TV DISTRIBUTION SYSTEM

1.03 REFERENCES

A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:

1. American National Safety Institute (ANSI).
2. American Society of Testing and Materials (ASTM).
3. Building Industry Consulting Service International (BICSI).
4. BICSI's Telecommunications Distribution Methods Manual (TDMM).
5. Electronics Industries Association (EIA).
6. Federal Communications Commission (FCC).
7. Institute of Electrical and Electronic Engineers (IEEE).
8. National Electrical Manufacturer's Association (NEMA).
9. Cable Television Technology (CTT), Kenneth T. Deschler, New York, McGraw-Hill, Inc., 1987.
10. Society of Cable Television Engineers (SCTE).
11. National Cable Television Association (NCTA).
12. Telecommunications Industries Association (TIA).
13. Underwriters Laboratories (UL).

1.04 DESCRIPTIONS AND REQUIREMENTS

1. It is the contractor's responsibility to coordinate with all plans and specification sections relating to the project for a complete and functioning system.

A. Provide extension of the existing Distributed Television System by Hybrid Fiber Coax (HFC) to the project. Pre-amplify, attenuate, equalize and filter each signal prior to being combined and distributed.

1. The system is based on a single mode fiber dedicated node HFC distribution system.

B. System DTV performance criteria:

1. Nominal digital carrier level: at 501 MHz (Channel 70), +5dBmV ± 3 dBmV, measured at the drop outlet.
2. Modulation Error Ratio (MER)
   a. At headend: ≥ 40dB
   b. At drop tap: ≥ 32dB
3. Bit Error Rate (BER)
   a. At headend: ≥ 10-9
   b. At drop tap: ≥ 10-7
4. Digital carrier level difference between adjacent channels: less than 1 dB.
5. Digital carrier level difference between non-adjacent channels: less than 3 dB.
6. Provide signal pads to adjust the drop service outlets not to exceed 15 dBmV.
7. Visual carrier level difference between adjacent channels: less than 1 dB.
8. Visual carrier level difference between non-adjacent channels: less than 7 dB.
9. Carrier-to-noise ratio, insofar as it is due to the contribution of noise by the System: greater than 46 dB.
10. Amplitude response across the visual portion of channels: flat, ± 2.0 dB.
11. Ratio, after demodulation, between the maximum level of the desired signal and the interference resulting from cross modulation from other signals on the System: greater than

50 dB.

12. Isolation between rooms, spaces, suites and offices: greater than 30 dB. Isolation value of devices separating any two given outlets will be used for the purpose of this calculation as well as the return loss attributed to interconnecting cabling.
13. Reflections: greater than 40 dB below the respective picture carrier.
14. Verify visible components of interference do not appear when receivers are tuned to each of the distributed channels.

C. Head-end channel assignments will remain as currently serve the existing Campus CATV system.

D. Provide a forward path fiber optic system to distribute Cable TV signals between the Headend and the telecommunication (SER) rooms. Provide a dedicated horizontal coaxial cable (drop) to each outlet to distribute Cable TV signals within the South Renovation area from the telecommunication rooms.

1. Multitaps or splitters outside the node are not acceptable.
2. All fiber strands are to be terminated, labeled and tested. All fiber connections are to be Angled Physical Contact (APC) connectors. Connector type is to be consistent from origination to destination without patch points and must be coordinated with the manufacturer of the equipment for fit and style.
3. Terminate all spare fibers to patch panels located in the DTV headend equipment rack.
4. Fusion splice breakout fiber cables (pigtails) will be required to allow for cables to be connected to the patch termination boxes in the nodes and at patch panels in the headend while allowing dedicated patch free connections to the HFC transmitter and fiber splitters at the headend and the HFC receivers at the node.

F. Provide no less than four (4) spare service taps on each value of multi-tap in the nodes. This will allow for future expansion.

G. Provide DTV service to suites, concession stands, clubs and other areas as shown on drawings.

H. Provide a drop service outlet to each audio equipment rack servicing the clubs for use by the sound systems for audio source selections and distribution.

I. The headend assumes provision of municipal cable television programming delivered in the clear (Clear QAM), except selected locations that may have cable boxes, provided by the cable company.

J. Coordinate location with surrounding equipment such as electrical motors, HVAC as well as structure or overhangs which may cause interference, blockage or reflective signals.

K. Provide dedicated signal cable from each television or display to the nearest node.

1. Multitaps or splitters outside the node are not acceptable.

L. Provide a dedicated multi-strand single mode fiber cable to each node indicated on the plans. This cable will be a continuous run without splices. Each fiber must be terminated to connector panels (when not connected to equipment), patch panels and dedicated equipment connections as described earlier in the section.

M. Provide patch cables to make fiber connections within the headend with regard to spare fibers. Refer to spare parts (attic stock) section for quantities.

A. Verify conditions on the job site applicable to this work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.

B. The Drawings show cables, conduit, wiring, and arrangements of equipment fitting the space available without interference. If conditions exist at the job site which make it impossible to install work as shown, recommend solutions and submit drawings to the Owner for approval, showing how the work may be installed.

1.11 FINAL OBSERVATION AND TESTING

A. Upon completion of the installation and contractor commissioning as specified in Part 3, observation and testing shall be performed by the Architect and their consultant.

B. To assist the Architect and their consultant, provide a minimum of one person for observation and two persons for testing who are familiar with all aspects of the system.

C. The process of testing the System may necessitate moving and adjusting certain components such as speaker aiming or transformer taps.

D. Testing includes operation of each major system and any other components deemed necessary. Provide required test equipment, tools and materials required to make necessary repairs, corrections or adjustments.

E. The following procedures will be performed on each System by the Architect and there consultant:

1. Observation of the methods provided to incorporate the System within the facility.
2. Verification of proper operation of all devices.
3. Verification that the equipment has been properly adjusted, balanced, and aligned for optimum quality and meets the manufacturer's published specifications.
4. In the event further adjustment or work becomes evident during testing, the Contractor shall continue his work until the system is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications, the Contractor shall pay for additional time and expenses of the Architect or his representative at the standard rate in effect at that time.

1.12 WARRANTY:

A. Contractor shall warrant equipment to be free of defects in materials and workmanship for two years following the date of the first regular season game, trouble free operation, or substantial completion, whichever is later.

B. The system to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or materials within the Warranty period without charge.

C. Within the Warranty period, answer service calls within eight hours, and correct the problem within twenty four hours.

D. This warranty shall not void specific warranties issued by manufacturers for greater periods of time, nor shall it void any rights guaranteed to the Owner by law.

E. Installing contractor to provide Owner with the name and telephone number of the person to call for service. This information to be part of Project Record Drawings.

F. Thirty days prior to the end of the warranty period provide a complete checkout of all system components. Repair or replace any defective equipment or transducers discovered during the testing. Correct any defects in wiring or other functional problems reported by Owner. Warranty replacement and service of equipment shall not apply to Owner furnished equipment. Coordinate inspection visit with the Owner.

1.1. INSTRUCTION OF OPERATIONS PERSONNEL

A. After final completion, provide eight (8) hours of instruction to Owner designated personnel on the operation and maintenance of the System. If any component is not operational at the time of testing or training, the vendor shall return to complete the testing or training on the component.

TV DISTRIBUTION SYSTEM

2.02 GENERAL

A. Product: New, free from defects and listed by UL or other acceptable testing agencies acceptable to local authorities with jurisdiction. Provide product of a given type from one manufacturer.

B. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturer's published specifications.

C. Equipment supply voltage: 120 VAC, 60 Hz.

D. Equipment temperature limits: 0 to 40 degrees Centigrade.

E. Provide product not specifically specified commensurate with the quality and standards established by the specified product.

2.03 HEADEND

A. Trunk Fiber Optic Transmitters (FO-TX1):

1. Frequency range: 48 to 1,000MHz
2. Center Wavelength: 1310nm
3. Optical Launch Power: +3dBm to +15dBm.
4. Coordinate the applicable APC style connector with manufacturer for consistent match.
5. Provide with manufacturer power supply and Rack mounting kit.
6. Acceptable product:
   a. Olson Technologies OTOT-1000C-*-XX series

B. Fiber Optic Splitter (FIBER-SPL1):

1. Center Wavelengths: 1310/1550nm
2. Bandpass: -40 to +40 nm
3. Split Ratios (1xN): 2, 3, 4,6, 8,12, 16, 24, and 32
4. Provide Rack Mount Kit
5. Acceptable Product:
   a. Olson Technologies OTCP Series

2.04 DISTRIBUTION

A. Fiber Optic Node Receiver (HFC NODE):

1. Provider fiber Node receiver with power supply for the reception and conversion of fiber optic signals to coax for distribution.
2. Center Wavelength: 1310nm
3. Output +46dBmV
4. Provide APC Fiber connections for forward path fiber connections.

1. Provide APC adapter bezels for termination of unused fiber.
2. Provide cable pigtails compatible with the APC manufacturer connectors.
3. Provide fusion splice housings.

2.05 SPLITTERS, COMBINERS AND PASSIVE DEVICES

A. The distribution components listed below cover 1000 MHz, Use is dependent on location within the system. Splitters and couplers are utilized in headend, local channel insertion and racks, multi-taps are utilized in node closets for distribution to drop taps.

B. Combiner (CMB-1)

1. Provide an eight by one passive RF combiner
2. Bandwidth: 5 to 1000 MHz
3. Return loss: 22 dB
4. Acceptable product:
   a. Blonder Tongue HPC-8

C. Splitters (SPL-1)

2.06 PROVIDE A ONE BY THREE PASSIVE RF SPLITTER

1. Bandwidth: 5 to 1000 MHz
2. Return loss: 25 dB
3. Acceptable product:
   a. Blonder Tongue DGS-3

B. Directional Coupler:

1. Provide 1000 MHz, directional coupler.
2. Tap Values: 3, 6, 9, 12, 16, 20, 24, 27, and 30 dB
3. Acceptable product:
   a. Toner DCWRG-* and DCRG-* Series

C. Drop Outlet:

1. Provide self-terminating feed through type.
2. Housing: radiation proof.
3. Provide cover plate to match service receptacles and data network plates. Coordinate color and finish with architect.
4. Provide blanks in unused ports.
5. Provide connector assembly mounted on a 106 Duplex Module Frame sub plate.
6. Coordinate color of with architect.
7. Acceptable product:
   a. Panduit CF1064 series frame
   b. Panduit CMFSRxx self-terminating F-connector
   c. Face Plate to match project power receptacles

D. Fixed Attenuator (PAD):

1. Provide as necessary to meet performance requirements.
2. Provide 10 spares of 3, 6, 10 and 20 dB values.
3. Acceptable product:
    a. Blonder Tongue FAM Series

E. DTV Node Multi-Taps:
1. Modular multi-tap assembly.
2. Provide eight (8) port 1000 MHz directional taps.
3. Provide three (3) or six (6) tap plate capacity housings.
4. Tap value from 26 to 11.5 dB.
5. Terminate unused taps with 75-ohm terminator.
6. Acceptable product:
    a. Toner TXMT108-** Total Tap
    b. Toner TMXT-3H or TMXT-6H Housing

F. DTV Housing Terminator:
1. Provide at last multi-tap in each NODE.
2. Acceptable product:
    a. Toner GTR-KS-M

G. Fiber Attenuators:
1. Provide Fiber attenuators to match levels as required.
2. Provide each of the following dB values.
    a. 1, 2, 3, 4, 5, 6, 7, 10, 12, 15, 20, and 25 db.
3. Provide in connectors that match equipment, and as recommended by the manufacturer.
4. Acceptable product:
    a. Fiberstore AT-M-SCA

2.07 ACCESSORIES

A. Custom and/or Engraved Panels:
1. Provide EIA 19-inch-wide panel constructed of 1/8-inch aluminum.
2. Finish: black anodize
3. Acceptable product:
    a. RCI AVD series
    b. ProCo Sound Products

2.08 CABLING AND ACCESSORIES

A. Drop Cable
1. Provide compliant with NEC type DTV.
2. Black jacket color, F6 or F11 Series type with copper clad center conductor.
3. Acceptable product:
    a. Belden 1189AP and Belden 7999AP (plenum)
    b. Belden 1322R and 1617A Series (non-plenum)
    c. CommScope F6SSEF or F11SSEF Flooded Cable (underground)

B. Head-end Cable
1. Provide compliant with NEC type DTV rating.
2. Black jacketed F59 Series with copper clad aluminum center conductor.

3. Velocity of propagation: at least 65 percent nominal.
4. Frequency attenuation at 60° F: less than 10.5 dB per 100 feet at 1000 MHz.
5. Acceptable product:
    a. Belden
    b. CommScope F59 HEC-2

C. Single-Mode Optical Fiber Cable: (For ceiling and areas not underground)
   1. Provide compliant with NEC type OFNR and ONFP ratings as applicable.
   2. 9/125 single-mode compliant with Corning SMF-28.
   3. Yellow jacket color.
   4. Provide 12 strand multiple optical fiber cable runs to each Node.
   5. Armored Jacket
   6. Acceptable product:
      a. Belden
      b. CommScope P-012-0Z-8W-YL
D. Single-Mode Optical Fiber Cable: (For underground)
   1. Provide compliant with NEC type ONFP ratings as applicable.
   2. 9/125 single-mode compliant with Corning SMF-28.
   3. Yellow jacket color.
   4. Provide 12 strand multiple optical fiber cable runs to each Node.
   5. Armored Jacket
   6. Acceptable product:
      a. Belden
      b. CommScope P-012-OZ-8W-F-S-U-B-K
E. Fiber Optic Cable Inner Duct:
   1. Provide duct compliant with NEC type OFNP rating where applicable.
   2. Color orange.
   3. Provide interconnect boxes and junction boxes as required for branch runs.
   4. Trade Size: as required.
   5. Acceptable product:
      a. Carlon
F. Fiber Optic Connector:
   1. Provide commercial style APC, connections compatible with fiber equipment and where indicated on the plans.
   2. Provide connectors recommended by the manufacturer for compatibility with equipment and mounting panels and sub plates.
   3. Acceptable product.
      a. Belden
      b. CommScope

G. F Connector:

1. Provide commercial style gold plated connector with integral sleeve for F6 Series, F11 Series, and F59 Headend cable.
2. Provide seal ring in all moisture intensive environments.
3. Install with manufacturer recommended compression tool.
4. Provide weatherized boots and seal covers for all antenna connections.
5. Verify connector cable type, size and construction with manufacturer.
6. Acceptable product:
   a. Gilbert Engineering GF-US-6Q series, GF-US-11Q, and GF-US-59Q series respectively
   b. Gilbert Engineering Seal ring: G-SR-1/2

c. Neutrik NC Series

H. Adapters:

1. Provide commercial style KS adapter for multiple directional taps.
2. Acceptable product:
   a. Gilbert Engineering G-KS-KS-MG

I. Ground Block:

1. Provide commercial style F and KS ground block per NEC Articles 810 and 820 with no less than #12 AWG grounding conductor.
2. Acceptable product:
   a. Gilbert Engineering GGB-4U and G-SPB-GLU

J. Terminator:

1. Provide 75-ohm termination at unused ports.
2. Provide four spare “KS” type.
3. Provide 50 spare “F” type.
4. Acceptable product:
   a. Gilbert Engineering GTR-M and GTR-59-DCB.

K. Tubing:

1. Provide heat shrink tubing on outdoor connectors
2. Acceptable product:
   a. Gilbert Engineering GC-HST series

2.09 PORTABLE EQUIPMENT:

A. Fiber Patch Cables and Accessories:

1. Quantity: (6)
2. In addition to patch cords required to interconnect the fiber transmitter provide the following spares.
3. Provide extra fiber patch cords minimum 3’ length compatible with fiber patch panel and transmitter. APC style to match equipment.
4. Acceptable product:
   a. Panduit

B. Fixed Cable Attenuator:

1. Quantity: (6)
2. Provide (2) of each value.
3. Acceptable product:
   a. Blonder Tongue FAM-3 (3dB)
   b. Blonder Tongue FAM-6 (6dB)
   c. Blonder Tongue FAM-10 (10dB
   d. Blonder Tongue FAM-20 (20dB)

C. Variable Attenuator:

1. Quantity: (1).
2. 75Ohm impedance.
3. Rotary attenuator.
4. Dual knob control.
5. Acceptable product:
   a. JFW Industries 75DR-009 series. (317-887-1340)

TV DISTRIBUTION SYSTEM

a. Temporarily lift the technical ground from the main electrical ground, measure and record the DC resistance between them. Resistance should be at least 1000 ohms.

2. Systems, equipment and devices are in full and proper adjustment and operation, and properly labeled and identified.

3. Store extra materials, portable equipment, and spares at the premises as directed by the Architect.

B. Perform the following Headend tests and adjustments in compliance with NCTA Recommended Practices for Measurements on Cable Television Systems. Correct any technical deficiencies until the NCTA preferred performance objectives are accomplished.

1. Adjust, measure and record carrier frequencies for channels assigned utilizing the spectrum analyzer method. Provide ATSC (convention) channel number, QAM carrier frequency, digital sub-channel number, and virtual channel number.

2. Adjust the gain of each active device to provide optimum signal to noise ratio per the manufacturer's instruction.

3. QAM Measurements:

a. Spectrum and digital average power level of each carrier

b. Modulation Error Rate - MER

c. Constellation display analysis - 256 QAM

d. Gain Compression

e. System Noise

f. Phase Noise

g. Coherent Interference Signal to noise ratio - SNR

h. Carrier to noise ratio - CNR

i. Bit Error rate - BER

j. Tilt

k. QAM Ingress (Ingress under the carrier)

4. Coherent Disturbance

5. Composite Second Order - CSO

6. Composite Triple Beat - CBT

7. Measure, record and correct any undesired disturbances utilizing a QAM signal level meter and spectrum analyzer. Include a written explanation within the report as to the nature of any uncorrected disturbance.

8. Measure and record any spurious signals.

9. Measure and record the audio and video input/output of each encoder/demodulator at the patch panel.

10. Perform a subjective evaluation of each channels picture quality with an HD television receiver connected to headend test outlet. Provide a system with no visible picture impairments.

C. Perform the following distribution system tests and adjustments in compliance with NCTA Recommended Practices for Measurements on Cable Television Systems. Correct any technical deficiencies until the NCTA preferred performance objectives are accomplished.

1. Adjust the gain of each active device to provide optimum signal to noise ratio per the manufacturer's instruction.

2. Measure and record the third order distortion utilizing the CW carrier method at the output of any RF amplifier.

3. Measure and record the frequency response utilizing the standard broadband or slow sweep method at the headend source, multitaps, amplifiers of any node and each drop-service outlet. A node is a fiber optic receiver or distribution amplifier.
4. Measure and record the aural and visual carrier levels at the output of each amplifier and one television outlet of any multitap. Measure at channels 2 (54 MHz), 44 (342 MHz) and 117 (750 MHz). Temporary set three of the modulators to these channels and provide, simultaneously, an audio and video test signal.
5. Perform leakage test utilizing the spectrum analyzer method.
6. Measure and record the aural and visual carrier levels and temperature every four hours three times within the same day. Make this measurement at the last multitap of each fiber optic receiver or distribution amplifier.
7. Perform a subjective evaluation of the picture quality with a standard television receiver connected to each System outlet. Provide a System with no visible components of cross modulation, ghosting, or beat interference when the receiver is tuned to each of the distributed channels.
8. Measure and record the sub-band aural and visual carrier levels from the truck dock and from the portable system at the headend. Measure with signal originating at electrically the furthest and nearest drop outlet on each level of the building.

3.10 TEST EQUIPMENT

A. Equipment listed by manufacturer and model number establishes a standard of quality; other approved equal equipment will be acceptable.

B. Thirty days prior to start of testing, provide a list to the Architect of test equipment make, model numbers and calibration dates that will be used.

C. Furnish the following equipment. Equipment to be available for the entire test period through final System testing.

1. Digital Analyzer: Televes H-60 Advance HD Premium
2. Signal level meter: Televes H30
3. Fiber Optic Cable Test Kit: Optical Wavelength Laboratories KIT-WT-WSVSDST
4. Multi-Meter: Fluke 87V
5. Variable Attenuator: JFW Industries 75TA-006 F
6. 75 ohm, 1 percent terminating resistors, impedance matching pads, traps, connection adapters, test cabling, etc., as required.
7. Ladders and scaffolding necessary to inspect multi-taps in cable trays and ceiling mounted junction boxes.

D. Provide two portable VHF or UHF business band radios for use during acceptance testing with transmission range sufficient to cover entire project.

1. Include rechargeable batteries and re-charger along with "holster" for wearing on belt.
2. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance.

END OF SECTION