****
USACE / NAVFAC / AFCESA **UFGS-16794A (April 2004)**

Preparing Activity: USACE **Superseding UFGS-16794A (July 2003)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 22 December 2004

Revised throughout - changes not indicated by CHG tags
****

SECTION TABLE OF CONTENTS

DIVISION 16 - ELECTRICAL

SECTION 16794A

COAXIAL CABLE DATA TRANSMISSION SYSTEM

04/04

****
USACE / NAVFAC / AFCESA	**UFGS-16794A (April 2004)**
Preparing Activity: USACE	**Superseding UFGS-16794A (July 2003)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 22 December 2004

Revised throughout - changes not indicated by CHG tags
****

SECTION 16794A

COAXIAL CABLE DATA TRANSMISSION SYSTEM
04/04

****
NOTE: This guide specification covers the requirements for coaxial cable for two-way data transmission in a data acquisition system, and one-way data transmission in a video system.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.
****

PART 1 GENERAL

****
NOTE: This section may be used in conjunction with Section 16751A CLOSED CIRCUIT TELEVISION SYSTEMS; Section 16415A ELECTRICAL WORK, INTERIOR; Section 16370A ELECTRICAL DISTRIBUTION SYSTEM, AERIAL; Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND; Section 16792A WIRE LINE DATA TRANSMISSION SYSTEM; Section 16768A FIBER OPTIC DATA TRANSMISSION SYSTEM; Section 13702N BASIC INTRUSION DETECTION SYSTEMS (IDS); Section 13703N COMMERCIAL INTRUSION DETECTION SYSTEMS (IDS); Section 13720A ELECTRONIC SECURITY SYSTEM; Section 13721A SMALL INTRUSION DETECTION SYSTEM; Section 13801A UTILITY MONITORING AND CONTROL SYSTEM (UMCS); any other UFGS

Sections required by the design.

****

1.1 REFERENCES

****

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide specifications.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 170	(1957) Electrical Performance Standards - Monochrome Television Studio Facilities

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2002) National Electrical Safety Code
IEEE C62.41	(1991; R 1995) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005) National Electrical Code

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 345-83	(1979; Rev Oct 1982) Gas Tube Surge Arrestors (PE-80)
RUS REA Bull 345-50 PE-60	(1979) Trunk Carrier Systems

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 3235.1	(1982) Test & Evaluation of System Reliability Availability and Maintainability - A Primer

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

1.2 SYSTEM DESCRIPTION

1.2.1 General

****
NOTE: For data acquisition systems, the designer must show on drawings the data transmission system (DTS) selected for each circuit between media components and the systems to be interconnected. NEC (e.g., Sections 300.11 (A) and 800.5) does not permit communication circuits to be supported by suspended ceiling panels or suspended ceiling support grids. Thus, give consideration for proper support of cables and raceways.
****

Coaxial cable data transmission system (DTS) for analog or digital communications shall be provided as specified. The data transmission system shall consist of: Coaxial Cable Modems repeaters, amplifiers, and other equipment as required. All computing devices, as defined in 47 CFR 15, shall be certified to comply with the requirements for Class A computing devices and labeled as set forth in 47 CFR 15.

1.2.2 Electrical Requirements

****
NOTE: The designer will show on the drawings the characteristics of each voltage source.
****

The equipment shall operate from a voltage source as shown. Equipment shall tolerate voltage source variations of plus or minus 10 percent, and 60 Hz frequency variations of plus or minus 2 percent, with no degradation in performance.

1.2.3 Power Line Surge Protection

****
NOTE: The designer will determine if any additional inputs or outputs require surge protection and show the requirements for them on the drawings, or in a schedule.
****

Equipment connected to AC circuits shall be protected from power line surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Surge protection devices shall be selected based on voltages and current ratings of the components to be protected. Fuses shall not be used for surge protection.

1.2.4 Communications Circuit Surge Protection

Communications equipment shall be protected against surges induced on any communications circuit. All cables and conductors which serve as communications circuits shall have surge protection circuits installed at each end at the communication circuit that meets the requirements of RUS REA Bull 345-50 PE-60. Additional triple electrode gas surge protectors meeting the requirements of RUS Bull 345-83 shall be provided on each conductor within 0.9 m 3 feet of the building cable entrance. For cables

that route between building exteriors and building interiors, or are exposed to voltages greater than 300 volts to ground, provide grounding of cable shields at the cable point of entrance to the building. Provide bonding conductors sized per NEC between communication system, and building power system, grounding electrode systems. Surge protection devices shall be selected based on voltages and current ratings of the components to be protected. Fuses shall not be used for surge protection.

1.2.5 Video and Sync Signal Circuit Surge Protection

All circuits, except coax cable interconnecting video equipment located indoors, used for sync or video signal transmission shall include protective devices at both ends to safeguard the video equipment against surges. The surge suppression device shall not attenuate or reduce the video or sync signal under normal conditions. The surge suppression device shall be capable of dissipating not less than 1500 watts for 1 millisecond, and the response time from zero volts to clamping shall not be greater than 5 nanoseconds. Surge protection devices shall be selected based on voltages and current ratings of the components to be protected. Fuses shall not be used for surge protection.

1.3 DELIVERY OF TECHNICAL DATA AND COMPUTER SOFTWARE

****

NOTE: The acquisition of all technical data, data bases and computer software items that are identified herein will be accomplished strictly in accordance with the Federal Acquisition Regulation (FAR) and the Department of Defense Acquisition Regulation Supplement (DoD FARS). Those regulations as well as the Army Corps of Engineers implementations thereof should also be consulted to insure that a delivery of critical items of technical data is not inadvertently lost.

Specifically, the Rights in Technical Data and Non-commercial Items clause, DoD FARS 52.227-7013, and the Data Requirements Clause, DoD FAR 52.227-7031, as well as any requisite software licensing agreements will be made a part of the CONTRACT CLAUSES or SPECIAL CONTRACT REQUIREMENTS of the contract. In addition, the appropriate DD Form 1423, Contract Data Requirements List, will be filled out for each distinct deliverable data item and made a part of the contract. Where necessary, a DD Form 1664, Data Item Description, shall be used to explain and more fully identify the data items listed on the DD Form 1423.

It is to be noted that all of these clauses and forms are required to assure the delivery of the data in question and that such data is obtained with the requisite rights to use by the Government. Include with the request for proposals a completed DD Form 1423, Contract Data Requirements List. This form is essential to obtain delivery of all documentation. Each deliverable will be clearly specified, both description and quantity being required.

The designer will specify the Section title that the equipment is to be used in conjunction with: Section 16751A CLOSED CIRCUIT TELEVISION SYSTEMS, Section 13702N BASIC INTRUSION DETECTION SYSTEMS (IDS), Section 13703N COMMERCIAL INTRUSION DETECTION SYSTEMS (IDS), Section 13720A ELECTRONIC SECURITY SYSTEM, Section 13721A SMALL INTRUSION DETECTION SYSTEM, and Section 13801A UTILITY MONITORING AND CONTROL SYSTEM (UMCS).

****

All items of computer software and technical data (including technical data which relates to computer software), which are specifically identified in this specification will be delivered strictly in accordance with the CONTRACT CLAUSES, SPECIAL CONTRACT REQUIREMENTS, Section 01330 SUBMITTAL PROCEDURES and in accordance with the Contract Data Requirements List (CDRL), DD Form 1423, which is attached to and thereby made a part of this contract. All data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. The Technical Data Packages shall be submitted as part of the Technical Data Packages for Section [_____], [_____] hard copies and [_____] electronic copies (CD-ROM or DVD-R) of the Technical Data Package(s) shall be submitted.

1.3.1 Group I Technical Data Package

The Group I Technical Data Package shall include the following:

1.3.1.1 System Drawings

a. System block diagram.

b. Receivers, transmitters, repeaters, or MODEM installation, block diagrams, and wiring diagrams.

c. Receivers, transmitters, repeaters, or MODEM physical layouts and schematics.

d. Details of interfaces to other systems.

e. Details of interfaces to other systems.

f. Details of surge protection device installations.

g. Details of cable splicing and connector installations and terminations.

h. Details of underground, aerial, and messenger cable installation on poles, cable entrance to buildings.

1.3.1.2 Manufacturers' Data

The data package shall include original manufacturers' data for all materials and equipment provided under this specification.

1.3.1.3 Data Transmission System Descriptions and Analyses

The data package shall include complete system descriptions, analyses, and

calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate with connected systems to meet the performance of this specification. The data package shall include the following:

a. Receiver, transmitter, MODEM transmit/receive levels, and losses in decibels (dB) on each DTS circuit.

b. Data transmitter and receiver communication speed and protocol description.

c. Video and sync signal transmission method and bandwidth of the transmitter and receiver.

d. Data transmission system expansion capability and method of implementation.

e. Signal-to-noise ratio calculation on each DTS circuit.

1.3.1.4 System Overall Reliability Calculations

The data package shall include all manufacturer's reliability data and calculations required to show compliance with the specified reliability. The calculations shall be prepared using DOD 3235.1 as a guide. The calculations shall be based on all equipment associated with one data circuit and one video circuit, excluding the cable.

1.3.1.5 Certifications

All specified original manufacturer's certifications shall be included with the data package.

1.3.1.6 Key Control Plan

****

NOTE: The designer will specify the Section title in which a key control plan is found, when this specification is used with IDS, ECS or CCTV: Section 13702N BASIC INTRUSION DETECTION SYSTEMS (IDS), Section 13703N COMMERCIAL INTRUSION DETECTION SYSTEMS (IDS), Section 13720A ELECTRONIC SECURITY SYSTEM, Section 13721A SMALL INTRUSION DETECTION SYSTEM, Section 13801A UTILITY MONITORING AND CONTROL SYSTEM (UMCS), and Section 16751A CLOSED CIRCUIT TELEVISION SYSTEMS.

****

The Contractor shall provide a key control plan as specified in Section [_____].

1.3.2 Group II Technical Data Package

The Contractor shall verify that site conditions are in agreement with the design package. The Contractor shall submit a report to the Government documenting changes to the site, or conditions that affect performance of the system to be installed. For those changes or conditions which affect system installation or performance, provide (with the report) specification sheets, or written functional requirements to support the findings, and a cost estimate to correct the deficiency. The Contractor shall not correct

any deficiency without written permission from the Government.

1.3.3 Group III Technical Data Package

The Contractor shall prepare test procedures and reports for the predelivery test. The Contractor shall deliver the predelivery test procedures to the Government for approval. After receipt by the Contractor of written approval of the predelivery test procedures, the Contractor may schedule the predelivery test. The final predelivery test report shall be delivered after completion of the predelivery test.

1.3.4 Group IV Technical Data Package

The Group IV Technical Data Package shall include the following:

1.3.4.1 Performance Verification and Endurance Tests

****
NOTE: Insert Section number and title for the appropriate specifications.
****

The Contractor shall prepare test procedures and reports in accordance with Section [_____] for the performance verification test and the endurance test. The test plan shall describe the applicable tests to be performed and other pertinent information such as specialized test equipment required, and length of performance verification test. The test procedures shall explain in detail, step-by-step actions and expected results to demonstrate compliance with the requirements of this specification. The Contractor shall deliver the performance verification test and endurance test procedures to the Government for approval. After receipt by the Contractor of written approval of the test procedures, the Contractor may schedule the tests. Coaxial cable is a low-impedance media, 50 or 75 ohms, that is used in broadband applications. The required tests or acceptance tests depend on the application and may include: DC loop resistance; impedance; length; time domain reflectometer (TDR); attenuation; noise; distortion; signal uniformity; signal-to-noise ration (SNR); bandwidth signal ingress; and hum modulation. Generally, impedance, time domain, and structural return loss tests are performed as a pre-installation check of the cable. Tests for distortion, signal uniformity, bandwidth and SNR are performed on installed cable using a signal level meter (SLM) unit. The final performance verification and endurance test procedures report shall be delivered after completion of the tests.

1.3.4.2 Operation and Maintenance Manuals

A draft copy of the operation and maintenance manuals, as specified for the Group V Technical Data Package, shall be delivered to the Government prior to beginning the performance verification test, for use during site testing. Protocols and software for operation and maintenance of coaxial cable modems shall be included in the manual.

1.3.4.3 Training Documentation

Lesson plans and training manuals for the training phases including type of training to be provided, with a list of reference material shall be delivered for approval.

1.3.5 Group V Technical Data Package

****

NOTE: The designer will specify the correct number of manuals on DD Form 1423. Unless the installation has a specific requirement, specify two copies of all manuals, except for the Operator's Manual, which should be specified to be six copies.

****

The Group V Technical Data Package shall consist of the operation and maintenance manuals. Final copies of the manuals as specified bound in hardback, loose-leaf binders, shall be delivered to the Government within 30 days after completing the endurance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, check-out, and acceptance. Manuals delivered shall include:

a. Functional Manual: [2] [_____] hardcopies, [1] [_____] CD-ROM or DVD-R

b. Hardware Manual: [2] [_____] hardcopies, [1] [_____] CD-ROM or DVD-R

c. Maintenance Manual: [2] [_____] hardcopies, [1] [_____] CD-ROM or DVD-R

d. Operator's Manual: [2] [_____] hardcopies, [1] [_____] CD-ROM or DVD-R

1.3.5.1 Functional Design Manual

The functional design manual shall identify the operational requirements for the data transmission system and explain the theory of operation, design philosophy, and specific functions. A description of hardware functions, interfaces, and requirements shall be included for all system operating modes.

1.3.5.2 Hardware Manual

A manual describing all equipment furnished, including:

a. General description and specifications.

b. Installation and check-out procedures.

c. Equipment electrical schematics and layout drawings.

d. Data and video transmission system schematics.

e. Alignment and calibration procedures.

f. Manufacturer's repair parts list indicating sources of supply.

g. Interface definition.

1.3.5.3 Operator's Manual

The operator's manual shall fully explain all procedures and instructions for operation of the system.

1.3.5.4 Maintenance Manual

The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components.

1.3.6 Group VI Technical Data Package

The Group VI Technical Data Package shall consist of the as-built drawings revised to include system revisions and modifications. Copies of the updated as-built drawings shall be delivered to the Government following approval of the PVT and endurance test.

1.4 ENVIRONMENTAL REQUIREMENTS

****

NOTE: Select equipment and cable temperature ratings within ambient temperature conditions at the project location. State additional requirements when ambient conditions are more extreme than manufacturers' equipment ratings (e.g., conformal coatings for 100% relative humidity or condensing atmospheres, enclosure heaters, or enclosure coolers). The designer will show hazardous (classified) environmental area(s), type of hazard(s) and hazard classification (Class I, II, or III, or combinations; Divisions 1 or 2; Groups A, B, C, D, E, F, or G or combinations; and operating temperatures.) Whenever possible, avoid placement of equipment and cables within the hazardous location to reduce installation costs and to simplify maintenance.

****

1.4.1 Indoor and Outdoor Environments

Equipment and cable to be used indoors shall be rated for continuous operation under ambient environmental conditions of 0 to 50 degrees C 32 to 122 degrees F dry bulb and 10 to 95 percent humidity, noncondensing. Equipment and cable to be used outdoors shall be rated for continuous operation under ambient environmental conditions of minus 40 to plus 70 degrees C minus 40 to plus 158 degrees F and humidity of up to 100 percent condensing or as normally encountered for the installed location. All equipment and cable shall be rated for continuous operation under the ambient vibration conditions encountered for the installed location. Cables installed in ducts, plenums, and other air-handling spaces shall be installed per NEC. Cables installed in plenums shall be plenum-rated cables listed for the use. Cables installed in risers shall be riser-rated cables listed for the use, unless the installed cable is identified in the NEC as a permitted substitution for the required riser-rated cable type. Components located in areas where fire or explosion hazards may exist

because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings, shall be rated and installed in accordance with Chapter 5 of NFPA 70 and as shown.

1.4.2 Hazardous Environment

Components and wiring located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings, shall be rated for the Classes, Divisions, Groups, and suitable for the operating temperatures and shall be installed in accordance with Chapter 5 of NFPA 70 and as shown.

PART 2 PRODUCTS

2.1 DATA TRANSMISSION EQUIPMENT

2.1.1 Modem

MODEMS shall be provided to allow mid-band-split, multidrop, polled, asynchronous operation. MODEMS shall have the following general requirements:

a. Mode: Asynchronous half or full duplex as applicable.

b. Data Rates: A minimum of 9600 bits per second.

c. Modulation Type: Narrow band frequency shift keying.

d. Coaxial Cable Connections: Standard BNC connector.

e. Error Rate: Less than 1 error bit in 100,000 bits.

f. Operating Mode: Multipoint or polled.

g. Test Function: Local digital loopback.

h. Turnaround Delay: Request to send / Clear to send (RTS/CTS) minus 8 milliseconds.

i. RF Output Power: 30 to 45 dBmv.

j. Transmit and Spurious Noise Levels: 50 dB below carrier.

k. Receiver RF Sensitivity: Minus 15 to minus 10 dBmv minimum.

l. Interface Impedance: 75 ohms, unbalanced.

2.1.2 Taps and Splitters

Taps and splitters shall have a frequency response suitable for two-way operation. All taps shall be of the directional coupler type. Isolation between desired and undesired signal paths shall be 30 dB minimum. The devices shall be designed for indoor or outdoor use as applicable. Fittings shall be of the center conductor screwdown type and shall be mechanically and electrically secure. All terminal installation material such as cable fittings and grounding blocks shall be provided.

2.1.3 Analog Repeater

Active circuitry in the equipment shall be solid state. Amplifier parameters shall be selected for the system requirements. The amplifier shall incorporate provisions for both forward and reverse changes. The frequency response for the forward channel, and for the reverse channel shall be selected to match the MODEMS used. The flatness of the amplifier (tilt and slope) shall be set to compensate for the installed cable system. The amplifier gain shall be set to provide levels per system requirements. The maximum amplifier gain shall not be exceeded. The amplifier shall be chosen with a dynamic range that meets the system requirements. The distortion shall be less than minus 50 dB from 50 to 300 MHz at full gain. The hum modulation shall be less than minus 60 dB.

2.2 VIDEO EQUIPMENT

2.2.1 Video Repeater

Active circuitry in the equipment shall be solid state. Amplifier parameters shall be selected for the system requirements. The amplifier shall incorporate provisions for both forward and reverse changes. The frequency response for the forward channel, and for the reverse channel shall be selected to match the MODEMS used. The flatness of the amplifier (tilt and slope) shall be set to compensate for the installed cable system. The amplifier gain shall be set to provide levels per system requirements. The maximum amplifier gain shall not be exceeded. The amplifier shall be chosen with a dynamic range that meets the system requirements. The distortion shall be less than minus 50 dB from 50 to 300 MHz at full gain. The hum modulation shall be less than minus 60 dB.

2.2.2 Other Video Equipment

Video equipment not specified herein shall be furnished as specified in Section 16751A CLOSED CIRCUIT TELEVISION SYSTEMS.

2.3 CABLE

2.3.1 Foam-Filled Rigid Coaxial Cable

Foam-filled cable shall be 10.5, 12.7, or 19.1 mm 0.412, 0.500, or 0.750 inch polyethylene foam insulated cable with solid copper or copper-clad aluminum center conductor and solid aluminum sheath. The cable shall have a characteristic impedance of 75 ohms plus or minus 2 ohms over the passband frequency range and a structural return loss of 26 dB maximum in the frequency passband. Maximum attenuation at 20 degrees C 68 degrees F and 270 MHz shall be 1.87 dB/30.5 m 1.87 dB/100 feet for 10.5 mm 0.412 inch cable, 1.48 dB/30.5 m 1.48 dB/100 feet for 12.7 mm 0.500 inch cable, or 1.10 dB/30.5 m 1.10 dB/100 feet for 19.1 mm 0.750 inch cable. The maximum dc loop resistance at 20 degrees C 68 degrees F shall be 2.4 ohms/305 m 2.4 ohms/1000 feet for 10.5 mm 0.412 inch cable or 1.5 ohms/305 m 1.5 ohms/1000 feet for 12.7 and 19.1 mm 0.500 and 0.750 inch cable. Cable manufacturer's recommendations for maximum pulling tension, maximum sidewall pressure, and minimum bend radius shall not be exceeded. All interior cables' insulation and jacketing material shall not contain any poly vinyl chloride (PVC) compounds.

2.3.2 Flexible Coaxial Cable

****

NOTE: Cable characteristics are representative of MIL Spec MIL-C-17 characteristics for specific RG-type cables. Designer will specify different characteristics as necessary for specific applications. Cable characteristics that are different from those listed here, such as larger diameter center conductor, dielectrics with lesser dielectric constant, and greater (e.g., 100%) shielding, make cables with lesser attenuation readily available.

When lesser attenuation is needed, the designer will enter the cable characteristic values for the cables used as the basis for the design. For installations in which limiting electromagnetic interference (EMI) has significant importance, shields which provide 100% shielding and also multiple shields, of both braided-type and foil-type, are available and for these applications the designer will edit the specification. For cables that will experience frequent movement or flexing, such as cables connected to CCTV cameras with pan and tilt capabilities, foil-type shields are not recommended. Similarly, for frequent flexing applications, use of center conductors comprised of steel with cladding or coating of higher conductivity (e.g., copper or aluminum) is not recommended.

****

The coaxial cable shall have a characteristic impedance of 75 ohms plus or minus 3 ohms. All cable components shall be able to withstand the environment the cable is installed in for a minimum of 20 years. All interior cables' insulation and jacketing material shall not contain any poly vinyl chloride (PVC) compounds. Coaxial cable shall meet the following requirements:

COAXIAL CABLE PARAMETERS
TYPE RG-59

Inner Conductor:	23 American Wire Gauge Solid, Copper Covered Steel Wire Nominal Overall Diameter of 0.058 mm Nominal Direct current resistance at 20 degrees C of 154.2 ohms per km Elongation of 1 percent minimum
Dielectric Core:	Solid Polyethylene Nominal Diameter of 3.71 mm
Outer Conductor:	Single braid of 34 American Wire Gauge bare copper wire 95 percent shield coverage minimum Maximum Diameter of 0.485 mm
Jacket:	Manufacturer's recomendation as required for installed location (e.g., plenum, riser, general)
Velocity of Propagation:	66 percent nominal

COAXIAL CABLE PARAMETERS
TYPE RG-59

Eccentricity:	10 percent maximum
Capacitance:	72 picofarads per m, maximum
Attenuation:	29.6 decibels per 100 m, maximum at 0.4 Gigahertz 52.6 decibels per 100 m, maximum at 1 Gigahertz

[COAXIAL CABLE PARAMETERS
TYPE RG-59

Inner Conductor:	20 American Wire Gauge Solid, Bare Copper Covered Wire Nominal Diameter of 0.81 inch Nominal Direct current resistance at 20 degrees C (68 degrees F) of 32.8 ohms per km (0.01 ohms per foot)
Insulation Material:	Foam or Cellular Fluorinated Ethylene Propylene (FEP) Nominal Diameter of 3.68 mm (0.145 in)
Shield Type and Coverage:	Copper braid, 95% coverage, minimum
Jacket:	Manufacturer's recommendation as required for installed location (e.g., plenum, riser, general). Nominal diameter of 5 mm (0.2 in)
Velocity of Propagation:	4% nominal
Eccentricity:	10 percent maximum
Capacitance:	53 picofarads per m (16 picofarads per ft), nominal
Attenuation:	2.56 decibels per 100 m (0.78 decibels per 100 ft) at 1 megahertz, maximum 37.7 decibels per 100 m (11.5 decibels per 100 ft) at 1000 megahertz, maximum
Minimum Bend Radius:	50.8 mm (2.0 in) or greater value per cable manufacturer's recommendations]

COAXIAL CABLE PARAMETERS
TYPE RG-11

Inner Conductor:	18 American wire Gauge Seven strands of tinned copper wire Nominal Overall diameter of 0.122 mm Nominal Direct Current Resistance at 20 degrees C of 19.9 ohms per km Elongation of 1 percent minimum

COAXIAL CABLE PARAMETERS
TYPE RG-11

Dielectric Core:	Solid Polyethylene Nominal Diameter of 7.24 mm
Outer Conductor:	Single braid of 33 American Wire Gauge bare copper wire 95 percent shield coverage minimum Maximum Diameter of 0.86 mm
Jacket:	Manufacturer's recommendation as required for installed location (e.g., plenum, riser, general). Nominal diameter of 0.405 inch
Velocity of Propagation:	66 percent nominal
Eccentricity:	10 percent maximum
Capacitance:	72 picofarads per m, maximum
Attenuation:	17.1 decibels per 100 m, maximum at 0.4 gigahertz 30.9 decibels per 100 m, maximum at 1 Gigahertz

[COAXIAL CABLE PARAMETERS
TYPE RG-11

Inner Conductor:	14 American Wire Gauge Solid bare copper Nominal DC resistance at 20 degrees C (68 degrees F) of 0.0082 ohms per m (0.0025 ohms per foot)
Insulation Material:	Foamed FEP or cellular polyethylene Nominal diameter of 7.11 mm (0.28 in)
Shield Type and Coverage:	Foil, 100% coverage Copper braid, 60% coverage
Jacket:	Manufacturer's recommendation as required for installed location (e.g., plenum, riser, general) Nominal diameter of 10.03 mm (0.395 in)
Velocity of Propagation:	83% nominal
Eccentricity:	10% maximum
Capacitance:	53.5 picofarads per m (16.3 picofarads per ft), nominal
Attenuation:	0.49 decibels per 100 m (0.15 decibels per 100 ft) at 1 megahertz, nominal 18.1 decibels per 100 m (5.5 decibels per 100 ft) at 1000 megahertz, nominal

[COAXIAL CABLE PARAMETERS
TYPE RG-11

Minimum Bend Radius:	102 mm (4.0 in) or greater value per cable manufacturer's recommendations]

COAXIAL CABLE PARAMETERS
TYPE RG-6

Inner Conductor:	18 American wire Gauge Solid bare copper wire of nominal diameter [[____] mm] [0.040 inch] Nominal Direct Current Resistance at 68 degrees F of 21.0 ohms per km ([_____] ohms per foot)
Dielectric Core:	Foam FEP Nominal Diameter of 4.32 mm (0.170 inch)
Outer Conductor:	Duofoil + 95% tinned copper braid coverage minimum Maximum Diameter of 5.94 mm (0.234 inch)
Jacket:	Black, Non-contaminating Polyvinylchloride (PVC)
Velocity of Propagation:	83 percent nominal
Eccentricity:	10 percent maximum
Capacitance:	53.1 picofarads per m, (16.2 pF/ft) maximum
Attenuation:	13.1 decibels per 100 m, (4.0 db/100 ft) maximum at 0.36 Gigahertz 25.6 decibels per 100 m, (7.8 db/100ft) maximum at 1 Gigahertz

[Miniature Coaxial Cable
TYPE RG-11

Conductor:	30 American wire Gauge Standard, tinned copper, nominal diameter of 0.305 mm (0.012 in) Nominal Direct Current Resistance at 20 degrees C (68 degrees F) of 0.33 ohms per km (0.1 ohms per foot)
Insulation Material:	Foamed high density polyethylene, nominal diameter of 1.47 mm (0.058 in)
Shield Type and Coverage:	Tinned copper braid, 89% coverage
Jacket:	Manufacturer's recommendation as required for installed location (e.g., plenum, riser, general), nominal diameter of 2.46 mm (0.097 in)
Velocity of Propagation:	78% nominal

[Miniature Coaxial Cable
TYPE RG-11

Capacitance:	56.7 picofarads per m (17.3 picofarads per ft), nominal
Attenuation:	2.3 decibels per 100 m, (0.7 decibels per 100 ft) at 1 megahertz, nominal
	87.3 decibels per 100 m (26.6 decibels per 100 ft) at 1000 megahertz, nominal
Minimum Bend Radius:	25.4 mm (1.0 in)
Maximum Operating Voltage:	30 VRMS, or greater per manufacturer's data]

2.3.3 Protective Coverings and Cable Jackets

Protective coverings and cable jackets in any single length of cable shall be continuous and of the same material. The protective coverings shall be free from holes, splits, blisters, and other imperfections. The covering shall be flame retardant, moisture resistant, nontoxic, and electrically nonconductive. All interior cables' insulation and jacketing material shall not contain any poly vinyl chloride (PVC) compounds.

2.3.4 Underground Cable

Where cable is installed in buried conduit, the cable shall contain an additional moisture barrier in the form of a flooding compound interspersed between the outer polyethylene jacket and the sheath. The flooding compound shall be electrically non-conductive, non-corrosive, and as recommended by the cable manufacturer.

2.3.5 Direct Burial Cable

****
NOTE: The designer will use this Paragraph if a rodent problem (such as gophers and prairie dogs) has been verified at the installation site or if the cable outer jacket might be damaged by adjacent sharp rocks or debris when the cable is going to be installed by direct burial.
****

Direct burial cable shall be protected with a steel armor (spiral wrap or corrugated). The steel armor shall be plastic coated or chrome plated or have a second polyethylene jacket protecting the steel from corrosion. The steel armor shall be applied longitudinally and have an overlap of at least 5 mm 3/16 inch. An inner jacket for armored cable is required. Flooding compound shall be applied to armored cable between the inner jacket and sheath. The flooding compound shall be electrically non-conductive, non-corrosive, and as recommended by the cable manufacturer.

2.3.6 Drop Cable

Drop cable used to connect distribution cable taps to terminal equipment shall be 100 percent shielded with aluminum foil or aluminized plastic covered by at least 40 percent aluminum braid and a polyvinyl chloride jacket. The foil shield shall be bonded to the cable dielectric. Shielding effectiveness shall be at least 80 dB at all frequencies from 50

to 300 MHz. Drop cable connectors shall be of a type specifically designed for use with aluminum foil shielded cable and shall incorporate a uniformly crimped sleeve for shield connection. Connections to tap and terminal devices shall conform to the established standards for BNC connectors. Jacket materials shall resist the effects of sunlight and oxidation for a period of at least 10 years non-contaminating. Drop cables used in underground applications shall be further protected by a moisture resisting flooding compound applied between the shield and the jacket. The flooding compound shall be electrically non-conductive, non-corrosive, and as recommended by the cable manufacturer.

2.4 CABLE CONNECTORS

2.4.1 Foam-Filled Rigid

Terminating connectors used to terminate foam-filled rigid coaxial cable shall incorporates an integral radiation suppressing sleeve supporting the aluminum sheath. Provide adapting connectors to adapt the terminating connector to match the connector type required for connection to amplifiers, taps, and splitters and end-of-link equipment. Connector cable retention force shall not be less than the cable manufacturer's maximum pulling tension specification. Impedance of terminating connectors and adapting connectors shall match the characteristic impedance of the cable on which installed.

2.4.2 Flexible and Semi Rigid

Connectors for RG/58 and RG/11 coaxial cable shall be bayonet connectors (BNC). Connectors shall be either crimp-on or solder type.

2.5 RACEWAY SYSTEMS

****

NOTE: The designer will show on the drawings which specific type of raceways are needed.

****

Raceway systems as specified in Section 16402 INTERIOR DISTRIBUTION SYSTEM and Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown shall be furnished and installed.

2.6 ENCLOSURES

****

NOTE: The designer will show on the drawings which specific type of enclosure is needed.

****

Metal enclosures shall be provided as needed for equipment not housed in racks or supplied with a housing. Enclosure finish color shall be manufacturer's standard, unless otherwise indicated. Damaged surfaces shall be repaired using original type finish. The enclosures shall be as specified or shown.

2.6.1 Interior

Enclosures used in an interior environment shall meet the requirements of NEMA 250, Type 12.

2.6.2 Exterior

Enclosures used in an exterior environment shall meet the requirements of NEMA 250, Type 4.

2.6.3 Corrosion Resistant

****
NOTE: Show corrosive locations on the drawings.
****

Enclosures in a corrosive environment shall meet the requirements of NEMA 250, Type 4X.

2.6.4 Hazardous Environment

Enclosures in a hazardous environment shall be installed and shall meet the requirements as specified in paragraph ENVIRONMENTAL REQUIREMENTS.

2.7 TAMPER PROVISIONS

****
NOTE: Specify tamper requirements only if the coaxial media is for IDS, ESS or CCTV applications.
****

Enclosures, cabinets, housings, and boxes of every description having hinged doors or removable covers, that contain the DTS circuit connections or power supplies, shall be provided with cover operated, corrosion-resistant tamper switches, arranged to initiate an alarm signal when the door or cover is moved. Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed. The enclosure and the tamper switch shall function together to not allow direct line of sight to any internal components and tampering with the switch or the circuits before the switch activates. Tamper switches shall be inaccessible until the switch is activated; have mounting hardware concealed so that the location of the switch cannot be observed from the exterior of the enclosure; be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating; shall be spring-loaded and held in the closed position by the door cover; and shall be wired so that they break the circuit when the door or cover is disturbed. Tamper switches on the doors which must be opened to make routine maintenance adjustments to the system shall be push/pull-set, automatic reset type.

2.7.1 Enclosure Covers

Covers of pull and junction boxes provided to facilitate installation of the system need not be provided with tamper switches if they contain no splices or connections, but shall be protected by tack welding or brazing the covers in place. Zinc labels shall be affixed to such boxes indicating they contain no connections. These labels shall not indicate that the box is part of the security system.

2.7.2 Conduit-Enclosure Connections

Conduit-enclosure connections shall be protected by tack welding or brazing the conduit to the enclosure. Tack welding or brazing shall be done in addition to standard conduit-enclosure connection methods as described in

NFPA 70.

2.7.3 Locks and Key-Lock Operated Switches

****
NOTE: Either round key or conventional key type locks as defined in this specification are acceptable. Selection should be based on hardware availability at the time of design and the requirement for matching locks currently in use at the site. If the locks do not have to be matched to locks in use at the site, and the designer has no preference as to lock type, all brackets may be removed.
****

2.7.3.1 Locks

Locks required to be installed on system enclosures for maintenance purposes shall be UL listed, [round-key type, with three dual, one mushroom, and three plain pin tumblers] [or] [conventional key type lock having a combination of five cylinder pin and five-point three position side bar]. Keys shall be stamped U.S. GOVT. DO NOT DUP. The locks shall be so arranged that the key can only be withdrawn when in the locked position. All maintenance locks shall be keyed alike and only two keys shall be furnished for all of these locks.

2.7.3.2 Key-Lock-Operated Switches

Key-lock-operated switches required to be installed on system components shall be UL listed, [with three dual, one mushroom, and three plain pin tumblers,] [or] [conventional key type lock having a combination of five cylinder pin and five-point three position side bar]. Keys shall be stamped U.S. GOVT. DO NOT DUP. Key-lock-operated switches shall be two position, with the key removable in either position. All key-lock-operated switches shall be keyed differently and only two keys shall be furnished for each key-lock-operated-switch.

2.8 MESSENGER SYSTEM

****
NOTE: Percent values stated below are based upon overload factors that apply to Grade B construction. If the aerial electrical distribution system construction is a lesser grade (e.g., Grade C, Grade N, or not graded), differing values will be provided by the designer in accordance with NESC and actual requirements.
****

A messenger system meeting the requirements of IEEE C2 to support all aerial cable shall be furnished and installed. The messenger system shall include all messenger support and attachment hardware and appurtenances needed to install the messenger system. Messenger tension due to combined ice and wind loading on the messenger with supported cables shall not exceed 60 per of the messenger rated breaking strength. Messenger tension due to extreme wind loading on the messenger with supported cables shall not exceed 80 percent of the messenger rated breaking strength. Messenger support and attachment hardware shall have rated strength not less than the

messenger rated breaking strength. All messenger support and attachment hardware and appurtenances shall be sized to exceed the rated breaking strength of the messenger cable. Messenger cables shall be galvanized zinc coated steel or aluminum clad steel.

PART 3 EXECUTION

3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. All necessary interconnections, services, and adjustments required for a complete and operable DTS system shall be provided.

3.1.1 Enclosure Penetrations

Enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed to preclude the entry of water.

3.1.2 Interconnection of Video Equipment

Signal paths shall be connected between video equipment of 7.5 m 25 feet or less with RG-59/U coaxial cable, and signal paths longer than 7.5 m 25 feet with RG-11/U coaxial cable. Cables shall be as short as practicable for each signal path without causing strain at the connectors. Rack mounted equipment on slide mounts shall have cables of sufficient length to allow full extension of the slide rails from the rack. Miniature coaxial cables may be used for interconnection and jumpers between rack-mounted equipment and equipment within enclosures.

3.1.3 Termination of Video Equipment

Terminators shall be installed on equipment as needed to properly terminate the video signal so that it complies with EIA 170.

3.1.4 Interior Electrical Work

****

NOTE: DTS cable should not be used for, or routed through, Sensitive Compartmented Information Facilities (SCIFs). The designer will not show any DTS cable routed through a SCIF. The designer should check DCID 1/21 for further direction.

****

Except as otherwise specified, interior electrical work shall be installed as specified in Section 16402 INTERIOR DISTRIBUTION SYSTEM and as shown.

3.1.5 Exterior Electrical Work, Underground

3.1.5.1 Underground

Except as otherwise specified, underground electrical work shall be installed as specified in Section 16375A ELECTRICAL DISTRIBUTION SYSTEM,UNDERGROUND and as shown.

3.1.5.2 Burial Depth

Minimum burial depth for direct burial cable shall be 760 mm 30 inches, but not less than the depth of the frost line.

3.1.5.3 Direct Burial Cable

Where direct burial cable will pass under sidewalks, roads, or other paved areas, the cable shall be placed in minimum 25 mm 1 inch zinc coated rigid steel conduit. Conduit may be installed by jacking or trenching of boring as approved. When direct burial cable is to be placed in heavy use areas other than paved areas and where the cable may be subject to damage from heavy equipment, the cable shall be placed in minimum 25 mm 1 inch rigid PVC conduit buried a minimum of 1.1 m 42 inches below the surface.

3.1.5.4 Warning Tape

Direct burial cable including cable contained within conduit shall be placed below a minimum 76.2 mm 3 inch wide plastic warning tape buried in the same trench or slot. The warning tape shall be 300 mm 12 inches above the cable. The warning tape shall be continuously imprinted with the words "WARNING - COMMUNICATION CABLE BELOW" at not more than 1.2 m 48 inch intervals.

3.1.5.5 Splices

Splices shall be installed in cable splice boxes. Sufficient cable shall be provided in each splicing location to properly rack and splice the cables, and to provide extra cable for additional splices. All cable ends shall be protected at all times with end caps except during actual splicing. During the splicing operations, means shall be provided to protect the unspliced portions of the cable from the intrusion of moisture and other foreign matter.

3.1.5.6 Installation in Ducts and Conduits

A cable feeder guide shall be used between the cable reel and the face of the duct and conduit to protect the cable and guide it into the duct and conduit as it is played off the reel. As the cable is played off the reel, it shall be carefully inspected for jacket defects. Precautions shall be taken during installation to prevent the cable from being "kinked" or "crushed." A pulling eye shall be attached to the cable and used to pull the cable through the duct and conduit system. Cable shall be hand fed and guided through each manhole. As the cable is played off the reel into the cable feeder guide, it shall be sufficiently lubricated with a type of lubricant recommended by the cable manufacturer. Where the cable is pulled through a manhole, additional lubricant shall be applied at all intermediate manholes. Dynamometers or load-cell instruments shall be used to ensure that the pulling line tension value and the sidewall pressure value do not exceed the installation tension value specified by the cable manufacturer. The mechanical stress placed upon a cable during the installation shall not be such that the cable is twisted or stretched or the cable impedance at any point along the length of the cable is altered.

3.1.5.7 Exterior Electrical Work, Aerial

****

NOTE: Aerial cable will be installed on existing poles where height, clearance requirements, and

structural loading allow addition of cables. Where this is not possible, requirements must be shown on the drawings. Installations will comply with IEEE C2 for Grade B construction and NFPA 70. Designer must coordinate with facility personnel for ground clearance and establish clearances to be shown on the drawings.

****

Except as otherwise specified, aerial electrical work shall be installed as specified in Section 16370A ELECTRICAL DISTRIBUTION SYSTEM, AERIAL and as shown.

3.1.5.8 Messenger System

****

NOTE: The designer will verify local electrical installation requirements to determine if new grounding conductors and electrodes are required at each messenger cable grounding connection and will select the first, or second, or both bracketed entries as determined to be necessary.

****

Furnish and install a messenger system to support aerial cables. Messengers shall be attached to poles with approved clamps and not less than 16 mm 5/8 inch through bolts. The messenger cable shall be stressed prior to lashing the cables to a tension higher than the final tension. This will prestretch the cable and ensure that there's minimum variation from the calculated values when the messenger is dead-ended under its final tension and sag. Messengers shall be grounded and guyed at all corners, dead-ends, entrances to each facility, and grounded at intervals not exceeding 305 m 1000 feet. [New grounding conductors and electrodes shall be provided at each ground connection.] [Where grounding connections are made in the vicinity of existing grounding conductors and electrodes, the grounding connection may be made by a bolted or welded connection to the existing grounding conductor.] Ground conductors shall be soft drawn copper, having a current capacity of at least 20 percent of that of the messenger to which it is connected. Ground conductors shall not be smaller than No. 6 AWG. The ground conductor shall be connected to a copper or copper clad steel ground rod not less than 19.1 mm 3/4 inch in diameter, and length shall be as needed to achieve the specified ground resistance. After installation is completed, the top of the ground rod shall be approximately 300 mm 1 foot below) finished grade. The ground conductor shall be protected by half-round wood, plastic, or fiber molding from the ground to a point at least 2.4 m 8 feet above the ground. Ground resistance shall be measured in normally dry conditions, not less than 48 hours after a rainfall, and the total ground resistance shall not exceed 25 [_____] ohms.

3.1.5.9 Aerial Cable Splices

Splices in aerial cable shall be within 1 m 3 feet of a pole and placed inside a watertight enclosure. Drip loops shall be formed at the cable entrance to the enclosure. Lashing clamps shall be placed within 300 mm 12 inches of the enclosure.

3.1.5.10 Lashing Wire

****
NOTE: Common lashing machines provide 1 turn per 380 linear mm (15 linear inches) in a single pass, which is acceptable for locations where loading due to weather conditions is moderate. Other locations may require multiple passes with the lashing machine.
****

Lashing wire shall be wound tightly around both the communication cable and messenger cable by machine methods. The lashing wire shall have a minimum of one turns per 380 linear mm 15 linear inches and not less than the number of turns per linear distance that is recommended by the cable manufacturer for the distance between cable support points and the combined ice and wind loading and extreme wing loading, specified or normally encountered for the installed location. Lashing clamps shall be placed at all poles and splices.

3.1.5.11 Stress Loops

Loops shall be formed in the aerial cable at all points of connection and at all poles to prevent damage from thermal stress and wind loading. The communication cable shall be protected from chafing and physical damage with the use of spiral cut tubing and PVC tape, or plastic sleeves. The ground clearance of installed cabling shall be as shown.

3.1.5.12 Service Loops

Each coaxial cable shall have service loops of not less than 3 meters 10 feetin length at each end. The service loops shall be housed in a service loop enclosure.

3.1.6 Identification and Labeling

Identification tags or labels shall be supplied for each cable. The labeling format shall be identified and a complete record shall be provided to the Government with the final documentation. Each cable shall be identified with type of signal being carried and termination points. All labels shall be non-fading when exposed to moisture, sunlight, soil minerals, chemicals, and other environmental elements.

3.1.7 Aerial to Underground Transitions

Transitions from aerial cable to underground cable shall be as specified in paragraph CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS in Section 16370A ELECTRICAL DISTRIBUTION SYSTEM, AERIAL.

3.1.8 Loading Conditions

****
NOTE: The designer will include the data listing the loading conditions, including radial thickness of ice, horizontal wind pressure, and temperature, for both combined ice and wind loading and for extreme wind loading encountered at the project site.
****

The loading conditions to be encountered at this installation are as

follows:

3.1.8.1 Combined Ice and Wind Loading

Radial thickness of ice: [_____] mm inch
Horizontal wind pressure: [_____] Pa psf
Temperature: [_____] degrees C degrees F
Constant to be added to the resultant: [_____] N/m psf

3.1.8.2 Extreme Wind Loading

Velocity pressure exposure coefficient, wire: [_____]
Basic wind speed: [_____] m/s mi/h
Gust response factor, wire: [1.0] [_____]
Importance factor: [1.0] [_____]

3.2 TESTING

****
NOTE: The section number and title of the appropriate specification must be inserted.
****

3.2.1 General

Personnel, equipment, instrumentation, and supplies necessary to perform all testing shall be provided.

3.2.2 Contractor's Field Test

The Contractor shall verify the complete operation of the data transmission system during the Contractor's field testing as specified in Section 13720A ELECTRONIC SECURITY SYSTEM, where applicable. Tests of video coaxial cable shall include testing each circuit for continuity and verification that each circuit passes a full bandwidth signal that complies with EIA 170. A report containing results of the field test shall be prepared and submitted.

3.2.3 Performance Verification Test and Endurance Test

The coaxial data transmission system procured and installed as part of a complete system shall be tested as a part of the completed system during the Performance Verification Test and Endurance Test as specified in Section 13720A ELECTRONIC SECURITY SYSTEM, where applicable.

-- End of Section --