

STATE	PROJECT NO.	YEAR	SHEET NO.	TOTAL SHEETS
KANSAS	87 N-0673-01	2017	84	99

### 14.3 CONSTRUCTION REQUIREMENTS

#### 14.3.1 GENERAL

Stake the proposed location of all Type 334 ground mounted cabinets, indicating the direction that the doors will open for approval by the Engineer prior to excavating and pouring of the cabinet foundation. Place pole mounted cabinets so that the top of cabinet shall not exceed 6 feet above ground and cabinet orientation shall not expose workers to traffic. Receive approval by the Engineer for orientation of all cabinets prior to placement. Install all equipment in all ITS cabinets as shown in the Plans and allowing sufficient space between equipment for ease of maintenance and trouble-shooting. Do not locate any devices in the bottom 10 inches of the cabinet. Submit to the Engineer for approval all ITS cabinet layouts including wiring diagram, dimensional plans and cabinet population drawings. Size and space the ITS equipment racks to accommodate any future communications equipment shown on the Communication Routing Schematics shown on the Project Plans.

#### 14.3.2 WIRING

Use insulated, stranded copper wire. Neatly bundle and secure wiring with plastic cable ties. Route incoming field circuits horizontally from the conduit to the back of the cabinet, then vertically to the terminal block. Label all terminals and ensure they are not visibly obstructed. Identify all field leads by means of round aluminum identification tags with a minimum thickness of 0.1 mils attached to the cables with a copper wire to correspond with the Plans. Use outgoing circuits of the same polarity as the line side of the power supply, and the common return of the circuits of the same polarity as the ground side of the power supply. Provide the power supply through three single conductor cables. Carry the ground side of the power supply throughout the cabinet in a continuous circuit, and secured to a ground bus bar in an approved manner. Terminate all field conductors in the ITS cabinet.

#### 14.3.3 CABINET PANEL WIRING

Neatly bundle and secure all wiring on the cabinet panel with plastic cable ties. Use an expandable braided sleeve for any multi-conductor cable between the controller or auxiliary equipment and the back panel. Use discrete insulated wires and solder directly to lugs on the back of terminal blocks and sockets. Do not use printed circuit boards.

#### 14.3.4 CABLES

Locate and secure all cables such that they do not interfere with the removal of the rack mounted equipment or opening access panels on the equipment.

#### 14.3.5 CONDUIT ARRANGEMENT

Install the conduits placed in the controller base such that the appropriate conduit is placed at the location where wire running through it will be attached in the cabinet. Each cabinet may require different conduit placement. Carefully design conduit placement to prevent crossing of cables within the cabinet.

#### 14.3.6 DOCUMENT POCKET

Install a document pocket on the inside of the front door of the cabinet for storage of wiring diagrams, maintenance logs, cabinet elevation drawings, communication schematic drawings, and test results.

#### 14.3.7 CABINET RACK ELEVATIONS

Submit rack elevation drawings for each ITS cabinet and all racks modified in the KDOT designated facility. Provide rack elevation drawings that are drawn to scale; include front, back, and side elevations. Label each rack elevation with a summary title stating the location, type of cabinet, cabinet outside dimensions, and rack dimensions (19" rack with XXU slots). Indicate the placement of each rack-mounted or shelf-mounted piece of equipment, including vehicle detector equipment, cisco switches, DIN Rail Adapters, blank panels, and blank spaces. Show vertical dimensions in both inches and rack units (multiples of 1.75 inches). Conform to Documentation section of these specifications.

### 15.0 FIBER OPTIC CABLE, INSTALLATION, AND HARDWARE

#### 15.1 DESCRIPTION

Provide, install, terminate, and test fiber optic cable.

#### 15.2 MATERIALS

Provide fiber optic components that are compatible, designed for the purpose intended, and manufactured by a company regularly engaged in the production of material for the fiber optic industry. Provide all cable, components, or assemblies that are best quality, non-corroding, with a design life of at least 20 years. Provide all components or assemblies of the same from the same manufacturer. Provide all components that are the size and type required for the specified fiber.

#### 15.3 FIBER OPTIC CABLE

Provide fiber optic cables in compliance with Corning ALTOS All-Dielectric gel free cables for fiber counts of 2-288 fibers or approved equal and that comply with the following minimum requirements. Provide all fiber optic cable required for this project that are all dielectric, duct type, with loose buffer tubes and conform to these Specifications. Ensure that the Single Mode Fiber Optic (SMFO) cables contain single mode (SM) dual-window (1310 nm and 1550 nm) fibers. Ensure the multi-mode fiber optic (MMFO) cables contain graded index fiber at 850 nm and 1300nm with 62.5 micron core diameters.

Ensure the optical fibers are contained within loose buffer tubes. Ensure the loose buffer tubes are stranded around an all dielectric central member. Ensure that Aramid yarn and/or fiberglass is used as a primary strength member, and a polyethylene outside jacket is provided for overall protection. Provide and install fiber optic cables as shown in the Plans and specifications. Provide single mode fibers within the finished cable that comply with the requirements in the following table:

Parameters	Value
Mode	Single
Type	Step Index
Core diameter	8.3µm (nominal)
Cladding diameter	125µm±1.0µm
Core to Cladding Offset	≤ 0.6µm
Coating Diameter	245 µm±10µm
Cladding Non-circularity defined as: [1-(min. cladding dia ÷max. cladding dia.)]x100	≤ 1.0%
Proof/Tensile Test	690 Mpa, min.
Attenuation @ 1,310nm	≤0.40 dB/km
Attenuation @ 1,550 nm	≤0.35 dB/km
Attenuation at the Water Peak	≤ 2.1 dB/km @ 1383±3nm
Chromatic Dispersion:	
Zero Dispersion Wavelength	1301.5 to 1321.5 nm
Zero Dispersion Slope at zero dispersion wavelength	≤0.092 ps/(nm <sup>2</sup> *km)
Maximum Dispersion:	3.3 ps/(nm*km) for 1285 - 1330nm <18 ps/(nm*km) for 1550 nm
Cut-Off Wavelength	<1260 nm
Mode Field Diameter (Petermann II)	9.3±0.5µm at 1310 nm 10.5±1.0µm at 1550 nm

#### 15.4 COLOR CODING

Comply with EIA/TIA-598a "color coding of fiber optic cables."

#### 15.5 GENERAL CABLE PERFORMANCE SPECIFICATIONS

As part of the material submittal for the cable, include evidence that the cable meets the ANSI/ICEA S-87-640 design and test criteria.

#### 15.6 PACKAGING AND SHIPPING REQUIREMENTS

Provide documentation of compliance to the required specifications to the Engineer prior to ordering the material. Attention is directed to "fiber optic testing" elsewhere in these Specifications. Ensure the completed cable is packaged for shipment on reels. Ensure the cable is wrapped in weather and temperature resistant covering. Ensure both ends of the cable are sealed to prevent the ingress of moisture.

Securely fasten each end of the cable to the reel to prevent the cable from coming loose during transit. Provide six feet of accessible cable length on each end of the cable for testing. Ensure that the complete outer jacket marking is visible on these six feet of cable length.

Provide each cable reel with a durable weatherproof label or tag showing the Manufacturer's name, the cable type, the actual length of cable on the reel, the Contractor's name, the contract number, and the reel number. Include a shipping record in a weatherproof envelope showing the above information and also include the date of manufacture, cable characteristics (size, attenuation, bandwidth, etc.), factory test results, cable identification number and any other pertinent information. Ensure that the minimum hub diameter of the reel is at least 30 times the diameter of the Cable. Provide the cable in one continuous length per reel with no factory splices in the fiber. Ensure that each reel is marked to indicate the direction the reel should be rolled to prevent loosening of the cable. Include all installation procedures and technical support information in the Technical Reference Manual.

#### 15.7 FIBER OPTIC SPLICE CLOSURE

Provide all fiber optic splices closure that are a Corning Lanscape Solution Advanced Splice Closure, Splice Closure Family (SCF) Product, or approved equal that meets the following minimum requirements. Provide the end cap of the canister splice closure with two express ports for uncut backbone cables and a minimum of four quick-seal TM mechanical seal cable ports for branch cables or additional backbone cables. Provide fiber optic splice closures with splice trays from the same manufacturer as the splice closure and with sufficient quantity of trays to account for all proposed splices required on the Plans at each splice point plus an additional two trays for future splicing capacity. Suspend all splice closures off floor of vault.

Do not use pressurized splice closures.

For end of reel splicing, use an approved fiber optic splice enclosure sized to accommodate full cable splice in one enclosure.

#### 15.8 FIBER OPTIC CABLE ASSEMBLIES

Provide cable assemblies (jumpers and pigtailed) that are Corning Lanscape Solution cable assemblies or approved equal that meets the following minimum requirements. Provide the cable used for cable assemblies that is made of fiber meeting the performance requirements of these Specifications for the fiber optic cable being connected. Provide Manufacturer's attenuation test results for all cable assemblies. Provide breakout cables that comply with the specifications for pigtailed.

#### 15.8.1 PIGTAILS

Provide pigtailed that are of simplex or duplex construction, in 900 micrometer tight buffer form, surrounded by aramid yarn for strength, with a connector on one end. Provide an outer jacket that is yellow PVC with a nominal diameter of 3 mm, marked with the Manufacturer's identification information. Provide all pigtailed a minimum of one meter in length. Provide pigtail connectors that are factory terminated. Field terminations are not permitted. Follow the installation procedures outlined for fiber optic cables for pigtailed installed in conduit, except that the pulling tension shall not exceed 200 pounds.

#### 15.8.2 JUMPERS

Jumpers may be of simplex or duplex design. Provide all jumpers to be at least six feet in length, sufficient to avoid stress and allow orderly routing. Provide jumpers that have connectors on both ends. Ensure that the outer jacket of duplex jumpers is yellow for all single mode; orange for 62.5µm multimode; aqua for 50µm multimode jumpers. Ensure that the two inner simplex jackets have contrasting colors to provide easy visual identification for polarity. Ensure that all jumper connectors are factory terminated. Do not use field terminations.

#### 15.8.3 CONNECTORS

Use LC connectors for all new connectors. Many existing connectors are SC. Use SC to LC jumpers to mate with equipment when required to assure all new connectors are type LC. Do not apply index-matching fluids, gels, or anti-reflection coating to the end of the fiber. Ensure that the connector operating temperature range is -40°C to +75°C. Ensure that typical insertion loss is 0.2 dB (or better) and the return reflection loss is 50 dB (or better). Ensure that connection durability is less than a 0.2 dB change per 500 mating cycles per EIA-455-21A (FOTP-21). Provide connectors with a blue color body or boot.

#### 15.8.4 FACTORY TESTING

Provide all pigtail and jumper connectors that are factory-installed and tested. Do not install connectors in the field.

#### 15.9 FIBER DISTRIBUTION UNIT (FDU)

Use the fiber distribution unit (FDU), also referred to as patch panels, to terminate fibers in all cabinets containing fiber terminations. Provide units that are capable of terminating the required number of fibers, as is indicated on the Plans. Use terminations that are SC or LC (as indicated on the plans), -bulkhead connectors which match the fiber optic jumper cables used for connection to the optical termination equipment in the controller assembly. Do not allow fiber optic splicing to occur outside of splice trays housed within the fiber distribution units. Provide all units located in POP buildings to be rack mountable in an EIA 23-inch rack. Provide all units located in roadside devices to be rack mountable in an EIA 19-inch rack. Use units that are of the minimum necessary dimensions to terminate the quantity of fibers indicated on the Plans as to maximize the total amount of available rack space. Provide units which terminate 6 or 12 fibers that occupy no more than one rack unit of space within the cabinet. Comply with the requirements of ANSI/TIA/EIA-568-A and ANSI/TIA/EIA-606.

#### 15.10 CONSTRUCTION REQUIREMENTS

Install all equipment per the manufacturer's instructions and industry standards. Do not exceed equipment and material ratings. When cable is delivered to the site, conduct optical time domain reflectometer (OTDR) tests on-the-spool. See testing section of these specifications.

#### 15.10.1 INSTALLATION AND SPLICING QUALIFICATIONS

Submit resumes and references detailing fiber splicing and installation experience for on-site personnel to the Engineer for approval. The subcontractors used on this project are considered part of the contractor's team and are also required to submit resumes and references. Submit to the Engineer references including client project manager, phone number and project experience. Failure to comply may result in a declaration of noncompliance. Provide necessary documentation of subcontractor qualifications to the Engineer upon request.

Minimum requirements for on-site personal involved in the installation and testing of fiber optic cable and fiber optic splicing equipment are: two years experience in the installation, testing, use, and maintenance of fiber optic cable and fiber optic splicing equipment.

In addition, ensure that a member of the contractor's team, that meets the above qualifications and has been approved by the Engineer, is on site at all times during the fiber optic cable installation and fiber optic splicing work until successful completion of the work. Receive approval from the Engineer for any substitution of this individual. The Engineer may stop activity on this project as a result of the absence of this on-site personnel from the project and may continue to charge time to the contractor and will not grant a time extension. Demonstrate successful completion of fiber optic installation and splice training courses. Provide any certificates.

KANSAS DEPARTMENT OF TRANSPORTATION			
ITS EQUIPMENT SPECIFICATIONS			
ITS-SIO		VERSION DATE: 05-29-17	
APP'D	DESIGNED	QUANTITIES	TRACED
DESIGN CK.	DETAIL CK.	QUAN. CK.	TRACE CK.