

## Section 674 Intelligent Transportation Systems - Cable

### 674.1 Description

- (1) This section describes providing, removing, and reinstalling ITS electrical wire and communications cable.

### 674.2 Materials

#### 674.2.1 ITS Communication Cable

- (1) Furnish communication cable conforming to IMSA 20-6. Use 6 pairs of 18 AWG in each cable. Turn individual pairs 12 turns per foot within the cable.
- (2) Furnish ITS communication cable and terminations conforming to Rural Electrification Administration (REA) specification PE-22. Use 6-pair, 12-pair, or 25-pair communications cable 19 AWG solid copper with color-coded polyethylene insulation, black polyethylene outer jacket, and aluminum tape shield between jackets required to connect ramp meter and detector processor assemblies.

#### 674.2.2 Microwave Detector Cable

- (1) Furnish 12 twisted pairs, 19 AWG, solid copper or color-coded polyethylene insulation, black polyethylene outer jacket, aluminum tape shield between jackets, and gel filled. The pair-utilization shall be as follows:

Pair 1: power.	Pair 7: detection zone contact closure.
Pairs 2 and 3: RS-232 bus for laptop computer.	Pair 8: detection zone contact closure.
Pair 4: detection zone contact closure.	Pair 9: detection zone contact closure.
Pair 5: detection zone contact closure.	Pairs 10 through 12: spare.
Pair 6: detection zone contact closure.	

### 674.3 Construction

#### 674.3.1 ITS Communication Cable

- (1) Under the Cable ITS Communication bid items, install 6 pair, 12 pair, and 25 pair copper communication cable as the plans show.
- (2) Install, terminate, and test twisted pair copper communications cable in the processor cabinets in order to transmit and share data communications between cabinets.
- (3) Prevent copper communication cable from damage during installation and storage. Do not step on or run over by any vehicle or equipment. Do not pull along the ground, or over or around obstructions.
- (4) Seal copper communication cable ends during installation using a heat shrinkable end cap. Do not use tape. Keep sealed until termination. For cable not immediately terminated, provide a 4-foot length of cable extending out of the cabinet opening.
- (5) Use cable grip to pull cable through conduit designed to provide a firm hold on exterior covering of cable.
- (6) Do not pull copper communication cable through any intermediate junction box, pull box, or any other opening in conduit or duct, unless the engineer approves. Pull the necessary length to be installed from the pull box or cabinet to the immediate next downstream pull box or cabinet. Carefully store remaining length of copper communication cable to prevent damage and in a manner not hazardous to pedestrian or vehicular traffic. Cable shall enter a pull box or cabinet directly from the cable reel or storage directly out of the immediate downstream pull box or cabinet.
- (7) Install copper communication cable without splices between hub or processor assembly cabinets.
- (8) Do not exceed the minimum bending radius at anytime during installation. Do not pull over edges or corners, over or around obstructions, or through unnecessary curves or bends. Copper communication cable shall be looped in and out of cabinets and pull boxes to provide adequate slack and minimize stress on conductors.
- (9) Use manufacturer's recommended pulling tension for pulling copper communication cable by the outer jacket or 80 percent of the manufacturer's maximum pulling tension whichever is smaller.
- (10) Use engineer-approved lubricant at manufacturer's recommended quantity to facilitate pulling cable. Lubricate as it is fed off of the cable reel or storage stack into the cable feeder. Place lubricator funnel around the cable just ahead of the feeder. After installation, clean the copper communication cable with a cloth at a pull box or cabinet before leaving.
- (11) Unless the plans show otherwise, provide slack in the cable of one full turn in box for pull boxes and a minimum of 6 feet for cabinets.
- (12) Terminate cable pairs entering a cabinet on termination blocks located in cabinets in a neat and orderly fashion and according to the REA color code. Ground cable shield for each run at only one of the termination locations. Attach 8 AWG grounding wire to the shield with an engineer-approved clamp according to REA PC-2.

(13) Test the copper communication cable following installation:

- Use a megger to test the ground resistance of all conductors including the shield, and conductor-to-conductor, including all individual conductors to the shield. Ensure that conductor tests, including the shield, read greater than 500 mega ohms to ground, and from conductor to conductor and all individual conductors to the shield, read greater than 500 mega ohms. Replace cable with one or more failing tests..
- Test continuity of each pair to show a resistance of not more than 8 ohms per 1000 feet of conductor. Use meter with a minimum input resistance measurement of 20,000 ohms per volt.

**674.3.2 Microwave Detector Cable**

- (1) Install and test cables and connectors required to connect the microwave detector assembly with the processor assembly as the plans show.
- (2) Prevent cable from damage during installation and storage. Do not step on or run over by any vehicle or equipment. Do not pull along the ground, or over or around obstructions.
- (3) Seal cable ends at all times during installation using a heat shrinkable end cap. Do not use tape. Keep sealed until connectors are installed.
- (4) Install cable without splices between microwave detectors and processor.
- (5) Provide slack in the cable as the plans show. Provide a minimum of 6 feet for cabinets.
- (6) Test the cable following installation as follows:
  - Use a megger to test the ground resistance of conductors including the shield, and conductor-to-conductor, including all individual conductors to the shield. Ensure that all conductor tests, including the shield, read greater than 500 mega ohms to ground, and from conductor to conductor and all individual conductors to the shield, read greater than 500 mega ohms. Replace cable with one or more failing tests.
  - Test continuity of each pair to show a resistance of not more than 8 ohms per 1000 feet of conductor. Use meter with a minimum input resistance measurement of 20,000 ohms per volt.

**674.3.3 Removing Cable**

- (1) Remove the existing group of cables within a section of existing conduit as the plans show.
- (2) Use caution not to damage any remaining cables from existing conduits as the plans show. Remove existing cable connections from the cabinet or remove splices.
- (3) Test cable continuity, and identify and mark cables before removal to ensure proper reconnection.
- (4) Demonstrate and document existing damage to engineer. Non-compliance to demonstrate and document existing damage shall make repair the responsibility of the contractor.

**674.3.4 Reinstalling Cable**

- (1) Reinstall existing group of cables removed within a section of conduit as the plans show.
- (2) Provide a liberal coating of an engineer-approved electrical varnish or sealant to allow flexible protection from oil, moisture, and corrosion.
- (3) Provide a pressure or compression fitting for electrical splices and connections from the department's approved products list.
- (4) Replace damaged cables in kind at no additional expense to the department.
- (5) Remake all cable connections.

**674.4 Measurement**

- (1) The department will measure the Cable ITS Communication bid items by the linear foot acceptably completed, measured along the centerline of the conduit, including slack between terminations within the ramp meter processor assemblies.
- (2) The department will measure Cable Microwave Detector by the linear foot acceptably completed, measured along the centerline of the conduit, including slack to its connection with the proper terminals in the processor assembly cabinet.
- (3) The department will measure Remove Cable by the linear foot acceptably completed, measured along the centerline of the conduits removed between 2 points such as pull boxes, manholes, or other points defined.
- (4) The department will measure Reinstall Cable by the linear foot acceptably completed, measured along the centerline of the conduit run in which the group of cables was reinstalled.

**674.5 Payment**

- (1) The department will pay for measured quantities at the contract unit price under the following bid items:

<u>ITEM NUMBER</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
674.0100 - 0199	Cable ITS Communication (pairs)	LF

674.0200	Cable Microwave Detector	LF
674.0300	Remove Cable	LF
674.0400	Reinstall Cable	LF

- (2) Payment for the Cable ITS Communication bid items is full compensation for providing cables; for making connections and testing installed cable system; and for disposing of surplus material.
- (3) Payment for Cable Microwave Detector is full compensation for providing cable and connectors; for making necessary connections; and for testing.
- (4) Payment for Remove Cable is full compensation for removing existing cables; for undoing connections and terminations, including wire nuts, splice kits, tape, insulating varnish or sealant, and ground lug fasteners; and for testing.
- (5) Payment for Reinstall Cable is full compensation for reinstalling existing cables; for remaking connections, including wire nuts, splice kits, tape, insulating varnish or sealant, and ground lug fasteners; and for testing.
- (6) The department will not pay for replacing cable not attaining a required resistance greater than 500 mega ohms.