PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Labor, materials, equipment, and services for a complete sound reinforcement system and testing of the assembled sound reinforcement system.

1. The sound reinforcement system includes, but is not limited to, the following:

   a. Mixing console.
   b. Signal processor.
   c. Amplifiers.
   d. Microphones and microphone jacks.
   e. UHF Wireless microphones.
   f. Front of house (FOH) or main speakers.
   g. Ceiling speakers.
   h. Control booth monitor speakers.
   i. Stage floor monitor speakers.
   j. Delay speakers.
   k. 1/8th inch stereo mini input-jack.
   l. Compact disc player (CD)/DVD with MP support.
   m. Hearing assistance system.
   n. Equipment rack.
   o. Power conditioner and light module.
   p. Production intercom system.
   q. Wiring.
   r. Connectors.
   s. Hardware.
   t. Other materials required for the complete operation of the system.

B. Provide and install:

   1. Assembly and setup of the system for normal operation, testing and training of operators and users.
   2. A permanently installed sound reinforcement system and equipment rack including the processing equipment, compact disc/DVD player and amplifiers.
   3. New microphones and microphone jacks.
   4. New cabling for components.
   5. New amplifiers and new speakers.
C. Related Sections:

1. 16112 - Raceways and Conduit.
2. 16160 - Terminal Cabinets.
3. 16131 - Outlet, Pull and Junction Boxes.

D. Applicable Standards and Codes:

1. In addition to all applicable local and state codes, provide the work under provisions of the latest revisions of all applicable standards and specifications of the following:
   a. NAB - National Association of Broadcasters
   b. NRTL - National Recognized Testing Laboratory (OSHA approved)
   c. EIA - Electrical Industries Association
   d. NEC - National Electrical Code

1.2 DEFINITION

A. Installer: Sound reinforcement system subcontractor.

1.3 SYSTEM DESCRIPTION

A. Material and equipment specified have been selected based on acceptable quality and performance and coordinated to function as components of the included systems. Similar equipment (speakers, amplifiers, etc.) described and furnished under these specifications shall be the standard product of the manufacturer.

B. Provide the work complete and the system fully operational as shown and described herein.

C. Electrical conduit, wiring and receptacle boxes for electrical power to sound equipment and conduit and standard electrical boxes, including terminal cabinets, for the sound system and other communications systems shall be installed in accordance to Section 16112.

D. Comply with applicable provisions of Section 01452, “Testing and Inspecting Services”.

1.4 SUBMITTALS

A. Submit 6 copies of the following as part of the submittals:

1. A list describing at least 5 installations comparable in scope and nature as specified. Include the name, current position, address, and telephone number of a representative of each installation owner.
2. Proof that the firm has been regularly engaged in the business of designing, installing, and servicing systems and equipment as specified, for at least the past 5 consecutive years.
3. Provide a listing of test equipment including a list showing procedures and service contacts.
4. A complete list of quantities, including materials, components, devices, and equipment required for the Work. Tabulate the list of quantities for the components of each system as specified, and provide the following information for each item listed:
a. Quantity.
b. Description.
c. Manufacturer's name and model number.
d. Corresponding specification section and article number.

5. Complete, comprehensive, single-line diagrams in computer aided drafting (CAD) format including equipment, devices, connectors, wiring, and wire numbering completely identified. Include label designations and locations.

6. Complete, scaled (1" = 1'-0" minimum) in CAD format, equipment rack elevation drawings, including equipment designation, manufacturer's name, model number, rack location, and rack designation.

7. Complete catalog cut sheets and manufacturer's literature.

B. Closeout Documents:

1. Prior to substantial completion submit the following documents to M-DCPS:

   a. Test reports as specified herein.
   b. Written warranties certifications.
   c. Operation and Maintenance manuals or all equipment installed under this section.
   d. Copy of FCC license for Hearing Assistance System FM transmitters.
   e. Copy of certificate of cables complying with fire retardant requirements.
   f. Submit 5 sets of as-built drawings to M-DCPS.

1.5 QUALITY ASSURANCE

A. Manufacturers' Qualifications:

1. Firms regularly engaged in the manufacture of sound reinforcement equipment.
2. Manufacturer's products shall have been satisfactorily used in similar service for a minimum of 3 years.
3. The manufacturers shall franchise Installers for the supply, design, installation, and maintenance of the products.
4. Designs and markets professional sound equipment for use in amplification, reproduction and recording of sounds.

B. Installer Qualifications:

1. The work of this section will be contracted to a single firm, referred to as the installer, for undivided responsibility.
2. A firm with a minimum of 5 years successful installation experience similar in scope with this project.
3. Maintain a fully staffed and equipped maintenance and repair facility.
4. Installer shall be primarily engaged in the supply, design, installation, and maintenance of commercial duty sound systems and franchised by the manufacturers of the major equipment items for the supply of these systems and not be an electrical subcontractor.
5. Installer shall be licensed as required by the county or state to do the work contemplated.
6. Installer shall hold factory computer control system certification.
7. Installer support services shall include:
   a. Service and maintenance manuals.
   b. Schematic information and parts list.
   c. Maintenance of a factory stock of replacement parts.
   d. Factory repair service.

8. The sound equipment installer shall have capabilities and in-house facilities for the installation, shop fabrication, and repair service of professional sound systems.

C. Code Compliance: Comply with national, state, and local electrical and structural codes as applicable to installation and construction of the sound reinforcement system.

D. Provide equipment listed and labeled by an OSHA approved Nationally Recognized Testing Laboratory (NRTL).

E. Sound Pressure Level (SPL): Provide a range of 80 to 90 dB SPL for the listeners in any location in the room where system is installed. Comply with ANSI S13-1971 (R1986).

F. All wiring shall be in raceways and conduits.

G. All equipment AC power shall have lightning surge protection.

1.6 WARRANTY

A. System shall be warranted in writing for:
   1. 1 year after date of Substantial Completion against defects in labor.
   2. 3 years after date of Substantial Completion against defects in materials.

B. The manufacturer or installer shall repair or replace malfunctioning products at no expense to M-DCPS, except for failures caused by damage or unreasonable use.

C. Installer shall maintain regular service facilities and provide a qualified technician familiar with the work at the site within 24 hours of receipt of a notice of malfunction, excluding weekends and holidays.
   1. Provide material, devices, equipment, and personnel necessary for repairs.
   2. Provide accepted temporary, alternate equipment, if required by M-DCPS, complete and operational within 48 hours after notification of malfunction, at no additional cost during the first year of warranty.

D. Installer shall conduct warranty repairs and service at the project site unless prohibited by manufacturer's warranty. If the latter, Installer shall provide substitute systems, equipment, and devices acceptable to M-DCPS for the duration of the off-site repairs. Replace items out of service more than 10 days with new equipment during the warranty period.

E. Installer shall transport warranty equipment, substitute systems, test systems, equipment, devices, materials, parts, and personnel to and from the project site at no additional cost to M-DCPS.
1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle equipment components carefully to prevent breakage, denting, and damage to equipment finish.

B. Do not install damaged equipment. Replace and return damaged units to equipment manufacturer.

C. Store equipment in a clean, dry space, in original cartons and protect from dirt, physical damage, weather, and construction traffic. Protect electronic components from dust debris and water.

1.8 SEQUENCING

A. Furnish a listing of test equipment to be used for this project. Include make, model number, serial number, and the date of last equipment calibration. Test equipment shall be calibrated within the past 24 months of contract award.

1.9 MAINTENANCE

A. Manual: Prepare and submit, before acceptance testing, copies of an operational and maintenance manual, neatly bound. Provide 4 hard copies and electronic copy, for M-DCPS use. Manual shall include:

1. Basic power on/off and operational procedures.
2. Manufacturer's service literature for each major system component.
3. A system block diagram with input/output terminations identified including wiring diagrams.
4. A copy of the verification test report.

PART 2 PRODUCTS

******************************************************************************
** SPECIFIER: Verify project school classification and select the listed components and quantities from the list noted below. **
******************************************************************************

2.1 TYPE AND QUANTITY OF SOUND EQUIPMENT

A. Cafeterias for Elementary Schools, Cafeterias for Middle Learning Centers (MLC), and Middle School Language Arts Labs:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixing Console Channel Inputs</td>
<td>16</td>
</tr>
<tr>
<td>Amplifier - 300 Watts per channel</td>
<td>2</td>
</tr>
<tr>
<td>Microphones</td>
<td>4</td>
</tr>
<tr>
<td>Microphone Stands</td>
<td>4</td>
</tr>
<tr>
<td>Microphone Cables (25 feet long)</td>
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<tr>
<td>Microphone Cables (50 feet long)</td>
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<tr>
<td>Overhead Microphones</td>
<td>4</td>
</tr>
<tr>
<td>UHF Wireless Body Microphones</td>
<td>4</td>
</tr>
</tbody>
</table>
9. UHF Wireless Hand Microphones 2
10. Production Intercom:
   a. Speaker Stations 3
   b. Wall Mount Receptacle 4
   c. Dual-Channel Belt-Pack 4
   d. Single Muff Headset with Microphone 4

B. Cafeteriories for K-8 Centers and Middle Schools:

<table>
<thead>
<tr>
<th>Equipment</th>
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</thead>
<tbody>
<tr>
<td>1. Mixing Console Channel Inputs</td>
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<tr>
<td>2. Amplier - 300 Watts per channel</td>
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<tr>
<td>3. Amplier - 600 Watts per channel</td>
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<tr>
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</tr>
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<tr>
<td>b. Wall Mount Receptacle</td>
<td>5</td>
</tr>
<tr>
<td>c. Dual-Channel Belt-Pack</td>
<td>5</td>
</tr>
<tr>
<td>d. Single Muff Headset with Microphone</td>
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</table>

C. Senior High School Language Arts Lab.

<table>
<thead>
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<td>c. Dual-Channel Belt-Pack</td>
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<tr>
<td>d. Single Muff Headset with Microphone</td>
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D. Senior High School Cafeterium:

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<tr>
<td>d. Single Muff Headset with Microphones</td>
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</table>

E. Senior High School Auditorium.

<table>
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</tr>
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<td>d. Single Muff Headset with Microphone</td>
<td>8</td>
</tr>
</tbody>
</table>

2.2 COMPONENTS

A. Mixing Console:

1. Provide a professional multichannel input mixing console.
2. The output section shall include a total of 10 buses: 4 group, 4 auxiliary, and the main stereo.

   a. The level of each group output shall be controlled by a master group fader, and the signal output shall be via balanced XLR type connections.
   b. Each group output shall be capable of being monitored using the cue facility, and an on/off switch shall allow group muting.
c. Each input channel shall include gain control and a 20db attenuator pad, switchable 48v phantom power, a 4-band EQ with sweepable high-mid and low-mid frequencies, 4 aux sends and 4 group buses.
d. The inputs shall be XLR type connectors for the microphone input and a standard jack socket for the line input on each channel. Frequency response shall be +1, -3dB, 20Hz to 20kHz for any input to any output.

3. Total harmonic distortion shall be less than 0.1 percent (20Hz-20kHz) from line input to group or mix output.
4. Manufacturers:
   a. Yamaha LS-9 or DM1000VCM.
   b. Accepted equivalent by Soundcraft.
   c. Accepted equivalent by Mackie.

B. Signal Processor:
   1. Provide a multi-channel analog matrix mixer with drag and drop processing blocks as follows:
      a. At Cafeteriums for Elementary Schools, Cafeteriums for Middle Learning Centers (MLC) and Middle School Language Arts Labs: 4 inputs channels and at least 4 output channels.
      b. At Cafeteriums for K-8 Centers and Middle Schools: 4 input channels and at least 6 output channels.
      c. At Senior High Schools Cafeteriums, Senior High School Language Arts Lab and Senior High School Auditorium: 4 input channels and at least 8 output channels.
   2. Processor blocks shall include equalization, automatic feedback reduction, compression/limiting, crossovers, and digital delay.
   3. Configure inputs for main front of house (FOH), stage monitor channels, and booth monitor feeds as a minimum and as applicable.
   4. Configure inputs for main front of house (FOH), stage monitor channels, booth monitor feeds, delay speaker feeds, backstage, and lobby/public area feeds, etc, as a minimum and as applicable.
   5. Manufacturers:
      a. Shure SCM820.
      b. Accepted equivalent by Crown, Yamaha, and Rane.

C. Compressor/Limiter:
   1. Provide 2 channels (minimum) of solid state design capable of detecting input levels above the threshold control setting and automatically reducing the gain of the signal level according to the compression ratio control setting.
   2. Include input and output level switching, and variable controls for compression ration and threshold.
   3. Provide 1 channel for front of house (FOH) speakers, and 1 channel for each stage floor monitor speaker and each control booth monitor speaker feed.
   4. To prevent unauthorized tampering, limiter shall be laptop control with no control knobs.
5. Manufacturers:
   a. Peavy CEL-2a
   b. DBX 166A
   c. Yamaha GC2020C.

SPECIFIER: Power amplifier wattage requirement is related to cafetorium/auditorium size. Determine appropriate wattage requirement to suit project conditions.

D. Power Amplifier:

1. Provide dual channel power amplifiers, for ceiling, FOH, delay, control booth and stage speakers with the following characteristics:
   a. Solid state design employing true complementary symmetry output circuitry.
   b. Contain sensing circuitry to provide protection against over-temperature, shorted output terminals, and radio frequency interference.
   c. The load shall be similarly protected against subsonic signals, startup/shutdown transients, and DC faults.
   d. Rear Panel shall include a 2-position switch for selecting between the dual (stereo) channel mode or the bridged-mono modes of operation.
   e. Individual channel rotary input level controls on the rear panel.
   f. Front Panel Controls shall include a power on/off rocker switch.
   g. Power Amplifier shall meet or exceed the following performance criteria:

      1) Input sensitivity for rated output: 0.784 volts (unbalanced).
      2) Rated FTC output in dual mode with less than 0.1 percent THD: 300 watts per channel (20 Hz to 20 kHz) into 8 ohms.
      3) Rated FTC output in dual mode with less than 0.1 percent THD: 600 watts per channel (20 Hz to 20 kHz) into 8 ohms.
      4) 70 volt output directly drives distributed loudspeaker systems without the need for outboard transformers.
      5) Soft-start circuit and 4 second pseudo-random turn-on delay.
      6) The amplifier shall fit in a standard 19 inch rack.
      7) Convection cooling with proportional, variable speed force air cooling that works only when needed and in proportion to amplifier cooling requirements.

2. Products/Manufacturers:
   a. 300 Watts per channel Amplifiers: Crown Audio CTS-600, or Yamaha or JBL accepted equivalent.
   b. 600 Watts per channel Amplifiers: Crown Audio CTS-1200, or Yamaha or JBL accepted equivalent.

E. Microphones:
a. Shure SM58S.
b. Electro-Voice ND367s with on/off switch.
c. AKG Acoustic D7 with on/off switch.

F. Microphone Stands:

1. Manufacturers:
   a. Ultimate MC-05B.
   b. Atlas/Sound MS-12C.
   c. ProLine MS235BK.

G. Microphone Cables.

1. Manufacturers:
   a. Whirlwind MK4-25 and MK4-50.
   b. Rapcon Horizon SBM4-25 and SBM4-50.
   c. Accepted equivalent by ProCo Sound.

H. Overhead Microphones:

1. Manufacturers:
   b. Shure MX202BP/C.
   c. ElectroVoice RE92H.

I. UHF Wireless Microphones:

1. Include remote antenna kits, antenna distribution units (1 for every 4 receivers).
2. Coordinate frequencies for proper operation at particular school location.
3. Provide and install microphone receptacles as shown on drawings.
4. Provide diversity wireless lavaliere microphone/body-pack system.

   a. Manufacturers:
      1) Trantec series by TOA, Electronics.
      2) BLX series by Shure
      3) RE-2 series by Electro-Voice.

5. Provide diversity wireless handheld microphone system.

   a. Manufacturers:
      1) Transec series by TOA, Electronics.
      2) BLX series by Shure.
      3) RE-2 series by Electro-Voice.
SPECIFIER: Determine quantity of Front of House (FOH) Main Speakers, Delay Speakers and Ceiling Speakers to meet the specific school classification and project requirements.

J. Speakers:

1. Front of House (FOH) or Main Speakers:
   a. Quantity according to plans.
   b. Description:
      1) Type: 2-way, vented enclosure.
      2) Frequency response +3dB: 45Hz to 16.5 kHz.
      3) Pressure sensitivity (2.83v): 96 dB @ 1m.
      4) Coverage (conically): 60 degrees.
      5) Crossover frequency: 1.5kHz.
      6) Power capacity:
         a) Noise: 200 watts.
         b) Program: 400 watts.
         c) Maximum: 800 watts.

    7) Maximum passive SPL: 117 dB @ 1m.
    8) Maximum bi-amplified SPL: 120 dB @ 1m.
    9) LF transducer: 15 inch.
   10) Compression driver: 2 inch.
   11) Nominal impedance: 8 ohms.

2. Stage Floor Monitor Speakers:
   a. Quantities:
      1) Elementary School Cafeteriums, Middle Learning Center (MLC) Cafeteriums and Middle School Language Arts Labs: 2.
      2) Cafeteriums for K-8 Centers, Middle School and Senior High School: 4.
      3) Senior High School Language Arts Lab: 4
      4) Senior High School Auditoriums: 6.
   b. Description:
      1) Type: 2-way, vented enclosure.
      2) Frequency response +3dB: 65Hz to 16.5 kHz.
      3) Pressure sensitivity (2.83v): 96 dB @ 1m.
      4) Coverage (conical): 75 degrees.
      5) Crossover frequency: 1.5 kHz.
      6) Power capacity:
         a) Noise: 200 watts.
         b) Program: 400 watts.
3. Delay Speakers:

a. Quantity according to plans.

b. Description:

1) Type: 2-way, vented enclosure.
2) Frequency response +3dB: 70Hz to 16.5 kHz.
3) Pressure sensitivity (2.83v): 93 dB @ 1m.
4) Coverage (conical): 105 degrees.
5) Crossover frequency: 2.2 kHz.
6) Power capacity:
   a) Noise: 100 watts.
   b) Program: 200 watts.
   c) Maximum: 400 watts.

7) Maximum passive SPL: 110 dB @ 1m.
8) Maximum bi-amplified SPL: 113 dB @ 1m.
9) LF transducer: 6.5 inch x 2.
10) Compression driver: 2 inch.
11) Nominal impedance: 4 ohms.

4. Control Booth Monitor Speakers:

a. Quantity: 2 required in cafeterias and auditoriums with control booth.

b. Description:

1) Type: 2-way, ported enclosure.
2) Frequency response -10db: 80Hz to 16 kHz.
3) Pressure sensitivity (2.83v): 88 dB @ 1m.
4) Coverage: 90 degrees x 90 degrees.
5) Crossover frequency: 3.0 kHz.
6) Power capacity: 150 watts.
7) LF transducer: 5.25".
8) Horn loaded tweeter: 0.75".
9) Nominal impedance: 8 ohms.
10) Mounting: Built-in, wall, rotatable.

5. Ceiling Speakers:

a. Quantity as shown on drawings.

b. Description:
1) Size:
   a) LF: 8 inch.
   b) HF: 3 inch.

2) Type: Coaxial.
4) Response: 60Hz to 20kHz.
5) Magnet weight (oz.):
   a) LF: 18.
   b) HF: 2.35.

6) Crossover frequency: 3.8kHz
7) Impedance: 8 ohms.
8) Sensitivity (2.83v): 97dB @ 1m.

6. Speaker Manufacturers:
   a. Yamaha.
   b. JBL.
   c. Electrovoice.
   e. Atlas Sound (ceiling speakers).

K. Compact Disc Player:
1. Front loading, universal disc player with DLNA 1.5 support and front USB port.
2. Provide one DC servo drive motor for the main spindle, one DC motor for laser head movement, and one DC motor operating the loading tray.
3. The transport with fully logic control with functions activated by momentary contact push buttons.
4. Single track skip in forward and reverse directions, and cue and review capabilities.
5. Each of the above functions shall have a dedicated momentary contact control.
6. The player capable of varying sample rates that affect a 12 percent shift in pitch.
7. Manufacturers:
   a. Denon DBT-1713UD.
   b. Yamaha BD-A1020.
   c. Onkyo BD-SP809.

L. Hearing Assistance System:
1. Provide a transmitter capable of transmitting on any of 40 approved 50 kHz band frequencies within the 72 to 76 MHZ band.
2. Transmission shall be directly to the user-worn FM receiver.
3. Provide single channel receivers powered by 2 AA batteries.
4. The system shall be capable of receiving an FM transmitted signal of any of 40 different narrow band frequencies within the 72 to 76 MHZ band.
5. Provide 1 FM transmitter, 3 receivers with earbuds and rechargeable batteries, 2 transformer/wall chargers, and antenna.
6. Manufacturers:
   b. Accepted equivalent by Listen Technology.
   c. Accepted equivalent by Williams Sound.

M. Amplifier Equipment Rack:

1. Provide a minimum of 1 amplifier equipment rack.
2. Cabinet Body: Minimum of 16 gage steel.
3. Dimensions: 81.25" high x 22.3" wide x 25.5" deep.
5. UL listed.
6. Key locking front and rear doors.
7. Manufacturers:
   b. Accepted equivalent by Middle Atlantic.
   c. Accepted equivalent by Winsted.

N. Power Conditioner and Light Module:

1. Mount in a standard 19 inch rack, and to occupy not more than 1 rack unit of space.
2. Provide rack illumination by means of a 2 point light source, of at least 7 watts each.
3. Provide a dimmer knob to adjust brightness, and provide a separate on/off switch for the lights.
4. The lighting assembly shall be sturdy and slide smoothly out of the way when not in use.
5. Provide a bar graph AC voltmeter on the front panel to read line voltage.
6. Provide a minimum of 8 outlets supplying conditioned power on the rear panel, with an illuminated front panel master switch.
7. Clamp spikes to not more than 250 V peak (line to neutral or neutral to ground) or 500 V peak (line to ground). Response time shall not exceed 1 nanosecond. The unit shall absorb a surge current of up to 5000 amperes for 10 micro-seconds without damage.
8. Provide a 20 ampere circuit breaker and with the AC cord at least 14 AWG and 10 feet long.
9. Manufacturers:
   a. ETA System.
   b. Furman Sound.
   c. Oneac Powervar Solutions.

O. Production Intercom:

1. Provide a high quality, dual channel production intercom system for production personnel. System shall include at a minimum:
   a. One master station, rack-mount with monitor speaker.
   b. One 2-channel power supply.
2. Manufacturers:
b. Production Intercom.
c. Telex.

P. Cable:
   1. Install speaker circuits in conduit.
   3. Manufacturers:
      a. Speaker Circuits: West Penn 226 or Belden 8473. When conduit run is installed underground use West Penn AQC 226 or Belden equivalent.
      b. Microphone, Line Level, and Production Intercom Circuits: West Penn 293 or Belden 8760. When conduit run is installed underground use West Penn AQC 293 or Belden equivalent.

2.3 ACCESSORIES

A. Materials shall be new and of the manufacturer's latest design, and permanently labeled with the manufacturer's name, model number, and serial number. Active circuitry shall be solid state and rated for continuous duty use. Similar devices shall be of the same manufacturer.

B. Electronic equipment shall be of the dead-front type and designed for 19 inch rack mounting unless otherwise noted. Access to terminals and components shall not require side access. Equipment shall be rated for continuous use and continuous duty.

C. Do not provide engraving, labels, decals, or other identification on any device, equipment, or miscellaneous component without prior approval from the A/E.

D. Provide intelligible, permanent, professionally engraved identification on or next to controls, fuses, circuit breakers, patching jacks, connectors, receptacles, terminal blocks, meters, indicators, switches, monitors, etc. The identification shall be directly engraved on Contractor-fabricated equipment and devices, clearly indicating the function of the item and numbered or lettered to correspond with the function, circuit and locations, consistent with the Field and Shop Drawings.

E. Identification of fuses and circuit breakers on contractor fabricated equipment shall indicate:
   1. Protected circuitry.
   2. Rating of protective device.
   3. Voltage across open circuited protected device.

F. Design devices connected to the protected electrical system and auxiliary equipment necessary for the operation of the equipment associated with systems specified to operate from 105 to 130 volt, 60 Hertz, alternating current service, and with stable performance. Provide integral fuse or circuit breaker protection.
   1. Provide Contractor fabricated items with fuses of the clear glass cartridge type and mounted in fuse holders that indicate when a fuse is blown or defective.
2. Locate protection devices to ease replacement, resetting, or observation of status without demounting the associated unit or de-energizing adjacent equipment.

G. Circuit components shall be operated according to recommendations of the component manufacturer and contain sufficient permanent identification to ease replacement.

H. Each principal element of each system shall be completely wired internally with consistently identified terminal strips provided for external connections. Indicate these designations on drawings where such connections are referenced and drawn.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not proceed with the work of this section until conditions detrimental to the proper and timely completion of the work have been corrected in an acceptable manner.

3.2 INSTALLATION

A. Verify exact locations of equipment with M-DCPS and A/E before installation and modifications to existing appurtenances and other trades necessary to provide a complete and operational system. Immediately notify M-DCPS and A/E of any discrepancies.

B. Coordinate work and service with the Contractor, electrical subcontractor, and M-DCPS scheduled use of facilities.

C. Coordinate final connection of power and ground wiring to equipment with electrical subcontractor. Power and ground wiring shall terminate inside sound rack and provide for interconnection to the building's electrical system.

D. Equipment and enclosures shall be plumb and square. Permanently attach equipment, except portable equipment, firmly in place to the structure. Supports shall be adequate to support their loads at a safety factor of at least three.

E. Prevent and guard against electromagnetic and electrostatic hum.

F. Make connections with accepted connectors and terminal blocks equal to Cinch Series 140 or 142, or Cooper Bussmann 504 series as required. If a device has screw terminal connections in addition to other types of receptacles, terminate cables to screw terminals using accepted spade lug type terminals. Tin all conductors at screw terminals of low level equipment.

G. According to IEC-268 standard, XLR connectors at equipment shall be wired pin 2 hot (high), pin 3 low, pin 1 shield. Drop shields at the outputs and connect at the respective equipment inputs to maintain ground integrity. Connections and signal hookup to low and medium level equipment shall be done in a balanced configuration. Unbalanced wiring without interfaces to balance signal with respect to ground is not allowed.

H. Provide visible termination resistors and not concealed within connector housings or inside devices being terminated.
I. Provide polarity at loudspeaker connections and use the same wire color code for speaker wiring throughout the project. Make joints and connections with rosin-core solder or with mechanical connectors or with terminal strips accepted by M-DCPS.

J. Pre-wire racks before delivery to project site. Wiring shall be according to standard broadcast practices.

K. Avoid damage to cables and to equipment. Isolate cables carrying signals at different levels and separate to restrict channel bleed through and feedback oscillation in any amplifier section. Keep the following wiring separated in groups of conduit:

1. Microphone level circuits (level below -20dbm).
2. Line level circuits (up to +30dbm).
3. Loudspeaker circuits (above +30dbm).
4. Power circuits.

L. Use insulating "spaghetti" and heat shrink tubing at each connection throughout system with an exposed drain wire or any other exposed shield. Use insulating collars consisting of heat shrink on rack terminations. Positively bond multiple racks together. Bond the racks to the isolated ground buss as applicable.

M. Insulate audio wiring and equipment racks from the building conduit system where applicable.

N. Grounding shall comply with isolated ground conventions described in:

2. Audio Cyclopedia by Howard Tremaine.

O. Mount XLR connectors to their plates using Phillips oval-head screws having a matching finish to the custom panel.

P. Mount equipment to racks using black Phillips screws and black anti-scruff washers.

Q. Engrave provided panels and paint fill.

R. Conceal wiring unless absolutely impossible within the public spaces. Perform installation of wire, conduit, junction boxes, or other fittings in a professional manner consistent with these specifications and M-DCPS’s requirements.

3.3 FIELD QUALITY CONTROL

A. Conduct preliminary checks and testing before performance testing and after completion of related or adjacent work of other trades. Verify safe and proper operation of components, devices or equipment, nominal signal levels within the systems, and the absence of extraneous or degrading signals.

B. Perform the following verification and testing procedures:

1. Provide proper grounding of devices and equipment per manufacturer's recommendation.
2. Integrity of insulation, shield terminations, and connections.
3. Proper provisions of power to devices and equipment.
4. Integrity of soldered connections.
5. Absence of solder splatter, solder bridges, debris of any kind, tools, etc.
6. Proper routing and dressing of wire and cable.
7. "Wire checking" of circuitry, including phase and continuity, concerning cable designations on run sheets, field and shop drawings.
8. Determine the proper sequence of energizing systems to minimize the risk of damage.
9. Measure and record impedance of loudspeaker lines terminating at equipment racks at 1000 Hz, with loudspeakers connected to their respective lines at "full on".
10. Measure and record overall system hum and noise level of each input channel with controls set so that -50dbm microphone input or +4dbm input would drive the system to full amplifier output. Terminate inputs with resistors (150 or 600 ohms) for this test.
11. Measure and record electrical frequency response for each input channel through the power amplifier. Required is flat response with permissible deviation of + 2db within the range of 60Hz to 15Khz.
12. Check polarity of loudspeakers by applying music program or constant power per octave (pink) noise to the system and walking through the transition areas of coverage from one loudspeaker to the next.
   a. Transition shall be smooth with no apparent shift in source from one speaker to the next. This test will be performed by M-DCPS at final inspection.
   b. Apply sine wave signal sweeping from 60Hz to 5000Hz and at a level of 10db below full output, and listen for rattles or objectionable noises. Correct if apparent.
13. Drive system with broadband, constant power per octave (pink) noise, and measure the SPL at the 4Khz octave band.
   a. Adjust noise level until the meter readings are between 80 and 90db.
   b. Take readings at seated ear height.
   c. Perform listening tests and readjust system for a pleasing overall sound.
   d. Use parametric equalizer and "ring out" system to eliminate the major portions of feedback from foldback speakers.
   e. Demonstrate to M-DCPS operator the adjustment of speakers as necessary to achieve minimum deviation over entire area covered by this system.
14. Check system to assure freedom from oscillations or stray RF pickup.
   a. Check inputs with no signal and 100Hz sine wave signal driving system to full output.
   b. Detect unwanted signals on oscilloscope at rack termination and at loudspeaker connected at farthest distance from rack for each loudspeaker line.
15. After successfully energizing the systems, make preliminary adjustments and document the setting of controls, parameters of corrective networks, voltages at key system interconnection points, and gains and losses, as applicable.
   a. Tabulate data along with an inventory of test equipment, a description of testing conditions, and a list of test personnel as itemized below.
b. Copies of preliminary test data shall accompany copies of performance testing data as part of the final submittal.

16. Verify the performance parameters of the individual system following established professional procedures, in addition to those specified.

17. Document acceptance testing, calibration, and correction procedures as specified with the following information:
   a. Performance date of the given procedure.
   c. Type of procedure and description.
   d. Parameters measured and their values, including values measured before calibration or correction, if applicable.
   e. Parameters associated with calibration or corrective networks, components, or devices.
   f. The names of personnel conducting the procedure.
   g. The equipment used to conduct the procedure.
   h. Provide permanent labels on controls, as applicable, to indicate correct setting after performance testing and adjustment procedures have been successfully completed.
   i. Provide documented voltage settings, hum and noise measurements, final elevations, and angle information for racks and loudspeakers as applicable.

18. Equalize system to provide full range operation and for commission foldback speakers. The final system response shall be set flat from 100Hz to 2kHz, +2dB, and then rolling off 3dB per octave to 10kHz. Average SPL response shall be 80 to 90 dB, "A" weighted and loss of consonants shall be less than 12 percent.

19. Check system to be free from rattles, buzzes, and objectionable distortion. Correct objectionable distortions and retest.

20. Provide operator support at first 2 uses of system after work is completed and accepted per this specification. Support limited to 8 hours of time on site. Provide emergency contact procedures in case of system trouble.

C. Upon completion of the Work and compliance with requirements, A/E representative will verify test data as part of the acceptance procedure. Provide personnel and equipment, at M-DCPS Representative convenience, to demonstrate any aspect or parameter of performance and to assist with such tests.

D. Failure of any component or system to meet specifications shall require immediate remedial action. In the event that material, device, equipment, system, or manual skill are found unacceptable as late as 15 days before the substantial completion date, Installer shall provide the temporary installation of operational components or systems satisfactory to M-DCPS until acceptance of the Work.

3.4 CLOSEOUT

A. Perform remedial work to correct inadequate or unacceptable conditions of, or relating to any portion of the Work, as determined by M-DCPS or A/E, at no expense to M-DCPS.

B. Furnish equipment to M-DCPS along with complete manuals and connection drawings of the materials presented. Equipment shall be in the original manufacturer's packing, complete with included instructions and miscellaneous manual and documents.
C. Present, review, and clarify materials to M-DCPS representative and operating personnel and fully demonstrate the operation and maintenance of the systems, equipment, and devices as specified.

D. Check, inspect, and if necessary adjust systems, equipment, devices, and components specified, at M-DCPS convenience, approximately 60 days after Substantial Completion of this work.

E. Further adjustments or if additional work becomes evident during acceptance of the system, the Installer will continue his Work until system is acceptable at no additional cost to M-DCPS. If approval is delayed because of defective equipment, failure of equipment, or installation to meet the requirements of these specifications, the Contractor shall pay M-DCPS expenses for additional time during any extension of the testing and acceptance period.

3.5 DEMONSTRATION AND TRAINING

A. Provide minimum of 4 hours of training to M-DCPS facility’s personnel on how to set-up, operate, and test system for proper function. M-DCPS Personnel receiving the instructional training will be designated by M-DCPS.

B. Provide training and instruction shall be conducted in the presence of the A/E and M-DCPS Project Manager.

C. During the training give the participants opportunities for “hands-on” experience with operating the controls. Provide visual and audible demonstrations using the systems themselves as aids.

END OF SECTION