Special Specification 6181

High Bandwidth Coaxial Cable

1. DESCRIPTION

Furnish, install, and test coaxial cable for high bandwidth communications. Included in this Item are all terminating connectors and associated equipment required for the installation and testing in a field environment.

Typical ITS applications for high bandwidth coaxial cable include, but are not limited to: video transmission applications; transponder readers; spread-spectrum radio; wireless communications systems. Some applications will utilize high-bandwidth or low-loss coaxial cable depending on length of run and equipment requirements.

2. MATERIALS

2.1 **General Requirements.** Provide new cable and connectors that are in conformance with the details shown on the plans and in this specification. The cable must be free of deformations, holes, splits, and splices.

All cable provided for underground installation must contain the Outside Plant designation for outdoor usage and must be rated Non-Plenum.

Provide cable in compliance with the most current version of the following industry standards:

- NFPA National Electric Code (NEC),
- ANSI/TIA-568-C.4 Broadband Coaxial Cabling and Components, and
- Underwriters Laboratory (UL).

Provide cable conforming to the gauge, type, impedance, and length shown on the plans. Compare the line loss criteria of the cable gauge supplied with the manufacturer line loss requirements specific to the cable application and overall run length.

See Table 1 for typical high bandwidth coaxial cable types and distance limitations.

Table 1
Typical High Bandwidth Coaxial Cable
Distance Limitations for Video Applications

Cable Type	Typical AWG Gauge	Recommended Maximum Cable Run[1]
RG-59/U	#20, #22 AWG	350 ft
RG-6/U	#18 AWG	450 ft
RG-11/U	#14, #18 AWG	750 ft

1. Cable distance limitation to be verified according to manufacturer for the cable application. Improper cable selection for video transmission requirements could result in dim or faint picture quality.

For longer cable runs than recommended above, verify the conductor gauge provided will meet signal length of run recommendations for the cable application.

All cable provided is to be manufactured with permanent markings at approximate 2 ft. intervals on the outer jacket according to manufacturer name, serial number, type, Underwriters Laboratory list and classification for identification purposes.

2.2 **Physical Requirements.**

2.2.1 **Conductor.** Cable must be tinned copper or bare copper conductor of stranded (braided) construction.

2.2.2 **Insulation**. Cable must be of foamed, cellular, or solid dielectric construction. Dielectric material must adhere to and support the center cable conductor.

2.2.2.1 **Insulation Material**. High-density polyethylene or equivalent.

2.2.3 **Shielding**. Provide a combination foil-polyester and copper braid shield to reduce EMI interference.

2.2.3.1 **Coverage.** Provide 100% effective foil coverage, minimum 95% braided coverage.

2.2.4 **Outer Jacket.** Outer jacket must be rated for heavy duty ultraviolet (UV) exposure, sunlight, oil, and weather resistance necessary for outdoor installation.

2.2.4.1 **Jacket Material.** Industrial grade PVC or polyethylene or equivalent.

2.2.5 **Connectors**. Connectors must be matching, weather resistant, water and moisture proof, and outdoor-rated hardware that meet cable operating voltage, temperature, and impedance characteristics.

The termination connector must be a Type BCN or Type N. The connectors must be installed as per manufacturer recommendation and connector loss must not exceed 1 dB per connector.

Connectors must prevent the entry and collection of moisture to the cable and electrical connection point. Provide coaxial cable sealant during installation to seal connections from moisture and corrosion.

2.3 **Electrical and Mechanical Requirements.**

2.3.1 **Capacitance.** Capacitance must not exceed 25 picofarads (pF) per foot of cable for RG-59/U cable. Capacitance must not exceed 20 pF per foot of cable for RG-6/U cable. Capacitance must not exceed 18 pF per foot of cable for RG-11/U cable.

2.3.2 **Inductance**. Inductance must not exceed 0.15 microhenrys μH) per foot of cable for RG-59/U cable. Inductance must not exceed 0.15 μH per foot of cable for RG-6/U cable. Inductance must not exceed 0.15 μH per foot of cable for RG-11/U cable.

2.3.3 **Impedance.** Provide 50 or 75 ohm nominal impedance.

2.3.4 **Attenuation.** Attenuation of the cable must be compliant with requirements of the proposed application. For high-bandwidth coaxial cable, the attenuation must not exceed 0.78 dB per 100 ft. at 10 MHz.

2.3.5 **Resistance.** The DC resistance of the inner conductor must not exceed 4 ohms per 1000 ft.

2.4 **Environmental Design Requirements.**

2.4.1 **Installation Temperature Rating.** Cable must be rated for an outside ambient temperature range of -20°F to 165°F (-30°C to 75°C).

2.4.2 **Storage Temperature Rating.** Cable must be rated for a storage temperature range of -40°F to 165°F (-40°C to 75°C).

3. CONSTRUCTION

3.1 **General**. Cable must be installed in accordance with the following industry procedures:

- ANSI/TIA-568-Cand ANSI/NECA/TIA/EIA-569-C,
- BICSI Telecommunications Distribution Methods Manual (TDMM) and Information Transport Systems Installation (ITSIM),
- NEC—installation safety,
- USDA—Construction of Direct Buried Plant, and
- ICEA Standard for Aerial Service Wire—ANSI/ICEA 5-89-648.

3.1.1 **Cable Storage.** All uninstalled cable must be stored according to manufacturer recommended bend radius and cable reel requirements.

3.1.2 **Cable Labeling.** All cable must be labeled using pre-laminated labels with UV protection according to usage at all terminations.

3.1.3 **Installation Procedure.** All cable must be inspected and tested for continuity when received with results compared with factory pre-shipping tests. Inspect the cable nomenclature to ensure that the correct product has been received. Notify the supplier (or manufacturer) of all discrepancies for immediate correction.

Install the coaxial cable routed as shown in the plans and follow the manufacturer recommendations for installation.

Ensure that all exposed cable ends are covered and protected against moisture and dust penetration at all times during installation. Protect cable ends during storage, cable pulls, and post-installation.

All terminating connectors must be installed per manufacturer recommendation and must be crimped using the manufacturer specified cable crimping tool.

3.1.4 **Cable Slack Requirements.** Provide 25 ft. cable slack maximum in pull boxes and per manufacturer requirements.

3.1.5 **Spacing Requirements.** Provide minimum 12 in. spacing between electrical power cable and communications cable types as described for underground installations within NEC Sections 840.44 and 840.47.

3.1.6 **Bend Radius.** Bend radii of the cable path must be verified and must not exceed manufacturer recommendations.

3.2 **Testing.** Procedures for the tests noted below are to be in accordance with industry standard practice and recorded in accordance with ANSI/TIA/EIA rules for documentation for the cable type. Perform tests in accordance with testing requirements in this Item. For all tests, provide test forms to be used that compare measured results with threshold values. The following tests must be performed, recorded, and submitted to verify the cable performance and installation:

3.2.1 **Cable Continuity**. Perform cable continuity test for center conductor and shield continuity and record results. The test must be performed on received cable reels to identify any discrepancies and upon final installed cable interconnections.

3.2.2 **Time Domain Reflectometry (TDR).** Perform TDR test for impedance continuity per manufacturer recommendations in coaxial cable interconnections and record results.

3.2.3 **Frequency Sweep.** Perform frequency sweep per manufacturer recommendations for bandwidth required in coaxial cable interconnections and record results.

3.2.4 **Visual Inspection.** Where cable installation is visible, perform visual inspection (with a Department representative) to verify any evidence of the following:

- cable damage (cracks, shield damage, kinks, knots, jacket damage, crushed cable),
- bend radius violations (at conduit fittings, cabinet locations),
- cable crimping method - verify use of proper cable crimp tool only (use of pliers not permitted), and
- cable-connector physical connection - verify all connectors are properly secured to the cable.

3.3 **Documentation.** Submit 3 copies of the following materials for each cable type provided for approval prior to item supply:

- manufacturer cutsheet(s) and complete specifications (physical, electrical, mechanical, and environmental),
- manufacturer warranty information,
- independent test lab (ITL) certification, and
- blank test forms.

Submit 3 copies of the following materials for each cable run provided for approval post installation:

- test results,
  - completed test forms,
  - cable continuity test,
  - Time Domain Reflectometry (TDR) test,
  - certification frequency sweep measurement,
- "as-built" documentation for cable path indicated on the plans,
- complete maintenance and trouble-shooting procedures, and
- furnish additional information as shown on the plans.

3.4 **Warranty.** Warrant all cable against defects or failure in design, materials, and workmanship in accordance with the manufacturer's standard warranty.

Supply cable with no less than 95% of the manufacturer's warranty remaining on the date that equipment invoices are submitted for final payment. Any material with less than 95% warranty remaining will be rejected.

Warrant all cable furnished and installed to perform according to the manufacturer published specifications for a period of 1 year after final acceptance of the project by the Department. Provide for "on-site" repair or replacement within 2 working days and at no cost to the Department. Repair or replace any defective cable, at the manufacturer's option, at no cost to the Department.

4. MEASUREMENT

This Item will be measured by the linear foot of cable.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "High Bandwidth Coaxial Cable." This price is full compensation for furnishing, installing, splicing, and testing cable and connectors, as well as for installation equipment, materials, tools, and incidentals.