE MODE

Effective: February 1, 2018

Description. This work shall consist of furnishing and installing loose-tube, single-mode, fiber optic cable of the number of fibers shown in the plans and as directed by the Engineer. The cable shall be capable of being installed via jetting in a microduct conduit system.

Other ancillary components, required to complete the fiber optic cable plant, including but not limited to, moisture and water sealants, cable caps, delineator post, etc., shall be included in the cost of fiber optic cable and will not be paid for separately.

Materials The single-mode, fiber optic cable shall incorporate a loose, buffer-tube design. The cable shall be an accepted product of the United States Department of Agriculture Rural Utilities Service (RUS) 7 CFR 1755.900 and meet the requirements of ANSI/ICEA Standard for Fiber Optic Outside Plant Communications Cable, ANSI/ICEA S-87-640-1999 for a single sheathed, non-armored cable, and shall be new, unused and of current design and manufacture.

Fibers.

The cables shall use dispersion unshifted fibers. The optical and physical characteristics of the un-cabled fibers shall include:

The single-mode fiber shall meet EIA/TIA-492CAAA, "Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers," and ITU recommendation G.652.D, “Characteristics of a single-mode optical fiber cable.”

Added 11/8/2023

Physical Construction		
Requirement	**Units**	**Value**
Cable Diameter	mm	8.6 (max)
Buffer Tube Diameter	mm	1.5
Colored Fiber Nominal Diameter	µm	253 – 259
Mode Field Diameter (1310 nm)	µm	9.2 ± 0.4
Mode Field Diameter (1550 nm)	µm	10.4 ± 0.5
Minimum Bending Radius (Installation)	mm	170

Optical Characteristics				
Requirement			**Units**	**Value**
Cabled Fiber Attenuation		1310 nm	dB/km	< 0.4
		1550 nm		< 0.3
Point Discontinuity		1310 nm	dB	< 0.1
		1550 nm		< 0.1
Macrobend Attenuation	Turns	Mandrel OD	dB	
	1	32 ± 2 mm		< 0.05 at 1550 nm
	100	50 ± 2 mm		< 0.05 at 1310 nm
	100	50 ± 2 mm		< 0.10 at 1550 nm
	100	60 ± 2 mm		< 0.05 at 1550 nm
	100	60 ± 2 mm		< 0.05 at 1625 nm
Cable Cutoff Wavelength (X_{ccf})			nm	< 1260
Zero Dispersion Wavelength (X_o)			nm	$1302 < X_o < 1322$
Zero Dispersion Slope (S_o)			ps/(nm^2•km)	< 0.089
Total Dispersion		1550 nm	ps/(nm•km)	< 3.5
		1285-1330 nm		< 17.5
		1625 nm		< 21.5
Cabled Polarization Mode Dispersion			ps/km^{-2}	< 0.2
IEEE 802.3 GbE – 1300 nm Laser Distance			m	up to 5000
Water Peak Attenuation: 1383 ± 3 nm			dB/km	< 0.4

Cable Construction.

The number of fibers in each cable shall be as specified.

Optical fibers shall be placed inside a loose buffer tube. The nominal outer diameter of the buffer tube shall be 1.5 mm. Each buffer tube shall contain up to 12 fibers. The fibers shall not adhere to the inside of the buffer tube.

Added 11/8/2023

Each fiber shall be distinguishable by means of color coding in accordance with TIA/EIA-598-B, "Optical Fiber Cable Color Coding." The fibers shall be colored with ultraviolet (UV) curable inks.

Buffer tubes containing fibers shall be color coded with distinct and recognizable colors in accordance with TIA/EIA-598-B, "Optical Fiber Cable Color Coding."

In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and shall not be subject to fading or smearing onto each other. Colors shall not cause fibers to stick together

The buffer tubes shall be resistant to external forces and shall meet the buffer tube cold bend and shrinkback requirements of 7 CFR 1755.900.

Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed. Fillers shall be placed so that they do not interrupt the consecutive positioning of the buffer tubes. In dual layer cables, any fillers shall be placed in the inner layer. Fillers shall be nominally 1.5 mm in outer diameter.

The central member shall consist of a dielectric, glass reinforced plastic (GRP) rod (optional steel central member). The purpose of the central member is to provide tensile strength and prevent buckling. The central member shall be overcoated with a thermoplastic when required to achieve dimensional sizing to accommodate buffer tubes/fillers.

Each buffer tube shall contain a water-swellable yarn for water-blocking protection. The water-swellable yarn shall be non-nutritive to fungus, electrically non-conductive, and homogeneous. It shall also be free from dirt or foreign matter. This yarn will preclude the need for other water-blocking material; the buffer-tube shall be gel-free. The optical fibers shall not require cleaning before placement into a splice tray or fan-out kit.

Buffer tubes shall be stranded around the dielectric central member using the reverse oscillation, or "S-Z", stranding process.

The cables shall contain one ripcord under the sheath for easy sheath removal.
Tensile strength shall be provided by the central member, and additional dielectric yarns as required.
The cables shall be sheathed with medium density polyethylene (MDPE). Jacketing material shall be applied directly over the tensile strength members (as required). The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.
The MDPE jacket material shall be as defined by ASTM D1248, Type II, Class C, Category 4 and Grades J4, E7 and E8.
The jacket or sheath shall be free of holes, splits, and blisters.
The cable jacket shall contain no metal elements and shall be of a consistent thickness.

Added 11/8/2023

Cable jackets shall be marked with the manufacturer's name, month and year of manufacture, sequential meter or foot markings, a telecommunication handset symbol as required by Section 350G of the National Electrical Safety Code (NESC), fiber count, and fiber type. The actual length of the cable shall be within -0/+1% of the length markings. The print color shall be white, with the exception that cable jackets containing one or more co-extruded white stripes, which shall be printed in light blue. The height of the marking shall be approximately 2.5 mm.
The maximum pulling tension shall be 1335 N (300 lbf) during installation (short term) and 400 N (90 lbf) long term installed.
The shipping, storage, and operating temperature range of the cable shall be -40°C to +70°C. The installation temperature range of the cable shall be –15°C to +60°C.

General Cable Performance Specifications

The fiber optic cable manufacturer shall provide documentation and certify that the fiber optic cable complies with the following EIA-455-*xxx* Fiber Optic Test Procedures (FOTP):

When tested in accordance with FOTP-3, "*Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components*," the change in attenuation at extreme operational temperatures (-40°C and +70°C) shall not exceed 0.15 dB/km at 1550 nm for single-mode fiber and 0.3 dB/km at 1300 nm for multimode fiber.

When tested in accordance with FOTP-82, "*Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable*," a one meter length of unaged cable shall withstand a one meter static head or equivalent continuous pressure of water for one hour without leakage through the open cable end.

When tested in accordance with FOTP-81, "*Compound Flow (Drip) Test for Filled Fiber Optic Cable*," the cable shall exhibit no flow (drip or leak) of filling and/or flooding material at 70°C.

When tested in accordance with FOTP-41, "*Compressive Loading Resistance of Fiber Optic Cables*," the cable shall withstand a minimum compressive load of 220 N/cm (125 lbf/in) applied uniformly over the length of the sample. The 220 N/cm (125 lbf/in) load shall be applied at a rate of 2.5 mm (0.1 in) per minute. The load shall be maintained for a period of 1 minute. The load shall then be decreased to 110 N/cm (63 lbf/in). Alternatively, it is acceptable to remove the 220 N/cm (125 lbf/in) load entirely and apply the 110 N/cm (63 lbf/in) load within five minutes at a rate of 2.5 mm (0.1 in) per minute. The 110 N/cm (63 lbf/in) load shall be maintained for a period of 10 minutes. Attenuation measurements shall be performed before release of the 110 N/cm (63 lbf/in) load. The change in attenuation shall not exceed 0.15 dB at 1550 nm for single-mode fibers and 0.30 dB at 1300 nm for multimode fiber.

When tested in accordance with FOTP-104, "*Fiber Optic Cable Cyclic Flexing Test*," the cable shall withstand 25 mechanical flexing cycles around a sheave diameter not greater than 20 times the cable diameter. The change in attenuation shall not exceed 0.15 dB at 1550 nm for single-mode fiber and 0.30 dB at 1300 nm for multimode fiber.

Added 11/8/2023

When tested in accordance with FOTP-25, "*Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies*," except that the number of cycles shall be two at three locations along a one meter cable length and the impact energy shall be atleast 4.4 Nm (in accordance with ICEA S-87-640)", the change in attenuation shall not exceed 0.15 dB at 1550 nm for single-mode fiber and 0.30 dB at 1300 nm for multimode fiber.

When tested in accordance with FOTP-33, "*Fiber Optic Cable Tensile Loading and Bending Test*," using a maximum mandrel and sheave diameter of 560 mm, the cable shall withstand a rated tensile load of 2670N (601 lbf) and residual load of 30% of the rated installation load. The axial fiber strain shall be ≤ 60% of the fiber proof level after completion of 60 minute conditioning and while the cable is under the rated installation load. The axial fiber strain shall be ≤ 20% of the fiber proof level after completion of 10 minute conditioning and while the cable is under the residual load. The change in attenuation at residual load and after load removal shall not exceed 0.15 dB at 1550 nm for single mode fiber and 0.30 dB at 1300 nm for multimode fiber.

When tested in accordance with FOTP-85, "*Fiber Optic Cable Twist Test*," a length of cable no greater than 2 meters shall withstand 10 cycles of mechanical twisting. The change in attenuation shall not exceed 0.15 dB at 1550 nm for single-mode fiber and 0.30 dB at 1300 nm for multimode fiber.

When tested in accordance with FOTP-37, "*Low or High Temperature Bend Test for Fiber Optic Cable*," the cable shall withstand four full turns around a mandrel of ≤ 20 times the cable diameter after conditioning for four hours at test temperatures of -30°C and +60°C. Neither the inner or outer surfaces of the jacket shall exhibit visible cracks, splits, tears, or other openings. The change in attenuation shall not exceed 0.30 dB at 1550 nm for single mode fiber and 0.50 dB at 1300 nm for multimode fiber.

Quality Assurance Provision

All cabled optical fibers > 1000 meters in length shall be 100% attenuation tested. The attenuation of each fiber shall be provided with each cable reel. The cable manufacturer shall be TL 9000 registered.

Added 11/8/2023

Packaging

Top and bottom ends of the cable shall be available for testing. Both ends of the cable shall be sealed to prevent the ingress of moisture. Each reel shall have a weather resistant reel tag attached identifying the reel and cable. The reel tag shall include the following information:

- Cable Number
- Gross Weight
- Shipped Cable Length in Meters
- Job Order Number
- Product Number
- Customer Order Number
- Date Cable was Tested
- Manufacturer Order Number
- Cable Length Markings

a: Top (inside end of cable)
b: Bottom (outside end of cable)

The reel (one flange) marking shall include:

- Manufacturer
- Country of origin
- An arrow indicating proper direction of roll when handling
- Fork lift-handling illustration
- Handling Warnings.

Each cable shall be accompanied by a cable data sheet. The cable data sheet shall include the following information:

- Manufacturer Cable Number
- Manufacturer Product Number
- Manufacturer Factory Order Number
- Customer Name
- Customer Cable Number
- Customer Purchase Order Number
- Mark for Information
- Ordered Length
- Maximum Billable Length
- Actual Shipped Length
- Measured Attenuation of Each Fiber

The cable shall be capable of withstanding a minimum-bending radius of 20 times its outer diameter during installation and 10 times its outer diameter during operation without changing the characteristics of the optical fibers.

Added 11/8/2023

The cable shall meet all of specified requirements under the following conditions:

- Shipping/storage temperature: -58° F to +158° F (-50° C to +70° C)
- Installation temperature: -22° F to +158° F (-30° C to +70° C)
- Operating temperature: -40° F to +158° F (-40° C to +70° C)
- Relative humidity from 0% to 95%, non-condensing

Optical Patch Cords and Pigtails.

The optical patch cords and pigtails shall comply with the following:

- The optical patch cords shall consist of a section of single fiber, jacketed cable equipped with optical connectors at both ends.
- The factory installed connector furnished as part of the optical patch cords and pigtails shall meet or exceed the requirements for approved connectors specified herein.
- The fiber portion of each patch cord and pigtail shall be a single, jacketed fiber with optical properties identical to the optical cable furnished under this contract.
- The twelve fiber single-mode fiber optic cable shall be installed as a pigtail with factory installed **SC** compatible connectors.
- The patch cords shall comply with Telcordia GR-326-CORE

Connectors.

The optical connectors shall comply with the following:

- All connectors shall be factory installed **SC** compatible connectors. Field installed connectors shall not be allowed.
- Maximum attenuation 0.4dB, typical 0.2dB.
- No more than 0.2dB increase in attenuation after 1000 insertions.
- Attenuation of all connectors will be checked and recorded at the time of installation with an insertion test minimum 5 times checked with an OTDR.
- All fibers shall be connectorized at each end.
- All fibers shall terminate at a fiber patch panel
- Unused fibers will be protected with a plastic cap to eliminate dust and moisture.
- Termination shall be facilitated by splicing factory OEM pigtails on the end of the bare fiber utilizing the fusion splicing method. Pigtails shall be one meter in length.

Added 11/8/2023

CONSTRUCTION REQUIREMENTS

Experience Requirements.

Personnel involved in the installation, splicing and testing of the fiber optic cables shall meet the following requirements:

- A minimum of three (3) years experience in the installation of fiber optic cables, including fusion splicing, terminating and testing single mode fibers.

- Install two systems where fiber optic cables are outdoors in conduit and where the systems have been in continuous satisfactory operation for at least two years. The Contractor shall submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the installed fiber optic systems.

- One fiber optic cable system (which may be one of the two in the preceding paragraph), which the Contractor can arrange for demonstration to the Department representatives and the Engineer.

Installers shall be familiar with the cable manufacturer's recommended procedures for installing the cable. This shall include knowledge of splicing procedures for the fusion splicer being used on this project and knowledge of all hardware such as breakout (furcation) kits and splice closures. The Contractor shall submit documented procedures to the Engineer for approval and to be used by Construction inspectors.

Personnel involved in testing shall have been trained by the manufacturer of the fiber optic cable test equipment to be used, in fiber optic cable testing procedures. Proof of this training shall be submitted to the Engineer for approval. In addition, the Contractor shall submit documentation of the testing procedures and a copy of the test equipment operation manual for approval by the Engineer.

Installation.

Prior to installation, the Contractor shall provide a cable installation plan. The plan shall include the following information:

- Identify where each cable will enter the underground system and the direction each pull.
- Identify locations where the cable is pulled out of a handhole, coiled in a figure eight, and pulled back into the hand hole.
- The plan shall address the physical protection of the cable during installation and during periods of downtime.
- Identify the location of slack storage locations
- Identify the locations of splices.
- Identify distances between fiber access points and crossings.

Added 11/8/2023

The cable installation plan shall be provided to the Engineer for approval a minimum of 15 working days prior to the start of installation. The Engineer's approval shall be for the operation on the freeway and does not include an endorsement of the proposed procedures. The Contractor is responsible for the technical adequacy of the proposed procedures.

During cable installation operations, the Contractor shall ensure that the minimum bending of the cable is maintained during the unreeling and installation operations. Unless specified otherwise by the fiber optic cable manufacturer, the outside bend radius of the cable during installation shall be no less than 20 times the outside diameter of the fiber optic cable. Entry guide chutes shall be used to guide the cable into the handhole conduit ports. Lubricating compound may be used to minimize friction. Corner rollers (wheels), if used, shall not have radii less than the minimum installation-bending radius of the cable. A series array of smaller wheels can be used for accomplishing the bend if the cable manufacturers specifically approve the array.

If figure-eight techniques are used during cable installation, the cable shall be handled manually and stored on the ground. The cable shall be placed on tarps to prevent damage from gravel, rocks, or other abrasive surfaces. Tarps should also be used in muddy conditions to keep the cable clean. Enough area to accommodate the cable length to be stored and sufficient personnel to maintain the required minimum-bending diameter as well as avoid kinking or otherwise damaging the cable shall be provided. If the cable has been figure-eighted in preparation for a forward feed, the figure-eight must be flipped over to access the outside cable end. Provide sufficient personnel to avoid kinking the cable as the figure-eight is flipped over. When removing the cable from the figure-eight, use care to avoid kinking the cable and violating the minimum-bending diameter.

Power assisted or figure-eight eliminator equipment, which is used to eliminate manual figure-eight procedures, shall not be used unless specifically allowed by the cable manufacturer in writing.

The cable shall be blown or jetted into the microduct. The Contractor shall use a micro cable blowing machine designed for use with the particular cable being installed. A Compressed air cooler shall be used when ambient air temperatures reaches 68°F or more.

Where cable is to be pulled through existing conduit which contains existing cables, optical or other, the existing cables shall be removed and reinstalled with the fiber optic cable as indicated on the plans. The removal of the cable(s) shall be paid for separately. Reinstallation of the existing cables, if indicated on the plans, along with the fiber optic cable shall be included in this item for payment.

Added 11/8/2023

Construction Documentation Requirements

Installation Practices for Outdoor Fiber Optic Cable Systems

The Contractor shall examine the proposed cable plant design. At least one month prior to starting installation of the fiber optic cable plant, the Contractor shall prepare and submit to the Engineer for review and approval, ten (10) copies of the Contractor's "Installation Practices for Outdoor Fiber Optic Cable Systems" manual. This manual shall address the Contractor's proposed practices covering all aspects of the fiber optic cable plant. This submittal shall include all proposed procedures, list of installation equipment, and splicing and test equipment. Test and quality control procedures shall be detailed as well as procedures for corrective action.

Operation and Maintenance Documentation

After the fiber optic cable plant has been installed, ten (10) complete sets of Operation and Maintenance Documentation shall be provided. The documentation shall, as a minimum, include the following:

- Complete and accurate as-built diagrams showing the entire fiber optic cable plant including locations of all splices.
- Final copies of all approved test procedures
- Complete performance data of the cable plant showing the losses at each splice location and each terminal connector.
- Complete parts list including names of vendors.

Testing Requirements

The Contractor shall submit detailed test procedures for approval by the Engineer. All fibers (terminated and un-terminated) shall be tested bi-directionally at both 1310 nm and 1550 nm with both an Optical Time Domain Reflectometer (OTDR) and a power meter with an optical source. For testing, intermediate breakout fibers may be concatenated and tested end-to-end. Any discrepancies between the measured results and these specifications will be resolved to the satisfaction of the Engineer.

Fibers which are not to be terminated shall be shall be tested with a temporary fusion spliced pigtail fiber. **Mechanical splice or bare fiber adapters are not acceptable**.

The Contractor shall provide the date, time and location of any tests required by this specification to the Engineer at least 5 working (7 calendar) days before performing the test. Included with the notification shall be a record drawing of the installed fiber optic cable system. The drawings shall indicate actual installed routing of the cable, the locations of splices, and locations of cable slack with slack quantities identified.

Added 11/8/2023

Upon completion of the cable installation, splicing, and termination, the Contractor shall test all fibers for continuity, events above 0.1 dB, and total attenuation of the cable. The test procedure shall be as follows:

A Certified Technician utilizing an Optical Time Domain Reflectometer (OTDR) and Optical Source/Power Meter shall conduct the installation test. The test equipment used shall have been calibrated within the last two years. Documentation shall be provided. The Technician is directed to conduct the test using the standard operating procedures defined by the manufacturer of the test equipment. All fibers installed shall be tested in both directions.

A fiber ring or fiber box shall be used to connect the OTDR to the fiber optic cable under test at both the launch and receive ends. The tests shall be conducted at 1310 and 1550 nm for all fibers.

All testing shall be witnessed by the IDOT Engineer and a copy of the test results (CD ROM or USB Drive) shall be submitted on the same day of the test. Hardcopies shall be submitted as described herein with copies on CD ROM.

At the completion of the test, the Contractor shall provide copies of the documentation of the test results to the Project Engineer. The test documentation shall be submitted as two bound copies and three CD ROM copies, and shall include the following:

Cable & Fiber Identification:

- Cable ID
- Cable Location - beginning and end point
- Fiber ID, including tube and fiber color
- Wavelength
- Pulse width (OTDR)
- Refractory index (OTDR)
- Operator Name
- Date & Time
- Setup Parameters
- Range (OTDR)
- Scale (OTDR)
- Setup Option chosen to pass OTDR “dead zone”

Test Results shall include:

- OTDR Test results
- Total Fiber Trace
- Splice Loss/Gain
- Events > 0.10 dB
- Measured Length (Cable Marking)
- Total Length (OTDR)
- Optical Source/Power Meter Total Attenuation (dB/km)

Added 11/8/2023

Sample Power Meter Tabulation:

Power Meter Measurements (dB)									
Location		**Fiber No.**	**Cable Length (km)**	**A to B**		**B to A**		**Bidirectional Average**	
A	**B**			**1310 nm**	**1550 nm**	**1310 nm**	**1550 nm**	**1310 nm**	**1550 nm**
		1							
		2							
Maximum Loss									
Minimum Loss									

The OTDR test results file format must be Bellcore/Telcordia compliant according to GR-196-CORE Issue 2, OTDR Data Standard, GR 196, Revision 1.0, GR 196, Revision 1.1, GR 196, Revision 2.0 (SR-4731) in a ".SOR" file format. A copy of the test equipment manufacture's software to read the test files, OTDR and power, shall be provided to the Department. These results shall also be provided in tabular form, see sample below:

Sample OTDR Summary				
Cable Designation:	*TCF-IK-03*	**OTDR Location:**	*Pump Sta. 67*	**Date:** *1/1/00*
Fiber Number	**Event Type**	**Event Location**	**Event Loss (dB)**	
			1310 nm	**1550 nm**
1	*Splice*	*23500 Ft.*	*.082*	*.078*
1	*Splice*	*29000 Ft.*	*.075*	*.063*
2	*Splice*	*29000 Ft.*	*.091*	*.082*
3	*Splice*	*26000 Ft.*	*.072*	*.061*
3	*Bend*	*27000 Ft.*	*.010*	*.009*

The following shall be the criteria for the acceptance of the cable:

The test results shall show that the dB/km loss does not exceed +3% of the factory test or 1% of the cable's published production loss. However, no event shall exceed 0.10 dB. If any event is detected above 0.10 dB, the Contractor shall replace or repair the fiber including that event point.

The total loss of the cable (dB), less events, shall not exceed the manufacturer's production specifications as follows: 0.5 dB/km at both 1310 and 1550 nm.

If the total loss exceeds these specifications, the Contractor shall replace or repair the cable run at the no additional cost to the state, both labor and materials. Elevated attenuation due to exceeding the pulling tension, or any other installation operation, during installation shall require the replacement of the cable run at no additional cost to the State, including labor and materials.

Added 11/8/2023

Splicing Requirements

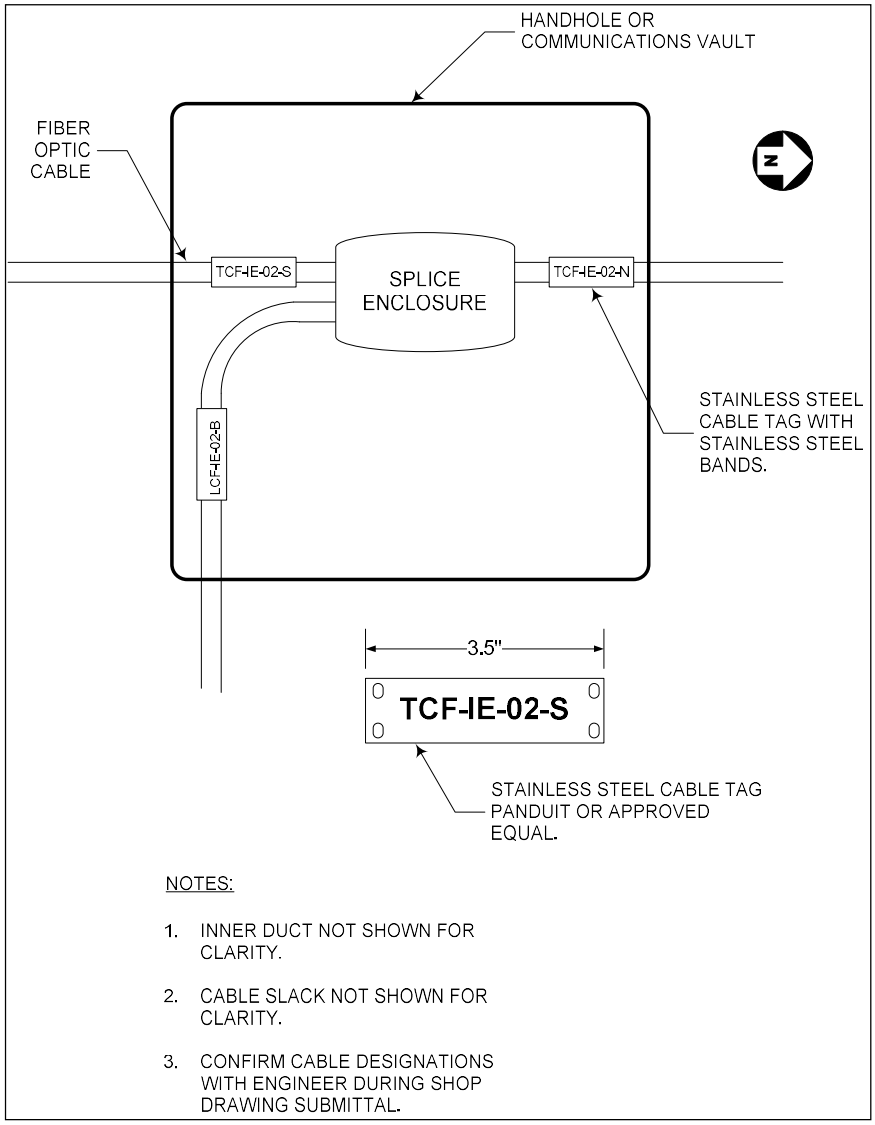
Splices shall be made at locations shown on the Plans. Any other splices shall be permitted only with the approval of the Engineer. Splices will be paid for separately. All splice locations must be identified in the Record Drawings. Cable runs which dead-end at a handhole, communications vault, interconnect cabinet, or any other type of enclosure, shall be dead ended in a splice enclosure.

Slack Storage of Fiber Optic Cables.

Included as a part of this item, slack fiber shall be supplied as necessary to allow splicing the fiber optic cables in a controlled environment, such as a splicing van or tent. After splicing has been completed, the slack fiber shall be stored underground in handholes or in the raised base adapters of ground mounted cabinets in accordance with the fiber optic cable manufacturer's guidelines. Fiber optic cable slack shall be 100 feet for each cable at each splice location, above or below ground. Fiber optic cable slack shall be 50 feet for each cable at access points, above or below ground, where splicing is not involved. If the innerduct is cut, the ends of the innerduct should extend beyond the first vertical rack so they can be secured at that point. This slack shall be measured for payment.

Fiber optic cable shall be tagged inside handholes with yellow tape containing the text: "CAUTION - FIBER OPTIC CABLE." In addition, permanent tags, as approved by the engineer, shall be attached to all cable in a hand hole or other break-out environment. These tags shall be stainless steel, nominally 0.75" by 1.72", and permanently embossed. These tags shall be attached with stainless steel straps, and shall identify the cable number, the number of fibers, and the specific fiber count. Tags and straps shall be Panduit or approved equal. See figure below:

Added 11/8/2023



Label the destination of each trunk cable onto the cable in each handhole, vault or cable termination panel.

Method of Measurement Fiber optic cable will be measured for payment in feet in place installed and tested. Fiber optic cable will be measured horizontally and vertically between the changes in direction, including slack cable. The entire lengths of cables installed in buildings will be measured for payment

Basis of Payment This work will be paid for at the contract unit price per foot for **FIBER OPTIC CABLE** of the type, size, and number of fibers specified. Payment shall not be made until the cable is installed, spliced and tested in compliance with these special provisions.

Added 11/8/2023

MODIFY EXISTING CONTROLLER CABINET (SPECIAL)

Description

This work shall consist of providing labor and materials necessary to modify an existing CCTV controller cabinet to accommodate Surveillance equipment. This work includes:

- Modification to existing cabinet components to allow the installation of a Wireless In-Pavement Vehicle Detector System, cellular modem, antenna, and associated cabling.
- Modifications may include, but are not limited to, relocation of existing cabinet equipment, modifications to the power supply, and configuration of cellular modem and network switch.
- Updating cabinet electrical drawings.

Construction Requirements

General requirements shall be in accordance with Section 801 of the Standard Specifications. Contractor shall install a cellular antenna to the outside of the cabinet. The cabinet penetration shall be environmentally sealed.

The contractor shall update the cabinet electrical drawings to illustrate connections to the new equipment.

Method of Measurement

This work will be paid for at the contract unit price for each controller cabinet modified and tested.

Basis of Payment

This work will be paid for at the contract unit price each for MODIFY EXISTING CONTROLLER CABINET, SPECIAL.

CELLULAR MODEM

Description

This work shall consist of furnishing, installing, integrating, and testing of an environmentally hardened CELLULAR MODEM and service coordination to provide ethernet connectivity with 334 cabinet as shown on plans.

Configuration of network equipment at IDOT's Headquarters will be performed by IDOT's Network Manager. Installation of cellular modem and ancillary equipment shall be performed in accordance with the Standard Specifications, except as modified herein.

General

(A) Furnish, install, integrate and test all equipment and required components, including antennas and antenna cables necessary to provide full and complete functionality in all respects.

Added 11/8/2023

(B) The Cellular Modem shall be compatible with the Verizon Wireless cellular wireless network. The Contractor shall be responsible for all fees associated with the cellular service plan during the duration of the contract. The initialization and monthly cellular service fees shall be paid for in accordance with Article 109.05 of the IDOT Standard Specifications. The monthly cellular service fees shall be transferred to IDOT at the end of the contract.

(C) Documentation detailing the bandwidth availability and utilization for each site shall be provided to IDOT by the Contractor. The device's necessary configuration software shall be provided to IDOT by the Contractor and shall be loaded on three of IDOT personal computers with all required licenses. The licenses shall be valid for a minimum of 2 years.

(D) Use identical and completely interchangeable equipment at each field location.

Functional and Performance Requirements

(A) Support Virtual Private Network (VPN) connections.

(B) Support firewall capabilities, such as, Internet Protocol (IP) block/allow listings.

(C) Provide an "always-on" connection, without dialing.

(D) Support local and remote management.

(E) Domain name addressable.

(F) Port Filtering.

(G) Generic Routing Encapsulation (GRE) Tunneling.

(H) IP Filtering.

(I) Media Access Control (MAC) Address Filtering.

(J) Provide a broadband communications link between DMS controller cabinets and IDOT Communications Center via the public cellular network.

Materials

The Cellular Modem shall meet the following requirements.

(A) Full duplex transceiver.

(B) SIERRA GX450 modem or approved equal

(C) Frequency Band and Cellular Network Interface.

1. Fourth Generation (4G) LTE models:
   a. Tri-band support for 700/1900/2100 megahertz (MHz);
   b. Backward compatible with: evolved high speed packet access (HSPA+), high speed packet access (HSPA), enhanced data-rates for GSM Evolution (EDGE), general packet radio service (GPRS) or evolution data only (EV-DO) (Rev. A), CDMA EV-DO (Rev. 0), CDMA 1x radio transmission technology (RTT) based on the selected provider's network.

Added 11/8/2023

2. Third generation (3G) CDMA models:
   a. Dual-band support for both 800 MHz and 1900 MHz;
   b. Backward compatible with CDMA 1xRTT and CDMA Interim Standard (IS)-95.
3. 3G HSPA+ models:
   a. Tri-band support for 850/1900/2100 MHz or quad-band support for 850/900/1800/1900 MHz;
   b. Backward compatible with: HSPA, universal mobile telecommunications system (UMTS), EDGE, GPRS, and GSM.

(D) Throughput.
1. Forward/download throughput of the cellular modem shall be 1 Mbps minimum.
2. Reverse/upload throughput of the cellular modem shall be 1 Mbps minimum.

(E) Ethernet Interfaces.
1. Support Transmission Control Protocol (TCP)/IP and User Datagram Protocol (UDP)/IP.
2. Registered Jacks (RJ)-45, IEEE 802.3 standard 10 Base-T Ethernet port for 3G cellular modems and 100 Base-TX Ethernet ports for 4G modems.
3. Minimum of 3 ethernet ports.
4. Provide network cables that are Electronic Industries Alliance (EIA) / Telecommunications Industry Association (TIA)-568-A complaint.

(F) Antenna.
1. Antenna assembly consists of two antennas spaced 22” apart on top of the cabinet.
2. Antenna cable shall be CBL-195-10FT-N1-S1 or approved equal.
3. Modem mountable omnidirectional external antennas rated for outdoor usage as defined in subsection H below.
4. Ohm SubMiniature version A (SMA) male connector.
5. Antenna cable shall be a PCTEL model BMLPVMB/LTE or approved equal.
6. Adapter part MVPHP with required adapters per the manufacturer’s recommendation
7. Signal loss due to cable length shall be minimized in order to meet throughput requirements.
8. Minimum Antenna gain of 2 database interface (dBi).
9. Right-angle swivel connector that allows for the antenna to be upright when connected to the cellular modem.
10. Operating Frequencies of 698-896 and 1700-2700 MHz.

(G) Management, Security, and Diagnostic.
1. Light-emitting diode (LED) indicators for Ethernet, power, cellular link/activity and signal strength.
2. Support signals for Transmit Data (TXD), Receive Data (RXD), Request To Send (RTS), Clear To Send (CTS), Data Terminal Ready (DTR), Data Set Ready (DSR), Data Carrier Detect (DCD) and hardware and software flow control.

Added 11/8/2023

3. Provide compatibility with Hypertext Transfer Protocol (HTTP)/HTTP Secure (HTTPS), Dynamic Host Communications Protocol (DHCP), Simple Network Management Protocol (SNMP) v2 or v3, Simple Mail Transfer Protocol (SMTP), Secure Socket Layer (SSL), Secure Shell (SSH)-2.
4. Web-based Graphical User Interface (GUI).
5. Command Line Interface (CLI) access via TELNET connection.
6. SNMP Management Information Base (MIB)-II and SNMP Traps.

(H) Power. Manufacturer recommended power supply shall be provided with the device.

(I) Environment.
1. Operating Temperature for Cellular Modem, Power Supply, Antenna, and all connectors. -22 degrees F to 158 degrees F.
2. Storage Temperature for Cellular Modem, Power Supply, Antenna, and all connectors. -22 degrees F to 158 degrees F.
3. Relative humidity for Cellular Modem, Power Supply, Antenna, and all connectors. 5 percent to 95 percent non-condensing.

(J) Mounting. All mounting hardware shall be supplied with the device.

Construction

(A) Install the cellular modem as indicated on the plans.

(B) Conduct a cellular site survey and submit to the Engineer for acceptance prior to the procurement of materials. The purpose of the survey is to measure the signal strength and throughput of cellular coverage at the project locations. Testing must include upload/download speeds, latency, and received signal strength. Alert the Engineer of any sites that do not have adequate signal strength or upload/download speeds. Testing is an appurtenance to the cellular modem and will not be paid for separately.

(C) Drill a hole in the top of the 334 cabinet to pass cables between external antenna and modem. Secure the external antenna to the cabinet and seal the cabinet penetration to prevent water entry.

(D) Install the cellular modem with proper settings to ensure interoperability and security, including VPN settings, local IP address, port forwarding and Network Address Translation (NAT), and IP-based filtering.

(E) Integrate and test the modem to meet IDOT specifications for integration and as shown on the plans.

(F) Provide a cellular modem with a standard manufacturer's warranty, transferable to IDOT. The cellular modem shall carry a warranty (parts, software and labor) of 4 years from the date of shipment with at least 3 years of warranty remaining at the start of burn-in. Furnish warranty and other applicable documents from the manufacturer, and a copy of the invoice showing the date of shipment, to the Engineer prior to final written acceptance.

Method of Measurement

This work will be paid for at the contract unit price for each modem installation.

Basis of Payment

This work will be paid for at the contract unit price per each for CELLULAR MODEM.

Added 11/8/2023

WIRELESS IN-PAVEMENT VEHICLE DETECTOR SYSTEM

Description. This work shall consist of furnishing, installing, configuring and testing a Wireless In-Pavement Vehicle Detector System at a location identified in the Plans or as directed by the Engineer.

Materials. The Wireless In-Pavement Vehicle Detector System shall include the following elements and features:

Wireless In-Pavement Detector

The Wireless In-Pavement Detector shall be a Wireless 2.4 GHZ Battery-Operated Sensor including epoxy (recommended by the wireless in-pavement VDS manufacturer):

- The Wireless Sensor shall transmit wireless vehicle detection and other output data to a Wired Radio Assembly or Repeater.
- The Wireless Sensor shall detect volume, occupancy and speed as shown in the plans and may be adjusted based on each deployment.
- The Wireless Sensor shall be designed for installation in pavement. Only a manufacturer's approved red epoxy shall be used to seal the in-pavement sensor into its resting hole. Prior to installation, the proposed details shall be submitted to the Engineer for approval.
- The Wireless Sensor shall be battery powered with minimum battery life of 5 years.
- Firmware of the Wireless Sensor shall be capable of being upgraded through wireless connection.
- The transmission range for a Wireless In-Pavement Detector shall meet the following requirements:

Height of Wired Radio or Repeater	Distance Range to Detector
Minimum of 30 feet above pavement elevation and cleared of any visual obstruction	Maximum of 150 feet with a minimum distance based on the mounting angle of the wired radio or repeater

- The Wireless In-Pavement Detector shall be NEMA 6P rated.
- The Wireless In-Pavement Detector shall operate within a temperature range of -40°F to + 176°F.

Added 11/8/2023

Wired Radio Assembly

The Wired Radio Assembly shall be a 2.4 GHZ Wired Radio Assembly including a mounting kit, associated cabling and surge protection device.

- The Wired Radio Assembly shall receive wireless output from in-pavement detectors or Repeaters.
- The Wired Radio Assembly shall operate within the temperature range -40°F to + 176°F (ambient).
- The Wired Radio Assembly shall be designed for mounting on an existing or proposed pole, tower or building per contract requirements or as directed by the Engineer.
- All other ancillary connection cables, brackets, and other items required for the installation of a fully functional Wireless In-Ground Pavement Sensor System are included under this provision. This includes required cabling, conduit and cabinet wiring needed from the Wired Radio to the In-Cabinet Isolation Module.

Wireless Detector In-Cabinet Processor Module

The Wireless Detector In-Cabinet Processor Module shall be an in-cabinet assembly central processor unit including power supply.

- The In-Cabinet Processor Module shall include manufacturer's license and capability for Ethernet connection to the IDOT Traffic Systems Center.
- The In-Cabinet Processor Module shall be powered via a 9-28 VDC input
- The In-Cabinet Processor Module shall operate within the temperature range -40°F to + 176°F (ambient).
- All required cabling, conduit and cabinet wiring needed from the In-Cabinet Processor Module to the IDOT network communications switch shall be paid for as part of this item.
- All required cabling, conduit and cabinet wiring needed from the In-Cabinet Processor Module to the In-Cabinet Isolation Module shall be paid for as part to this item.

Added 11/8/2023

Wireless Detector In-Cabinet Isolation Module

The Wireless Detector In-Cabinet Isolation Module shall be an In-Cabinet Surge Suppression and Isolation Module powered by in-cabinet processor module.

- An In-Cabinet Isolation Module shall be used between each Wired Radio Assembly and In-Cabinet Processor Module.
- The In-Cabinet Isolation Module shall support two Wired Radio Assembly ports.
- The In-Cabinet Isolation Module shall extend the communication range between the In-Cabinet Processor Module and Wired Radio Assembly from 33 feet to a maximum of 2000 feet.
- The In-Cabinet Isolation Module shall provide electrical isolation of 1500V.
- The In-Cabinet Isolation Module shall provide surge protection of up to 12A.
- The In-Cabinet Isolation Module shall provide AC power cross protection.
- All required cabling, conduit and cabinet wiring needed from the In-Cabinet Isolation Module to the In-Cabinet Processor Module shall be paid for as part of this item.
- In-Cabinet Isolation Module shall operate within the temperature range -40°F to + 176°F (ambient).

Wireless Repeater

The Wireless Repeater shall be a Wireless 2.4 GHZ Battery-Operated Repeater and mounting kit:

- The Wireless Repeater shall be capable of transmitting data up to 1,000 feet from the Wireless In-Pavement Detector to another Wireless Repeater or Wired Radio Assembly as shown on the contract plans.
- The Repeater shall have an operating temperature range -40°F to + 176°F.
- The Repeater shall be powered by a Long-life battery pack.

Dual Antenna Wireless Repeater

The Dual Antenna Wireless Repeater shall be a Wireless Battery-Operated Repeater with two antenna housings and two mounting kits:

- The Wireless Repeater shall be capable of transmitting data up to 1,000 feet, or 2,000 feet with optional long-range antenna, from the Wireless In-Pavement Detector to another Wireless Repeater or Wired Radio Assembly as identified in the manufacturer’s specifications and as shown on the contract plans.
- The Repeater shall have an operating temperature range from -40°F to + 185°F (ambient).
- The Dual Antenna Repeater shall be powered by a Long-life battery pack.

Added 11/8/2023

CONSTRUCTION REQUIREMENTS

The Contractor shall closely coordinate with the Engineer throughout the duration of the construction contract. This includes, but is not limited to, the following:

Pre-Procurement Meeting and Documentation Approval

- The Contractor shall submit for approval to the Engineer, within 10 business days from NTP, a detailed schedule showing dates for: product submittals and approvals; device configuration; construction/installation; testing; burn-in period; and warranty of each Wireless In-Ground Pavement Sensor System. This detailed schedule shall be included in the project schedule. Schedules for each Wireless In-Ground Pavement Sensor System to be deployed within the larger construction contract and shall be staggered based on resources to be employed.
- If this installation is part of a larger ITS deployment or construction project, then the furnishing, installation, calibration and testing of the Wireless In-Ground Sensor System site(s), shall be specifically noted in the overall project schedule.
- The Contractor shall submit for approval to the Engineer, within 10 business days from NTP, a completed Contractor Submittal Checklist and associated submittals.
- Design locations of each sensor system component including Wireless in-pavement vehicle detectors, wired radios, in-cabinet processor, and repeater locations shall be field verified and recommended for construction by the manufacturer in the submittal described below and shall be submitted to the Engineer for approval.
- The Contractor is responsible for the choice of communication channels for programming each wireless device and shall be approved by the Engineer.

The Contractor shall obtain approval of the schedule, catalog cut sheets, cabinet wiring diagrams, and calculations from the Engineer prior to purchasing any equipment and subsequently performing the installation per the approved documents, contract plans, and specifications.

Pre-Installation Requirements

- The Contractor shall follow the plans as no deviations shall be allowed.
- The Contractor and subcontractor employees assigned to work on the wireless sensor installation shall be required to attend installation training by the wireless sensor manufacturer prior to the installation of the equipment. Training certificates shall be submitted to the Engineer for record. The Contractor is advised that the Contractor's failure to request training sufficiently in advance of when the employee is required on the work site shall not be cause for relaxing the requirement for installation training. Upon completion of sensor installation training, each trainee will be issued a nontransferable sensor installation identification card with the trainee's photo and a decal with pressure sensitive adhesive to be affixed on the hard hat. The installation identification card and the decal are valid for one (1) year from the date of issue. The validity of the card and decal are in no way related to the length of this contract. Contractor and subcontractor personnel shall renew their installation identification cards annually by successfully completing installation training again. Contractor or subcontractor personnel who fail to maintain a valid sensor installation identification card are not permitted to work on sensor installation sites. The Engineer reserves the right to remove such personnel from the work site.

Added 11/8/2023

- The costs incurred by the Contractor for sensor installation training will not be reimbursed.
- Thirty (30) days prior to the scheduled field installation of each Wireless In-Ground Pavement Sensor System, the Contractor shall notify the Engineer of the anticipated delivery date of System(s) and name of the certified field installation personnel.
- The Contractor shall provide an A-14 form to the Engineer during acceptance of the equipment showing the equipment, each equipment specific serial number, and the field location of each piece of equipment. This form will be signed by both the Engineer and the Contractor.

Installation

- Each device (radio, in-cabinet processor, repeater, and sensor) shall be first upgraded to the latest firmware version, then configured in the field by the Contractor using manufacturer's configuration software and its installation parameters documented on the installation record form attached.
- The Contractor shall request IP addresses for the In-Cabinet Processor Module from the Engineer in writing by a minimum of two weeks prior to installation.
- The Contractor shall install sensor units in the pavement at locations shown in the plans following manufacturer recommended procedures for installation.
- Any costs resulting from damage incurred shall be the sole responsibility of the Contractor.
- The Contractor shall mount the Wireless Wired Radio Assembly and the Wireless Repeater units to the structures indicated on the plans, or other nearby locations as directed by the Engineer and as recommended by the manufacturer. Tapping existing poles to run cables inside the pole shall be included with this item.
- Poles and handholes penetrated to install the in-pavement wireless detection unit cables shall be environmentally sealed to prevent water entry. Contractor must use caution to avoid camera existing camera cables and lowering device cables within the pole. Existing infrastructure Damaged must be repaired at no additional cost to the contract.
- The Contractor shall configure appropriate RF channels and aim all repeaters and wired radios to provide a greater than -79dBm signal strength and greater than 90 LQI on all wireless RF path segments unless approved by the Engineer.
- During the site acceptance test, the Contractor shall coordinate with the Engineer to ensure that the Wireless In-Pavement Vehicle Detector System can communicate back to the IDOT Traffic System Center.

Testing

The Contractor shall be required to perform the following tests after the installation of the Wireless In-Ground Pavement Sensor System. The Contractor shall use the test plans within this special provision to conduct the following tests in the presence of the Engineer.

- First Unit Factory Acceptance Inspection
    1. Site Test
    2. System Test
    3. 30-Day Burn-in Period
    4. Final System Acceptance and Training

Added 11/8/2023

Site Testing

The purpose of the Site Test is to have the Contractor demonstrate to the Engineer that all Wireless In-Ground Pavement Sensor System components have been installed, connected, labeled, and configured correctly as per contract plans and as per the manufacturer's requirements. This installation shall result in the reviewing of accurate (per manufacturer's specification) volume and speed data at the site before being connected to the switch and communications system. The site testing also requires monitoring the speed and vehicle count manually for the specified duration.

For the Site Test to be accepted, the Contractor shall demonstrate to the Engineer that:

- The installation has been performed as per contract plans and as per the manufacturer's recommendations.

All connections are tight and cannot be dislodged by incidental contact from the Engineer.

- Verify presence and quality of Wireless In-Pavement Vehicle Detector System device data through visual checks to verify volume, occupancy, speed, and classifications as determined by the required functionality. Use a local laptop running manufacturer's configuration software to verify that the In-Cabinet Processor Module is receiving vehicle detection data from each sensor.
- Connect the In-Cabinet Processor Module Ethernet port Cat 6 cable into the communication network's assigned switch port.
- Configure the System Manager to recognize and accept data from the In-Cabinet Processor Module.
- The Wireless In-Ground Pavement Sensor System Detection form and configuration spreadsheet have been fully completed, signed by the Engineer at the finish of the Site Test. Configure each In-Cabinet Processor Module and sensor to achieve the accuracy specified below:
    - A minimum 20 vehicle count (manual and via the Sensor System) has been conducted, per lane, has accurately recorded the counts on the Volume Verification Sheet (attached to this specification), and the Volume Verification Sheet has been signed by the Engineer.
        - The counts from the Sensor System shall be within 10.0% of the manual counts taken.
    - A one for one vehicle comparison has been conducted when determining the recorded speed results on the Speed Verification Sheets (attached to this special provision).
        - The Contractor shall test a minimum of 40 vehicles per lane of traffic, per site. The observed average speed of the detector shall be within 10.0% of the average speed measured by the Lidar gun. If this requirement cannot be attained, then the Contractor shall adjust the unit and repeat the entire volume and speed tests.

Added 11/8/2023

- The Contractor shall perform a Subsystem Test during Site Testing, which will involve personnel on-site at the Wireless In-Pavement Vehicle Detector System stations and at the IDOT Traffic System Center to confirm that data collected by the Wireless In-Pavement Vehicle Detector System devices is being properly and accurately received by the IDOT Advanced Traffic Management System (ATMS). During the Subsystem Test, the Contractor shall provide qualified personnel to support the diagnosing and repair of Wireless In-Pavement Vehicle Detector System devices and ancillary components. These personnel shall be available for this support within 48 hours of notification of the need for their services.
- The In-Cabinet Processor Module diagnostic records application shall be run by the Contractor once every 30 minutes over a 6 hour period and all available parameters shall be recorded on a test data sheet. The parameters include average RSSI, LQI, # of reboots (of each sensor), stuck Hi, blips, and total counts by sensor, as well as average speed and deviation from average speed (if 3 sensors are installed in the lane). This speed data is to be compared with nearby loop detector count station data by the Contractor and any significant differences explained. The Subsystem Test Data Sheet and Test Report are to be delivered to the Engineer for approval prior to proceeding with the System test.

System Test

The System Test will be conducted by the Department.

The System Test demonstrates that the field devices can be operated at the IDOT Traffic System Center utilizing the Advanced Traffic Management Software.

For the System Test to begin the Contractor shall notify the Engineer in writing, within 5-Days prior to the start of System Testing, stating that all project Wireless In-Ground Pavement Sensor System sites are ready for integration into the IDOT ATMS:

System Acceptance of the Wireless In-Ground Pavement Sensor System

- Successfully complete a pre-final walk-through with the Engineer.
- Contact the Engineer, after the 5-Day request from above, to request that all Wireless In-Ground Pavement Sensor System sites within the project are tested for:
    - Communications connectivity from the IDOT Traffic System Center to each Wireless In-Ground Pavement Sensor System device.
    - Accurate Wireless In-Ground Pavement Sensor System data transmission from each Sensor System site to the IDOT Traffic System Center.
- Receive written approval from the Engineer verifying the communications connectivity and data transmission are within Department requirements.
- Receive written approval from the Engineer verifying the communications connectivity and data transmission are within the Department requirements, and that the System Test has passed and the 30-Day Burn-In Period has immediately started.

The Department will complete the System Test within 2 weeks of notification from the Engineer requesting that all Wireless In-Ground Pavement Sensor System sites be tested.

Added 11/8/2023

30-Day Burn-in Period

The purpose of the 30-Day Burn-in Period is to demonstrate that the Wireless In-Ground Pavement Sensor System communicates 100% of the time with the IDOT Traffic System Center and that accurate speed and volume data is being received during the duration of the test.

- In most cases, for every one (1) day the Contractor is required to mitigate/fix a problem, an additional one (1) day of testing will be added to the 30-Day test. If components need to be replaced, then the entire 30-day burn-in process shall restart.
- The Engineer will provide written approval upon successful completion of the 30-Day Burn-In period.

Final System Acceptance and Training

The final inspection of the Wireless In-Ground Pavement Sensor System will be performed by the Engineer in the presence of a representative of the Contractor. Final acceptance of the work associated with this pay item will be made after:

- Successful completion of the project final walk-through and successful resolution of the Engineer's punch list.
- Submission and written approval by the Engineer of all Record Drawings and Warranty documents including an electronic computer file (MicroStation and PDF) including a sketch of each ITS element assembly, user/operator manuals, listing each device's location, identification number, wireless channel information and GPS coordinates to the Engineer.
  - The Contractor shall provide three hard and three electronic (PDF) copies of each of the operation and maintenance manuals to the Engineer for approval.
- Notification of Final Acceptance will be sent in writing by the Engineer.

WARRANTY

All Wireless In-Ground Pavement Sensor Systems and associated components shall be warrantied and guaranteed against defects and/or failure in design, materials, and workmanship for one year from date of contract completion. The Contractor shall submit the warranty terms as part of each material item's shop drawing submittal for approval.

The warranty shall provide that, in the event of a malfunction during the warranty period, the defective system component shall be replaced with a new component by the manufacturer or his/her representative.

Any system component that, in the opinion of the Engineer, fails three (3) times prior to the expiration of the warranty will be judged as an unsuitable system and shall require the entire system be replaced by the device manufacturer or representative with a new system of the same type at no additional cost to the IDOT. The unsuitable system shall be permanently removed from the project. A failure shall also be defined as the field device becoming unable to comply with all applicable standards at the time of original construction.

Added 11/8/2023

All manufacturer's equipment guarantees or warranties shall be included in the maintenance manuals for the subject equipment.

Method of Measurement. This work will be paid for at the contract unit price for each at each site where the wireless in-pavement vehicle detector system is installed, configured and tested.

Basis of Payment. This work will be paid for at the contract unit price per each site WIRELESS IN-PAVEMENT VEHICLE DETECTOR SYSTEM.

The payment to the Contractor will adhere to the following schedule:

Sixty-five percent (75%) of the contract unit price will be paid by the Engineer at full completion of the requirements listed under the Site Test of the Wireless In-Ground Pavement Sensor System location(s). Written approval from the Engineer of acceptance of the Site Test is required before payment is released.

Twenty-five percent (25%) of the contract unit price will be paid after the acceptance of the 30-Day Burn-In period, Final System Acceptance, and Training by the Engineer in the presence of the Contractor. Written approval from the Engineer that Final Acceptance is required before payment is released.

REBUILD EXISTING HANDHOLE
Effective: January 1, 2002
Revised: November 1, 2023
895.04TS

This item shall consist of rebuilding and bringing to grade a handhole or double handhole at a location shown on the plans or as directed by the Engineer. The work shall consist of removing the handhole frame and cover and the walls of the handhole to a depth of eight (8) inches below the finished grade.

Handhole
Four (4) holes, four (4) inches in depth and one half (1/2) inch in diameter, shall be drilled into the remaining concrete; one hole centered on each of the four handhole walls. Four (4) #3 epoxy coated steel rebar, eight (8) inches in length, shall be furnished and shall be installed in the drilled holes with a masonry epoxy.

Double Handhole
Six (6) holes, four (4) inches in depth and one half (1/2) inch in diameter, shall be drilled into the remaining concrete; one hole centered on both short walls and two spaced equally on both long walls. Six (6) #3 epoxy coated steel rebar, eight (8) inches in length, shall be furnished and shall be installed in the drilled holes with a masonry epoxy.

Added 11/8/2023

All concrete debris shall be disposed of outside the right-of-way. All rebar must meet the specifications set forth in 1006.10.

The area adjacent to each side of the handhole shall be excavated to allow forming. All steel hooks, handhole frame, cover, and concrete shall be provided to construct a rebuilt handhole according to applicable portions of Section 814 of the Standard Specification and as modified in 814.01TS HANDHOLES Special Provision. The existing frame and cover shall be replaced if it was damaged during removal or as determined by the Engineer.

Basis of Payment.
This work shall be paid for at the contract unit price each for REBUILD EXISTING HANDHOLE, which price shall be payment in full for all labor, materials, and equipment necessary to complete the work described above and as indicated on the drawings.

JUNCTION BOX, TYPE J

Description.

This work will consist of furnishing and installing a stainless steel, Type “J” junction box with cover embedded in concrete as described herein, as shown on the plans and as directed by the Engineer. When used in a median barrier or parapet wall with a sloped face, the front of the junction box shall be sloped to match the barrier wall as depicted in Standard Drawings. The depth indicated in the dimensions shall be the bottom depth.

Construction Requirements.

Furnishing and installing the junction box shall meet the requirements according to Section 813 of the Standard Specifications, unless modified in this special provision.

Materials.

The junction box shall meet the requirements according to Section 1088.04 of the Standard Specifications, unless modified in this special provision. The junction box shall be continuously welded and consist of ¼” thick, Type 316 stainless steel with a stainless steel ¼” Type 316 cover, neoprene gasket and a minimum of ten 3/8” X ¾” 16 threads/inch flat-head stainless steel slotted screws.

Added 11/8/2023

Installation.

All junction boxes shall be water tight. Predrilled holes shall be provided for the applicable conduit size and location. Unless otherwise specified, conduits terminating at stainless steel boxes shall be terminated in conduit hubs. The cover shall be recessed within an outside frame, having a water-tight gasket mounted flush with the surface of this frame. Recessed stainless steel slot head screws shall secure the cover. Each box shall have a 4.625 inch diameter hole for installing a 4" diameter conduit on both sides of the box. For locations where conduits also exit through the bottom of the box, two additional 2.625 inch diameter holes shall be provided in the bottom of the box for installing the 2" diameter conduits. For locations where a junction box is to intercept an existing 4" surveillance conduit, a 4.625 inch diameter hole shall be provided on the appropriate side of the box.

Method of Measurement. Junction boxes shall be counted as, each installed. **Basis of Payment.** This item shall be paid at the contract unit price each for JUNCTION BOX, TYPE J, of the type and dimensions indicated, which price shall be payment in full for all labor and materials necessary to complete the work as described above.

BITUMINOUS MATERIALS COST ADJUSTMENTS (BDE)

Effective: November 2, 2006
Revised: August 1, 2017

Description. Bituminous material cost adjustments will be made to provide additional compensation to the Contractor, or credit to the Department, for fluctuations in the cost of bituminous materials when optioned by the Contractor. The bidder shall indicate with their bid whether or not this special provision will be part of the contract.

The adjustments shall apply to permanent and temporary hot-mix asphalt (HMA) mixtures, bituminous surface treatments (cover and seal coats), and preventative maintenance type surface treatments that are part of the original proposed construction, or added as extra work and paid for by agreed unit prices. The adjustments shall not apply to bituminous prime coats, tack coats, crack filling/sealing, joint filling/sealing, or extra work paid for at a lump sum price or by force account.

Added 11/8/2023

Method of Adjustment. Bituminous materials cost adjustments will be computed as follows.

$CA = (BPI_P - BPI_L) \times (\%AC_V / 100) \times Q$

Where: CA = Cost Adjustment, $.
BPI_P = Bituminous Price Index, as published by the Department for the month the work is performed, $/ton ($/metric ton).
BPI_L = Bituminous Price Index, as published by the Department for the month prior to the letting for work paid for at the contract price; or for the month the agreed unit price letter is submitted by the Contractor for extra work paid for by agreed unit price, $/ton ($/metric ton).
$\%AC_V$ = Percent of virgin Asphalt Cement in the Quantity being adjusted. For HMA mixtures, the % AC_V will be determined from the adjusted job mix formula. For bituminous materials applied, a performance graded or cutback asphalt will be considered to be 100% AC_V and undiluted emulsified asphalt will be considered to be 65% AC_V.
Q = Authorized construction Quantity, tons (metric tons) (see below).

For HMA mixtures measured in square yards: Q, tons = A x D x (G_{mb} x 46.8) / 2000. For HMA mixtures measured in square meters: Q, metric tons = A x D x (G_{mb} x 1) / 1000. When computing adjustments for full-depth HMA pavement, separate calculations will be made for the binder and surface courses to account for their different G_{mb} and % AC_V.

For bituminous materials measured in gallons: Q, tons = V x 8.33 lb/gal x SG / 2000
For bituminous materials measured in liters: Q, metric tons = V x 1.0 kg/L x SG / 1000

Where: A = Area of the HMA mixture, sq yd (sq m).
D = Depth of the HMA mixture, in. (mm).
G_{mb} = Average bulk specific gravity of the mixture, from the approved mix design.
V = Volume of the bituminous material, gal (L).
SG = Specific Gravity of bituminous material as shown on the bill of lading.

Basis of Payment. Bituminous materials cost adjustments may be positive or negative but will only be made when there is a difference between the BPI_L and BPI_P in excess of five percent, as calculated by:

$\text{Percent Difference} = \{(BPI_L - BPI_P) \div BPI_L\} \times 100$

Bituminous materials cost adjustments will be calculated for each calendar month in which applicable bituminous material is placed; and will be paid or deducted when all other contract requirements for the work placed during the month are satisfied. The adjustments shall not apply during contract time subject to liquidated damages for completion of the entire contract.

Added 11/8/2023