SECTION 27 51 13 PAGING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This document covers the general requirements for the installation of overhead paging systems with SIP interface.

B. Project Overview

1. Design Consultant to provide project overview here.

1.2 RELATED DOCUMENTS

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

B. Related Sections

1. Div 26
2. Section 270000 Communications
3. Section 270526 Grounding and Bonding for Communications Systems
4. Section 270528 Interior Pathways for Communications Systems
5. Section 270543 Exterior Pathway for Communications Systems
6. Section 270553 Identification for Communications Systems

1.3 CODES AND STANDARDS

A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.

B. The equipment, materials, and installation shall confirm to the latest version of all applicable codes, standards and regulations of authorities having jurisdiction including the following:

1. American National Standards Institute (ANSI)
2. American Society for Testing and Materials (ASTM)
3. Alliance for Telecommunications Industry Solutions (ATIS)
4. Federal Communications Commission (FCC)
5. International Electrotechnical Commission (IEC)
6. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
7. International Organization for Standardization (ISO)
8. International Organization of Standardization/International Electrotechnical Commission (ISO/IEC)
9. National Cable Television Association (NCTA)
10. National Electrical Code (NEC)
11. National Electrical Manufacturers Association (NEMA)
12. National Fire Protection Association (NFPA)
13. National Institute Standards and Technology (NIST)
14. Occupational Safety and Health Administration (OSHA)

15. Telecommunications Industry Association (TIA)
16. Comply with terms and conditions of Americans with Disabilities Act, especially regarding provisions for hearing impaired and wheelchair access in control areas.
17. Execute work in accordance with best paging system installation practices, and applicable state and local codes.
18. Owner's Design Guidelines and Construction Standards

1.4 SUBMITTALS

A. General

1. Refer to Division 1 and section 27 00 00.
2. Submit in quantities, format and timetable as required by General Conditions.

B. Product Submittals

1. Contractor shall submit catalogue cut-sheets that include manufacturer, trade name, and complete model number for each product specified. Model number shall be handwritten and/or highlighted to indicate exact selection.
2. Contractor shall identify applicable specification section reference for each product performance for each component specified for approval prior to purchase and installation.
3. Minimum number of Sets: four (4) or one (1) electronic copy.
4. Provide a list of equipment (model and quantity) for paging system.
5. Timetable
   a. Submit within thirty (30) days after award of contract.
   b. Submit simultaneously with Shop Drawings.
   c. Allow minimum of ten (10) business days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, resubmit total quantity of complete sets. If second resubmit is required, Contractor shall reimburse Owner for expenses incurred during additional review process.
   d. Review and approval of Product Data is required before equipment purchase and installation.

C. Shop Drawings

1. Shop drawings shall be submitted for review and approval before installation.
2. Minimum Number of Sets: four (4) or one (1) electronic copy.
3. Timetable
   a. Submit within thirty (30) days after award of contract.
   b. Submit simultaneously with Product Data Binders.
   c. Allow minimum of ten (10) business days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, resubmit total quantity of complete sets. If second resubmit is required, Contract shall reimburse Owner for expenses incurred during additional review process.
4. Description:
   a. Shop Drawings shall be used for coordination between trades and updated as final record drawings.
   b. Bind all Shop Drawings together to form set. Loose drawings will not be accepted.

c. Each drawing shall include: Project, Building, Location, Contractor Name, Architect, Paging Consultant, Date and Revision Number.
d. Number and title each drawing in logical manner as a set.
e. Include cover sheet with listing of all drawings included in bound set.
f. Ensure that labeling on Shop Drawings match labeling on equipment.
g. Minimum Scale:
    1) Floor Plans: 1/8 inch = 1 foot.
    2) Rack Elevations: 1-½ inch = 1 foot.
    3) Plate/Panel Details: 6 inches = 1 foot.
    4) Loudspeaker Details: 1 inch = 1 foot.
h. Include as a minimum:
    1) Floor plans indicating locations of all paging devices, vertical risers, pull boxes, and exposed wiring. Include Device ID (SPKR, AMP, etc., as referenced in design contract documents), as appropriate for wall mounts, racks, floor boxes, face plates in walls, etc.
    2) Schematic diagram showing all primary and secondary devices, interconnectivity and signal flow.
    3) Plate details showing size, material, finish, connectors, engraving, etc.
    4) Speaker zoning
    5) Mounting detail drawings of loudspeakers, racks, and overhead equipment. Hire services of professional structural engineer, licensed by the appropriate governing authority, to review shop drawings, building structural drawings, and any existing structures from which equipment is to be suspended. Include Structural Engineer's stamped report with shop drawing submittal. Report shall include:
        a) Itemization of items reviewed by the Structural Engineer.
        b) Confirmation that proposed methods of suspending equipment as shown on the shop drawings conform to required safety factors.
        c) Confirmation that building structure from which equipment is to be suspended will support equipment including required safety factors.
    6) Rack elevations.
    7) Complete schematic diagram. One-line diagram with detailed descriptions of product inputs and outputs is acceptable. Include terminal strip details and cable label information. If wiring diagram spans more than three (3) sheets, additionally provide simplified block diagram of entire system on one (1) sheet.
    8) Electrical power wiring diagram. Include circuit, switching, and control details.
    9) Wiring diagram of grounding and shielding scheme.
    10) Drawings for custom-fabricated items (i.e., plates, panels, cables, and assemblies).
    11) General construction drawings necessary for completion of work.

D. Operation and Maintenance Manuals

1. Minimum number of Sets: four (4).
2. Bind Operation and Maintenance Manuals using either GBC or 3-ring binders.
3. Format and Minimum Information below:

a. Section 1 - System Operation.
   1) Introduction/overview to system components and their functions and locations. Include a brief listing of basic system functions.
   2) Complete but simple system operating instructions to accomplish basic system functions, written for non-technical personnel.
   3) Certificate indicating names of Owner personnel trained by Paging Contractor, date of training, name of Paging Contractor representative that provided training, and name of project.
b. Section 2 - System Documentation.
   1) Simplified system one-line schematic diagram showing changes made during construction.
   2) Complete inventory of system components including serial numbers. Identify location (equipment rack, over stage, stored in control room, etc.) of each component.
   3) Cable and terminal strip documentation including cable numbers, functions, originating locations, terminating locations, and signal levels.
   4) All Shop Drawings corrected to reflect as-built conditions.
   5) Other data and drawings required during construction.
   6) Initial Tests and Adjustments data.
   7) Final Tests and Adjustments data.
   8) Electronic file including all utilized manufacturer's software and saved copies of software configurations (configurations as established during Final Tests and Adjustments).
c. Section 3 - Manufacturer's Documentation.
   1) For each equipment model at no additional costs to Owner, even if manufacturer does not include costs of such documentation with purchase of equipment item.
   2) Manufacturer's Product Data.
   3) Operating instructions.
   4) Installation instructions.
   5) Service information.
   6) Schematic diagrams.
   7) Replacement parts list.
d. Section 4 - Maintenance Information.
   1) Preventive maintenance schedule letter clearly stating target dates of six month and end-of-warranty preventative maintenance inspections, and list of maintenance tasks performed.
   2) Maintenance instructions including manufacturer's recommended maintenance, recommended maintenance schedule and information concerning proper inspection, testing, and replacement of components.
   3) Troubleshooting information complete with instructions for procedures during equipment failure.
e. Section 5 - Warranty Information
   1) System warranty letter.

4. Provide a share file location that include the file with all material in Operation and Maintenance Manuals in PDF format except for copyrighted material.

5. Submit one (1) set of Operation and Maintenance Manuals at least ten (10) days before Final Tests and Adjustments procedures (minus data from Final Tests and Adjustments). This set will be reviewed by Owner and returned to Contractor. Re-submit after Final Tests and Adjustments and include data. NOTE: Do not schedule Final Tests and Adjustments or perform training of Owner personnel before submitting Operation and Maintenance Manual.
6. Submit remaining number of complete manuals as required by General Conditions within ten (10) days after return of reviewed set(s). Include Final Tests and Adjustment data, warranty period letter, and any other data not included in first submission.

E. Samples.

1. Request for Samples - Upon request, furnish samples (at no additional cost) to Owner and/or General Contractor of submitted items proposed as substitutes for specified items. Products will be reviewed to determine if proposed substitute items meet required function and quality.
2. Product Tests
   a. Products submitted as samples may require testing by independent laboratory. Testing at expense of Contractor.
   b. Obtain written approval of tested products before incorporating into system.

1.5 AS-BUILT DRAWINGS

A. Submit one electronic copy and one hard copy with project deliverables within three (3) weeks subsequent to substantial completion. Minimum Number of Sets: four (4) or one (1) electronic copy.

A. The As-Built drawings shall incorporate all changes made to the building identified in, but not limited to, addendum, change notices, site instructions or deviations resulting from site conditions.
1. Contractor shall clearly identify any resubmitted drawing sheets, documents or cut sheets either by using a color to highlight or cloud around resubmitted information.
2. Maintain drawing numbering or page/sheet scheme consistency as per previously issued Shop drawings/documents.

1.6 QUALITY ASSURANCE

A. Paging Contractor Qualifications.

1. Be an established Paging System Contractor, regularly engaged in furnishing and installing paging systems. NOTE: Electrical or general contracting firms responsible for completion of this work, but not meeting above requirement, shall employ services of approved Paging Contractor as subcontractor to perform work described herein.
2. Be experienced in installations of similar size and scope within last five (5) years. Submit list of four (4) (minimum) installed jobs of similar magnitude, completed within last five years. For verification, submit complete information, including project name, project address, contact person, daytime telephone number plus month and year of project completion. At Owner’s request, accompany Owner or Owner’s representative on visit to any or all example completed projects submitted.

3. Must have at least one permanent staff member who is formally trained in the installation and maintenance of each major product line offered. Must be trained and certified for installing and program Valcom paging system products.
4. Employ personnel (at all levels of work) experienced in projects of similar size and scope. Provide list of key personnel to be responsible for each of the following aspects of work: Project Management, Technical Documentation, Control System programming and Leadership of Field Work (one who is present for all field work). For each identified employee, indicate number of years employed by contractor, number of years experience in assigned responsibilities, and list of previously completed projects where similar responsibilities were required.
5. Project manager assigned to this project must have a minimum of five (5) years experience in installing and integrating paging systems of similar scale.

1.7 PRODUREMENT

A. Refer to 270000

B. Technology Implementation Plan shall be provided during the submittal review process.

PART 2 - PRODUCTS

2.1 GUIDELINES

A. Infrastructure Products - All conduits, basket tray/cable tray, pull boxes and associated parts required for infrastructure shall be installed by the electrical contractor unless specifically excluded in these specifications or drawings.

B. Performance - Regardless of completeness of descriptive paragraphs herein, each device shall meet its manufacturer’s published specifications. Verify performance.

C. Contract Documents - Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general the specifications determine the nature and quality of the materials, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to in the installation of the paging system components. If there is an apparent conflict between the drawings and specifications, the items with the greater quantity or quality shall be provided and installed. Clarification with the owner about these items shall be made prior to the ordering and installation.

D. Quantities - All quantities are indicated on paging drawings or in Part 2 Paging Products list. Confirm quantities on final Contract Documents. If Contract Documents do not include quantities necessary to deliver complete working system, provide notification of disparity, and install required quantity of devices for complete working system.

E. Small Parts - Systems are described in terms of major products. Even if not specifically mentioned, provide and install patch cables, connectors, hardware, converters, power supplies, labels, terminals, mounting accessories etc. necessary for complete and working system meeting design intent of specifications.

F. Condition - Provide and install products listed in this section in factory new condition, conforming to applicable provisions of American National Standards Institute.

G. Designations - Each major product item is given unique designation (such as SPKR 1 for speaker number 1). The product designations are unique in this section only and may be repeated in other specification sections.

2.2 PAGING PRODUCTS

A. VoIP Paging Interface
1. Valcom V-9972-2

B. Network Page Zone Extender
1. Valcom VE8004BR – four channel enhanced output module

C. Amplifier
1. Crown CDi 4/300
2. Or approved equal

D. Gypsum Ceiling Speaker
1. Atlas SD72
2. Or approved equal

E. Acoustical Ceiling Speaker
1. Quam System 12/VC
2. Or approved equal

F. Wall Mounted Horn Speaker
1. Atlas AP30T
2. Or approved equal

G. Surface Mounted Speaker
1. Quam System 2
2. Or approved equal

H. Equipment Cabinet

1. CPI CUBE -iT
2. Or approved equal

I. PDU with Sequencer

1. Furman M-8S
2. Or approved equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Guidelines

1. Quality of Work - Perform labor to accepted industry standards and state and local codes to accomplish complete and working system.

2. Material and Labor - Provide specified products and other incidental materials, appliances, tools, and transportation required for complete and functioning systems. Provide personnel to perform labor who are skilled in techniques and can demonstrate technical knowledge of paging infrastructure system installations.

3. Provide a complete functioning sound system that's been fully tested and properly balanced, configured, and equalized. Be of maximum assistance to the Owner during the warranty period of the system, to the degree that maximum Owner satisfaction is assured.

4. Provide all audio circuits balanced and floating, except as noted in the Specifications or directed by the Consultant at the time of final equalization and testing. Shields of audio cables shall be grounded at one end only, at the outputs of the various equipment items in the system

5. Route cables and wiring within equipment racks and cabinetry according to function, separating wires of different signal levels (microphone level, line level, amplifier output, 120VAC, intercom, control, etc.) by as much physical distance as possible. Neatly arrange and bundle all cables loosely with plastic cable ties. Cables and wires shall be continuous lengths without splices.

6. All system wire, except spare wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No unterminated wire ends will be accepted. Heat-shrink type tubing shall be used to insulate and dress the ends of all wire and cables. Include a separate tube for the ground or drain wire.

7. All cables in conduits shall be insulated from each other and from the conduit the entire length and shall not be spliced. All cables and wires are to be continuous lengths without splices.

8. Use suitable cable fittings and connectors.

9. Splice cable is not allowed, UON.

10. Label all wires in racks and console as to destination and purpose with permanent labels. Clearly and permanently label all controls and connections at the front and back of the rack, with permanent labels. Wall plates and custom panels shall be engraved and filled with contrasting paint, unless otherwise noted. All labeling shall be completed prior to final system inspection.

11. Documents at Job Site - Keep following documents at job site during entire construction period:

    a. Complete Specifications and Drawings.

    b. Approved Shop Drawings.

    c. Approved Product Data.

    d. Progress Set of Project Record Documents.

12. Mounting - Mount equipment and enclosures plumb and square. Ensure that permanently installed equipment is firmly and safely held in place. Design equipment supports to support loads imposed with project safety factor of five (5) or greater. For devices hung overhead, obtain review by Structural Engineer licensed by the appropriate governing authority prior to installation.

13. Provide adequate protective vandal guards for all devices located in areas subject to damage from activities or vandalization.

14. Dimension Verification - Verify dimensions and space requirements to assure that proper mounting, clearance, and maintenance access space is available for system components.

15. Clean-Up - Leave project clean each day. Place debris where designated by General Contractor. Debris includes but not limited to: solder splatter, cable ends, stripped insulation, spent crimp connectors, gypsum board and ceiling tile dust, and product wrappings and cartons. After completion of installation, thoroughly clean areas worked, including non-visible areas such as equipment rack interiors, rack top panels, and inside lockable floor and wall boxes.

16. Coordinate installation of paging infrastructure and equipment with other trades in order to follow project schedule.

17. Leave a three (3) foot service loop of cable at each termination and a ten (10) foot service loop at the MDF/IDF.

18. Support cables above accessible ceilings to keep them from resting on ceiling tiles. Use a ceiling suspension system at five (5) foot intervals.

19. Mounting Heights: Coordinate locations of outlet boxes to obtain mounting heights as indicated on drawings.

20. Ground and bond equipment and circuits in accordance with Division 26 and 27 requirements.

21. Maintain any licensing required by the appropriate governing authority to install and terminate low voltage systems.

B. Labeling

1. Equipment Labels - Paging Contractor shall provide engraved lamicoid labels on front of wall-mounted equipment. Mount labels plumb and square. Include schematic reference design, item name, and system or area controlled by labeled component. On equipment interfaces, provide label for each input indicating which source is controlled by labeled channel. Unless otherwise indicated, provide permanently-mounted black labels engraved with 1/8-inch white block characters. Handwritten, self-laminating, or embossed plastic (Dymo) labels are not acceptable. Provide labels for major equipment with two (2) lines (minimum) of engraving, coded as follows:
   a. Line 1: Generic name of device, such as AMPLIFIER.
   b. Line 2: Schematic designation of device, such as PAGING-AMP-1.

2. Control Labels - Paging Contractor shall provide engraved label over each user-operated control that describes the function or purpose of control. Provide label of proper size to fit available space.
3. Terminal Strip Labels – Paging Contractor shall label each terminal strip with unique identification code in addition to numerical label (Cinch MS series) for each terminal. Show terminal strip codes on system schematic drawings included with Project Record Documents.
4. Rear Equipment Labels - Paging Contractor shall provide adhesive label on rear of equipment where cables attach, to indicate designation of cable connected at each point.
5. Cable and Wire Labels - Label cables and wiring logically, legibly and permanently for easy identification. Labels on cables shall be adhesive strip type, covered with clear heat shrink tubing. Factory stamped heat shrink tubing may be used. Hand-written or self-laminating type labels are not acceptable.
6. Cable Label Codes and Locations - Label each cable with unique alpha-numeric code. Locate cable designation at start and end of each cable run, within three (3) inches of termination point. For cable runs that have intermediate splice points, label cable with same designation throughout, with additional suffix to indicate each segment of run. Provide cable designation codes to schematic drawings included with Project Record Documents and Operation and Maintenance Manuals.

C. Power and Grounding

1. Power Coordination - Coordinate final connection of power and ground wiring to rack. Electrical contractor will provide power to paging systems. Before installation, verify load requirements for systems as accepted.
2. Refer to Division 26.

D. Wiring

1. All wiring shall be listed for the intended purpose. All interior wiring shall be in accordance with new construction guidelines.
2. Run cable in ceiling plenums neatly parallel to building walls, supported every three feet to structure with plenum rated ties.
3. All wiring shall be installed in raceways or plenum rated cables where routed in plenum ceiling areas.
4. Accessibility - Ensure that wiring and connections are completely visible and labeled. Mount termination resistors, if required, on terminal strips, fully visible and not concealed within equipment or connectors.
5. Loudspeaker Polarity - Connect loudspeakers electrically in phase, using same wire color for loudspeaker wiring throughout project.
6. Physical Damage Prevention - Take necessary precautions to prevent physical damage to cables and equipment. Damaged cables or equipment will not be accepted. Separate, organize, and route cables to restrict channel crosstalk and feedback oscillation.

3.2 FIRESTOPPING

A. Refer to section 27 00 00.

3.3 STORAGE AND HANDLING

A. The contractor shall provide all necessary protection on the AC power feed and on all station lines leaving/entering the building.

B. The contractor shall note in his system drawings, the type of protection devices and all relative information.

C. Ensure that materials (especially electronic and electro-acoustic devices) are protected against physical, environmental, and electronic damage until final acceptance by Owner.

D. Schedule delivery to minimize delays in the project.

E. Provide storage protection against temperature and humidity extremes, theft, vandalism, physical damage, and environmental damage.

3.4 WARRANTY

A. Refer to Division 1.

B. Warranty - Submit letter providing warranty covering labor and materials supplied under this contract. Bind in Operation and Maintenance Manuals. Terms as described in General Conditions. Minimum terms as follows:

1. System - Systems shall be free of manufacturing or installation defects for a minimum period of one (1) year from the date of final acceptance. Clearly designate begin and end dates of system warranty period.
2. Parts and Labor - Provide parts and labor to repair defects in materials and workmanship during system warranty period.
3. Response Time - Within system warranty period, provide initial on-site service response within one (1) business day of service call. Provide resolution to any system defects within 72 hours or within 48 hours of receipt of repaired or replaced product from manufacturer.
4. Replacement Products - If any item must be removed for repair during system warranty period, provide replacement item of similar quality at no charge.
5. Repair Limit - Do not repair any piece of equipment found defective during installation or system warranty period more than two (2) times. After second repair, replace defective item with similar approved item at no additional cost to Owner.
6. Extended Manufacturer’s Warranties - Identify products with manufacturer’s warranties extending beyond one (1) year. Provide terms and conditions of such warranties.
7. Service Personnel Information - Provide name(s) and telephone number(s) of service personnel to be contacted regarding repair and maintenance.

C. Extended Warranty - Provide cost to extend complete paging system warranty from one (1) year to three (3) years. Included a list of all provided services including maintenance schedules.

3.5 GROUDNING AND BONDING

A. Refer to Section 270526

3.6 PATHWAY

A. Refer to Section 270528

3.7 LABELLING

A. Refer to Section 270553

3.8 INITIAL TESTS

A. Purpose - These tests are to ensure that the paging system is installed and functioning as specified, and to ensure the system is ready for Final Tests and Adjustments (described later).

B. Testing Standards - Perform testing in accordance with ANSI standards.

C. Inspection - Verify prior to beginning actual tests and adjustments on systems:

1. Proper grounding of all electronic components (through third prong of power connector or separate connection between component chassis and ground bus bar).
2. Cables dressed, routed, and labeled, connected with proper polarity.
3. Insulation and shrink tubing in place.
4. Dust, debris, solder splatter, etc. removed.
5. Proper frequency settings (or modules) at crossovers and controllers.
6. All equalizer bands and tone controls set for flat frequency response.
7. Survey temperatures of each piece of equipment after four (4) hours use (minimum). Note and report any hot equipment.

D. Electrical Power Quality - While all sound and paging system components are unplugged from electrical power outlets, Paging Contractor shall turn on power to outlets, and confirm proper voltages at each outlet across the following pairs of terminals: hot and neutral, hot and ground, and neutral and ground (zero volts across neutral and ground). Paging Contractor to document measurements.

E. General Function Tests - Test each piece of equipment to ensure that it performs its intended function. Include all portable equipment in tests. Intent of initial tests is to verify complete, functioning system before Final Tests and Adjustments. Correct problems found during initial testing before beginning Final Tests and Adjustments. Document whether all pieces performed intended functions; note any unresolved malfunctions.

F. Initial Tests and Adjustments Data - Submit written report of Initial Tests and Adjustments data upon completion to Owner. Include printed name(s) of technician(s) performing tests, date(s) and time(s) of tests, model and serial numbers of test equipment, results of each initial test, descriptions of problems encountered and their solutions, and statement that system is ready for Final Tests and Adjustments. Initial Tests and Adjustments Data to include signatures of technician(s) performing tests.

3.9 FINAL TESTS AND ADJUSTMENTS

A. Purpose - These tests are to be witnessed by the paging Consultant to determine if system is complete and functioning as designed and specified. Also, the paging Consultant will perform listening and viewing tests and witness adjustments of all images for optimum clarity.

B. Timetable - Coordinate with Owner, General Contractor, and paging Consultant to schedule Final Tests and Adjustments after submittal of Initial Tests and Adjustments data.

C. System and Site Conditions – Paging Consultant will witness Final Tests and Adjustments. Have systems fully functional and ready for observation and testing upon paging Consultant's arrival. Coordinate with all trades for quiet conditions throughout the listening areas and for the duration of the test schedule. If upon paging Consultant's arrival, systems do not meet criteria, site is not sufficiently quiet, or if Owner or paging Consultant is required to make additional trips to job site to witness additional testing or perform additional reviews of installed equipment, Contractor shall reimburse Owner for labor and expenses incurred by having incurred costs deducted from payments to contractor.

D. Test Labor - Provide technician familiar with this project's paging systems and operation of test equipment to perform testing. Provide additional technician to assist in the tests and to perform troubleshooting, repairs, and adjustments. Include labor for these technicians to be present for one (1), eight (8)-hour day during Final Tests and Adjustments.

E. Tools - Provide standard hand tools including screwdrivers, pliers, wire strippers, nut drivers, soldering iron, and other tools appropriate for troubleshooting system problems.

F. Ladders and Scaffolds - Provide ladders and scaffolds to inspect/adjust loudspeakers and rigging points.

G. Verification of Initial Tests and Adjustments - Verify that Initial Tests and Adjustments have been performed and meet criteria. During Final Tests and Adjustments, the paging Consultant may require portions of the Initial Tests and Adjustments to be repeated. Repeat measurements as requested without claim for additional payment.

H. Installer shall perform thorough preliminary testing of the paging systems prior to the final inspection by the Consultant. All systems and subsystems shall be tested to ensure that they are in proper working order and meet the performance specifications. Perform preliminary programming and setup of digital signal processors as necessary to conduct these tests.

I. The testing and equalization work shall be performed after the installation work has been completed, but prior to any use of the system. During the testing and equalization work, the Installer shall have on the job site one (1) competent technician who is familiar with the project, and who will be prepared to stay as long as his services are needed. It is estimated that approximately eight (8) hours will be required for this work

J. The process of equalizing and testing the system may necessitate moving and adjusting certain loudspeakers. Adjustments shall be performed without claim for additional payment.

K. Coordinate as necessary to ensure a totally quiet room during the sound reinforcement systems testing and balancing period.

L. Prior to requesting systems testing, verify the following:

1. All systems are in first-class working condition and free of short circuits, ground loops, parasitic oscillations, excessive system noise beyond published.
2. All specified equipment, including loose equipment, is on the job site for proper accounting.

3. All loudspeaker circuits have been tested, are connected to the proper crossover frequency, and are in perfect working order. Furnish impedance measurements of each circuit in PDF format prior to final tests.
4. All equipment controls shall be labeled, even if unused. If permanent labels cannot be furnished prior to system inspection, temporarily label every control on the front and in the rear of the racks as to its function with write-on tape. Supply printer labels or markers suitable for permanently indicating knob settings after equalization is performed.
5. Operation manuals for every equipment item furnished are on hand at the job site.
6. Installer shall provide all signal processing software loaded on a portable PC and ready for use at time of testing. Installer shall provide a calibrated RTA and microphone, and pink noise generator at time of testing.

M. Should the performance testing show that the Installer has not properly completed the systems, the Installer shall make all necessary corrections or adjustments and a second demonstration shall be arranged at the Installer's expense.

N. The final acceptance of the system by the Owner will be based upon the report of the Consultant following inspection, testing, and demonstration. A list of items in need of completion or correction shall be generated by the Consultant, which must be corrected by the Installer before final acceptance will be granted.

3.10 SOUND SYSTEM PERFORMANCE

A. After equalization and testing, the sound system shall meet or exceed the following specifications:

1. System shall be free of short circuits, ground loops, parasitic oscillation, excessive system noise, hum, RF interference, and instability of any form.
2. Minimum SPL with band-limited pink noise input to the system in the targeted space shall be 95 dB before audible distortion occurs.
3. Seat-to-seat variation in SPL at 4kHz octave band pink noise shall be within a tolerance of plus or minus 3dB SPL.
4. Acoustic response of the system shall be plus or minus 1.5dB along a line which is flat from 50 Hz to 4000 Hz and which rolls off at 1dB per octave to 16kHz.

B. The following tests and adjustments shall be performed by the Contractor.. Make all necessary corrections to bring systems into specification compliance. Record the results of these tests in project record drawings. Submit written results of tests to Architect and Engineer prior to scheduled equalization and final inspection date.

1. Measure and record impedance of each speaker line at frequency of 1,000 Hz, with loudspeakers connected to their respective lines.
2. Measure and record overall system hum and noise level of each input channel with controls set so that -50 dBm microphone input or +4 dBm input would drive the system to full amplifier output. Terminate inputs with resistor (150 to 600 ohms) and disconnect power to noise generator for this test.

3. Adjust the gain of each active device to provide both optimum signal - to noise ratio, and at least 10 dB headroom at each active device. Observe the output of each active device with an oscilloscope of 5 MHZ bandwidth and verify visually that the signal required for full amplifier output is free of overload, clipping, parasitics, and radio frequency components. Adjust gain structure of all active components and record the input and output signal levels of all active components and record the input and output signal levels of all active components in both dBm and volts, during normal program levels.
4. Measure and record system electrical frequency response for each input channel through power amplifier. Required is flat response with permissible deviation of +/- 1 dB within the range of 30 Hz to 16 kHz.
5. Check system to assure freedom from oscillations or stray RF pickup. Check inputs with no signal and with typical program material driving system to full output Detect unwanted signals on Oscilloscope at termination.
6. Check phasing of loudspeakers by applying constant power per octave (pink) noise to system and walking through the transition areas of coverage from one loudspeaker to the next. Transition should be smooth with no apparent shift in source from one speaker to the next. Apply sine wave sweet signal to each loudspeaker system sweeping from 50 Hz to 5,000 Hz and at a level of 10 Db below full amplifier output, and listen for rattle or objectionable noises Correct if apparent.
7. Achieve uniform distribution of sound from each loudspeaker (with bleachers in their extended position in gymnasium where applicable). Drive system with broadband, constant power per octave (pink) noise, and measure the SPL using a sound level meter incorporating an octave-band filter centered at 4 kHz. Adjust noise level until the meter readings are between 75 and 80 dB. Use a sound level meter filter that meets ANSI S1 4-1971 Type 2 and ANSI S1 11-1971 standards set for slow meter damping. Take all readings at seated ear height. Adjust speaker as necessary to achieve +/-3 dB over entire area covered by this system.

3.11 FINAL ACCEPTANCE BY OWNER

A. Certificate - Submit Certificate of Final Acceptance form signed by Owner verifying complete installation and proper operation of systems upon fulfillment of all requirements and upon recommendation by Owner.

B. General Adjustments - Adjust, balance, and align equipment for optimum quality, meeting manufacturers published specifications.

C. Input/Output Jack Demonstration - Demonstrate proper performance and phase of each system input and output jack (all audio input and output jacks) as received at paging and network systems.

D. Inventory - Inventory all installed and portable equipment for correct quantities.

E. Functional Demonstration - Demonstrate operation of each function of each major piece of equipment.

F. Other Tests - Perform any other tests on any part of the paging system as requested by Owner.

G. Final Equipment Settings - Record final settings of all equalizer bands, tone controls, filters, delays, limiters, etc., including those established through computer software settings. Include descriptions of settings (including software settings) in Operation and Maintenance Manual. Include software copy of configuration file(s) in Operation and Maintenance Manual.

H. Security Inspection - Inspect equipment for security from tampering (covers, shaft-locks, etc.).

I. Review of Labels - Review installed labels on cables, equipment, controls, and terminal strips.

3.12 OWNER TRAINING

A. Provide Owner training as described in General Conditions. As a minimum, provide eight (8) hours instruction (within two (2) trips to site) regarding Paging Systems operation to Owner-designated personnel. Schedule instruction time(s) with Owner to occur after completion of Final Tests and Adjustments. Coordinate with Owner in advance to schedule instruction time. Document date, time, and attendees of the training session and include documentation in Operation and Maintenance Manuals to serve as record of trained personnel.

3.13 SUPPORT DURING OWNER'S FIRST USE OF COMPLETED SYSTEM

A. Provide personnel familiar with design, installation, and operation of each system to be present at Owner's first use of each completed system (up to eight (8) hours total in a single session). During first use of each system, respond to Owner requests for troubleshooting, adjustments, and additional training. If no one contractor employee or representative can provide expertise in all aspects of the system, provide multiple personnel for the eight (8) hours per session as required. Schedule presence of personnel in advance with Owner. Should significant elements of the new system be operational prior to final completion, Owner may elect to schedule contractor presence for Owner function prior to final completion of system. Should Owner exercise this option, contractor presence will not be required at first use following final completion.

3.14 PROJECT CLOSEOUT

A. Refer to section 270000

END OF SECTION 27 51 13