

## SECTION 271900 – BROADBAND CABLE SYSTEM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:

1. This Section specifies the broadband cabling system for buildings and structures.
2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.
3. The Contractor shall furnish and install a complete broadband cabling system with all necessary components for a complete system as described in the specification and shown on the drawings.
4. General
  - a. The broadband system is defined as a complete operating broadband communications system consisting of all trunk cable, drop cables, RF outlets, connectors, amplifiers, splitters, taps, couplers, and power supplies. It encompasses all devices from each building service entrance to each RF outlet on the system.

Use the following paragraph for trunk distribution system. If the project involves work on the trunk modify paragraph a. to include information from the last NOTED paragraph in this item. If the project is a trunk system project from the Headend replace paragraph b. with the last paragraph in this item.

- b. Provide a complete broadband coaxial cable system the extent of which is indicated on the drawings and specified herein, including all equipment, materials, labor, tests, operations, and complete detailed as-built documents for a complete operational system.
- c. All broadband cable, amplifiers, power supplies, and passive devices, shall be electrically and mechanically compatible with existing equipment on the Campus trunk system. Each component shall comply with the specifications contained in PART 2 - PRODUCTS. Substitution of other component types or manufacturer must be approved in writing by the Engineer prior to installation.

- d. The systems shall allow return RF signal origination to be introduced into the distribution cables from any reception point in the buildings and be received at the headend location for processing and retransmission. Processing and retransmission equipment, as well as return signal modulators, will be provided by others.
- e. The distribution system shall be operative at all times in such a manner that it is not subject to possible human error during the course of attachment or detachment of equipment at any outlet.
- f. The system as installed shall be rated and capable of continuous 24-hour operation.
- g. The Contractor shall employ the use of a sweep system to measure the forward and return signal levels at the input and output at each project related system amplifier. These signal levels shall be recorded as part of the as-built drawings and manuals.
- h. The Contractor shall not connect the building distribution system or any equipment to the Campus Trunk cable system at any time.
- i. Testing must be performed without connecting to the Campus Trunk system. Unless power supplies are installed in the building as part of the Contract, the Contractor must provide temporary powering of amplifiers while testing the system.

Use the following two paragraphs for the television system only.

- j. The RF distribution systems shall provide for two-way transmission of color television signals throughout the buildings.
- k. The distribution system shall provide for ready attachment of RF monitor/TV receivers and return channel modulators at any outlet and at any time without additional auxiliary equipment.

Use the following paragraph for trunk system projects.

- l. The broadband system is defined as a complete operating broadband communications system consisting of all trunk cables, drop cables, RF outlets, connectors, amplifiers, splitters, taps, couplers, and power supplies. It encompasses all devices from the Headend to each RF outlet in each building on the system.

B. Related Sections include the following:

- 1. Applicable sections of Division 26 – Electrical

### 1.3 DEFINITIONS

- A. "Interface devices" are defined as user devices (modems, TV equipment, etc.) attached to the system. User devices attached at the headend are not defined as "interface devices".
- B. The "headend" location is identified on the drawings and indicates the point of reference for "forward" and "reverse" transmission. The headend equipment is as specified herein.
- C. This means that all interface devices will send information in the "Reverse", or Inbound, direction (toward headend) and receive information in the "Forward", or Outbound, direction (away from headend).

### 1.4 SYSTEM DESCRIPTION

#### A. Frequency Spectrum and Allocation

- 1. The broadband system shall be equipped for and shall operate over the frequency ranges identified below.
- 2. Cable numbers 1 and 2 shall use a "Midsplit" CATV frequency configuration requiring any trunk amplifiers and equipment to have the following characteristics:
  - a. REVERSE direction: 5 MHZ to 32 MHZ signals amplified toward headend.
  - b. FORWARD direction: 52 MHZ to 450 MHZ signals amplified away from headend.

#### B. System Signal Levels

##### 1. General

- a. The following levels are for a 6 MHz wide frequency band (i.e., the width of one TV channel by FCC standards).
- b. Unused device ports shall be properly terminated to avoid reflections and antenna effects.
- c. Based on the system forward and return signal levels given below, signal levels at each outlet in the forward direction shall be minimum of +5 dBmV, and a maximum of +15 dBmV. Signal levels at each outlet location shall be within +/- 2 dBmV of design target value. Isolation between any two outlets in the system shall be a minimum of 26 dB.

- 2. Building entrance signal levels (at broadband equipment location - input to first tap or amplifier)

Insert signal levels where indicated in the following two paragraphs.

- a. The forward signal level (based on +54 dBmV input at a headend port) at 450 MHz at the input of the first building entry amplifier or first tap if no amplifier is installed, located ..... shall be:
  - b. The return signal level at 30 MHz at the output of the building entry amplifier or first tap if no amplifier is installed, located ..... (based on a +54 dBmV signal input at any user tap) shall be:
3. Operating levels and interface devices

- a. TV modulators: units shall be capable of +60 dBmV, +54 dBmV nominal.
- b. TV receivers: units shall operate within the RF outlet range of +5 to +15 dBmV. +10 dBmV shall be the outlet design value with +54 dBmV signal input at headend port.
- c. RF modems: Data modem transmitter output level shall be determined by the number of subchannels contained in a 6MHz channel using the following formula:

$$54 - 10 \log (\text{Channel Spacing (KHz)} / 6000 (\text{KHz}))$$

- d. The channel spacing used is that which the manufacturer specifies.
- e. The following are modem and translator operating levels for various modem types:

Modem	Spacing KHz	Translator Xmit Level DBmV	Translator Rcv Level DBmV	Translator Xmit Level DBmV	Translator Rcv Level dBmV
UB640	96	+36	-8	+36	-8
ZETA Z19	50	+33	-11	+33	-11
Chipcom	18,000	+50	+6	+50*	+6**
Television	6,000	+54	+10	-	-

\* After 5 dB output attenuator

\*\* Before 6 dB input attenuator

- f. The input levels shall be within +/- 2 dB.
  - g. In all installations the final determining factor for setting modem transmitters shall be to achieve the above translator input levels.
  - h. Required modem receive levels are those recommended by the manufacturers.
4. Spurious signals

- a. The following levels are the maximum acceptable for unwanted harmonic and non-harmonic signals. From TV equipment attached: 60 dB below video carrier output level. From modems attached: 40 dB below data carrier output level.

5. Amplifier operating levels
  - a. The design amplifier levels shown on the drawings shall be achieved within +/- 2 dB.
6. Trunk amplifiers
  - a. Trunk amplifier signal levels are measured at the test ports, and are based upon TV carrier power.
  - b. Forward inputs are to be: +14 dBmV worst case minimum.
  - c. Forward outputs are to be: +39 dBmV maximum, +35 dBmV nominal (design target).
  - d. Reverse inputs shall be: +14 dBmV worst case minimum.
  - e. Reverse outputs shall be +39 dBmV maximum.
7. Distribution amplifiers
  - a. To achieve the desired system Carrier-To-Noise (C/N) ratio the minimum signal input to any building amplifier is +13 dBmV, forward and return. This signal input is the level at the input to the amplifier itself, not the input to the amplifier housing. Any input pads or equalizers used must be considered in determining the amplifier input. The +13 dBmV amplifier input corresponds to +54 dBmV input at a building user port or a headend port.

## 1.5 SUBMITTALS

### A. Shop Drawings:

1. Broadband cables
2. Equipment, enclosures, and all related components
3. Outlets

## 1.6 QUALITY ASSURANCE

- ### A.
- Installation of cabling systems shall be performed by fully qualified personnel having had a minimum of five years experience on installing these types of systems.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. The components shown below indicate the minimum acceptable standard of quality. These should serve as a guide in selecting equipment, but are not mandatory if higher performance equipment is available. Variations shall be subject to written approval by the Engineer. The contractor assumes responsibility for ensuring the electrical and mechanical integrity of the combination of components used in the system. Any components which are not engineered suitably for the devices to which they are attached shall be subject to exchange before or after installation at the contractors expense. All components shall be operated within the manufacturer's specifications without modification.
- B. The Contractor shall sweep test all cable to be used in the system. The test shall be performed at the installation site with cables on reels in accordance with IEEE 802.7 Broadband LAN Recommended Test Practice. The Wavetek 1855B/1865B continuous full sweep system or approved equal shall be used. The test shall be performed at the installation site with cables on reels. The test data shall be submitted to the Project Representative prior to cable installation.

### 2.2 SYSTEM CABLE

#### A. Trunk Cable

- 1. Cable shall be 75 Ohm broadband coaxial cable with flooding compound. Flooding compound to be corrosion resistant gel between outer jacket and the aluminum shield
- 2. Both 1/2 inch and 3/4 inch cable shall be checked to assure proper diameter of the outer conductor. Improper sized cable shall be exchanged and not used by the contractor.
- 3. 1/2 inch coax shall be: Times Fiber T-6 Plus T6500 JB
- 4. 3/4 inch coax shall be: Times Fibre T-6 Plus T6750 JB

#### B. Internal Building Distribution Cable

- 1. Internal building distribution cable shall be 1/2", RG-11, and RG-6 coaxial broadband cable.

#### C. 1/2 Inch Coaxial Broadband Cable

- 1. 1/2 inch coaxial broadband cable for inside building work shall be plenum rated, 75 ohm impedance, Commscope 2311.
- 2. 1/2 inch coaxial broadband cable for outside building work shall be flooded jacketed, 75 ohm impedance, Times Fibre T-6 Plus T6500 JB.

3. The cable shall be checked to assure proper diameter of the outer conductor. Improper sized cable shall be exchanged and not used by the Contractor.
4. Equivalent cable may be proposed and is subject to approval by the Owner.

D. RG-6 and RG-11 Coaxial Broadband Cable

1. RG-11 and RG-6 coaxial broadband cable shall be 75 ohm impedance.
  - a. Shield construction shall be of either:
    - 1) Foil-braid-foil-braid, with 60% minimum coverage for the inner braid and 40% minimum coverage for the outer braid, or
    - 2) Foil-braid-foil, with 75% minimum braid coverage. The dielectric shall be gas-expanded polyethylene (foam).

- b. Acceptable cable types are:

Type	Belden	CommScope
RG-6/U	9060	5740
RG-11/U	9064	5940
RG-6/U Plenum	1152A	2227
RG-11/U Plenum	1153A	2287

- c. Equivalent cable may be proposed and is subject to approval by the Owner

2.3 CONNECTORS

- A. Connectors shall have integral radiation sleeves, center-seizing of inner conductor, and integral stingers (of length to match equipment) for connecting inner conductor of cable to amplifiers, taps, directional couplers and other passive devices.

- B. 1/2" and 3/4" cable: Gilbert GRS Series Part No.

GRS-XXX-CH-DU-03	cable to equipment
GRS-XXX-BAFF-DU-03	cable to F
GRS-XXX-SP-DU-03	cable splice
(XXX is 500 or 750 depending on cable size.)	

- C. RG-11 and RG-6 cables: Gilbert: GF-11-AH, GF-6-AH (one piece).

- D. Equivalent connectors may be proposed, subject to approval by the Engineer.

## 2.4 OUTLETS

### A. Video Outlets

1. Video outlets shall be comprised of an Augat LRC TF-81 self terminating connector, mounted on a blank two gang stainless steel plate. Cover plates shall be stainless steel, non-magnetic type 302, such as Hubbell S24. Drill one gang of the blank plate with a 3/8" hole to accommodate the LRC connector. The plate shall be mounted to the outlet box using Pass & Seymour catalog no. 340 adjustment yokes.
2. All recessed outlets, except as otherwise specified, shall consist of approved 2-gang extra deep galvanized steel boxes of pattern adapted to the special requirements of each outlet, securely fastened in place in an approved manner.
3. All surface mounted outlets, except as otherwise specified, shall consist of approved 2-gang extra deep boxes Wiremold V-5744-2, securely fastened in place in an approved manner.

## 2.5 SPLITTERS, TAPS, AND DIRECTIONAL COUPLERS

- A. All splitters, taps, and directional couplers must operate on the entire 5 to 450 MHz range, and unused ports must be properly terminated and protected with an LRC model FCS5T 0.75 inch long security shield. Trunk/branch ports must be power-passing, but non power-passing to tap legs.
- B. These devices shall have plug-in modules to allow change of attenuation without disconnecting the tap from the main cable.
- C. Approved manufacturers are Jerrold, RMS, and Viewsonics.
- D. Splitters shall be as follows:

Insert list of splitters

- E. Directional Couplers shall be as follows:

Insert list of couplers

- F. Taps shall be as follows:

Insert list of taps

## 2.6 POWER SUPPLY AND POWER LINE INSERTERS

- A. Power supplies to be installed with the cable system shall match the amplifiers selected, and shall be capable of supplying at least ten amplifiers. Power supplies shall be located as noted on drawings and shall operate on 120 VAC power, with connection to building power provided by the Contractor. Power supply output voltage of 60 volts is required. Power supplies shall be Power Guard model NS-6015-0, Cable Power Inc. model 737, or approved equal.

- B. Power inserters shall be Jerrold model SSP-PI.

## 2.7 AMPLIFIERS

### A. Trunk Amplifiers

1. Forward amplifiers shall have a 50 to 450 MHz passband and must accept power from the multiple amplifier power supply.
2. Amplifiers shall be Jerrold Starline 20/450 Mainstations with SJPA-450-27 forward amplifier modules.
3. Reverse amplifiers shall be Jerrold:  

Subsplit	TRA-30M
Midsplit	TRM-110.
4. Unless otherwise specified, all system amplifiers must be interchangeable and gain adjustable to allow any unit to be replaced with spare amplifiers kept on hand.
5. Adjustable modular plug-in type slope compensators (equalizers) shall be used to allow easy change when required for variances of cable tilt.
6. Each amplifier installed shall be complete with all necessary modules, equalizers, pads, and filters to be a fully operational two-way station.

### B. Internal Building Distribution Amplifiers

1. Internal building distribution amplifiers shall be:  

Midsplit cable:	Jerrold model JLE-MS-450,
or	Jerrold model JLP-MS-450.
Subsplit cable:	Jerrold model JLC-7-450-2W,
or	Jerrold model JLP-7-450-2W.
2. Internal building amplifiers at all other points shall be Jerrold model IDA-450.
3. Each amplifier installed shall be complete with all necessary modules, equalizers, pads, and filters to be a fully operational two-way station.

## 2.8 MODEMS

### A. Data Modems

1. Broadband radio frequency (RF) data modems shall be designed for half and full duplex operation over a two-way broadband cable system. The mode of operation shall be capable of both synchronous and asynchronous. The modem shall be capable of at least the following data rates - 1.2, 2.4, 4.8, 7.2, 9.6, 19.2 kbps. The modem shall have status indicators for carrier detect, request to send, data set ready, receive data, and send data. It shall have its own internal clock, and shall have an EIA RS- 232D 25 pin modem connector.
2. The modem shall transmit in the reverse direction and receive in the forward direction.
3. The frequencies of the modems shall be located in channels T-7;H, T-8;I, T-9;7, or specified by Owner on shop drawings.
4. The output levels of the modems shall be adjusted such that the broadband cable system operates within specifications (1.2 B 3).

B. Audio Modems

1. Broadband radio frequency (RF) audio modems shall be designed for full duplex operation over a two-way broadband cable system.
2. The frequencies of the modems shall be located in channels T-7;H, T-8;I, T-9;7, or as specified on shop drawings.
3. The output levels of the modems shall be adjusted such that the broadband cable system operates within specifications. (1.3 B 3).

2.9 FREE STANDING EQUALIZERS

- A. Free standing equalizers shall be Jerrold model EH-MS for midsplit systems and Jerrold model FFE-8-450 for subsplit systems.

2.10 TERMINATION DEVICES

- A. Terminating resistors shall be used to terminate the ends of all branches of the system and unused ports and shall be devices specifically designed for the purpose of terminating coaxial lines carrying VHF and UHF signals. Terminating resistors shall cover the frequency range of the system. The terminators shall be Gilbert GTR-M; and on non-power passing devices, Jerrold TR-75F, or approved equal.

2.11 PULL WIRE

- A. A braided nylon pull string, 600 pound test, shall be installed with each vertical riser for installation of future cables.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. All equipment shall be installed and firmly secured in place per manufacturers specifications. No equipment shall be suspended by its coaxial cable connection.
- B. All boxes, equipment, etc. shall be plumb and square. Consideration shall be given operational efficiency and aesthetic factors in the installation of equipment and cables.
- C. Broadband cable shall be installed continuous from termination to termination without splices.
- D. All cable, regardless of length, shall be marked with wrap-around number or letter cable markers at both ends. There shall be no unmarked cable any place in the system. Labels shall be able to withstand high temperatures and humidity as well as an unclean environment. Marking codes used on the cables shall correspond to the following:
  - 1. Codes shown on the drawings;
  - 2. Room numbers indicating TO and FROM for cables serving various rooms;
  - 3. Coding system provided by Contractor for all other cables.
- E. All inter-rack cabling shall be neatly laced, dressed, and adequately supported.
- F. Care shall be exercised in wiring so as to avoid damage to the cables and to the equipment. Open riser cables and horizontal runs in close proximity to steam or hot water pipes will be isolated so as to protect the cables from damage.
- G. Cable runs shall be neatly routed, strapped, dressed and adequately supported to building structural members, slab, or walls only; not ceiling hanging wires, existing conduit, or pipes.

#### 3.2 CABLE INSTALLATION

- A. Trunk Cable
  - 1. Trunk cable to be installed using 1/2 in. or 3/4 in. galvanized conduit clamps appropriate for size of cable. Anchor conduit clamps to wall using Hilti anchors. Place clamps at 6 foot intervals along cable.
  - 2. When cables are installed on vertical walls, they shall be installed so top most cable is the same cable throughout system to match existing system. The middle and lowest cable to be installed likewise.
  - 3. Cables shall be color coded at each trunk device location (both input and output) according to the following schedule. Colored PVC tape shall be used.

- a. TV Cable (Subsplit) Red
  - b. Data Cable (Midsplit) Black (no tape)
  - c. Spare Cable (Midsplit) Blue
4. Cable connectors on amplifiers and passive device housings which are located within building locations shall not be covered by heat shrink tubing. Cable flooding compound shall be prevented from leaking by cleaning the exposed aluminum outer conductor and wrapping tightly with black PVC tape.
  5. All splices in buildings, steam tunnels, or vaults shall be covered with sealing heat shrink tubing. At least three inches of tubing shall extend on either side of the connector and shall be made to overlap one inch and seal to the outer PVC jacket on the cable. No aluminum outer conductor shall be exposed.
  6. No splices shall occur in duct lines, conduits, or inaccessible locations.

B. Internal Building Distribution Cable

1. Non-plenum distribution cable shall be installed in wireways or conduit unless noted otherwise. Cable manufacturers recommended bending radius shall be strictly adhered to for the minimum bending radius of all cables.
2. Plenum distribution cable shall be bundled and fastened to building structural members; slabs or walls only; every three feet using Panduit CCH 25-S 10-M cable clamps, 1/4" diameter, or larger to suit cable. Anchor with minimum 1" long screws. Cable shall not be anchored to ceiling hanging wires, other conduit or pipes.

3.3 PULL STRING INSTALLATION

- A. The pull string shall be installed running parallel to the vertical riser distribution cables. It shall run the entire length of the risers with a two foot service loop on each floor and six feet of string coiled at the top and at the bottom of the riser.

3.4 TAPS, SPLITTERS, AMPLIFIERS, EQUALIZERS

- A. All cable devices shall be firmly attached to building walls, or structure. Cable shall be supported within two feet on both sides of each device by attachment to building walls, or structure. The methods of attachment shall be proposed by the installation Contractor for approval by the Engineer prior to installation.
- B. All equipment installed in mechanical rooms and amplifier hubs shall be mounted on fire-rated (4' x 8' x 3/4") plywood.
- C. All devices shall be installed in locations selected for physical and free access for maintenance. All equipment, boxes, etc. shall be mounted plumb and square. The Contractor must take precautions as are necessary to prevent and guard against electromagnetic and electrostatic hum.

- D. All equipment mounted on the inside surface of an exterior wall shall be spaced 1/2" from the wall for ventilation.

END OF SECTION 271900