# SECTION 18370
# SIGNAL WIRE AND CABLE

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Section includes requirements for all cable and wire required for signal and signal power system wiring to wayside shelters, junction boxes, and factory wired mechanisms.

### 1.02 REFERENCE STANDARDS

A. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Communications and Signals Manual of Recommended Practices (C&S Manual). When following the recommendations of the AREMA C&S Manual substitute the word "shall" for the word "should" in the applicable Manual Part.

B. International Organization of Standardization (ISO):

1. 9001 Quality Management Systems Requirements

### 1.03 SYSTEM DESCRIPTION

A. Material and workmanship shall be of the highest quality, assuring durability for minimum life expectancy of 40 years. Cables shall be suitable for use in the environment to be encountered on a railroad signal system, and shall be certified for continuous operation, in wet or dry locations, with no conductor failing in continuity or with loss of insulation to cross or ground less than one megohm.

### 1.04 SUBMITTALS

A. Product Data: Manufacturer's catalog cuts, material descriptions, and specifications for each type of wire and cable the Contractor proposes to provide.

B. Quality Assurance: Submit a list of cable manufacturer's installations complying with the past performance and experience requirements specified herein.

### 1.05 QUALITY ASSURANCE

A. Cable manufacturer's qualifications shall be as follows:

1. Past Performance and Experience: Demonstrated previous successful experience in supplying cable to the railway or transit industry for use as vital signal control cables. A list of such installations shall be provided for each cable manufacturer to be considered.

2. Quality Assurance Program: The manufacture of cables in accordance with the requirements of these specifications shall be accomplished in compliance with a Quality Assurance Program that meets the intent of ISO 9001.

## 1.06 DELIVERY, STORAGE, AND HANDLING

A. Shipping, storage, and handling shall be in accordance with the recommendations of AREMA Signal Manual, Part 10.4.1.

B. During storage and handling, prior to final conductor termination, cable ends shall be sealed to prevent the entrance of moisture.

# PART 2 – PRODUCTS

## 2.01 INTERNAL WIRE AND CABLE

A. Individual cable make-up and conductor sizes shall be as shown on the Contract Drawings.

B. Internal wire and cable shall conform to the recommendations of AREMA C&S Manual, Part 10.3.14, and the following requirements:

1. Solid conductors shall be Type I in accordance with AREMA C&S Manual Part 10.3.14.

2. Stranded conductors shall be Type II in accordance with AREMA C&S Manual Part 10.3.14.

C. Internal wire and cable insulation shall conform to the recommendations AREMA C&S Manual Part 10.3.24 and the following requirements:

1. The minimum insulation rating shall be 600 volts.

## 2.02 EXTERNAL WIRE AND CABLE

A. General

1. Individual cable make-up and conductor sizes shall be as shown on the Contract Drawings.

2. Conductors shall be soft or annealed copper, coated with tin in accordance with Type I wire as shown in the applicable AREMA C&S Manual Part.

3. Stranded conductors shall be soft or annealed copper, coated with tin in accordance with Type II wire as shown in the applicable AREMA C&S Manual Part.

B. Track Wire

1. Track wire shall be Okonite-Okolene(EP-PE) manufactured by Okonite Co., or Engineer approved equal.

2. Track wire shall meet the recommendations of AREMA C&S Manual, Part 10.3.15.

C. Signal, Switch, and Express Cable

1. Wire and cable used for direct burial to signals, to switches and express cable shall be Okonite (EP) Armored Underground Signal Cable manufactured by Okonite Co., or Engineer approved equal.

2. Conductors number six (#6AWG) and smaller shall be solid. Conductors number 4 (#4AWG) and larger shall be stranded.

3. Armored cable used for direct burial shall be furnished with a 10-mil flat bronze tape between the conductors and the outer jacket, helically applied, and adequately cushioned from the conductors.

4. Armored cable shall meet the recommendations of AREMA C&S Manual, Part 10.3.17.

5. Any cable installed in conduit or trough for its entire run need not be armored, but shall meet the recommendations of AREMA C&S Manual Part 10.3.16.

D. AC Power Cable

1. AC power shall be Okonite-FMR (EP) Okolon (CSPE) Type TC Cable manufactured by Okonite Co., or Enginer approved equal.

2. Cable shall meet the recommendations of AREMA Signal Manual, Part 10.3.16.

E. Modem Cable

1. Modem cables shall be C-L-X Type SP-OS manufactured by Okonite Co., or Engineer approved equal.

2. Modem cable shall be protected by a moisture impervious, continuously welded, corrugated, aluminum sheath with an overall EFTE fluoropolymer jacket.

3. Individual twisted pairs shall be separately shielded with an aluminum polyester tape to provide shield isolation between pairs of 100 megohms per 1000 ft. minimum.

4. Modem cable shall meet the requirements of AREMA Signal Manual, Part 10.3.17 except as specified herein.

## 2.03 SOURCE QUALITY CONTROL

A. Coordinate with the Engineer for Engineer's inspections and tests at point of product.

B. Provide, at the point of production, apparatus and labor for the following tests:

1. Conductor size and physical characteristics

2. Insulation HV and IR tests

3. Physical dimension tests

4. Special tests on materials in coverings

5. Final HV, IR, and conductor resistance tests on shipping reels

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. General:

1. The installation of wire and cable shall conform to AREMA C&S Manual Parts 10.4.1, 10.4.30, except as specified herein.

2. All external cable runs shall be direct burial or in conduit in accordance with the PCJPB Communication & Signaling Standard Drawings, and as called for in the Contract Drawings.

3. The Contractor shall separate signaling cables from parallel run of ac feeder cables, where adjacent locations are fed from one ac service location.

4. Give the Engineer 24 hours notice prior to installing cables.

5. Provide sufficient slack in cable conductors at all terminating posts to enable three terminations of the conductor, due to broken eyelets without re-servicing or repotheading the cable.

6. In certain types of installation, the cable cannot be constrained; therefore, ample cable slack shall be provided for additional flexibility due to vibration of such equipment.

7. Do not bend cables to a radius less than manufacturer's recommendation.

8. Distribution cable runs shall be continuous without splices between cable terminating locations. Express cable runs longer than cable lengths shall be spliced together in junction box, instrument case, or other acceptable shelter. Prior to any cable or wire splicing, obtain the Engineer’s approval. Approval will not be granted for cables damaged by the Contractor or vandalized by others. It is the responsibility of the Contractor to protect all cables until final installation.

9. Identify individual cable conductors at each cable termination with plastic tags, as specified in Section 18360, Signal Systems Miscellaneous Products. Identify and terminate all spare conductors in each cable.

10. Seal cable entrance openings in equipment enclosures and junction boxes with either compression type fitting or pliable sealing compound after the cable is in place. Use sealing compound to seal the area around cable where the cable emerges from the end of a conduit or pipe. Seal and plug all spare conduits.

11. Wherever multiple conductor cables are terminated, carefully remove the outer sheath of the cable to a minimum point of 3 inches from the cable entrance. At the end of the cable sheath or covering, apply two layers of plastic electrical tape.

12. Terminate all cable conductors in conductor sequence from top to bottom.

13. Cable shields or sheaths shall be grounded at the entrance to signal shelters and shall float when terminated in field apparatus.

B. Underground Buried Installation

1. Bury cable to a uniform minimum depth of 36 inches as measured from bottom of tie to top of cable, unless installed in a cable trough. When paralleling the tracks, bury cable a minimum depth of 36 inches as measured from the finished grade to top of cable. Lay cable loosely in trench with a sand bed and backfill as specified in these Specifications. Install cable within four-inch PVC schedule 80 conduit at a uniform minimum cover depth of 36 inches below grade when passing under tracks.

2. Upon request and only under extreme circumstances because of installation hardship will installation of a cable be allowed to a depth of less than 36 inches, subject to the Engineer's acceptance. Protect the cable in a manner acceptable to the Engineer.

3. Whenever any signal cable is to pass under pavement or roadway, if existing conduit is not provided, install cable in a 4-inch PVC Schedule 80 conduit and extend conduit 2 feet beyond the edges of the pavement. Installation of conduits and pull boxes shall be in accordance with Caltrain Standard Drawings (SD-5000 series), for typical installations. Restore pavement or roadway to its original condition, subject to the Engineer's acceptance.

4. Whenever any signal cable is to pass under the hot-mix asphalt concrete (HMAC) underlay installed at interlockings, install cable in conduit with pull boxes in accordance with Caltrain Standard Drawings (SD-5000 series).

5. Where cable leaves the ground at other than buildings or in foundations, protect cable by a bootleg or other covering extending above the ground line. Fill top of such protective coverings with a sealing compound.

6. Where buried cables enter a concrete foundation, junction box, shelter or case, leave sufficient slack in each cable in the nearest pullbox to allow an additional one foot of cable to be pulled into the shelter or junction box.

7. The potheading of buried cables shall be applied whenever cable is terminated in signal equipment, and such termination is within two feet

of the grade level. This neoprene and seal pothead shall be installed in accordance with the manufacturer's instructions.

8. Cables shall not cross one another when they are pulled into a conduit or pipe; the conductors shall not be pulled tight or kinked in conduit fittings or boxes. All cables to be installed in a conduit or pipe shall be pulled and installed simultaneously.

9. Cables, track wire, and conduits shall be installed per Contract Drawings and Sections 02300 Earthwork.

10. All cables except final connection of flex wires to rail shall be installed in a conduit system as shown on the Contract Drawings.

C. Special Protection: Provide appropriate special protection for cables in areas where the cables are unavoidably exposed to hazardous conditions, such as vibration or sharp corners on equipment. Replace any cable that is installed but subsequently damaged prior to acceptance as a result of the Contractor's failure to provide such special protection.

D. AC Power Cable

1. AC power cable shall be installed in dedicated conduit from the service meters to the signal shelters and between signal shelters.

## 3.02 REPAIR

A. Immediately call to the Engineer’s attention any instance of damaged cable observed at any time, whether prior to installation, occurring during construction, or discovered by test observation after installation. The method of correction shall be in accordance with the Engineer's written instruction. Promptly repair such damage.

## 3.03 FIELD QUALITY CONTROL

A. Test all installed external cable in accordance with the requirements of Section 18600, Signal Systems Testing, and AREMA C&S Manual, Part 10.4.30.

# END OF SECTION