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USACE / NAVFAC / AFCEC / NASA	**UFGS-27 51 16 (May 2020)**
	Change 1 - 05/22

Preparing Activity: USACE	**Superseding**
	UFGS-27 51 16 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023

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SECTION TABLE OF CONTENTS

DIVISION 27 - COMMUNICATIONS

SECTION 27 51 16

PUBLIC ADDRESS SYSTEMS

05/20, CHG 1: 05/22

PART 1 GENERAL

1.1 RELATED SECTIONS
1.2 SUMMARY
1.2.1 Scope
1.3 REFERENCES
1.4 SUBMITTALS
1.5 SYSTEM DESCRIPTION
1.5.1 Design Requirements
1.5.2 System Application Design
1.5.3 Standard Products
1.5.4 Local Products
1.5.5 Minimum Requirements
1.5.6 Current State-of-the-Art Technology
1.5.7 Design Analysis and Calculations
1.5.8 Environmental Requirements
1.5.9 Electrical Requirements
1.5.10 Power supplies
1.5.11 Power Line Surge Protection
1.5.12 Shielding and Grounding
1.5.13 System Capability and Configuration
1.5.13.1 System Capability
1.5.14 Performance Requirements
1.5.14.1 System Initiation and Operation
1.5.14.2 Priority
1.6 CYBERSECURITY
1.7 QUALIFICATIONS
1.7.1 General Qualification Requirements
1.7.2 System Contractor Qualifications
1.7.3 Installer Qualifications
1.7.4 Manufacturer Qualifications
1.8 DELIVERY, STORAGE, AND HANDLING
1.9 EXTRA MATERIALS

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION
2.1.1 Multi-Channel System with Paging
2.1.2 Single-Channel System
2.1.3 System Performance
2.1.4 Detail Drawings
2.1.5 Network IP System Design
2.2 STANDARD PRODUCTS
2.2.1 Identical Items
2.2.2 Nameplates
2.3 IP NETWORKED PUBLIC ADDRESS SYSTEM
2.3.1 System Components
2.3.1.1 Headend Equipment
2.3.1.2 Auxiliary Inputs
2.3.2 Distribution Equipment
2.3.2.1 Monitor Panel
2.3.2.2 Loudspeaker System
2.3.2.3 Indoor Loudspeaker Assemblies
2.3.2.4 Outdoor Loudspeaker Assemblies
2.3.2.5 IP Addressable PoE Loudspeakers
2.3.2.6 Microphones
2.3.3 System Configuration
2.3.3.1 All Call
2.3.3.2 Zone Paging
2.3.3.3 Medical and Dental Clinic Zoning
2.3.3.4 Auditorium Zone
2.3.4 System Performance
2.3.5 Electrical Power
2.4 ANALOG AUDIO SYSTEM
2.4.1 MIXER-PREAMPLIFIER
2.4.2 POWER AMPLIFIERS
2.4.3 MIXER AMPLIFIER
2.4.4 MICROPHONE INPUT MODULES
2.4.5 MICROPHONES
2.4.5.1 Desk Microphone
2.4.5.2 Gooseneck Microphone
2.4.5.3 Microphone Jack
2.5 LOUDSPEAKERS
2.5.1 Cone Speaker
2.5.2 Horn Speaker
2.5.3 Dual Horn Speaker
2.5.4 High Output Speaker Enclosures
2.5.5 Wall Baffle Speaker Enclosures
2.5.6 Ceiling Speaker Enclosures
2.6 SPEAKER SWITCHING PANEL
2.6.1 Selector Switches
2.6.2 System Power supply
2.7 PRIORITY RELAYS AND CONTROLS
2.8 SWITCHES AND CONTROLS
2.8.1 Remote Loudspeaker ON/OFF Switches
2.8.2 Remote Loudspeaker Volume Controls
2.9 EQUIPMENT RACKS AND CABINETS
2.10 CABLES
2.10.1 Speaker Cable
2.10.2 Microphone Cable
2.11 TERMINALS
2.12 SURGE PROTECTION
2.12.1 Power Line Surge Protection

2.12.2 SIGNAL SURGE PROTECTION
2.13 TELEPHONE INTERFACE MODULE
2.13.1 Analog Interface Module
2.13.2 VoIP Interface Module

PART 3 EXECUTION

3.1 EXAMINATION
3.2 INSTALLATION
3.2.1 Equipment Racks
3.2.2 Wiring
3.3 GROUNDING
3.4 TRAINING
3.5 ACCEPTANCE TESTS
3.5.1 Testing Requirements

-- End of Section Table of Contents --

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SECTION 27 51 16

PUBLIC ADDRESS SYSTEMS
05/20, CHG 1: 05/22

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NOTE: This guide specification covers the requirements for public address systems.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

****

PART 1 GENERAL

****

NOTE: This guide specification is to be used in conjunction with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

If there is a requirement to integrate a Personnel Alerting System (to alert building occupants of eminent threat) to the PA system, assure that the necessary inputs and interfaces are included in this specification.

****

1.1 RELATED SECTIONS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, applies to this section, with the additions and modifications specified herein. In addition, refer

to the following sections for related work and coordination:

[Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.]
[Section 07 84 00 FIRESTOPPING for additional work related to firestopping.]

[1.2 SUMMARY

****
NOTE: This paragraph is intended to be used when a perfomance based IP Networked Public Address System is used where the contractor is responsible for design of the system. Include SUMMARY paragraph and all sub-paragraphs only if specification includes IP Networked Public Address System.
****

1.2.1 Scope

****
NOTE: Modify scope to clearly include desired capabilities of the public address system.

****

a. This work includes design and providing a new, complete, public address system as [required and as]described herein for the [building name]. Provide a turnkey system capable of receiving, processing, and transmitting indicated input signals including the system wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, control equipment, amplifiers, microphones, speakers, mounting hardware and other accessories and miscellaneous items required for a complete operating system even though each item is not specifically mentioned or described. Provide system[s] complete and ready for operation. See paragraph titled SYSTEM DESCRIPTION for additional requirements.

[b. The system layout on the drawings show the intent of coverage and are shown in suggested locations. Submit plan view drawing showing all component locations, cable routing, junction boxes, other related equipment, conduit routing, and wire counts for all floors.]

]1.3 REFERENCES

****
NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a 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.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S3.2	(2020) American National Standard Method for Measuring the Intelligibility of Speech Over Communication Systems (ASA 85)

ELECTRONIC COMPONENTS INDUSTRY ASSOCIATION (ECIA)

ECIA EIA/ECA 310-E	(2005) Cabinets, Racks, Panels, and Associated Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST SP 800-82	(2015; Rev 2) Guide to Industrial Control Systems (ICS) Security

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 8510.01	(2022) Risk Management Framework (RMF) for DoD Systems
UFC 4-010-06	(2016; with Change 1, 2017) Cybersecurity of Facility-Related Control Systems

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15	Radio Frequency Devices (47 CFR 15)

UNDERWRITERS LABORATORIES (UL)

UL 1449	(2021; Reprint Dec 2022) UL Standard for Safety Surge Protective Devices
UL 1778	(2014; Reprint Apr 2023) UL Standard for Safety Uninterruptible Power Systems

1.4 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified 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 Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualifications; G[, [_____]]

SD-02 Shop Drawings

Detail Drawings; G[, [_____]]

System Layout; G[, [_____]]

[System Design; G[, [_____]]]

SD-03 Product Data

Spare Parts

[SD-05 Design Data

Design Analysis and Calculations; G[, [_____]]]

SD-06 Test Reports

Approved Test Procedures; G[, [_____]]

Acceptance Tests

Accreditation; G[, [_____]]

SD-07 Certificates

Components

SD-10 Operation and Maintenance Data

Public Address System; G[, [_____]]

Submit Data Package 5 for each component in accordance with the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA.

****
NOTE: Include the following paragraph if specification includes IP Networked Public Address System.
****

[1.5 SYSTEM DESCRIPTION

1.5.1 Design Requirements

Provide a Public Address System, capable of distributing the indicated audio signals from equipment including LAN controllers, communication links, cabling, battery backup, power line surge protection and all other necessary components to make a complete and operational system. Complete coverage will be provided for all interior public spaces and other spaces as indicated on the drawings.

Provide a zoned system capable of evenly distributing live [and pre-recorded] paging and music program sources. Provide balanced and highly intelligible distributed sound free of noise and distortion. Provide capability of both individual and simultaneous paging all separate paging zones. Intelligibility must meet the requirements of Modified Rhyme Test (MRT) of ASA S3.2

Provide all headend interface, amplification components, conditioners and any other equipment necessary. Provide system capable of interfacing with the GFGI telephone system for zone paging.

Provide all materials and labor needed for a complete and operational system for the services in this specification plus the additional system capabilities as indicated. This includes but not limited to all necessary equipment, interfaces, jumpers, terminations, cabling, amplifiers,

conditioners, power supplies, battery backup, software and all components required for system operation.

1.5.2 System Application Design

Provide the system application design required to provide a public address system that complies with and satisfies all of the requirements specified in this Section [and indicated on the Telecommunications Drawings] for this application and project.

1.5.3 Standard Products

Provide an application design that utilizes standard system components that are the product of a Manufacturer regularly engaged in the manufacture of networked public address system, and that have been in satisfactory use for at least six months. Provide all major components from the same manufacturer. The System must be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the facility. Do not deliver material to the project site more than six months prior to the scheduled date of installation.

Provide hardware, software, and installation of a complete and engineered system. Provide a submitted design that is properly engineered for the operational requirements. Include all components required to meet this specification section in the design, other than a change in, or in addition to the operational frequencies identified herein.

1.5.4 Local Products

Incorporate local materials to the greatest extent possible. All proposed local products must meet all applicable hardware and software requirements set forth in these specifications.

1.5.5 Minimum Requirements

Specifications are minimum requirements. If the provided system requires enhanced specifications that exceed those specified herein in order to satisfy the specified design, configuration, capability, and performance requirements, then a provide a system with the enhanced specifications.

1.5.6 Current State-of-the-Art Technology

Provide application design and products that utilize current state-of-the-art products that provide the enhanced capability and performance specified herein. Provide design and products representing the latest manufacturer make and model.

1.5.7 Design Analysis and Calculations

Include in the design analysis and calculations, at a minimum, the following:

a. Power supply requirements for each component and each separate speaker zone of the system in accordance with the manufacturer's instructions. Provide power consumption and dissipation data under normal and maximum operating conditions.

b. Cable types and sizes.

c. Interfaces with all other systems such as the fire alarm and mass notification system for muting of public address system upon fire alarm or mass notification announcement.

1.5.8 Environmental Requirements

Provide equipment to be used indoors rated for continuous duty operation under ambient environmental conditions of 1.7 to 49 degrees C 35 to 120 degrees F dry bulb and 10 to 95 percent reflective humidity, noncondensing. Provide all other equipment rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location.

1.5.9 Electrical Requirements

105 VAC to 130 VAC at 60 Hz operating voltage range, plus or minus 2 percent.

1.5.10 Power supplies

Provide power supplies that provide sufficient power for worst-case conditions of system operation that could occur without signal loss or perceptible degradation.

1.5.11 Power Line Surge Protection

Provide power line surge protection for all equipment connected to AC power. Provide surge protection integral to the equipment or installed as an accessory item in accordance to manufacturer's recommendations. Do not use fuses for surge protection.

1.5.12 Shielding and Grounding

Provide shielding and grounded as required by the system design, Manufacturer's instructions, FCC Part 15 listing, and regulatory requirements.

1.5.13 System Capability and Configuration

1.5.13.1 System Capability

Provide a public address system with capabilities to support [VoIP interface,][zone paging,][background music,][all-call,][priority paging,][messaging processors,][software,][input modules,][controllers,][interface modules,] [and] [_____].

1.5.14 Performance Requirements

1.5.14.1 System Initiation and Operation

No user controlled features are permitted on this system. System is to be active on power up and perform as specified without any form of manual control.

1.5.14.2 Priority

****

NOTE: Indicate paging priorities on the drawings or in this specification section.
****

Provide paging priorities as indicated.

][1.6 CYBERSECURITY

****
NOTE: Coordinate public address integration requirements with facility needs and cybersecurity requirements. Simple public address system may be segregated from the facility network and greatly reduce the cost of cybersecurity compliance.
****

a. The Risk Management Framework (RMF) is the process by which information systems are accredited for operation by a designated official from the Using Military Department. It is the standard process under which all DoD information systems must achieve and maintain their Authority To Operate. The Cyber Security process is documented in DOD 8510.01 and NIST SP 800-82. Refer to UFC 4-010-06 for additional requirements.

b. All systems that are IP addressable or interface with the Assured Network must be certified to operate. Coordinate with the Government to initiate and complete the accreditation process.

c. Cybersecurity requires input from the system vendor or provider and support from the local IMD. The local IMD-IA office is the point of contact for all Cybersecurity requirements. The local CMIO is the point of contact for all clinical and functional system requirements.

]1.7 QUALIFICATIONS

1.7.1 General Qualification Requirements

a. The System Contractor, Installer and Manufacturer must each have the minimum qualifications specified, related to the type of system specified for this project.

b. The Government reserves the right to accept or reject the System Contractor, Installer or Manufacturer based upon qualifications and ability to conform to specified technical or licensing requirements of this Section. System Contractors, Installers and Manufacturers that do not have the specified qualifications will not be acceptable and will not be allowed to perform the work of this section.

c. The Government will determine the acceptability of any proposed System Contractor, Installer and Manufacturer based on submitted and verified documentation that substantiates that the proposed System Contractor, Installer and Manufacturer have the qualifications specified in this Section.

d. Submit documented verification of the specified qualifications as part of the Data Qualifications submittal. The Government maintains the right to request, inspect and verify references and resumes of all technical and managerial personnel assigned to the project.

e. Include qualification documentation, but not limited to the

information outlined below:

(1) A list of projects performed by the System Contractor and Installer during the last five years explicitly involving the type of system specified in this section, including:

(a) Name of facility where work was completed.

(b) Name, title, address and telephone number of a point of contact for the listed facility.

(c) The make and model of the system provided and total scope of work for the facility.

(d) Restrict list to the facilities where the same type of system was installed for the same purpose provided.

1.7.2 System Contractor Qualifications

a. Contractor qualifications must include the following:

(1) The Contractor is regularly engaged in the system application design, documentation, installation, testing, training, and maintenance of the type of system specified in this section.

(2) The Contractor has a minimum of five years experience providing these services for systems having the same level of features and functions as the system being provided.

(3) The Contractor has a minimum of five years as the manufacturer or an authorized distributor and service organization for the manufacturer of the system provided.

b. Contactor personnel qualifications must:

(1) Be factory trained or certified for the make and model of the system provided.

(2) Have a minimum of five years experience performing the services specified in this specification section.

(3) Maintain a full compliment of spare parts for the provided system with the ability to furnish on-call maintenance 24 hours per day, 365 days per year.

1.7.3 Installer Qualifications

a. The installer personnel must be regularly engaged in the installation of the type of system in this specification section.

b. The installation supervisor must be factory trained or certified for the make and model of the system provided.

c. The installation supervisor must have a minimum of five years experience providing services having the same level of features and functions for the system included in this specification section.

d. The installation personnel must have a minimum of three years experience providing services having the same level of features and

functions for the system included in this specification section.

1.7.4 Manufacturer Qualifications

The system manufacturer must:

a. Have a minimum of five years experience in producing the products and type of system included in this specification section.

b. Produce a system that satisfies all specified features, functions and product requirements.

c. Guarantee the availability of the replacement parts for the designed system for a minimum of seven years from the date of final acceptance of the system by the Contracting Officer.

1.8 DELIVERY, STORAGE, AND HANDLING

Equipment placed in storage until installation must be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

1.9 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than [2] [_____] months prior to the date of beneficial occupancy. The data must include a complete list of parts and supplies, with current unit prices and source of supply.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

The public address system must consist of an audio distribution network to include amplifiers, mixers, microphones, speakers, cabling, and ancillary components required to meet the required system configuration and operation. Submit Data Package 3 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

2.1.1 Multi-Channel System with Paging

The system must include microphones, microphone outlet receptacles, microphone inputs with preamplifiers, inputs for [digital music,] [telephone,] [and] [_____] program sources, [single] [all] channel paging, control for each input, power amplifying equipment, and accessories required to output the public address and paging audio signals through selected portions of the audio distribution network as indicated. The paging signal must be replaced [by zones] [channel [_____]] [all channels] of the system output, when the paging function is activated.

2.1.2 Single-Channel System

The system must control and amplify an audio program for distribution within the areas indicated. Components of the system must include a [mixer-preamplifier,] [mixer-amplifier,] [mike input expander,] [power amplifier,] [microphone,] [speaker system,] cabling and other associated hardware.

2.1.3 System Performance

The system must provide even sound distribution throughout the designated area, plus or minus 3 dB for the 1/1 octave band centered at 4000 Hz. The system must provide uniform frequency response throughout the designated area, plus or minus 3 dB as measured with 1/3-octave bands of pink noise at locations across the designated area selected by the Contracting Officer. The system must be capable of delivering 75 dB average program level with additional 10 dB peaking margin sound pressure level (SPL) in the area at an acoustic distortion level below 5 percent total harmonic distortion (THD). Unless otherwise specified the sound pressure reference level is 20 micro Pascal (0.00002 Newtons per square meter).

2.1.4 Detail Drawings

Submit detail drawings 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. Note that the contract drawings show layouts based on typical speakers. Check the layout based on the actual speakers to be installed and make necessary revisions in the detail drawings. Detail drawings must also contain complete point to point wiring, schematic diagrams and other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings must show proposed layout of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

[2.1.5 Network IP System Design

Submit system design consisting of a design analysis, calculations, and drawings as described in paragraph titled Detail Drawings. In the design analysis, describe all components, equipment, and appurtenances required for a fully functional system. Also include a detailed description of system operation to include paging priorities, interfaces with other systems, telephone interface for paging, all system inputs, and paging zones.

]2.2 STANDARD PRODUCTS

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products, and that essentially duplicate material and equipment that have been in satisfactory use at least 2 years. All components used in the system must be commercial designs that comply with the requirements specified. Submit copies of current approvals or listings issued by UL, or other nationally recognized testing laboratory for all components. Equipment must be supported by a service organization that is within [_____] miles of the site.

2.2.1 Identical Items

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

2.2.2 Nameplates

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

the equipment.

****

NOTE: Chose digital IP based system or analog type system. For analog type system, show all components on drawings to include riser diagram showing all required components.

Digital IP based system must be by performance specification. Show headend location on drawings to include required mounting racks. Show all speaker locations to include speaker zone assignments. Include system operation description on the drawings to describe required features and specific operational requirements.

Digital IP system must not reside on Government networks. Performance specification must include all active networking components and wiring necessary for system operation. At a minimum, include block diagrams on the drawings to include required functional components such as required inputs, microphones, interfaces with other systems, telephone interface modules, speakers, and volume controls. Define paging priorities on the drawings.

****

[2.3 IP NETWORKED PUBLIC ADDRESS SYSTEM

Provide complete digital IP based audio network as required to deliver high quality audio signals to paging speakers as indicated on the drawings. Provide amplifiers of sufficient power to drive speakers indicated based on the defined paging zones. Provide additional amplifiers or modules as required for indicated paging zones.

2.3.1 System Components

Provide all system components as required for a complete and operational system to include the following minimum components.

2.3.1.1 Headend Equipment

Provide floor mounted equipment rack to house all headend equipment.

2.3.1.2 Auxiliary Inputs

****

NOTE: Include specific inputs as required by project specific requirements.

****

Provide rack space and input modules for a minimum of two auxiliary inputs. Input sources are [_____].

2.3.2 Distribution Equipment

Provide all distribution equipment necessary to process and distribute paging and music to zones as indicated on the drawings.

2.3.2.1 Monitor Panel

Provide system monitor panel with speaker and zone selection capability to check each output, voice input, and zone selection.

2.3.2.2 Loudspeaker System

****

NOTE: Show all speaker locations and associated speaker zones on the construction drawings. Space corridor ceiling speakers at a maximum of twice the ceiling height where ceiling heights do not exceed 3 m 10 feet above finished floorin order to provide maximum uniform coverage. Space speakers in other locations as recommended by the speaker manufacturer for maximum coverage at low volume levels.

NOTE: Show individual room volume control locations on the contract drawings to meet project specific requirements. Indicate specific rooms that require all-call bypass feature on the contract drawings.

****

Provide low power loudspeakers for uniform sound distribution at low volume levels. Space speakers [as indicated on the drawings][_____]. Provide separate volume control for individual rooms as indicated on the drawings. [In rooms designated on the drawings, provide volume control with bypass feature to allow for all-call paging to bypass the local volume control and be audible at normal system volume.]

Provide speakers that are designed to provide even sound dispersion over the 20 Hz to 20 kHZ frequency range within the entire area the speaker covers.

2.3.2.3 Indoor Loudspeaker Assemblies

Provide cone type speakers with wall or ceiling enclosures and baffles as indicated on the drawings.

2.3.2.4 Outdoor Loudspeaker Assemblies

Provide weather resistant cone speakers with enclosures and baffles for outdoor ceiling locations. Provide horn type loudspeakers for outdoor wall mounted locations.

[2.3.2.5 IP Addressable PoE Loudspeakers

****

NOTE: Delete if not using IP network type system.

NOTE: IP Addressable PoE Loudspeakers must not reside on Government networks without prior permission nor without meeting RMF requirements.

****

Provide PoE speakers with integral amplifiers to provide a maximum of 8 Watts of power from the PoE connection. Provide all networking

components, PoE switches, cabling, and termination equipment to be an integral part of the public address system.

]2.3.2.6 Microphones

****
NOTE: Show microphone locations on the contract drawings as required to meet project specific requirements. Microphones are normally only provided at the headend equipment for testing purposes in medical facilities. All other paging input is via the telephone system.
****

Provide types and quantities of microphones as indicated on the drawings.

2.3.3 System Configuration

2.3.3.1 All Call

Provide all call paging capability. All call paging will have priority over all other paging zones. Provide access to all call paging via a microphone, telephone, or both. Microphone access will have priority over telephone access for all paging zone types.

2.3.3.2 Zone Paging

****
NOTE: Show all paging zones on the contract drawings. Coordinate paging zones with project specific requirements.

NOTE: Show zone volume control locations on the contract drawings.
****

Provide local paging zones as indicated on the drawings. Provide access to local zones using the telephone system[, microphones,][or both]. All call paging will have priority over all local paging zones. Provide zone volume control at a controlled access location as indicated on the drawings.

****
NOTE: Include the following paragraph only in medical facilities that contain combined medical and dental clinics.
**********[

2.3.3.3 Medical and Dental Clinic Zoning

Provide separate wide area zone for the medical clinic areas and separate wide area zone for dental clinic areas as indicated on the drawings. These wide area zones are in addition to all call for the entire facility. All call will have priority over wide area zones.
]

****
NOTE: Include the following paragraph only in medical facilities that contain an auditorium equipped with an auditorium AV system.
****

[2.3.3.4 Auditorium Zone

Provide all call paging in the auditorium only. Do not include auditorium within a local or wide area paging zone.

]2.3.4 System Performance

Provide system that evenly distributes sound throughout loudspeaker zones at plus or minus 3 dB for the 1/1 octave band centered at 4,000 Hz. Provide system that has uniform frequency response throughput loudspeaker zones of plus or minus 3 DB as measured with 1/3 octave bands of pink noise at locations as selected by the Contracting Officer. Provide system capable of delivering 75 dB average program level with additional 10 dB peaking margin sound pressure level without causing the associated amplifier to exceed normal operating specifications for power or distortion. Reference sound pressure level is 20 micropascal, unless otherwise indicated. Minimum audio sound pressure level must be at least +15 dB in all areas. System must not produce audible hum, noise, buzz, or rattles at any loudspeaker. Electoral/acoustic signal-to-noise ratio for the entire system must be at least 66 dB.

[2.3.5 Electrical Power

****

NOTE: Include this paragraph for all medical facilities. Include for other facilities as necessary to meet project specific requirements.

NOTE: For medical facilities with a Type I or Type II essential, connect the public address system to the essential system life safety branch. Coordinate with project electrical engineer. Public address equipment must be connected to dedicated circuit breakers that serve no other loads.

****

Provide uninterruptable power supply (UPS) units that will support AC powered equipment for a minimum of 15 minutes of full power during an AC power failure. Provide UPS units that comply with UL 1778 and FCC Part 15

]][2.4 ANALOG AUDIO SYSTEM

2.4.1 MIXER-PREAMPLIFIER

****

NOTE: Verify that the designated number of inputs is sufficient to meet the requirements of the design and increase the number of inputs if required.

Consideration should be given to the use of a mixer-amplifier instead of a mixer-preamplifier/power-amplifier combination. Mixer-amplifiers may not be available for power outputs of 200 watts or greater.

****

Mixer-preamplifier must as a minimum conform to the following specifications:

Rated Output	18 dB
Frequency Response	Plus or Minus 1 dB, 20 - 20,000 Hz
Distortion	Less than 0.5 percent, 20 - 20,000 Hz
Signal to noise	Microphone - 60 dB
	Aux - 70 dB
Inputs	5 independent balanced low-impedance transformer-isolated
Input Sensitivity	Microphone - 0.003 volts
	Aux - 0.125 volts
	Magnetic Cartridge - 0.0005 volts
Input Channel Isolation	80 dB minimum
Tone Controls	Plus or Minus 10 dB range at 50 and 15,000 Hz
Power Requirement	110-125 Vac 60 Hz

2.4.2 POWER AMPLIFIERS

****

NOTE: The required wattage rating will be inserted in the blank. This wattage may be computed as follows: Allow 1 watt for each loudspeaker. Use 1.4 multiplier for reserve power. Auditorium systems will have an output of not less than 20 watts or not less than 10 watts per 100 seats, whichever is greater. Special consideration will be given to acoustics, speaker placement, and the functions for which the system will be used, particularly for large auditoriums where music will be reproduced or amplified.

****

Power amplifiers as a minimum conform to the following specifications:

Rated power output	[60] [125] [250] [_____] watts RMS
Frequency Response	Plus or Minus 3 dB, 20-20,000 Hz
Distortion	Less than 2 percent at RPO, 600-13,000 Hz
Input Impedance	50 k ohm unbalanced
Output Impedance	Balanced 4 and 8 ohms

Output voltage	25 and 70.7 volts
Power Requirement	110-125 Vac 60 Hz

2.4.3 MIXER AMPLIFIER

****

NOTE: Verify that the designated number of inputs are sufficient to meet the requirements of the design and increase the number of inputs if required.

Consideration should be given to the use of a mixer-amplifier instead of a mixer-preamplifier/power-amplifier combination. Mixer-amplifiers may not be available for power outputs of 200 watts or greater.

The required wattage rating will be inserted in the blank. This wattage may be computed as follows: Allow 1 watt for each loudspeaker. Use 1.4 multiplier for reserve power. Auditorium systems will have an output of not less than 20 watts or not less than 10 watts per 100 seats, whichever is greater. Special consideration will be given to acoustics, speaker placement, and the functions for which the system will be used, particularly for large auditoriums where music will be reproduced or amplified.

****

Mixer amplifier must as a minimum conform to the following specifications:

Rated Power Output (RPO)	[35] [60] [125] [_____] watts RMS
Frequency Response	Plus or Minus 3 dB, 20-20,000 Hz
Distortion	Less than 1 percent at RPO, 60 - 13,000 Hz
Inputs	2 microphones (high impedance or low-impedance unbalanced 2 Aux. (high-impedance)
Output Impedance	Balanced 4 and 8 ohms
Output Voltage	25 and 70.7 volts
Power Requirement	110-125 Vac 60 Hz

2.4.4 MICROPHONE INPUT MODULES

****

NOTE: Verify that the designated number of inputs are sufficient to meet the requirements of the design and increase the number of inputs if required.

****

Microphone input modules must as a minimum conform to the following specifications:

Rated Outputs	0.25 volts into 10,000 ohms
	1.0 volts into 10,000 ohms
Frequency Response	Plus or Minus 2 dB, 20 - 20,000 Hz
Distortion	Less than 0.5 percent 20 - 20,000 Hz
Inputs	4 transformer - coupled balanced 150 ohm
Input Sensitivity	0.003 volts
Input Channel Isolation	70 dB minimum

2.4.5 MICROPHONES

2.4.5.1 Desk Microphone

Microphones must as a minimum conform to the following specifications:

Element	Dynamic
Pattern	Cardioid
Frequency Response	50 - 12,000 Hz
Impedance	Low impedance mic (150-400 ohms)
Front-to-back Ratio	20 dB
Selector switches	Selector switches for zone must be be [integral microphone] or [Separate console adjacent to microphone]

2.4.5.2 Gooseneck Microphone

Gooseneck microphone must meet the minimum requirements of the desk microphone. Microphone must have push to talk button. Gooseneck tube length must be [305] [406] [_____] mm [12] [16] [_____] inch.

2.4.5.3 Microphone Jack

Each outlet for microphones must consist of a standard outlet box, flush-mounted, and fitted with a three-pole, polarized, locking-type, female microphone jack and a corrosion resistant-steel device plate.

]2.5 LOUDSPEAKERS

****

NOTE: Indicate on drawings type of speaker and

location. Horn Speaker must be specified only in areas with high ambient noise or outdoors. High output speaker enclosures must be restricted to large open spaces i.e. gymnasiums, auditoriums or commons

****

2.5.1 Cone Speaker

The cone speaker must as a minimum conform to the following specifications:

Application	[Wall baffle] [Ceiling]
Frequency range	60 to 12,000 Hz
Power Rating	Normal - [7] [_____] watts
	Peak - [10] [_____] watts
Voice Coil Impedance	8 ohms
Line Matching Transformer Type	25/ 70.7 volt line
Capacity	4 watts
Magnet	10 ounces or greater
Primary Taps	0.5, 1, 2 and 4 watts
Primary Impedance	25 volts - 1250, 625, and 312 ohms
	70.7 volts - 10k, 5k, and 2.5k ohms
Frequency Response	30 - 20,000 Hz
Insertion Loss	Less than 1 dB

2.5.2 Horn Speaker

The horn speaker must as a minimum conform to the following specifications:

Application	[Indoor] [Outdoor] [Weatherproof]
Frequency Response	400 - 14,000 Hz
Power Taps	70 volt line - .9, 1.8, 3.8, 7.5, and 15 watts
Impedance	5000, 2500, 1300, 670, 330, 90, and 45 ohms
	Normal - [7] [_____] watts
	Peak - [15] [_____] watts

Dispersion	110 degrees

2.5.3 Dual Horn Speaker

The dual horn speaker must meet the minimum requirements of horn speaker except the dispersion must be 100 degrees.

2.5.4 High Output Speaker Enclosures

High Output speaker enclosures must be of the tuned-port design for precise balancing and tuning of the speaker. The enclosures must be constructed throughout of 19.1 mm 3/4 inch high density board, with screwed and glued joints, durably braced, and padded with fiberglass where acoustically required. Speaker enclosures must have a [25] [45] degree [_____] vertical dispersion and [90] [120] degrees [_____] horizontal dispersion. The effective length of throw must be a minimum of [15] [40] [60] [_____]m[50] [130] [200] [_____] feet.

2.5.5 Wall Baffle Speaker Enclosures

The wall baffle speaker must be of [particle board construction covered with [walnut laminate]][full steel construction painted [off-white][_____] [_____] and complete with [black] [_____] cloth grille]. Baffle must feature 9.5 [12.5] degree slope to provide directional sound dispersion offset in the direction of radiation. Wall baffle enclosure must come equipped with a wall mounting bracket designed to assure a rigid mounting to any flat surfaces.

2.5.6 Ceiling Speaker Enclosures

Ceiling speaker enclosure must be constructed of heavy gauge cold steel with interior undercoating and 38 mm 1-1/2 inch thick high density fiberglass 24 kg/cu. m 1-1/2 lbs/cu. ft. The unit must be [round] [square] and designed for [recessed] [surface] installations which will be accomplished via [standard screw] [torsion spring] [flange mount] mounting. Recessed models must have a rust-preventive, [textured black coating] [_____] and the surface mount unit finished in textured [white] [_____]. Enclosure must include four triple compound conduit knockouts.

2.6 SPEAKER SWITCHING PANEL

****
NOTE: Delete if paging function is not required.
Show zone boundaries on the drawings.
****

2.6.1 Selector Switches

Zone control must be provided for the paging function. The speaker switching panel must contain at least [_____] double-pole, [[4-] [3-] position] [push button] selector switches and must be [rack-mounted] [desk mounted] [selector switches built in microphone]to activate priority relays. Selector switches labeling must be provided to identify the zones.

2.6.2 System Power supply

Power supply must be provided for priority relays and controls,

rack-mounted and sized for a capacity equal to 200 percent of the as-built control system, and must operate at 24 Vdc. Input and output must be protected to permit Class 2 wiring in accordance with NFPA 70.

2.7 PRIORITY RELAYS AND CONTROLS

Provide priority relays and controls required to accomplish operations specified. Relays must be completely enclosed with a plastic dust cover for maximum protection against foreign matter, and must be plug-in type. Relays must be provided with a diode wired across the relay coil for transient suppression and must be installed utilizing factory-prewired, rack-mounted receptacle strips. Coil must be maximum 24 volts dc.

2.8 SWITCHES AND CONTROLS

2.8.1 Remote Loudspeaker ON/OFF Switches

****

NOTE: If more than one switch is required, indicate in a schedule on the drawing.

****

Remote switches must be [key-operated] [toggle switch] 2-pole, wall-mounted, single gang type with engraved switch plates finished to match the approved finish of electrical wall switches. Low-voltage priority override relays must be provided as part of the switches with all wiring to the racks to allow override of the ON/OFF switches for priority announcements.

2.8.2 Remote Loudspeaker Volume Controls

****

NOTE: If more than one control is required, indicate in a schedule on the drawing.

****

Remote volume controls must be an auto transformer type with detented 3 dB steps and an OFF position. The controls must be wall-mounted in single-gang outlet boxes and furnished with engraved switching plates finished to match approved finish of electrical wall switches. Insertion loss of the controls must not exceed 0.6 dB and the power-handling capacities of the control must be [10] [35] [75] [_____] watts. Low-voltage priority override relays must be furnished as part of these controls with all wiring to the racks to allow override of the volume controls for priority announcements.

2.9 EQUIPMENT RACKS AND CABINETS

****

NOTE: For low powered systems i.e. only paging systems,specify perforations or louvers for cooling through convection currents. Systems with total amplifier capacity exceeding 400 watts use top rack mounted fan option.

****

Equipment must be mounted on[482.6 mm 19 inch racks] [swing wall mounted cabinets with hinged front removable and reversible door and [right hand] [left hand] hinged rear section that provides access to equipment with

482.6 mm 19 inch mounting rails] [and] [floor mounted cabinets with 482.6 mm 19 inch mounting rails] as indicated on the drawings UL listed andin accordance with ECIA EIA/ECA 310-E and located as shown on drawings. Ventilated rear panels, solid side panels, and solid top panels must be provided for cabinets. Equipment cabinets must be provided with lockable front panels that limit access to equipment. The lockable front must not cover items that require operator access. Cabinet cooling must be through [perforations or louvers in front panels to ensure adequate ventilation of equipment] [top cabinet mounted fan]. The racks and cabinets must be factory finished with a uniform baked enamel over rust inhibiting primer.

2.10 CABLES

2.10.1 Speaker Cable

Cables must be of the gauge required depending upon the cable run length. In no case are cables to be used which is smaller than 18 AWG. Insulation on the conductors must be polyvinyl chloride (PVC) or an equivalent synthetic thermoplastic not less than 0.2 mm 0.009 inch. Cables must be jacketed with a [PVC] [Fluoropolymer] compound. The jacket thickness must be 0.5 mm 0.02 inch minimum.

2.10.2 Microphone Cable

Cable conductor must be stranded copper 20 AWG. Insulation on the conductors must be polyvinyl chloride (PVC) or an equivalent synthetic thermoplastic not less than 0.2 mm 0.009 inch. Cable must be shielded 100 percent of aluminum polyester foil with a bare 22 gauge stranded soft copper drain conductor. Cables must be jacketed with a [PVC] [Fluoropolymer] compound. The jacket thickness must be 0.5 mm 0.02 inch minimum.

2.11 TERMINALS

Terminals must be [solderless, tool-crimped pressure] [or] [_____] type.

2.12 SURGE PROTECTION

2.12.1 Power Line Surge Protection

Major components of the system such as power amplifiers, mixer-preamplifiers, and tuners, must have a device, whether internal or external, which provides protection against voltage spikes and current surges originating from commercial power sources in accordance with IEEE C62.41.1/IEEE C62.41.2 B3 combination waveform and NFPA 70. Fuses must not be used for surge protection. The surge protector must be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground). Surge protection device must be UL listed and labeled as having been tested in accordance with UL 1449.

2.12.2 SIGNAL SURGE PROTECTION

Major components of the system must have internal protection circuits which protects the component from mismatched loads, direct current, and shorted output lines. Communication cables/conductors must have surge protection installed at each point where it exits or enters a building.

2.13 TELEPHONE INTERFACE MODULE

****

NOTE: Telephone Interface module may be used to access PA system from telephone in conjunction or lieu of microphone. If there is a requirement to integrate Telephone Interface module to the PA system, assure that the necessary inputs and interfaces are included in this specification.

****

[2.13.1 Analog Interface Module

Telephone Interface module must provide one way all call paging access from telephone to PA system. Paging must be accomplished by the building telephone system instruments interconnected to the PA system via an interface module to allow telephone dial up access to the paging amplifier. Telephone interface module must as a minimum conform to the following specifications:

Impedance	600 ohms
Frequency response	100Hz to 10Khz
70V Input Impedance	200K ohms
Output level	400mV rms
Input Power Requirement	12-24Vdc (from power supply)
Access requirement	Electronic (analog) or IA2 line key (line card required) PABX loop or ground-start trunk port, or dedicated single-line phone

][2.13.2 VoIP Interface Module

Provide paging interface module suitable for use with VoIP telephone systems.

]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

Install equipment as indicated and specified, and in accordance with the manufacturer's recommendations except where otherwise indicated. Equipment mounted out-of-doors or subject to inclement conditions must be weatherproofed.

3.2.1 Equipment Racks

****
NOTE: Racks be located adjacent to walls. If a mechanical rack/floor attachment is required, controls must not be lower than 762.0 mm (30 inches nor higher than 1.7 m 66 inches above floor.
****

Mount racks side-by-side and bolt together. Group items of the same function together, either vertically or side-by-side. Arrange controls symmetrically at a height as indicated. Make audio input and interconnections with approved shielded cable and plug connectors; output connections may be screw terminal type. All connections to power supplies must utilize standard male plug and female receptacle connectors with the female receptacle being the source side of the connection. Inputs, outputs, interconnections, test points, and relays must be accessible at the rear of the equipment rack for maintenance and testing. Each item must be removable from the rack without disturbing other items or connections. Empty space in equipment racks must be covered by blank panels so that the entire front of the rack is occupied by panels.

3.2.2 Wiring

Install wiring in rigid steel conduit, intermediate metal conduit, cable trays, or electric metallic tubing as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Wiring for microphone, grounding, line level, speaker and power cables must be isolated from each other by physical isolation and metallic shielding. Shielding must be terminated at only one end.

3.3 GROUNDING

All grounding practices must comply with NFPA 70. Equipment must be grounded to the serving panelboard ground bus through a green grounding conductor. Metallic conduits serving the equipment must be isolated on the equipment end with an insulating bushing to prevent noise from being transferred to the circuit. Equipment racks must be grounded to the panelboard ground bus utilizing a 8 AWG conductor. Grounding conductor must be terminated to the rack using connector suitable for that purpose.

3.4 TRAINING

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

3.5 ACCEPTANCE TESTS

Submit test reports in booklet form showing all field tests performed to adjust each component and to prove compliance with the specified performance criteria, upon completion and testing of the installed system. The reports must include the manufacturer, model number, and

serial number of test equipment used in each test. Each report must indicate the final position of controls and operating mode of the system. After installation has been completed, conduct acceptance tests, utilizing the approved test procedures, to demonstrate that equipment operates in accordance with specification requirements. Submit test plan and test procedures for the acceptance tests. The test plan and test procedures must explain in detail, step-by-step actions and expected results to demonstrate compliance with the requirements specified. The procedure must also explain methods for simulating the necessary conditions of operation to demonstrate system performance. Notify the Contracting Officer [14] [_____] days prior to the performance of tests. In no case will notice be given until after the Contractor has received written Contracting Officer approval of the test plans as specified.

3.5.1 Testing Requirements

Include the following minimum testing:

a. Operational Test: Perform tests that include originating program and page messages at microphone outlets, preamplifier program inputs, and other inputs. Verify proper routing and volume levels and that system is free of noise and distortion.

b. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:

   (1) Disconnect microphone at connector or jack closest to it and replace it in the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at corresponding connectors with dummy loads, each equal in impedance to microphone it replaces. Measure signal-to-noise ratio.

   (2) Repeat test for each separately controlled zone of loudspeakers.

   (3) Minimum acceptance ratio is 50 dB

c. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.

d. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.

e. Power Output Test: Measure electrical power output of each power amplifier at normal gain settings of 50, 1000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.

****

NOTE: Include the following paragraph where UPS units are included for the public address system.

****

[f. Power Outage Test: Turn off AC power at the circuit breaker for AC powered components connected to a UPS unit to ensure components continue to operate for a minimum of 15 minutes.]

g. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.

Public address system will be considered defective if it does not pass any of the required individual tests and inspections listed above.

-- End of Section --