SECTION 16810 - BROADBAND VIDEO DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to the work of this Section.

1.2 SUMMARY

A. Central Washington University has installed a broadband cable system which consist of a complete and operational bi-directional coax backbone. This network is capable of transporting video, audio, and data services over the entire system. It is designed to be transparent to the modulator/demodulator equipment, including data equipment, attached to the network, regardless of attachment location. Over 30 buildings are currently connected to this backbone system with additional buildings to be added as constructed. While present construction is based on a coaxial cable architecture, future installations will begin a migration to a Hybrid Fiber-Coax architecture.

a. The identified equipment types and model numbers listed in this document are to be used as guidelines. Bidders can propose the specified equipment or an equivalent product with equal or better performance. Any and all alternatives must be approved by CWU's video telecommunication department. Approval will be confirmed in writing.

b. The University reserves the right to change the parameters based on technological improvements, environmental conditions and University priorities.

c. Related Sections include the following:

i. Division 7 Section — "Firestopping"
ii. Division 10 Section — "Cutting and Patching"
iii. Division 16 Section — "Raceway and Boxes for Communications Circuits"
iv. Division 16 Section — "Grounding for Communications Circuits and Raceway"
v. Division 16 Section — "Cable Trays for Communications Circuits"

1.3 REFERENCES

A. ANSI/TIA/EIA - 568A: ***Commercial Building Telecommunications Cabling Standard***
B. ANSI/TIA/EIA - 569: ***Commercial Building Standard for Telecommunication Pathways and Spaces***
C. ANSI/TIA/EIA - 570: ***Residential and Light Commercial Telecommunications Wiring Standard***
D. ANSI/TIA/EIA - 606: ***The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings***
E. ANSI/TIA/EIA - 607: ***Commercial Building Grounding and Bonding Requirements for Telecommunications***
F. TIA/EIA -TSB67: ***Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems***
G. ISO/IEC IS 11801: ***Generic Cabling for Customer Premises***

H. ***NCTA Recommended Practices for Measurements on Cable Television Systems***

1.4 DEFINITIONS

A. MID-SPLIT CONFIGURATION: The system is a single cable mid-split design capable of carrying RF signals over a system bandpass spectrum of 5 MHz to 112 MHz, return and 150 MHz to 450 MHz, forward. The system is designed to be transparent to any media transported over the network, whether it be voice, video, data communication, or modulated RF carriers. The mid-split bi-directional configuration is accomplished using duplex filters in the trunk and distribution system.

B. CONTINUOUS OPERATION: The trunk and distribution systems are rated for continuous 24 hours operation with 99.95% reliability under the temperature and environmental conditions encountered in the area.

C. AMPLIFIERS: All trunk, bridger, and line extender (or Distribution) amplifiers are and shall be bidirectional and be capable of accepting readily available duplex filters, forward and reverse cable equalizers, forward and reverse pads, and separate modular forward, bridger and reverse amplifiers. Trunk amplifiers shall have automatic gain/slope control stages in the forward modules.

D. PASSIVE EQUIPMENT: The minimum bandpass of all splitters, combiners, directional couplers, and directional taps shall be at least 5 MHz through 1000 MHz.

a. THE CRF OR HEADEND: Includes all amplifiers, directional couplers, return channel filters, combiners, pilot carrier generators, test points, racks, connectors, and other devices associated with the headend.

F. THE TRUNK SYSTEM: Includes the trunk amplifiers, the inter-building coaxial cable, passive electronic devices, and other applicable devices associated with the trunk system. The trunk system shall not be tapped for user service connection. The trunk design incorporates unity gain with at least 21 dB of amplifier operational spacing. A hybrid fiber-coax architecture shall define the fiber portion and any device converting from RF on coax to or from fiber as the trunk.

G. THE DISTRIBUTION SYSTEM: Includes the trunk bridging amplifiers, line extender amplifiers, intra- and inter-building coaxial distribution cable, directional couplers, taps, and other applicable devices associated with the distribution system. The hybrid fiber-coax system shall consider the output of a fiber to coax conversion device and all following coax devices as the distribution system. The distribution shall be tapped for user service connections and utilize high output levels for greater distribution coverage.

1.5 SYSTEM DESCRIPTION

A. EXISTING SYSTEM DESCRIPTION

i. The coax based network frequency spectrum is 5 MHz to 450 MHz. The system has been designed with dual frequency methods. Frequencies employed in forward direction 150 - 450 MHz, reverse 5 - 112 MHZ.

ii. The system is designed with respect to video carrier levels as the reference for all design operations and for all signals on the system drawings.

iii. The system provides the maximum number of TV channels even if the number of channels transported over the network is not at full load.

iv. The system utilizes pilot carrier referenced automatic gain/slope control amplifiers with

thermal compensating networks installed.

v. The distribution cable system provides for service levels of not less than +11 dBmV (measured at 450 MHz at 68 degrees F) at the output ports of all taps.

B. DESIGN REQUIREMENTS

1. All amplifiers shall be designed for operation from 47 to 60 volts RMS, from ferro-resonant power supplies. The cable system shall carry this voltage to provide active elements with power as required. External power combiners are not to be used in this system without specific direction from the CWU Video Telecommunications engineering staff..

2. All trunk and distribution cable, .500 inches and larger, shall have a minimum structural return loss of 30 dB or greater from 5 MHz to 1000 MHz prior to installation.

3. Trunk cable shall have a minimum structural return loss of 28 dB from 5 MHz to 1000 MHz after installation and before splicing or installing any passive or active devices.

4. All amplifiers and passive devices in the total system shall have a minimum structural return loss of 16 dB at all ports.

5. The system shall be capable of delivering all NTSC color and monochrome signals to EIA standard television receivers without discernable degradation.

i. Worst Case Trunk Station Cascade: 6

ii. Worst Case Distribution Cascade from the Trunk Station Bridger = 1

8. Amplifier level selection is based on performance requirements. All inputs to the distribution amplifiers shall be increased above the manufacturer's minimum recommended levels to achieve better signal to noise ratio (C/N). The output of the amplifiers have been kept at the manufacturer's recommended levels, and therefore, the manual gain is adjusted to achieve the specified output level.

C. PERFORMANCE REQUIREMENTS

1. Balance

(1) Overall signal balance within the distribution system shall be a maximum of 3 dB difference between any two user connections in the forward direction as measured at the tap port at design frequencies. The University may require exceptions to this parameter.

(2) Overall system signal balance shall be within a 3 dB difference between any two carriers at the design frequencies, regardless of direction. Measurements shall be taken at both the headend and user tap ports in each distribution leg.

2. Tap Port Signal Level

(1) Each tap service port shall provide not less than the following signal levels as measured at the end of a typical 50 foot drop.

(a) Output levels:

(i) Television video modulator . . . . +10 dBmV; +/- 1.5 dB

(ii) Data carrier shall be computed based on 10 (+/- 1.5) - 10Log(6Mhz/Carrier Bandwidth)

(b) Input levels:

(i) Television video modulator . . . . . +53 +/- 1.5 dBmV

(ii) Data carrier at 53 - 10 Log(6Mhz/Data Carrier Bandwidth)

3. Service Drop Cables:

a. The system service drops shall use quad shielded Times Fiber 2260 cable or equivalent with maximum attenuation of 4.4 dB per 100 feet at 450 MHz. Service drop cable length shall be maintained within a maximum length of 75 feet, 50 feet nominal. This gives a system drop variation of plus or minus 1.51 dB at 450 MHz and plus or minus .74 dB at 108 MHz.

4. Headend Signal Levels: The headend operates with the following signal levels:

a. Forward direction output levels as measured at the input of the HC-8 combiner:

Television RF processor . . . +53 +/- 1.5 dBmV
NTSC video modulator . . . . +53 +/- 1.5 dBmV
Television aural carrier . . . . 15 dB below video
Data translator . . . . . 53 - 10 Log (Translation Bandwidth)

b. Return direction input level as measured at the output of the HC-8 splitter:

Television video carrier . . . . . +10 dBmV; + /-4 dB
Television aural carrier . . . . . -5 dBmV; + /-4 dB
Data Carrier shall be computed based on:
8 (+ / - 1.5) - 10Log(6Mhz/Data Carrier Bandwidth)

5. Amplifier Signal Levels

a. All forward amplifiers shall be aligned for flat input and tilted output in forward direction. Reverse amps shall be aligned for flat output. Equalizers shall be used at each amplifier and adjusted according to the response of the amplifier.

b. All amplifier modules of each type shall be interchangeable to allow unit replacement with a spare module. Amplifier outputs shall be push-pull solid state design, with interstage slope and compensation networks.

6. Amplifiers shall be CCOR models or equivalent as specified below and operate at the following forward signal levels:

Model	Description	Ave. Input / Max. Output
LAN-5024/5053Trunk		+10 dBmV / +31 dBmV
*LAN-5024/5053	Bridger	+19.5 dBmV / +45 dBmV
LAN-100-2RE	Line Extender	+8 dBmV / +43 dBmV

*Not including SMT and bridger input coupler.

7. Reverse amplifiers shall be CCOR models or equivalent as specified below and operate at the following approximate levels:

Model	Description	Input / Output
LAN-5024/5053Trunk		+16 dBmV / +32 dBmV
*LAN-5024/5053	Bridger	+17.5 dBmV / n/a
LAN-100-2RE	Line Extender	+16 dBmV / +45 dBmV

*Not including SMT and bridger input coupler.

i. All amplifiers shall have an external bi-directional precision test point (see 2.2.Q) installed onto the housing output port. All output measurements shall be performed using this test point.

ii. Scope

(1) All performance calculations are based on manufacturer's specification data for the trunk station and the extender amplifiers. (See referenced documents per Section 2.)

(2) Performance of the CWU Broadband System has been grouped into two categories: Forward (broadcast) and Reverse. In each category, worst case analysis figures are presented. The system must meet the specification in each category independent of the other.

iii. Note To Contractor

(1) If in the contractor's judgment the system will not meet the specifications presented herein, a written list of the items that cannot be met, and the reason why in detail, must be submitted as a part of the Response (proposal).

iv. Worst Case Runs and Their Attributes

(1) The longest cascade in the system is composed of:

Trunk stations cascade	6
Trunk to bridger cascade (same housing)	1
Bridger to line extender cascade	1

(1) See Phase I (17 sheets) and Phase II (30 sheets) schematics for cascade routing. Copies may be viewed or obtained for copying at the CWU Center for Learning Technologies.

i. The total power allowed in a single channel (6 MHZ bandwidth) is 53 dBmV, injected at the end of any drop cable. 100 feet of TFC RG6 Quad Shield cable shall be used for signal injection except for the Headend ports. Minimal lengths are advised for use at the Headend.

ii. Signal receive level average 9 dBmV at the end of the drop cable at 450 MHZ. The tap will deliver an average signal of 12 dBmV +/- 1.5 dBmV. The tap I/O power is referenced to a single video channel, 6 MHZ in bandwidth.

i. Bandpass:

(1) Forward 150-450 MHz
(2) Reverse 5-112 MHz

ii. Tap Level As Measured At The Directional Tap:

(1) Forward
  (a) TV +12 dBmV to +/- 1.5 dBmV
  (b) Data 12 - 10Log(6 MHz/Data Carrier Bandwidth)
(2) Reverse
  (a) TV +53 dBmV
  (b) Data 53 - 10Log(6 MHZ/Data Carrier Bandwidth)

iii. Headend Level As Measured At The Input And Output Of The HC-8's Respectively:

(1) Forward In
  (a) TV +53 +/- 1.5 dBmV
  (b) Data 53 - 10Log(6 MHZ/Data Carrier Bandwidth)
(2) Reverse Out
  (a) TV +10 dBmV; +/- 1.5 dBmV
  (b) Data +8 - 10Log(6 MHZ/Data Carrier Bandwidth)

iv. Response Flatness:

(1) Forward +/-1 dB across 6 MHz
(2) Reverse +/-1 dB across 6 MHz

v. Peak-To-Valley:

(1) *Trunk only 1 + (n/10) dB
(2) *Trunk & Distribution 1 + (n/10) dB + .5 dB, where *n = Number of Trunk Amps Measured at amp outputs across 450 MHz.

i. Spectrum Loading

(1) Spectrum Loading for System Values using a Dix-Hill Matrix Multiple Carrier Generator with simultaneous carriers from 5-450 MHz.

Parameter	Spectrum Loading
Carrier-to-Noise (C/N)	Fully Loaded
Composite Triple Beat (CTB)	Fully Loaded
Second Order Harmonics	3 Channels ($F_1 + F_2$)
Third Order Harmonics	Fully Loaded
HUM Modulation	Single Channel
Cross Modulation (X-MOD)	Fully Loaded
Random and Spurious Signal	-----
System Forward Tilt	Fully Loaded
System Reverse Tilt	Fully Loaded
System Peak-to-Valley	Fully Loaded

i. System Performance - Forward

(1) Carrier-To-Noise Ratio:

(a) Forward and Reverse: Not less than 45 dB. Measured anywhere in the system.

(b) Shall depend on the number of amplifiers in the cascade. Computed as:

(i) $10\text{Log}[10^{(dB}1^{/10)} + 10^{(dB}2^{/10)} + \ldots + 10^{(dB}n^{/10)}]$
(ii) dB_n = c/n per amplifier.

(1) Hum-Modulation:

(a) Forward: <1.5%
(b) Reverse: <1.5%

(2) Carrier-To-Second Order Beats: < -65 dB

(3) Composite Triple Beat (CTB): < -53 dB

(4) Cross Modulation:Less than - 52 dB

ii. Reverse Values

(1) As presented in 1.5.C.11, the cascade applies to reverse calculations also. However, the carrier to noise is computed on the basis of the total reverse noise generated by each amplifier. The bridger amplifier does not affect the reverse calculations since it does not contain active elements in the reverse direction. Therefore, the cascade is redefined for reverse as follows:

Trunk Station Cascade	6
Trunk to Line Extender (via passive bridger)	1

(1) The reverse noise calculations are independent of the number of amplifiers in cascade, since the total number of amplifiers (11 trunks and 30 line extenders) has been considered.

(2) Carrier-to-Noise (C/N)

(a) Carrier-to-Noise (based on 11 trunk stations and 8 LAN-100 line extenders) shall not be lower than 49.76 dB.

(b) Reverse C/N must not be less than 49.76 dB anywhere in the system. The worst case reverse noise will be at the headend reverse output of the primary headend trunk amplifier.

(3) Second Order Products

(a) (F_1+F_2) shall not be greater than -73.96 dB

(4) Composite Triple Beat (CTB)

(a) Reverse CTB shall not be greater than -69.92 dB.

(5) Cross Modulation (X-MOD)

(a) The reverse X-MOD shall not be greater than -69.92 dB.

(6) Reverse System Response (Peak-to-Valley)

(a) Trunk 1.7 dB
(b) Distribution 1.7 + 1.5 dB

(c) Other characteristics that are shared between forward and reverse are:

(i) HUM Modulation
(ii) RF Radiation
(iii) Spurious Signals
(iv) For common characteristics, refer to forward values.

ii. Outlet Isolation: >20 dB between any two outlets

iii. System Radiation: Must meet FCC Specification section 76.605(a)(12)

(1) 5-24 MHz less than 15uv/meter @ 100'

(2) 54-216 MHz less than 20uv/meter @ 10'

(3) 216-300 MHz less than 15uv/meter @ 100'

iv. System Ingress:

(1) Shall meet or exceed system radiation specifications.

v. Measurement and System Tolerances

(1) All values associated with levels at the subscriber taps and distortion levels (harmonic and non-harmonic) are calculated values which are theoretical. In practice, a tolerance window of +/- 3 dB from the calculated values is nominal. Therefore, the actual system parameters will vary +/- 3 dB.

1.6 SUBMITTAL INFORMATION

A. Design documents shall be submitted prior to bid as part of the 85% bid document, or earlier, for approval by the University. The documents shall show and identify all active and passive devices, their locations with cable distances between all devices, tap port signal levels to be achieved upon construction, amplifier input and output levels, forward and return tilt levels, equalization required, and how the new construction will interface with the existing broadband system. The design document must be submitted as complete within itself without requiring reference to the submitted floor plans or by simply showing the component locations as symbols on the floor plans. The design document may be incorporated as a separate portion of the total building bid document. It should be noted that University approval does not alleviate the bidder from their responsibility to provide the University with a properly designed mid-split broadband system as per the specification with in this document. The University will assume no responsibility as to the validity of the proposed design. It is the sole responsibility of the individual/firm to provide the University with a complete, functional and optimized broadband system upon completion of construction.

1.7 CONTRACTOR QUALIFICATIONS

A. Persons and/or firms wishing to design additions to the present broadband system whether through new building or remodeling must have a demonstrable history of quality design and integration. This will be determined by documenting their direct involvement in designing bi-directional mid-split coaxial cable and hybrid fiber-coax broadband LAN systems that integrate ten or more buildings in a campus-type environment. These systems must have been designed to transmit both data and RF modulated video and audio services. A minimum of three successful projects within the previous four years must be provided with contact names for reference. Any system addition created through new construction or the remodeling of an existing building must couple into the existing system and meet or exceed the operating parameters established by the present system's operation documentation.

B. Persons or firms wishing to bid on installing an addition to the existing broadband system, whether through a building remodel or new construction, must demonstrate a history of successful bi-directional mid-split coaxial cable and hybrid fiber-coax broadband system installations. These must have included both indoor construction and outdoor construction, demonstrating both aerial and underground construction experience. A minimum of three successful projects within the previous four years must be provided with contact names for reference.

1.8 WARRANTY

A. Warranty: The selected bidder shall warrant the system to be free of defects for a period of one year following acceptance of the installed system. This warranty shall include all active and passive components installed under the original construction. This warranty shall not be voided by CWU personnel attaching additional drop cables to the contractor installed distribution taps and drops. Normal installation procedures recognized by the broadband CATV/LAN industry will be utilized by CWU. These added drops will not become part of the warranty. This warranty shall not limit any other warranties that may be established in a system construction contract.

B. Nothing in this section shall be construed to terminate the warranty by performance of any normal maintenance or service on the network, or by expanding the network in any manner consistent with the original design and plan for the network.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified or shown on the Drawings required for a fully operational, tested, certified and warranted system.

B. The Contractor shall physically verify underground and overhead pathway lengths to be used for backbone cabling prior to purchase and delivery of materials.

2.2 **MATERIALS**

A. The brand names listed herein are indicated to establish quality and performance criteria. Selected Bidders ARE ALLOWED TO PROPOSE EQUIVALENT EQUIPMENT FOR CONSIDERATION AS LONG AS IT MEETS THE RFP SPECIFICATIONS AND DESIGN REQUIREMENTS. SUBSTITUTIONS MUST BE SPECIFICALLY APPROVED BY CWU BEFORE USE. Items indicated “no substitute” shall be provided as specified.

B. All basic equipment for which there are Underwriters Laboratories Standard Requirements shall be listed by UL and be so labeled. The coaxial cable and support equipment utilized for the broadband communications system shall conform to the following specifications.

C. TRUNK CABLE .750 INCH (FOR UNDERGROUND CONDUIT):

Conductor - electrical grade copper clad aluminum .165 in diameter
Dielectric - gas injected foam polyethylene
Shield - seamless high purity electrical grade aluminum tube .750 in diameter
Jacket - tough, medium density, low friction black polyethylene with sequential footage numbering
Flooding Compound - viscous, non-hardening, non-drying flowing/sealing material
Maximum pulling force - 425 lbs.
Minimum bending radius - 10.5 inches
Velocity of propagation - 88%
Nominal capacitance - 15.3 pF/ft.
loop resistance - .77 ohms/1000 feet
Attenuation - 1.15 dB/100 feet @ 450 MHz and 68 degrees F
Impedance - 75 ohms
Manufacturer: TIMES FIBER COMMUNICATIONS, INC. T10-750JB, or equivalent, for underground conduit installation.

A. TRUNK CABLE, .500 INCH (FOR UNDERGROUND CONDUIT):

Conductor - electrical grade copper clad aluminum .109 in diameter
Dielectric - gas injected foam polyethylene
Shield - seamless high purity electrical grade aluminum tube .500 in diameter
Jacket - tough, medium density, low friction black polyethylene with sequential footage markings
Flooding Compound - viscous, non-hardening, non-drying flowing/sealing material
Maximum pulling force - 200 lbs.
Minimum bending radius - 7 inches
Velocity of propagation - 88%
Nominal capacitance - 15.3 pF/ft.
loop resistance - 1.75 ohms/1000 feet
Attenuation - 1.65 dB/100 feet @ 450 MHz and 68 degrees F
Impedance - 75 ohms
Manufacturer: TIMES FIBER COMMUNICATIONS, INC. T10-500JB, or equivalent, for underground conduit installation.

A. TRUNK/DISTRIBUTION CABLE, .500 INCH, JACKETED (INTERIOR CONDUIT PLACEMENT):

Conductor - electrical grade copper clad aluminum .109 in diameter
Dielectric - gas injected foam polyethylene

Shield - seamless high purity electrical grade aluminum tube .500 in diameter
Jacket - tough, medium density, low friction black polyethylene with sequential footage markings
Maximum pulling force - 200 lbs.
Minimum bending radius - 7 inches
Velocity of propagation - 88%
Nominal capacitance - 15.3 pF/ft.
loop resistance - 1.75 ohms/1000 feet
Attenuation - 1.65 dB/100 feet @ 450 MHz and 68 degrees F
Impedance - 75 ohms
Manufacturer: TIMES FIBER COMMUNICATIONS, INC. T10-500J,#22501, or equivalent, for indoor non-plenum conduit installation.

A. TRUNK/DISTRIBUTION CABLE, .500 INCH, NON-JACKETED (NON PLENUM FREE SPACE ENVIRONMENT):

Conductor - copper clad aluminum .109 in diameter
Dielectric - gas injected foam polyethylene
Shield - seamless high purity electrical grade aluminum tube .500 in diameter
Maximum pulling force - 200 lbs.
Minimum bending radius - 7 inches
Velocity of propagation - 88%
Nominal capacitance - 15.3 pF/ft.
loop resistance - 1.75 ohms/1000 feet
Attenuation - 1.63 dB/100 feet @ 450 MHz and 68 degrees F
Impedance - 75 ohms
Manufacturer: TIMES FIBER COMMUNICATIONS, INC. T10-500V, or equivalent cable conforming to NEC Art. 820 “CATV” rating for indoor non-plenum installation.

A. TRUNK/DISTRIBUTION CABLE, .500 INCH (PLENUM ENVIRONMENT):

Conductor - copper clad aluminum .109 in diameter
Dielectric - foamed Teflon
Shield - high purity electrical grade aluminum tube .500 in diameter
Maximum pulling force - 200 lbs.
Minimum bending radius - 8 inches
Velocity of propagation - 86%
loop resistance - 1.72 ohms/1000 feet
Attenuation - 2.16 dB/100 feet @ 450 MHz and 68 degrees F
Impedance - 75 ohms
Manufacturer: Comm Scope 2311.

A. SERVICE DROP CABLE - NON PLENUM

Conductor - copper clad steel
Dielectric - T6 foam polyethylene
First Shield - sealed APA tape - 1/16" overlap
Second Shield - 60% aluminum braid
Third Shield - APA tape - 1/16" overlap
Fourth Shield - 40% aluminum braid
Jacket - PVC black
Attenuation - 4.31 dB/100 feet @ 450 MHz and 68 degrees F
Impedance - 75 ohms

Manufacturer: TIMES FIBER COMMUNICATIONS, INC. 2260V, or equivalent NEC CATV rated cable, for indoor non-plenum service drop connections.

A. SERVICE DROP CABLE - PLENUM

Conductor - 18 AWG copper clad steel
Dielectric - Teflon foam
First Shield - tape
Second Shield - 60% aluminum braid
Third Shield - tape
Fourth Shield - 60% aluminum braid
Jacket - Kynar flex
Attenuation - 4.86 dB/100 feet @ 450 MHz and 68 degrees F
Impedance - 75 ohms
Manufacturer: COMMSCOPE 2227K with Kynar jacket or equivalent, for indoor air-plenum service drop connections.

A. CABLE CONNECTORS

1. All connectors utilized to provide interfacing of cabling to equipment or splices shall be solderless, 75 ohm impedance, with integral radiation sleeve and compression ring. Connectors shall be Gilbert GRS series cable connectors or equivalent.

2. Trunk Connectors - .750

   a. CATV solid coaxial connector, with integral radiation sleeve, internally seized center conductor with captive center conductor pin, outer compression ring and “O” ring seals. Use CPT-750 to prepare cable end.

   b. Manufacturer: GILBERT GRS-750-CH-DU-01

3. Trunk Splice Connector - .750

   a. CATV solid shield coaxial splice connectors, with integral radiation sleeve, internally seized center conductor, outer compression ring and “O” ring seals. Use CPT-750 to prepare cable end.

   b. Material: Machined aluminum, chromate film coating

   c. Environmental: Weatherproof, compatible with shrink tubing

   d. Manufacturer: GILBERT GRS-750-SP-DU-01

4. Trunk/Distribution Connectors - .500

   a. CATV solid shield coaxial connector, with integral radiation sleeve, feed through center conductor pin type with internal center conductor seizure, outer compression ring and “O” ring seals. Use CPT-500 to prepare cable end.

   b. Fitting interface: Standard 5/8 x 24 diameter

   c. Material: Machined aluminum, chromate film coating

   d. Environmental: Weatherproof, compatible with shrink tubing

e. Manufacturer: GILBERT GRS-500-CH-DU-03

1. Trunk/Distribution Splice Connectors - .500

a. CATV solid shield coaxial splice connector, with integral radiation sleeve, internally seized center conductor, outer compression ring and “O” ring seals. Use CPT-500 to prepare cable end.

b. Material: Machined aluminum, chromate film coating

c. Environmental: Weatherproof, compatible with shrink tubing

d. Manufacturer: GILBERT MODEL GRS-500-SP-DU-03

2. Housing to Housing Connectors

a. Standard CATV/Male coupling connector for joining two equipment housings.

b. Interface: Standard 5/8 x 24 diameter

c. Material: Machined aluminum, chromate film coating

d. Environmental: Weatherproof, compatible with shrink tubing

e. Manufacturer: GILBERT G-KS-KS-M-T or G-KS-KS-M

3. Cable to 90 Degree Adapter and 180 Degree Adapter

a. Type: Male-VSF to female-VSF 90 degree adapter. Used to make right angle connections between cable and equipment housing. Female accepts any VSF-5/8 x 24 connector, center conductor is seized by tightening hex plug on end of the connector. The pin is 1.16 inch with standard 5/8 x 24 threads.

b. Manufacturer: GILBERT MODEL GP-90, GP-PA SERIES

4. Splice block

a. Type: Universal splice for two 5/8 X 24 threaded connectors.

b. Manufacturer: GILBERT MODEL G-SPB-2.0

9. Distribution Connectors - RG6-QS, Non-Plenum and Non-Teflon Jacket Plenum

a. Type: Standard CATV “F-56” connector with integral ferrule. Use Gilbert G-CRT-USA or equivalent .360 hex crimp tool.

b. Interface: Standard “F” female ports

a. Material: Aluminum, chromate film coating

b. Environmental: Indoor applications without weather boot

c. Manufacturer: GILBERT GF-6-AHS-1312 OR GF-6-AHS/USA

10. Connectors - .500 to “F”

    a. Type: Standard CATV/female coupling connector. Used to connect .500" cable to “F” fitting. Connector has center conductor internal seizing with an integral sleeve. These connectors may not be used on any cable carrying power.

    b. Manufacturer: GILBERT MODEL GRS-500-BAFF-DU-03

11. Series Splice

    a. Type: Standard CATV/female adapter for joining two “F” connectors with 3/8 x 32 thread.

    b. Manufacturer: GILBERT MODEL GF-81-S

A. TERMINATION, GENERAL

1. The terminators utilized shall be provided for system matching and termination which minimizes reflections and spurious signal ingress onto the system.

2. Trunk Terminators

    a. Type: Standard 75 ohm impedance, with RF and AC blocking characteristics, and 30 dB return loss. Completely weatherproof with soldered internal connections.
    b. Manufacturer: GILBERT GTR-M-T

3. Tap Port Termination

    a. Type: Standard 75 ohm impedance, with RF termination characteristics, and 30 dB return loss. RF only.
    b. Manufacturer: GILBERT GTR-59-A

4. End of Line Terminators

    a. Type: When a trunk or distribution cable is not terminated in an active or passive device it shall be terminated with an appropriate AC blocking RF terminator of 75 ohms impedance. Termination shall grip both the center conductor and sheath with a seizing type grip. Cable type for connector selector shall be based on Times Fiber for non-plenum and CommScope plenum cable.
    b. Manufacturer: GILBERT

    c. (500 cable type) GRS-500 TR-xxxx

    d. (750 cable type) GRS-750 TR-xxxx

5. Room Drop Termination

    a. Type: Dual cable device which will mount in a deep single gang electrical box.

Box depth to be not less than 2.5 inches. Termination devices to be determined as needed to comply with the planned telecommunications assembly to be installed in the wall. For standard duplex cover plate installations utilize a Blonder-Tongue V-2GF-FT Versa Tap device. Either assembly is to use Gilbert G-MF/90 adapters as needed to comply with minimum cable bend radii within the outlet box.

B. REDUCER CONNECTOR:

1. Type: Standard 5/8 x 24 to female “F” Adapter with long pin and 60 Hz AC Termination

2. Manufacturer: GILBERT GF-625-CH-DCB-T

C. POWER SUPPLY:

1. Type: The power supply shall provide voltage for the amplifiers from a line source of 110 VAC. Output voltage shall be 60 VAC with maximum current of 10 amperes. AC power feed port, delivers a constant output voltage of 60V RMS ferro-resonant AC. Output to be constant +3% for input variations from 95 to 130 V and load variations from 4 to 12 Amps.
2. Manufacturer: ALPHA TECHNOLOGIES AP-960 with floor mount enclosure without batteries.

D. TWO AND THREE WAY SPLITTER, DIRECTIONAL COUPLER, POWER PASSING:

Type: The splitter or directional coupler shall provide division, directivity and AC passing characteristics as used on trunk and distribution cabling.
Interface: Standard 5/8 x 24, internal screw clamp for center conductor.
Electrical: 10 amperes each leg
Return Loss: 16 dB at 75 ohms
Bandpass: 5-450 MHz
Isolation: 20 dB minimum
Physical: Cast-aluminum, pole, strand, or pedestal mounting
Manufacturer: RMS CA-5400 SERIES

A. DIRECTIONAL COUPLER TAP, POWER PASSING:

Type: Directional coupler taps shall be of various values with 4 or 8 ports for signal distribution.
Interface: Standard 5/8 x 24, internal screw clamp for center conductor.
Port Values: Tap port values shall not have step increments of more than 1.5 dBmV.
Electrical: 7 amperes
Bandpass: 5-450 MHz.
Return Loss: 20 dB at 75 ohms minimum
Isolation: Minimum of 25 dB between ports
Physical: Cast-aluminum, pole, strand, or pedestal mounting
Manufacturer: Broadband Networks International, General Instruments or Antronics

1. Values

a. Broadband Networks International - Nominal Tap Loss dB:

Model	Insertion	Value +/-1 dB
TAP-36.5	0.5	36.7
TAP-35	0.5	35.0

TAP-33.5	0.5		33.5
TAP-32	0.5	32.0	
TAP-30.5	0.5		30.5
TAP-29.0	0.5		29.5
TAP-27.5	0.6		27.5
TAP-26	0.6	26.3	
TAP-24.5	0.6		24.5
TAP-23	0.9	23.0	
TAP-21.5	0.9		21.5
TAP-20	0.9	20.5	
TAP-18.5	1.9		18.5
TAP-17	1.9	17.0	
TAP-15.5	4.0		15.5
TAP-14	4.0	14.0	
TAP-12.5T	N/A		12.5
TAP-11.0T	N/A		11.0

General Instruments and Antronix

a. Eight Port Distribution Taps

Tap Value	Tap Loss	Through Loss
OMT78-36	36	0.8
OMT78-36	36	0.8
FFT8-35J	35	0.8
OMT78-33	33	0.8
FFT8-32J	32	0.8
OMT78-30	30	0.8
FFT8-29J	29	0.8
OMT78-27	27	0.9
FFT8-26J	26	0.8
OMT78-24	24	1.2
FFT8-23J	22.5	1
OMT78-21	21	1.4
FFT8-20J	20	1.2
OMT78-18	18	2.1
FFT8-17J	18.6	1.8
OMT78-15	15	3.8
FFT8-14J	14.2	4.3
OMT78-12T		12T
OMT78-11T		11T
FFT8-10T		10.8T

OMT78-** is the Antronix Tap Series
FFT8-** is the General Instruments Tap Series

A. HEADEND COMBINER

Type: Dual directional coupler with 8 ports on each coupler for signal combining or splitting.
Interface: Standard female “F” ports
Return Loss: 18 dB
Bandpass: 5-450 MHz
Isolation: 28 dB between ports
Physical: Rack mount 19" EIA, 3" high

Insertion Loss: 11 dB
Manufacturer: CCOR MODEL ASM-2909-D

A. PRECISION TEST POINT

Precision dual directional coupler test point with tap port values of -20 dBmV. Test point shall provide two directional coupler ports, one each for measuring the forward and reverse signal levels.
Bandpass: 5 - 450 MHZ. with +/- 0.5 dB max. variation
Insertion Loss: 1.0 dB max.
Tap Loss: 20 dB, -0.1 / +1.1 dB
Return Loss: 18.0 dB All ports
Isolation: 29 dB minimum, Tap 1 to Tap 2
Interface: Standard 5/8 x 24, internal clamp screw for connector center conductor.
Power: Device to be power passing capable of 10 amps per leg.
Hum modulation: -70 dB min. @ 6A, 60 HZ square wave.
Required Device: AM Communications TP450/2A LANguard Precision Test Point

A. TRUNK AMPLIFIER, MID-SPLIT

1. The amplifiers utilized shall be of the automatic gain type, with equalizers, filter, pads, and amplifiers so as to be configured for two-way operation on a single coaxial cable system. All modules shall be of plug-in design implementing a mid-split spectrum division for the following options: input and output filters, fixed input pads, variable equalizers, feeder line splitters, return and forward amplifiers, and power options. Test points shall be provided to check pertinent levels. The amplifiers shall meet the minimum requirements. The amplifier shall be fully redundant with redundant amplifier modules and power supplies.

2. All trunk amplifier housing to be supplied with active fail-safe amplifier, and stand-by power supply.

   Type: CATV single cable trunk amplifier, mid-split, manual gain
   Bandpass: Forward 150 to 450 MHz; return 5 to 112 MHz
   Filters: Forward 150 to 450 MHz; return 5 to 112 MHz
   Pads: Fixed value plug-in at 3dB steps from 0-21 dB
   Noise Figure: 9.0 dB
   Gain: Trunk in to trunk out 25 dB max. Return amplifiers 23 dB max.
   System Operation Level: Forward, +31 dBmV flat output; return +32 dBmV flat output
   Composite Triple Beat: -85 dB at typical outputs
   Gain Control Ranges: 0-6 dB forward
   dB reverse
   AGC Pilot Channels: G, NN
   Return Loss: 15-16 dB at all ports
   AC Input Range: 44-60 VAC
   AC Bypass Capability: 8 amps trunk
   Interface: Standard 5/8 x 24 with captive screw for central conductor
   Physical: Cast aluminum housing, messenger or pedestal mounting, weatherproof and fully shielded against radiation. The enclosure shall be hinged for maintenance and adjustments.
   Manufacturer: CCOR LAN 5024/5053 TRUNK AMPLIFIER

A. LINE EXTENDER

High gain line extender amplifiers shall be used to increase building distribution requirements.
Type: CATV single cable amplifier, mid-split, manual gain
Bandpass: Forward 150 MHz to 450 MHz; return 5 MHz to 112 MHz
Duplex Filters: Built-in
Equalizers: Forward 150 to 450 MHz, EQ-450-XX; return 5 to 112 MHz, EQ-112-XX
Pads: Plug-in at 3dB increments 0-21 dB
Noise Figure: 8 dB
Gain: Forward 36 dB; Return 30 dB
Gain Control Range: 0 - 8 dB minimum
Slope Control Range: Forward 0 - 3 dB @ 450 MHz; Return 0 - 3.5 dB @ 112 MHz
System Operating Levels: Forward +43 dBmV; Return +45 dBmV
Composite Triple Beat: -64 dB
Cross Modulation: -62 dB
Return Loss: 16 dB input and output minimum
Signal to Noise: 58 dB
Input Range: 44-60 volts
Interface: Standard 5/8 x 24 threads with captive screw for center conductor
Physical: Cast aluminum housing, messenger or pedestal mounting, weatherproof, fully shielded against radiation and modular
Manufacturer: CCOR LAN-100-2RE

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall install all components strictly to manufacturers recommendations.

B. All work shall comply with the Uniform Building Code, Uniform Fire Code, WAC, and the National Electrical Code as well as the ANSI/TIA/EIA and ISO/IEC standards listed in Part 1 — References, above.

1. Where questions arise regarding which standards apply, the more stringent specification or policy shall prevail.

C. Materials (ceiling tiles, cables, network equipment, etc.) inadvertently demolished or damaged by the Contractor during the course of construction shall be replaced and/or repaired by the Contractor at no additional cost to the Owner.

D. If raceway or pathway (conduits, sleeves, cable pathway etc.) is installed after walls are installed and/or after finish to walls has been applied, wall penetrations shall be sealed, patched and painted to match condition and finish of undisturbed wall.

3.2 INSTALLATION

A. All amplifiers and all power supplies shall be earth grounded using #6 soft drawn, bare copper wire. Where required, drive 5/8" x 8' copper-clad ground rod(s) full length into the soil to provide adequate grounding performance. A grounding rod will be required at every outside amplifier. Amplifiers within building shall be grounded to the building electrical service ground electrode. The rod shall be of sufficient length to reach permanent moisture. Telephone grounding electrodes shall not be used. A common communications room grounding buss system may be used provided it meets or exceeds EIA/TIA 607 standards.

B. Installation of the cable in the existing cable trays will require, as a minimum, tie-straps to the tray every five feet. The maximum distance allowed between cable supports is not to exceed ten feet. For cable runs where no structural support exists, an external messenger cable capable of withstanding a minimum of 3,000 pounds shall accompany the signal cable to properly support the cable.

1. Cables shall be routed in such a manner as to allow other mechanical or electrical maintenance activities to occur without damage to the cable.

C. Selected Bidders shall exercise due care in handling rigid coaxial cable in order not to damage the cable. Cable shall be left uncut, and fastened securely to its shipping reel until immediately prior to its installation. Techniques such as sag, payoff, reel braking, and clamping shall be employed to avoid kinking or bending the cable beyond its limits. Correct tooling shall be used in making all bends to ensure that the minimum safe bending radius is not exceeded.

D. Selected Bidders shall schedule and coordinate the coaxial cable placement with other activities to avoid damage to the cable by other activities which may take place subsequent to cable placement. Notice is given that the cable construction is such that relatively minor physical damage, such as dents and kinks, can have major impacts on system performance.

E. Minimum bending radius for all solid sheathed aluminum cables is 16 times the cable diameter, or manufacturer's specifications, whichever is greater.

F. "Shepherd's crook" splicing for 180 degree turns is not acceptable. Ninety degree connectors shall be utilized.

G. Cable Bends

1. Under no circumstance shall the cable be looped in one turn of more than 90 degrees. If the cable is to be bent more than 90 degrees to satisfy a routing requirement, the cable must be bent using multiple turns and there must be at least nine inches between the bisector of each turn.

H. Cable shall have standard flat bottom expansion loops formed with a bending board at the input and output connectors of each outdoor device. Devices in pullboxes or pedestals shall conform to this section where minimum bending radius can be maintained. If two expansion loops cannot be placed in a pullbox or pedestal, one shall be used if possible. In indoor or other continuously temperature controlled areas a single expansion loop shall be placed at every third device. Devices connected by housing to housing connectors shall count as one device.

I. Equipment shall be installed to be readily accessible for maintenance and shall be located so as not to interfere with servicing of other utilities or services.

J. All active and passive equipment shall be securely fastened to supporting messenger strand, concrete tunnel/vault walls, internal building structures or to supported wireways using adequate support hardware. Equipment suspended by the coaxial cable and connectors will not be accepted. All electronic equipment installed in manholes or pull vaults shall be physically attached at the top of vault walls.

1. The cable must be supported within two feet of each component. Whether the component is active or passive, an expansion loop must be made at each port such that it can withstand 100 degrees F (from ambient) temperature change or have a minimum radius of six inches.

2. Cable shall run parallel and at right angles to structure. Exposed cable shall be run on wall at ceiling and painted to match adjacent surfaces.

K. Connectors and equipment covers shall be torqued to manufacturer's specifications.

L. Outdoor connectors and splices shall be sealed water tight. Boots shall not be shrunk until completion of inspection. All connectors shall have shrink boots with integral sealant compound installed and shrunk at each connector. Shrink tubing shall extend over the cable jacket a minimum of 3 inches.

M. Indoor terminations of jacketed, flooded cables shall have its jacket end sealed with a heat shrink boot which covers not less than 3" of jacket material and 3" of bare cable. The boot shall be shrunk evenly in circumference to prevent leakage of the flooding compound. The jacket shall be trimmed back to allow not less than 1" of exposed bare cable behind the attached connector after the boot is installed. Indoor, unjacketed cables need no shrink sealing unless in high moisture or humidity environments.

N. All connections to equipment are to be of the center pin seizure set screw type.

O. All connectors shall be installed in such a manner that the connector pin will adequately pass through the set screw. The set screw shall be tightened per manufacturer's specifications.

P. All connectors shall be Gilbert or equivalent, with integral sleeve.

Q. All cable connections shall have the dielectric removed using an approved DPT coring tool. The center conductor shall be free of all dielectric material bonded to it by use of a dielectric removal tool. Damage to the copper cladding of the center conductor shall be avoided to the greatest possible extent.

R. All splicing shall be accomplished by using a utility cable cutting tool. Tubing cutters shall not be allowed. Cables which have had their aluminum shield scored during jacket removal shall be replaced. Cables must be inspected before boots are shrunken.

S. All passive equipment, taps, splitters, or directional couplers installed in tunnels or vaults shall be coated with two coats of zinc chromate primer prior to installation and coated with appropriate protective sealant after installation. Manufacturer applied factory corrosion retardant coatings may be used instead of paint/sealant, if a satisfactory showing can be made to the University.

A. Equipment-to-equipment connection shall be accomplished using a housing-to-housing connector wherever possible. All housing-to-housing connectors installed in vaults shall be water proofed with electrical rubber shrink tape or approved equivalent.

B. At all distribution termination points, an 'F' female to AC blocking adapter and an 'F' series RF terminator, shall be used.

C. All directional taps and couplers shall be properly oriented in relation to the headend's signal flow direction. Exception to this rule applies to specific reverse test points located at specific locations in the trunk system.

D. All directional couplers, taps or any closely spaced components shall be spliced within two inches of the output of amplifier or other device using a housing-to-housing connector whenever possible.

E. The trunk line shall not be tapped for service connection. Distribution lines shall be connected to a trunk line cable through high isolation devices and distribution amplifiers.

F. No splices will be permitted in trunk lines except for connections to existing cable. If splices are required, the selected Bidder must designate desired location on system maps and obtain University's approval prior to any cable pulling on that run. Splicing of intra-building cables will not be permitted.

G. All equipment and taps shall be spliced on the input side of columns or strand attaching points.

H. Taps shall be CATV/LAN type with a bandwidth not less than 5-***1000*** MHZ. and must be readily accessible. In finished areas they shall be concealed by a re-enterable sheet metal housing, painted to match adjacent surfaces.

I. All tap ports shall be terminated. Taps shall be mounted to permit access to unused ports without subjecting distribution cable sheath to damage.

J. Each amplifier shall be identified with the amplifier number stenciled on its cover. The system of materials and numbering sequences currently in use shall be continued. Superior materials may be recommended by Vendor.

K. All amplifiers and distribution taps shall be installed in locations where they are readily accessible for future connection or maintenance without the use of special ladders or lifts. All equipment and taps shall be permanently mounted to building structures or attached to supporting messenger strand so access for normal maintenance and expansion operations can be accomplished without damaging the distribution or trunk cables.

L. System shall be designed with excess tap port capacity of 1.5X in each distribution leg to accommodate additional service drops and/or tap installations, located as directed by the University.

M. Cable Termination. The drop cable will be terminated utilizing a system authorized interface as determined by the Media Center for each project. The terminating devices shall be compatible with the approved voice/data jack systems specified for the project. If no specification is given, the termination shall be Blonder -Tongue V-2GF-FT Versatap walltap with Gilbert G-MF/90 degree adapters. All jacks will be terminated with a standard 75 ohm "F" terminator.

N. CABLE TYPES, BEND RADIUS AND PULLING TENSION

TFC T10-Plus .750 inch
Part #22701 (Jacketed Non-Plenum)
Part #22702 (Jacketed Flooded-Underground)
O.D.: .880 inches
Minimum Bend Radius: 14 inches
Maximum Pulling Force: 375 pounds maximum

TFC T10-Plus .500 inch
Part #22500V (Non-Jacketed CATV)
Part#22501 (Jacketed)
O.D.: .570 inches
Minimum Bend Radius: 10 inches
Maximum Pulling Force: 190 pounds maximum

TFC T10-Plus RG-11 Part #2262
O.D.: .434 inches
Minimum Bend Radius: 6.94 inches
Maximum Pulling Force: 120 pounds maximum

TFC T10-Plus RG-6 Quad Shield Part #2260
O.D.: .297 inches
Minimum Bend Radius: 4.75 inches
Maximum Pulling Force: N/A

Comm Scope 2312 Teflon Plenum
O.D.: .525 inches
Minimum Bend Radius: 8 inches
Maximum Pulling Force: 200 pounds maximum
The pulling tension shall be verified via a dynamometer.

A. CABLE TERMINATION AND SPLICES

1. Should the installation contractor decide to carry out the installation in separate phases (i.e., place all cable, then splice components), the cable shall be pulled and prepared as follows:

   a. The cable ends shall be capped with a closed end heat shrink cover.

   b. The cable cap shall be installed such that the last four inches of the cable is fully covered.

   c. The cable end piece shall have an appropriate amount of useable length to allow for flexibility in routing within the specified parameters of design. The extra length shall be stored in the most protected area available until used.

B. All fuses from the passives fed by a line extender must be removed prior to system power up. All ports designated as test points or any passive in any location must be defused to avoid passing power to user devices or measuring instruments. Such ports will be terminated via Pin-to-F connectors of ***AC*** blocking type which, in turn, are terminated via 75 ohm F-type terminators.

C. CABLE TESTING AND VALIDATION:

1. All cables supplied for the entire project shall be tested by the Vendor before and after installation to validate the cable electrical integrity. All cable reels shall be swept for structural return loss prior to installation. Each cable reel shall be measured from both cable ends, and a Polaroid picture taken for verification that the reel passes the return loss specification. A “Before” cable log book shall be maintained containing both Polaroids of each cable reel identified by reel number and mill run number. These records shall become part of the submittal documents provided to the owner under “As-Builts” and “System Testing”.

2. After cable installation and prior to splicing, all cables shall be measured again for structural return loss to verify that all cables meet or pass the cable specification. One picture per cable length shall be required for cable validation. Each cable span shall be identified on a system design print, and an “After” cable log book maintained for all cable photographs. Exact length of cable must be determined using a Time Domain

Reflectometer or footage numbers on cable sheath. These lengths shall be entered in the as-built drawings. These records shall become part of the submittal documents provided to the owner under “As-Builts” and “System Testing”.

3. A variable return loss bridge and sweep generator shall be used for all cable measurements. Pictures shall identify frequency markers at 100 MHz intervals. A return loss reference shall be indicated on each picture. Cables not meeting specifications shall be replaced by the responsible party. Sweep and return loss data must be made available to the Project Coordinator before a cable is connected to any active or passive device.

3.3 CONSTRUCTION PRINTS

A. Provide interim as-built prints with each completed project segment within 15 working days following completion.

3.4 AS-BUILT PRINTS

A. Upon completion and before final acceptance of the project, Contractor/ Bidder shall submit final as-built drawings. One set of as-builts shall be reproducible full size Mylar sepia prints. Two sets shall be standard full size blue line prints. Final as-built drawings will also be furnished to the University on diskette in AutoCad 2000 or version specified in the project construction documents.

B. As-built sets shall consist of three parts.

1. A complete set of floor plans indicating the exact location of all passive and active devices, splices, power supplies, etc.

2. A complete set of schematic diagrams of the system constructed with each floor on a separate sheet. Each schematic shall indicate all actives, passives, cable lengths, and measured tap port signal levels at each tap. Levels shall be indicated as bandwidth average with +/- the extremes.

3. All documents and photographs developed under section 3.2-JJ - Cable Testing and Validation and 3.5 - System Tests and Alignment.

3.5 SYSTEM TESTS AND ALIGNMENT

A. All tests, measurements, and photographs will be the responsibility of the Vendor. A University Video Telecommunication Representative and the Vendor’s project manager or other designated representative will be present during final system testing. Tests shall be conducted on a scheduled basis, with one week’s written notice to Project Manager prior to each test series. All test data will be submitted to the Project Coordinator within one week of the test for review and approval by the Video Telecommunication Department.

B. SYSTEM TEST: System testing shall employ test equipment and procedures approved in advance by the Project Coordinator. The selected Bidder will submit a written test and alignment plan to the Project Coordinator for approval, no later than 30 days after contract award and at least 30 days prior to the start of any testing or alignment. Final system certification testing shall employ a matrix multiple carrier generator (Dix-Hill or equivalent) as the source generator.

C. VARIANCE: All installed signal levels shall meet the design level criteria specified for the

forward path and for the return path. (See Section 1.5 of this document.)

D. LEVELS: The level difference between TV or data carriers shall not exceed 2 dB for adjacent channels nor 3 dB between the strongest and weakest channels carried. Sound carrier level ratio on any lower adjacent channel shall not be less than 12 dB nor more than 18 dB below the video carrier. TV carrier to data carrier ratio shall be per the loading formula of 10 log (x) (N), where N equals the number of carriers in one 6 MHz assignment.

E. TERMINATIONS: Each cable shall be inspected for proper termination. All unused ports on taps shall be terminated. All unused outlets shall be terminated. At the end of all distribution cables, all test carriers shall be measured and recorded.

F. DISTORTION TEST: Using a standard TV receiver connected to randomly selected outlets, observe picture quality. No visible components of cross-modulation, ghosting, or beat interference shall appear on any tuned channels.

G. CARRIER-TO-NOISE TEST: Carrier-to-noise test shall be made at the output of the last amplifier in the system. With normal levels in the system, a properly calibrated spectrum analyzer shall be tuned to the picture carrier of each channel in turn and a reading obtained and noted. The signal shall then be removed and the input to the headend processor shall be terminated in 75 ohms and turned to MGC control. With the spectrum analyzer, read the level of remaining noise in the absence of the signal and add a bandwidth correction factor as specified by the manufacture. It shall not be less than 45 dB for the forward system and 45 dB for the reverse system.

H. BANDPASS TEST: A sweep generator may be used for preliminary system testing, structural return loss documentation, and rough alignments as required.

1. For final documentation a properly adjusted matrix multiple carrier generator (i.e.. Dix-Hill) is to be inserted into the forward combiner at the system headend. The outputs of all amplifiers shall be adjusted for flatness and documented with a Polaroid picture. The return system shall be certified by inserting the generator at an outlet at the midpoint of the distribution leg of the longest of each trunk cascade. Bandpass flatness and tilts to be appropriately adjusted and documented with a Polaroid picture. Building distributions shall be similarly documented with forward testing at the midpoint of each distribution leg and reverse injection at the same tap port or drop jack.

I. ALIGNMENT: All forward amplifiers shall be aligned for flat input and tilted output in forward direction. Reverse amps shall be aligned for flat output. Equalizers shall be used at each amplifier and adjusted according to the response of the amplifier.

1. Alignment Setup, Forward And Reverse: The forward and reverse paths are aligned utilizing CW carriers and a variable signal generator located at the headend. With a spectrum analyzer, adjust all amplifier input and output levels to proper levels as measured at amplifier test points.

J. TEST DOCUMENTATION:

1. Within two weeks after test data is taken and before the system is accepted for operational usage, the following system performance data shall be submitted:

a. Cable sweep data and structural return loss tests with the original Polaroid picture of each cable test before and after installation. Return loss tests, after installation, shall be taken before connection to any active or passive device.

b. Amplifier sweep photographs, input and output levels measured at bandpass extremes for both the forward and reverse directions.

c. Signal-to-noise ratio measurements at the output of all amplifiers.

d. Forward distribution levels at the termination of all distribution lines (signals generated at the headend).

e. Reverse distribution levels at the input of all amplifiers from all distribution lines (signals generated at the termination tap of all distribution lines).

2. Thirty days prior to the end of the guarantee period, the selected bidder shall repeat tests as called for in paragraphs 3.5.K.3 under Library/IMC's observation.

a. If the re-tested system does not support the original data submitted and approved as "as-built" performance documentation, the contractor shall, within 30 days, make any repairs and adjustments required to restore the system to those specifications. After repairs and adjustments are completed, the resultant data is to be submitted to CWU for permanent record. All warranty labor and all other costs associated with recertification testing and repairs shall be the responsibility of the contractor.

3. Certification Testing:

a. The following tests will be performed by the Designing Engineers or their representative after the selected Bidder's system installation is complete in the presence of a representative of the Media Engineering and Technical Support Division of the University's Inst. Media Center and the Vendor's Project Manager. The selected installation Bidder may perform these same tests during system balancing and testing, if desired, but is not required to do so. The selected installing Bidder will, however, be required to replace any defective cable, equipment, or other parts identified during the Engineering Consultant's testing.

b. Certification Tests

Carrier to Noise
Hum Modulation
Data Error Rate Testing -To be accomplished by CWU
Outlet Level
Radio Frequency Leakage
Sweep Flatness Test
Level Test

END OF SECTION