Special Specification 6182
Low Loss Coaxial Cable

1. DESCRIPTION

Furnish, install, and test coaxial cable for short haul communications requiring low attenuation (loss) over cable distance. 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 low loss coaxial cable include, but are not limited to: spread-spectrum radio, microwave systems and wireless communications systems. Low loss coaxial cable must be provided for short distance runs requiring low attenuation, flexibility and bending in short jumper cable assemblies, and antenna cable feeds. Some applications will utilize loss-loss or high-bandwidth 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/EIA/TIA-568, TIA 568-C.4, and
- Underwriters Laboratory (UL).

Provide cable conforming to the gauge, type, 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 low loss coaxial cable types and cable distance limitations.

Table 1
Typical Low Loss Coaxial Cable
Distance Limitations

Cable Type	Typical AWG Gauge	Recommended Maximum Cable Run[1]
RG-8, RG-8X, or equivalent	#11 AWG, #16 AWG	200 ft.
RG-58/U, RG-142, or equivalent	#19 AWG, #20 AWG	100 ft.
RG-316/U, RG-174/U, or equivalent	#26 AWG	100 ft.
RG213, RG-214/U, or equivalent	#13 AWG	200 ft.

1. Cable distance limitation to be verified according to manufacturer for the cable application. Line loss versus cable diameter shown at 2.4 GHz/100 ft.

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

Provide cable 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.** Provide high flexibility low loss coaxial cable meeting the following physical requirements:

2.2.1. **Conductor.** Cable must have an outer conductor of bonded aluminum tape and an overall braid of tinned copper with an inner conductor of copper-clad steel or aluminum.

2.2.2. **Insulation.** Cable must be of foamed, cellular 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 Electromagnetic Interference .

2.2.3.1. **Coverage.** Provide 100% effective foil coverage, minimum 85% braided coverage.

2.2.3.2. **RF Shielding Rating.** >90 dB (50 dB greater than type single shielded coax).

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.** Polyethylene or equivalent.

2.2.5. **Connectors.** Connectors must be matching, weather resistant, water proof, moisture proof, and outdoor-rated hardware that meet cable operating voltage, temperature, and impedance characteristics. 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 32 picofarads (pF) per foot of cable.

2.3.2. **Inductance.** Inductance must not exceed 0.077 microfarads (μH) per foot of cable.

2.3.3. **Impedance.** Provide 50, 75, or 120 ohm nominal impedance, according to the cable application.

2.3.4. **Attenuation.** Attenuation of the cable must be compliant with requirements of the proposed application.

2.3.5. **Resistance.** The DC resistance of the inner and outer shield conductors must not exceed 0.55 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/NECA/TIA/EIA-568-B,-569-B,
- BICSI Telecommunications Distribution Methods Manual (TDMM) and Information Transport Systems Installation (ITSIM),
- NFPA National Electric Code (NEC),
- USDA Specifications and Drawings for Construction of Underground Plant, RUS Bulletin 1753F-151, RUS Form 515b, 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 withUV protection according to usage at all terminations. Provide weatherproof labels rated for outdoor use.

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. Refer to the Electrical Details Standards (for further details on installation technique and install using flat pull tape.

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.

Install all terminating connectors per manufacturer recommendation and must be crimped using the manufacturer specified 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 as 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 on final installation 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 tight to the cable and are not loose connections.

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

- manufacturer cutsheets 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,
  - 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 "Low Loss 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.