
USACE / NAVFAC / AFCEC / NASA UFGS-27 41 16.00 10 (April 2006)

Preparing Activity: USACE Superseding
UFGS-27 41 16.00 10 (December 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMLR dated October 2019

SECTION TABLE OF CONTENTS

DIVISION 27 - COMMUNICATIONS

SECTION 27 41 16.00 10

TELEVISION SIGNAL RECEPTION SYSTEM

04/06

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SYSTEM DESCRIPTION
 - 1.2.1 System Configuration
 - 1.2.1.1 Head End Equipment
 - 1.2.1.2 Premises Distribution System
 - 1.2.1.3 System Hardware Design
 - 1.2.1.4 Maintenance Accessibility
 - 1.2.1.5 Configuration and Future Expansion
 - 1.2.2 System Performance
 - 1.2.2.1 Television Broadcast Stations
 - 1.2.2.2 FM Broadcast Stations
 - 1.2.3 System Configuration
 - 1.2.4 User Input Interface
 - 1.2.5 Detail Drawings
- 1.3 SUBMITTALS
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 ENVIRONMENTAL REQUIREMENTS
- 1.6 SPARE PARTS

PART 2 PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT
 - 2.1.1 Identical Items
 - 2.1.2 Nameplates
- 2.2 ANTENNAS
 - 2.2.1 Off-Air Television Antenna
 - 2.2.1.1 Mechanical Specifications
 - 2.2.1.2 Electrical Specifications
 - 2.2.2 Off-Air FM Antenna
 - 2.2.3 Antenna Support Tower
 - 2.2.4 Transmission Line
- 2.3 HEAD END EQUIPMENT
 - 2.3.1 General
 - 2.3.2 Off-Air Reception

- 2.3.2.1 Coaxial Downlead Preamplifier
- 2.3.2.2 Channel Mixers (Nonadjacent)
- 2.3.2.3 Processors
- 2.3.2.4 Broadband Amplifier
- 2.3.2.5 Single Channel Amplifier
- 2.3.3 Combining Network
- 2.3.4 FM System
 - 2.3.4.1 System Specifications
 - 2.3.4.2 RF Module
- 2.4 EQUIPMENT RACK
 - 2.4.1 Free Standing Open Frame
 - 2.4.2 Wall Mounted Open Frame
 - 2.4.3 Cabinet
 - 2.4.4 Cable Guide
- 2.5 EQUIPMENT BACKBOARD
- 2.6 PREMISES DISTRIBUTION SYSTEM
 - 2.6.1 General
 - 2.6.2 Distribution Amplifier
 - 2.6.3 Signal Distribution System Power Supply

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 INSTALLATION
 - 3.2.1 Head End Equipment
 - 3.2.2 Distribution System
 - 3.2.3 Components
 - 3.2.4 Tower
 - 3.2.5 Antenna
- 3.3 GROUNDING
- 3.4 FIELD TRAINING
- 3.5 TESTING
 - 3.5.1 Cable Testing
 - 3.5.2 System Testing

-- End of Section Table of Contents --

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2017; Errata 1-2 2017; INT 1 2017)
National Electrical Safety Code

NATIONAL CABLE AND TELECOMMUNICATIONS ASSOCIATION (NCTA)

NCTA RP (1989) NCTA Recommended Practices for
Measurements on Cable Television Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2;
TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6;
TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10;
TIA 17-11; TIA 17-12; TIA 17-13; TIA
17-14; TIA 17-15; TIA 17-16; TIA 17-17)
National Electrical Code

NFPA 780 (2017) Standard for the Installation of
Lightning Protection Systems

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-222 (2005G; Add 1 2007; Add 2 2009; Add 3
2014; Add 4 2014; R 2014; R 2016)
Structural Standards for Steel Antenna
Towers and Antenna Supporting Structures

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1 (2015; Rev L) Obstruction Marking and
Lighting

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

47 CFR 15 Radio Frequency Devices

47 CFR 17 Construction, Marking, and Lighting of
Antenna Structures

47 CFR 25

Satellite Communications

47 CFR 76

Multichannel Video and Cable Television
Service

UNDERWRITERS LABORATORIES (UL)

UL 467

(2013; Reprint Jun 2017) UL Standard for
Safety Grounding and Bonding Equipment

1.2 SYSTEM DESCRIPTION

NOTE: This guide specification is to be used to specify reception and subsequent distribution of off-the-air television and FM radio broadcast signals. If there is a specific requirement at the project site (if defined in the Architect-Engineer's Statement of Work) for direct broadcast satellite (DBS) reception for multiple users, the designer will apply current state-of-the-art design information available from manufacturers of this equipment to configure a cabling and equipment arrangement to provide the required operation and service distribution. Product-specific requirements should be validated during the system testing, which should be done in accordance with the requirements herein, modified as necessary to ensure a fully functional installation.

Provide a television signal reception system to receive radio frequency (RF) signals available from [FM radio transmitters] [and] [television broadcast transmitters] for transmission to end users via a coaxial cable distribution system. The system shall utilize industry standard, commercially available antenna systems and solid-state electronic passive and active devices to receive and distribute the RF signals to each end user and meet the specifications and requirements listed herein. The system shall comply with 47 CFR 15, 47 CFR 25, and 47 CFR 76. The equipment used shall be designed for commercial and industrial applications. The system shall be designed to provide continuous entertainment on a series of VHF and non-broadcast channels selectable by the users. UHF channels received shall be translated to a vacant VHF or non-broadcast channel before distribution over the single cable distribution system.

1.2.1 System Configuration

The system shall consist of [log-periodic or yagi antenna for off-air signal reception,] and [passive] [and] [active] cable distribution equipment and head end equipment.

1.2.1.1 Head End Equipment

The head end equipment shall serve as an interface between the receiving antennas and the premises distribution system to allow for signal reception [processing,] [and] [modulation,] [and] [translation to vacant channels,] [and] [combining signals for single cable distribution,] [and] [amplification,] [and] [equalization].

1.2.1.2 Premises Distribution System

The premises distribution system shall consist of coaxial cables and user outlets as specified in Section 27 05 14.00 10 CABLE TELEVISION PREMISES DISTRIBUTION SYSTEM. The signal reception system specified herein shall provide for hardware including [signal splitters,] [RF line and distribution amplifiers,] [signal equalizers,] [power supplies,] and other ancillary hardware. Submit [6] [_____] copies of each manufacturer's operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include equipment layout and schematics of simplified wiring and control diagrams of the system as installed, the manufacturer's name, model number, and a brief description of equipment and components and their basic operating features. Submit [6] [_____] copies of the maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The manual shall include equipment layout and schematics and simplified wiring and control diagrams of the system as installed.

1.2.1.3 System Hardware Design

System hardware shall be solid state and shall utilize modular components to provide maximum flexibility, ease of maintenance, and ease of expansion where practicable. Solid state and integrated circuitry containing silicon-based materials shall be employed to the maximum practicable extent. Mechanical and electro-mechanical relays, tuning controls, and other mechanical components and parts shall not be used where the necessary functions can be performed in a more reliable manner by electronic components.

1.2.1.4 Maintenance Accessibility

Make parts which require periodic service or maintenance easily accessible. Components in the head end equipment requiring tuning adjustments shall be externally accessible from the front of the equipment and racks.

1.2.1.5 Configuration and Future Expansion

NOTE: The designer will show the building layout and detailed service requirements identifying the proposed or available equipment locations, equipment closets, and user outlets. Available riser and conduit diagrams as required, planned cable routing noting restrictions and general requirements that may impact cost of the project (i.e. plenum cable, conduit placement required), etc., will be supplied.

The designer will show a geographical representation of the area including buildings, roads, and potential obstructions to ensure a clear path to the broadcast stations, if used. The size and complexity of the system will determine the extent to which the drawings should include all or part of the above information. The equipment selected for the design will be configured to support High Definition Television (HDTV) via the signal

distribution system (if defined in the Architect-Engineer's Scope of Work). At a minimum, the system will support future implementation of Internet access and HDTV without the need to replace equipment. Complete design information will be given to allow bidders to prepare competitive bids.

The distribution equipment will typically be set up for 12 or 35 channels, depending upon user requirements. If additional channels are required, the designer will specify available non-broadcast (CATV) channels.

The system shall accommodate future expansion with minimum service interruption.

- a. The head end equipment shall be configured to allow adequate rack space, power supplies, mixers, modulators, and combiners for a minimum of twelve VHF channels.
- b. The distribution equipment shall be configured as indicated. Components in the distribution system shall, as a minimum, be capable of distributing [12 VHF channels (2 - 6 low band VHF including FM band and 7-13 high band VHF),] [35 CATV channels (2 - W(36) low, mid, high and super band),].

1.2.2 System Performance

NOTE: The designer will prepare a listing of off-air stations to be included in the installation, with call letters, broadcast/cable channel, and system distribution channel. The designer will utilize the appropriate tables for the particular system proposed. The tables numbered "Ia" and "Ib" may be deleted and renumbered as required. The results of the signal surveys conducted by the designer will be included in TABLES Ia or Ib as they apply. TABLES IIa and IIb reflect minimum system performance requirements expected at each user interface.

The exact number of FM stations and TV channels the designer is specifying for the project is indicated by the number of call letters and channels listed.

Reception and distribution of a TV channel or FM station will not be attempted unless the antenna height and antenna gain can be selected to deliver at least a minus 10 dBmV signal to the amplifier. Translation equipment will be provided to convert VHF channel broadcast frequency to a suitable unused VHF channel, in case of co-channel or adjacent channel interference. Where UHF channels are available, they will be converted to VHF or non-broadcast channels available for distribution.

Provide a system capable of receiving broadcast signals from the [television off-air] [and] [FM radio] stations designated below. The designated stations named by call letters designated below are entered in the "USE" column of TABLE I [a] [b] to indicate correspondence between the channel on the cable distribution system and the received TV channels. The system shall deliver to all user outlets the performance specified in TABLES IIa and IIb.

1.2.2.1 Television Broadcast Stations

Programming received from the following listed television stations shall be distributed on the cable distribution system.

Station Name	Broadcast Channel	City	Distance	Azimuth
[_____]	[_____]	[_____]	[_____]	[_____]

1.2.2.2 FM Broadcast Stations

Programming received from the following listed FM radio stations shall be distributed on the FM band of the cable distribution system:

Station Name	Frequency	City	Distance	Azimuth
[_____]	[_____]	[_____]	[_____]	[_____]

1.2.3 System Configuration

NOTE: The designer will complete the tables to be used and delete those that are not needed.

The system stations shall be configured as shown in the following table(s).

TABLE Ia			
FOR USE WITH TELEVISION OFF-AIR BROADCASTS			
CABLE CHANNEL 2	FREQUENCY RANGE (MHz)	USE	AVERAGE RECEIVED SIGNAL STRANGTH (dBmV)
[_____]			
[_____]			

TABLE Ib			
FOR USE WITH FM RADIO STATIONS			
REQUIRED FM CABLE CHANNEL	FREQUENCY (MHz)	USE	AVERAGE RECEIVED SIGNAL STRANGTH (dBmV)
[_____]			
[_____]			

1.2.4 User Input Interface

NOTE: Calculations for signal strength must be performed based on the highest frequency in use in the system, generally 860 MHz in the United States, to verify that the design will provide the minimum specified RF video carrier level at the farthest outlet.

Home run systems are those in which each outlet has its own coaxial cable from the outlet back to the secondary distribution point. In this home run system, the secondary distribution points will typically be located at the head end equipment location. This is typically the preferred design approach because of the inherent simplicity.

However, in systems serving several floors, it may be more effective to design a cascade, tapped-trunk architecture. In this case, the secondary distribution points will typically be located at a central point on each floor. Some systems will, of necessity, be most appropriately designed as a combination of home run and cascade networks, forming a "tree and branch" structure.

Submit [system calculations](#), [45] [_____] days prior to proposed installation start date, encompassing the losses and gains for the various components of the system, including cable runs. Establish the required signal strengths for each component of the signal reception system and verify each with respect to signal strength and quality. Interfaces shall be according to the following tables:

TABLE IIa. TELEVISION RECEIVER INPUT INTERFACE	
Impedance	75 ohms unbalanced
RF Video Carrier Level	
Minimum	3 dBmV

TABLE IIa. TELEVISION RECEIVER INPUT INTERFACE	
Maximum	12 dBmV
Relative RF Video Carrier Level	Within 3 dB to adjacent channel All channels within 12 dB
Carrier Level Stability	
Short-term (1 hour)	Within 0.5 dB maximum
Long-term (24 hours)	Within 2.0 dB maximum
Frequency range (MHz)	54-300 MHz
Frequency Response	
Peak to valleys for system bandpass	Plus or minus 3 dB
Across any 6 MHz channel referenced to video carrier plus 200 kHz sideband amplitude	Plus or minus 1 dB
Carrier to Noise Ratio	Greater than or equal to 45 dB
Cross Modulation (NTCA Test Method)	Less than minus 50 dB
Carrier to Echo Ratio	Greater than 40 dB
Composite Triple Beat	Less than minus 53 dB
Second Order	Less than minus 60 dB
Terminal Isolation	
Minimum TV-TV	25 dB
Minimum TV-FM	35 dB
Hum Modulation (maximum)	2 percent (equivalent to minus 40 dB sidebands)
TABLE IIb. FM RECEIVER INPUT INTERFACE	
Impedance	75 ohms unbalanced
RF Video Carrier Level	13 to 17 dB below video carrier level
Relative RF Video Carrier Level	Within 3 dB to adjacent channel All channels within 12 dB
Carrier Level Stability	
Short-term (1 hour)	Within 0.5 dB maximum
Long-term (24 hours)	Within 2.0 dB maximum

TABLE Iib. FM RECEIVER INPUT INTERFACE	
Frequency range (MHz)	88 to 108 MHz
Frequency Response	Within 0.75 dB over the specified frequency range
Carrier to Noise Ratio	More than 24 dB
Terminal Isolation (FM-TV)	More than 35 dB

1.2.5 Detail Drawings

Submit system design drawings conforming to **NCTA RP** and consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Detail drawings shall contain complete wiring and schematic diagrams, equipment layout and anchorage, and other details required to demonstrate that the system has been coordinated and will function properly as a unit.

1.3 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section **01 33 00 SUBMITTAL PROCEDURES** and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" following a submittal item indicates that the submittal is required for the Sustainability eNotebook to fulfill federally mandated sustainable requirements in accordance with Section **01 33 29 SUSTAINABILITY REPORTING**. Locate the "S" submittal under the SD number that best describes the submittal item.

Choose the first bracketed item for Navy, Air Force
and NASA projects, or choose the second bracketed
item for Army projects.

Government approval is required for submittals with a "G" designation;
submittals not having a "G" designation are for [Contractor Quality
Control approval.] [information only. When used, a designation following
the "G" designation identifies the office that will review the submittal
for the Government.] Submittals with an "S" are for inclusion in the
Sustainability eNotebook, in conformance to Section 01 33 29
SUSTAINABILITY REPORTING. Submit the following in accordance with Section
01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Spare Parts
Testing

SD-05 Design Data

System Calculations

SD-06 Test Reports

Testing

SD-10 Operation and Maintenance Data

Signal Reception System; G[, [_____]]

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver equipment in original packages with labels intact and
identification clearly marked. Protect equipment and components from the
weather, humidity and temperature variations, dirt and dust, and other
contaminants.

1.5 ENVIRONMENTAL REQUIREMENTS

System components located inside buildings shall conform to the specified
performance when subjected to any combination of the following
environmental conditions:

Temperature	At 4 to 38 degrees C 40 to 100 degrees F
Relative humidity	From 0 to 95 percent (no water condensation).

1.6 SPARE PARTS

Submit spare parts data for each different item of material and equipment
specified, after approval of the detail drawings and not later than

[_____] months prior to the date of beneficial occupancy. The data shall include a suggested list of spare parts and supplies, with current unit prices and source of supply.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacture of such products and that are the manufacturer's latest standard design in satisfactory use for at least 2 years prior to bid opening.

2.1.1 Identical Items

Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

2.1.2 Nameplates

Each major component of equipment shall have the manufacturer's name, address, model and catalog number, and serial number on a plate secured to the equipment.

2.2 ANTENNAS

NOTE: For VHF, UHF, and FM antennas only, the designer may choose to use a separate antenna for each channel, or to combine several channels in one receiving antenna to provide greater economy. Combining of channels on one antenna should not be attempted unless there is ample signal strength to enable one antenna to receive sufficient signal from multiple sources to drive multiple head end inputs. Reliability may suffer to some degree if one antenna is used for more than one channel.

Antenna shall be cut-to-channel or broadband model designed for heavy duty commercial use, as shown.

2.2.1 Off-Air Television Antenna

2.2.1.1 Mechanical Specifications

Crossarms shall be high-strength aluminum alloy, seamless, with ends sealed. Elements shall be high-strength aluminum alloy tubing, 10 mm 3/8 inch diameter, 635.0 micrometers 0.025 inch wall thickness. Antenna shall be rated for an operational/survival wind velocity of 160.9 km/h 100 mph with no ice. Antenna shall be completely weatherproofed. Aluminum shall have an electrically conductive anti-corrosion (anodized) finish. Metals for installation and mounting shall be high-strength non-corrosive type. No drilling shall be required for installation. Antenna cable connector shall be a built-in, 75 ohm anodized brass, type F-61 connector.

2.2.1.2 Electrical Specifications

Antenna used for television off-air reception shall be yagi or

log-periodic type. Antenna shall, as a minimum, conform to the following specifications:

Gain Front-to-Back	8 dBi
Ratio	18
Output Impedance	75 plus or minus 2 ohms unbalanced
Maximum VSWR	1.5:1
Frequency Range	[VHF] [, FM] [, UHF] [_____]

2.2.2 Off-Air FM Antenna

Antenna used for FM broadcast reception shall be [incorporated in the broadband log-periodic] [a separate omni-directional] [a separate directional] antenna. Antenna shall be designed for commercial application and shall be completely weather and corrosion resistant. Electrical characteristics shall be as specified for television off-air antenna with the exception of gain, which shall be 2 dBi minimum for omni-directional or 7 dBi minimum for separate directional and broadband antennas.

2.2.3 Antenna Support Tower

Design antenna support tower to [TIA-222](#) specifications and adhering to [FAA AC 70/7460-1](#) and [47 CFR 17](#) requirements. Provide appropriate off-set antenna-tower mounts and download cable supports.

2.2.4 Transmission Line

Transmission line connecting antenna and head end equipment shall be RG-6/U, quad shield coaxial cable.

2.3 HEAD END EQUIPMENT

2.3.1 General

The head end shall utilize conditioning and transmission components as specified and shown for receiving off-air television and FM signals and interfacing them with the premises distribution system. Coaxial download of off-air antenna shall be provided with preamplification as required to supply the proper signal level input required by the head end equipment. Furnish and install equipment required to collect, condition, convert, and distribute signals from the above sources for programming.

2.3.2 Off-Air Reception

2.3.2.1 Coaxial Download Preamplifier

Preamplifier shall be [single channel] [broadband] type. Preamplifier shall be enclosed in a weatherproof housing with a universal bracket. Appropriate power supply and power inserter shall be provided to power the preamplifier through the coaxial download cable. Lightning protection shall be inherent in the preamplifier design. Preamplifier shall, as a minimum, conform to the following specifications:

Frequency Response	Plus or minus 0.75 dB
Minimum Input	Minus 20 dBmV
Return Loss	14 dB
Impedance	75 ohms
Maximum Noise	
Figure	VHF 6.5 dB
UHF	7.5 dB

2.3.2.2 Channel Mixers (Nonadjacent)

Channel mixers shall, as a minimum, conform to the following specifications:

Insertion Loss (Maximum 54-216 MHz)	2.5 dB
Return Loss	14 dB
Out-of-Band Rejection	12 dB
Impedance	75 ohms

2.3.2.3 Processors

Provide a processor for each channel translation specified. Processors for channel translation shall, as a minimum, conform to the following specifications:

Bandwidth	6 MHz
Impedance (input and output)	75 ohms
Return Loss (within 6 MHz bandwidth)	16 dB
Max. Noise Figure (at maximum gain)	10 dB
Input Level Range	VHF minus 20 to plus 30 dBmV
	UHF minus 20 to plus 25 dBmV
Output Level Range	50 to 60 dBmV
Carrier to Noise Ratio (with plus 10 dBmV input)	57 dB

AGC Regulation	Plus or minus 1 dB output variation for rated input level range variation
Frequency Stability	Plus or minus 10 KHz over operational temperature range
Spurious Output	60 dB below video carrier with video carrier output level at plus 60 dBmV and audio carrier level at plus 45 dBmV
Adjacent Channel Rejection	Equal to or greater than 60 dB

2.3.2.4 Broadband Amplifier

Broadband amplifier shall, as a minimum, conform to the following specifications:

Frequency Range	[54-108, 174-220] [54-220] MHz
Frequency Response (across bandpass)	Plus or minus 1.0 dB
Impedance	75 ohms
Maximum Noise Figure	10 dB
Return Loss	16 dB

2.3.2.5 Single Channel Amplifier

Single channel amplifier shall, as a minimum, conform to the following specifications:

Frequency Range	6 MHz for channel specified
Frequency Response	Plus or minus 0.5 dB
Impedance	75 ohms
Return Loss	14 dB
Maximum Noise Figure	10 dB
AGC Regulation	Plus or minus 1 dB output variation for rated input level range
Skirt Rejection	Minus 26 dB at plus or minus 9 MHz from channel center

2.3.3 Combining Network

A signal-combining network (mixer) shall be provided to combine the [VHF] [and FM broadcast band network] into a single broadband signal. Combining network shall have an output test point, [mixer output step attenuator] [,

dual pilot insertion network,] and removable mixer-to-trunk jumper. Combining network shall be [rack] [wall] mounted with the associated head end equipment and shall, as a minimum, conform to the following specifications:

Band pass	As specified for system performance
Flatness over any 6 MHz segment	Plus or minus 0.1 dB
Flatness 54 - 216 MHz	Plus or minus 0.5 dB
Maximum Insertion Loss	2.5 dB
Channel Input to Trunk Output	15 dB
Channel Input to Mixer Output	13 dB
Test Point (loss from trunk output)	20 dB
Return Loss	16 dB on channels employed
Isolation between any two inputs	30 dB
Impedance, Input and Output	75 ohms

2.3.4 FM System

The FM system shall, as a minimum, conform to the following specifications:

2.3.4.1 System Specifications

Impedance, Input and Output	75 ohms
Output Level	Plus 36 dBmV
Frequency	88 - 108 MHz
Spurious	Greater than 60 dB below signal level
Hum and Noise	Greater than 60 dB below rated output
Oscillator Harmonics	Greater than 60 dB below rated output

2.3.4.2 RF Module

One RF processor module shall be provided for each station in the FM broadcast band listed under system performance in paragraph SYSTEM DESCRIPTION. RF module shall, as a minimum, conform to the following specifications:

Frequency	88 - 108 MHz in or out as required
Output Level-Module	Plus 52 dBmV
Output Level Control	Plus or minus 10 dB
Stability	0.005 percent, crystal
Limiting	20 microvolts (minus 3 dB point)
Sensitivity	3 microvolts for 30 dB quieting
Input Level	Minimum 40 microvol monaural and 60 microvol stereo
Image Rejection	90 dB
Passband	200 kHz
Selectivity	Under plus or minus 150 kHz at 30 dB down
	Under plus or minus 250 kHz at 50 dB down

2.4 EQUIPMENT RACK

2.4.1 Free Standing Open Frame

NOTE: The designer will select the appropriate equipment mounting approach and will show a layout to accommodate all system components at the head end.

Free standing open frame equipment rack shall be [welded steel] [aluminum] relay rack with uprights to mount equipment [482 mm 19 inches] [584 mm 23 inches] wide. Uprights shall be 76 mm 3 inch deep channel, 32 mm 1-1/4 inches wide, drilled and tapped 12-24 in a 13 mm 1/2 inch pattern. Rack shall be provided with a standard top crossmember, and predrilled base plate to allow floor fastening. Rack shall be 2134 mm 7 feet in height and [clear coated] [painted]. Color shall be the manufacturer's standard.

2.4.2 Wall Mounted Open Frame

NOTE: Delete hinge requirement when not needed.

Wall mounted open frame equipment rack shall be [steel] [aluminum] relay rack with uprights to mount equipment [482 mm 19 inches] [584 mm 23 inches] wide and standoff brackets for wall mounting. Standoff brackets shall be of sufficient length for a [152 mm 6 inch] [_____] clearance between rack and wall. Uprights shall be drilled and tapped 12-24 in a 13 mm 1/2 inch pattern. Rack shall be hinged. Rack shall be [clear coated] [painted]. Color shall be the manufacturer's standard.

2.4.3 Cabinet

Equipment rack cabinet shall be free standing steel enclosure with side panels, [acrylic plastic] [perforated] [louvered] [metal] front doors, [perforated] [louvered] metal rear doors, depth-adjustable front and rear mounting rails, and [solid] [louvered] top. Cabinet shall mount equipment [482 mm 19 inches] [584 mm 23 inches] wide. Cabinet shall be 1829 mm 72 inches high and 762 mm 30 inches deep and shall be provided with [leveling feet] [wheels]. Cabinet exterior shall be [painted] [clear coated]. Color shall be the manufacturer's standard.

2.4.4 Cable Guide

Cable guide shall be specifically manufactured for the purpose of routing cables and wires horizontally and vertically on the supplied equipment racks. Cable guide shall consist of ring or bracket-like devices mounted on rack panels for horizontal use or individually mounted for vertical use. Cable guide shall be mounted to rack using screws and/or nuts and lockwashers.

2.5 EQUIPMENT BACKBOARD

NOTE: When equipment backboards are used in the
system, the designer will locate and dimension the
backboards on the drawings.

Equipment backboard, where shown, shall be Type ACX plywood coated on both sides with at least two coats of insulating varnish, sized and located as shown.

2.6 PREMISES DISTRIBUTION SYSTEM

NOTE: The designer will coordinate requirements for
combiners, splitters, amplifiers, and other
ancillary components required in the design with
SECTION 27 05 14.00 10 CABLE TELEVISION PREMISES
DISTRIBUTION SYSTEM.

2.6.1 General

The coaxial cabling from outlets to the head end equipment location shall be installed in accordance with SECTION 27 05 14.00 10 CABLE TELEVISION PREMISES DISTRIBUTION SYSTEM. Coordinate components required by this section in order to ensure satisfactory operation of the installed system.

2.6.2 Distribution Amplifier

Distribution amplification shall be provided as required to deliver the minimum signal parameters specified in paragraph SYSTEM DESCRIPTION and TABLES IIa and IIb to user interfaces. Distribution amplifier shall be designed for heavy duty commercial and industrial applications. As a minimum, amplifier shall be contained in a wall-mountable steel or aluminum housing, vented or finned for convection cooling. Amplifier cable ports shall be "F" type. External RF test points shall be provided

to monitor signals without opening the housing. Amplifier may be powered through the cable or by a 120 Vac, 60 Hz source. Surge protection module shall be provided on outside cable entry ports. Cable powered amplifier shall be capable of passing a maximum of 10 amperes through cable ports without damage. The individual components, amplifiers, filters, splitters, pads, equalizers and automatic level control circuitry shall be modular in construction and shall plug into the main RF chassis.

2.6.3 Signal Distribution System Power Supply

The signal distribution system power supply required for cable powered amplifiers shall be 100 percent plug-in modular construction and shall include lightning surge, short circuit, and overload protection. Circuitry shall be fully protected by circuit breakers. Power supply shall be standby type with sealed batteries supplied. Power supply shall be housed in a fully weatherproofed steel cabinet, and shall, as a minimum, conform to the following specifications:

Input Voltage	95-130 Vac, 60 Hz
Output Voltage	30 or 60 Vac as required by amplifier
Output Current	12 amperes @ 30 or 60 Vac
Line Regulation	Plus or minus 2 percent, 95 - 130 Vac
Local Regulation	Plus or minus 2 percent, 1/3 of full load
Noise Level	Less than 48 dB at 300 mm 1 foot distance

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with the details of the work and working conditions, verify dimensions in the field, and advise the Contracting Officer of any discrepancies before performing the work.

3.2 INSTALLATION

For interior installations comply with NFPA 70. For exterior installations comply with IEEE C2, NFPA 70, and NFPA 780. System components shall be installed and tested in accordance with the manufacturer's specifications and recommendations.

3.2.1 Head End Equipment

Locate the components comprising the head end equipment as shown. Grounding of the system shall comply with NFPA 70. Rack mounted head end equipment shall be mounted at least 900 mm 36 inches from any wall. Head end equipment shall be aligned to meet system performance and manufacturer's requirements.

3.2.2 Distribution System

Configure the distribution system components in a manner consistent with

the manufacturer's specifications. The distribution system configuration and placement shall conform to available cable routing and proposed equipment locations as shown.

3.2.3 Components

Locate amplifiers, combiners, splitters, and power supplies in a secured area on the specified equipment backboard or rack mounted as shown.

3.2.4 Tower

Install tower in accordance with the manufacturer's instructions. Inspect tower parts upon receipt. Members which sustain damage either in shipment or in construction shall be replaced immediately.

3.2.5 Antenna

Install antenna in accordance with the manufacturer's instructions. Exact antenna alignment to receive the maximum signal level and quality is the responsibility of the Contractor. Antenna downlead cable shall be supported at intervals of not more than 1 m 3 feet.

3.3 GROUNDING

Perform grounding in accordance with applicable portions of NFPA 70, NFPA 780, IEEE C2, UL 467 and TIA-222. Maximum resistance to ground at the connection point for system components shall be 25 ohms. Grounding conductor shall be minimum No. 6 AWG solid copper. Existing tower, if utilized, shall be made to conform to the above requirements. System components shall have a direct connection to ground. Each cable shall be grounded at the point of building entry with a grounding block or shall be equipped with a surge protector to dissipate electrical surges. Grounding block shall be directly connected to a driven ground. Head end equipment shall be equipped with surge protection by either inherent design or external device. Unless otherwise specified, lightning and transient surge protection shall be provided in accordance with NFPA 780.

3.4 FIELD TRAINING

Conduct training courses for operating and maintenance staff designated by the Government. The training course will be given at the installation during normal working hours for a total of [_____] hours for [_____] persons and shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the approved operation and maintenance manuals, as well as demonstrations of routine maintenance operations. Notify the Government at least 14 days prior to start of the training courses.

3.5 TESTING

Notify the Contracting Officer [30] [_____] days before the system is ready for acceptance tests. Submit test procedures and plans, [30] [_____] days prior to proposed test date. The plan shall conform to NCTA RP and other applicable codes, regulations, and manufacturer requirements. The plan shall include proposed methods of documenting test results. Acceptance tests shall not be conducted until the system has experienced [60] [90] days of satisfactory operation, the last 20 days of which shall have been with no component failures. Perform acceptance tests in accordance with the approved Test Plan, conforming to NCTA RP,

and conducted in the presence of the Government. Provide instruments, personnel, and transportation required for the tests. Submit test reports in booklet form showing field tests performed to adjust each component and acceptance tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of the controls.

3.5.1 Cable Testing

After installation of the cable and before connection to system components, test each cable section using a time domain reflectometer (TDR) to determine shorts, open, kinks, and other impedance discontinuities and their locations. Cable sections showing adverse impedance discontinuities (defined as greater than 6 dB loss) shall be replaced at the Contractor's expense. There shall be no cable splices between system components unless approved by the Government.

3.5.2 System Testing

Conduct an end-to-end system test to determine if the system performance requirements have been met. Tests shall also be performed on randomly selected equipment, components, and modules selected at the time of testing by the Government, to determine if the system meets the specified requirements. Deficient portions of the system shall be repaired and retested at the Contractor's expense.

-- End of Section --