

GAI-Tronics Corporation

Industrial Communication System (ICS)

Publication 101201:
ICS SmartSeries Intelligent Intra-Plant
Communication and Emergency
Notification System

Guide Specification for NEC Standards

1.	General.....	3
a.	Scope of Work.....	3
b.	Work Included.....	3
c.	Seller Warranties.....	3
d.	Workmanship.....	3
e.	Material and Construction.....	3
f.	Work Not Covered.....	3
g.	References.....	3
h.	Documentation.....	4
i.	Quality Assurance.....	4
2.	Overview and system architecture:.....	4
3.	System features:.....	5
a.	Without head-end central control cabinet:.....	5
b.	With head-end central control cabinet:.....	5
4.	Environmental and Approval requirements:.....	6
a.	Indoor safe-area locations.....	6
b.	Indoor UL Division 2 locations.....	6
c.	Outdoor (weatherproof) UL Division 2 locations.....	6
d.	Hazardous-area UL Division 1 locations.....	6
5.	Power requirements.....	7
6.	Head-end Central Control Unit.....	7
a.	General.....	7
b.	Enclosure.....	7
c.	Card Rack Assembly.....	7
d.	Master Control Unit.....	7
e.	Voice/Tone Generator/Telephone Interface.....	8
f.	External Audio Interface Card.....	8
g.	Dual Distributed Amplifier Zone Interface Card.....	8
h.	Central Amplifier Zone Interface Card.....	9
i.	Access Panel Interface Card.....	9
j.	Monitored Input Module.....	9
k.	Monitored Relay Module.....	10
l.	Audio Distribution/Monitoring Module.....	10
m.	Access panels.....	10
7.	Field Stations:.....	11
a.	Intelligent distributed paging/alarm amplifier stations.....	11
b.	Intelligent distributed intercom/paging/alarm amplifier stations.....	12
c.	Intelligent distributed remote intercom/paging/alarm amplifier stations with subset.....	13
8.	Field Station Options:.....	14
a.	Auxiliary Jack.....	14
b.	Remote Terminal Unit.....	14
c.	Alternate Page.....	15
d.	Incident Reporting (Emergency Party Line).....	15
e.	70/100V Speaker Output.....	15
9.	Ancillary devices and cable:.....	15
a.	Voice/tone generator/telephone interface.....	15
b.	Line balance.....	16
c.	Headset and extension cable.....	17
d.	Terminal boxes.....	17
e.	Speakers and horns.....	18
f.	Cable.....	19

1. General

a. Scope of Work

Furnish all labor, materials, equipment, and services necessary and required for a complete and operating intelligent (addressable and supervised) communication [and emergency notification] system. Any material not specifically mentioned in this specification or shown on the applicable drawings, but required for proper performance and operation shall be provided.

b. Work Included

Intelligent paging, intercom and alarm system, including controls (central and remote), software, handset stations, amplifiers, loudspeakers and horns, wiring and all specified and/or required accessories.

c. Seller Warranties

The Seller warrants the satisfactory and successful operation of all equipment furnished under this specification at the ratings, under the conditions, and for the type of service specified herein. Goods manufactured by the seller are warranted to be free from defects in material and workmanship until one year after the date of shipment.

d. Workmanship

All work shall be performed in accordance with the best practice in design, manufacture, and fabrication of all material and apparatus by this specification, notwithstanding any omission from the specifications or drawings.

e. Material and Construction

All materials used in the construction of the apparatus shall be new and selected as the best available for the intended purpose, considering long life and best engineering practices. Factors of safety shall be used throughout the design. Only heavy-duty industrial components rated to operate within the temperature ranges and other environmental conditions specified in section 4.

f. Work Not Covered

- i. Fire alarm system, including control panel and alarm initiating devices (detectors, pull stations, flow switches, etc.)
- ii. Fire alarm system visual indicating devices (strobes).

g. References

- i. National Fire Protection Association (NFPA)
 - NFPA 70 National Electric Code
- ii. Occupational Safety And Health Act (OSHA)
- iii. Underwriters Laboratory (UL)
 - UL 464 Audible Signal Appliances
 - UL 1604 Electrical Equipment For Use In Class I and II, Division 2 and Class III Hazardous Locations

- UL 1638 Visual Signaling Appliances
- iv. Institute of Electrical and Electronics Engineers (IEEE)
 - IEEE 323-2003 Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations
- v. Safety Of Life At Sea (SOLAS)
- vi. American Bureau of Shipping (ABS)
- vii. American Petroleum Institute (API)

h. Documentation

After award of contract, and at the buyer's request, the seller shall furnish two sets of the following:

- Installation, Operation and Maintenance literature complete with mounting details and dimensions, installation and connection instructions, operating and maintenance instructions, a list of replacement parts and equipment specifications.
- Outline and connection drawings.

i. Quality Assurance

- i. All work shall be performed in accordance with this specification, applicable drawings and the best practices in design, manufacture and fabrication.
- ii. The system equipment manufacturer shall be ISO 9001 registered for the design, manufacture, contract installation management and service of industrial intelligent communication [and emergency notification] systems. The system manufacturer shall have at least 10 years documented experience in the manufacture of similar systems currently demonstrating proven satisfactory service.
- iii. The system installer shall be a company having the approval of the manufacturer and having at least 5 years documented experience in the installation of similar systems currently demonstrating satisfactory service.

2. Overview and system architecture:

The paging, intercom and alarm system shall consist of intelligent paging amplifier stations, intercom stations and ancillary devices located throughout the facility. All paging amplifier stations and intercom stations shall be arranged in a distributed topography, such that loss of a single device will not adversely affect the system as a whole.

The system shall provide four main functions:

- i. Page – the ability to make announcements for public address and emergency notification to personnel throughout the facility. When a head-end central control cabinet is used the system shall have the ability to be divided into separate paging zones to minimize page traffic.
- ii. Party – the ability to communicate in a full-duplex manner on an intercom “party” line. All party lines shall be non-private to allow instant conference calls of at least five users. Party lines shall be immediately accessed by means of a selector switch. No keypad call-in shall be required.

- iii. Alarm – the ability to broadcast emergency and process alarms to personnel throughout the facility. There shall be at least 99 available alarm messages, each comprising of tones and/or pre-recorded speech messages. Alarm tones shall be recognized by both the Nuclear Regulatory Commission (NRC) and United States Coast Guard (USCG). A priority scheme shall be included to ensure that more important alarms override less important alarms. When a head-end central control cabinet is used the system shall have the ability to be divided into separate alarm zones. Use of a head-end central control cabinet shall also add an “Incident Control” function such that selected field stations shall have the ability to override alarms in progress.
- iv. Input / Output (I/O) – the ability to accept contact closure inputs and provide relay outputs between other systems, such as alarm detection, process control and other communication systems. I/O shall be used for alarm initiation, activation of beacons or fault notification.

Intelligent stations shall be capable of operating either as a stand-alone system or with a head-end central control cabinet (as specified in section 5).

The stations shall be interconnected using system cable (as specified in section 7).

3. System features:

a. Without head-end central control cabinet:

The system shall have the following features as a minimum when used without a head-end central control cabinet:

- i. One-way live paging and alarm announcements over system speakers. Pages shall be live to prevent the delay associated with record/play paging. Paging shall be available from any handset-equipped field station.
- ii. Full-duplex party line communication with up to five party lines.
- iii. Automatic Ambient Noise Sensing circuitry to compensate for changing background noise levels at each station.
- iv. Class D paging amplifiers with a minimum output of 30 watts at 8Ω, or 24 watts at 70/100V.
- v. Noise rejection to enable installation close to other electrical equipment.
- vi. Noise-cancelling microphone to enable use in high noise areas.
- vii. Local speaker muting and mutual muting of nearby speakers to prevent acoustical feedback of live pages.
- viii. Off-hook and page switch time out function.
- ix. Distributed amplifier topography such that the loss of a single amplifier shall not adversely affect the system as a whole.
- x. Interfacing of system to telephone, radio and Voice over Internet Protocol (VoIP) systems.

b. With head-end central control cabinet:

The system shall have the following additional features when used with a head-end central control cabinet:

- i. Station supervision for faults and system activity.
- ii. Speaker monitoring for cable and voice coil faults.
- iii. Ability to accept contact inputs (dry or 24VDC) into both the head-end central control cabinet and remote field stations.
- iv. Activation of relays for use with beacons, strobes, etc. from both the head-end central control cabinet and suitably-equipped field stations.
- v. Monitoring of contact inputs and relay outputs.

- vi. System cable supervision for open circuit, short circuit and ground faults.
- vii. System status display from master stations and Graphical User Interface (GUI) software.
- viii. Zoned paging and intercom based upon cable structure.
- ix. Ability to select one of four paging destinations from suitably-equipped field handset stations.
- x. Incident Reporting feature such that an off-hook field station shall be reported at master stations and system status displays.
- xi. Up to nine priority levels for paging.
- xii. Ability to network systems together.

4. Environmental and Approval requirements:

a. Indoor safe-area locations

- i. Indoor safe-area equipment shall have a minimum environmental rating of Type 1
- ii. Operating temperature range shall be +32°F to + 122°F with relative humidity of up to 80% (non-condensing)
- iii. Equipment shall be compliant with the CE Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC amended by the Directive 93/68/EEC.

b. Indoor UL Division 2 locations

- i. Indoor UL Division 2 area equipment shall have a minimum environmental rating of Type 1
- ii. Operating temperature range shall be -22°F to + 158°F with relative humidity of up to 95% (non-condensing)
- iii. Equipment shall be NRTL listed for USA and Canada as follows:
 - Class I, Division 2, Groups A, B, C, D
 - Class II, Division 2, Groups F, G
 - Class III, Division 3
 - Temperature code T4A

c. Outdoor (weatherproof) UL Division 2 locations

- i. Weatherproof UL Division 2 area equipment shall have a minimum environmental rating of Type 3R with door open, Type 4X with door closed.
- ii. Operating temperature range shall be -22°F to + 158°F with relative humidity of up to 95% (non-condensing)
- iii. Equipment shall be NRTL listed for USA and Canada as follows:
 - Class I, Division 2, Groups A, B, C, D
 - Class II, Division 2, Groups F, G
 - Class III, Division 3
 - Temperature code T4A

d. Hazardous-area UL Division 1 locations

- i. UL Division 2 area equipment shall have a minimum environmental rating of Type 4X
- ii. Operating temperature range shall be -4°F to + 151°F with relative humidity of up to 95% (non-condensing)
- iii. Equipment shall be NRTL listed for USA and Canada as follows:
 - Class I, Division 1, Groups B, C, D
 - Class II, Division 1, Groups F, G
 - Class III, Division 1

- Temperature code T6

5. Power requirements

a. Head-end central control cabinet

The head-end central control unit shall operate from 120/230VAC, 50/60Hz.

b. Field stations

- AC stations shall operate from 120/230VAC, 50/60Hz. Maximum current draw shall be 400mA at 120VAC or 220mA at 230VAC.
- DC stations shall operate from 24VDC +/-20%. Maximum current draw shall be 1.95A at 24 VDC.

6. Head-end Central Control Unit

a. General

The head-end central control unit shall provide annunciation, supervision and control for the system. The head-end central control unit shall be modular in construction and contain all modules or printed circuit board cards as necessary to operate according to this specification and applicable drawings.

b. Enclosure

The head-end central control unit shall consist of components installed in either a free-standing or wall-mounted metallic enclosure. The enclosure shall have either front and rear doors or a front door and swing-frame for operational and maintenance access. The front access door shall be translucent to provide unobstructed view of all visual indicators. The enclosure shall support mounting of 19-inch rack equipment with vertical mounting rails for attachment of system cable termination modules, in accordance with DIN standards. The enclosure shall accommodate entry and termination of all system cabling. The enclosure shall be adequately sized by the system manufacturer to accommodate all system components required to provide operation as described herein.

c. Card Rack Assembly

The card rack assembly shall include an AC power supply with an input of 120/230 VAC at a frequency of 50/60 Hz, a VME type backplane, the master control unit and up to 18 removable cards. The following cards shall control the operation and topology of the system and shall be installed in the card rack assembly (actual quantity as required):

- | | |
|--|---------|
| • Master control unit card | (1 max) |
| • External audio interface card | (1 max) |
| • Dual distributed amplifier zone interface card | (6 max) |
| • Central amplifier zone interface card | (4 max) |
| • Access panel interface card | (2 max) |
| • Voice network adapter card | (1 max) |

d. Master Control Unit

The Master Control Unit (MCU) shall be the central component of the system and shall be installed in the Card Rack Assembly. All system functions shall be coordinated by the microprocessor based MCU and its associated software. The MCU shall maintain constant

communication links with the cards and shall supervise all field devices. The MCU shall contain a bootable disk which maintains the system program software and the system configuration program. The system configuration may be pre-programmed at the factory or may be loaded during system installation. The MCU shall incorporate, as a minimum, a X86/200 MHz microprocessor, with 64 MB of read/write solid state memory.

e. Voice/Tone Generator/Telephone Interface

The voice/tone generator shall provide the audio messages (tones, digitally pre-recorded speech or a combination of both) that will be broadcast over the system loudspeakers during emergency conditions. The voice/tone generator shall provide frequency-modulated (FM) tones, including steady, alternating, swept and siren. Each tone type shall have the following programmable parameters: tone frequency, play time and time segment duration.

The unit shall include an onboard real-time clock. The clock shall allow the voice/tone generator to play scheduled events at specific times or intervals such as daily, weekly, monthly or specific days or dates. The user shall be able to program up to 29 scheduled events.

The voice/tone generator shall include an LCD screen. The LCD shall display current time and indicate current message playing.

The voice/tone generator shall include a supervisory output. This output shall remain active (closed) when the unit's processor is healthy. The contact shall be opened if the processor fails.

The voice/tone generator shall be user programmable by means of a PC-based configuration tool allowing the user to configure messages and alarm tones.

The voice/tone generator shall use a removable media card to hold configurations and alarm tones and messages.

A telephone interface shall be included to allow users to access the system via a telephone network. The telephone interface shall auto-answer and may either provide a live audio path to the system or be programmed by the user for record and playback. With telephone paging, acoustical feedback - or howling - is a common problem. To prevent acoustic feedback, the telephone interface shall include a built-in feedback eliminator. If the system is configured to use the feedback eliminator, incoming telephone pages are recorded and stored until the telephone connection is terminated. After the telephone connection is terminated, the telephone interface will broadcast the page. The delay between the recording and the playback of the page eliminates any possibility of feedback.

The telephone interface can provide secure telephone access to the system by being configured to allow telephone access only if a remote access security code is entered. The remote access code is used to prevent unwanted callers from directly accessing the system.

f. External Audio Interface Card

The External Audio Interface (EAI) shall provide four audio paths to allow external audio sources to be interfaced to the system. Primary and secondary Voice Tone Generator/Telephone Interface units (if installed) will use one audio path each. The EAI shall be installed within the card rack assembly and be controlled by the Master Control Unit (MCU) installed in that same card rack. The EAI shall provide a fail-safe contact in the event that the MCU stops operating.

g. Dual Distributed Amplifier Zone Interface Card

The dual distributed amplifier zone interface card shall provide the interface between the head-end central control unit and field stations. One card shall be required for every two zones of field stations. The card shall include the following features and capabilities:

- Interface head-end central control unit to intelligent field stations through data/voice page line and two party lines.
- Interface head-end central control unit to non-intelligent field stations through page line and two party lines.
- Support party line 1 and party line 2 on/off hook detection.
- Provide ground fault detection on page line and party line 1.
- Implements self-check path diagnostics.
- Provide external relay output (driver output) to indicate page audio routing to zone.
- Accepts contact closure input to request page audio routing to other system areas.

h. Central Amplifier Zone Interface Card

The central amplifier zone interface card shall provide the interface between the head-end central control unit and up to 12 power amplifiers/loudspeaker loops. The card shall execute the following functions:

- Perform audio switching of the page resources to the power amplifiers. There shall be two page resources or buses available in the card rack.
- Perform audio switching from the tone resources to the power amplifiers.
- Provide RS485 communication to field devices.

i. Access Panel Interface Card

The access panel interface card shall be responsible for interfacing access panels (if required) to the system for public address, intercommunication, and alarm control. The card shall include the following features:

- Support data communication to access panels – allowing data transmission over a single twisted pair of wires.
- Digital to analog audio converter – allows access panels to communicate with analog equipment such as field handset/speaker stations.
- Provide a digital audio/data interface to the access panels.
- Provide an analog interface to the page resources.

Constant communication shall occur between the access panel interface card and MCU. The MCU shall supervise this communication link. Each interface card shall accommodate up to eight access panels.

j. Monitored Input Module

The Monitored Input Module (MIM) shall be a microprocessor-based module that monitors remote devices, such as alarm panels, process equipment control panels, emergency eyewash/shower stations, etc., for contact closure. The MIM shall be suitable for mounting in an equipment rack using standard DIN rail. The MIM shall communicate with the MCU via either an RS485 (provided by central amplifier zone interface card) or an FSK interface (provided by central dual distributed amplifier zone interface card.)

The MIM shall be capable of supervising eight inputs, each configured independently to supervise single, multiple or deactivated devices as follows:

- Deactivated – Input is not monitored
- Line Supervision Multiple Switch – Detects open circuit, ground faults and switch actuation from one or more normally-open dry contact closures.
- Single N.O. Switch – Detects open circuit, wire-to-wire short circuit, ground faults and switch actuation from a single normally-open dry contact closure.
- Single N.C. Switch – Detects open circuit, wire-to-wire short circuit, ground faults and switch actuation from a single normally-closed dry contact closure.
- Non-supervised N.O. Dry Switch – Detects switch actuation from one or more normally-open dry contact closures.
- Non-supervised Wet Switch – Detects the presence or absence of 24 VDC voltages.

k. Monitored Relay Module

The Monitored Relay Module (MRM) shall be a microprocessor-based module that supervises up to eight Notification Appliance Circuits (NACs) and route power to the particular AC or DC signaling devices, such as high intensity strobe indicators. The MRM shall be suitable for mounting in an equipment rack using standard DIN rail. The MRM shall communicate with the MCU via either an RS485 (provided by central amplifier zone interface card) or an FSK interface (provided by central dual distributed amplifier zone interface card.)

The MRM shall be capable of supervising eight circuits. These circuits shall be used for input (IDC) or output (NAC) operations. Each line shall be configured independently to supervise single, multiple or deactivated devices as follows:

- Deactivated – Input is not monitored
- Line Supervision Multiple Switch – Detects open circuit, ground faults and switch actuation from one or more normally-open dry contact closures.
- Single N.O. Switch – Detects open circuit, wire-to-wire short circuit, ground faults and switch actuation from a single normally-open dry contact closure.
- Single N.C. Switch – Detects open circuit, wire-to-wire short circuit, ground faults and switch actuation from a single normally-closed dry contact closure.
- Relay Circuit (NAC) – Detects open circuit, short circuit, and ground faults while the relay is not energized.
- Non-supervised N.O. Dry Switch – Detects switch actuation from one or more normally-open dry contact closures.
- Non-supervised Wet Switch – Detects the presence or absence of 24VDC voltages.

Relay circuits shall have a minimum current capacity of 5A at 24VDC or 132VAC

l. Audio Distribution/Monitoring Module

The Audio Distribution/Monitoring Module (ADM) shall be used to distribute up to six loudspeaker loop outputs from the AZI card. The ADM shall compare transmitted and received audio to supervise the integrity of these loops. The module shall also monitor for ground faults on the speaker loops. The ADM shall be suitable for mounting in an equipment rack using standard DIN rail. The ADM shall communicate with the MCU via an RS485 interface (provided by central amplifier zone interface card.)

m. Access panels

An access panel shall be an electronic assembly that is either rack mounted in the head-end central control unit or desk mounted remotely as required. The unit shall be capable of initiating paging, public address announcements and audio messages, as well as controlling and/or monitoring the system. Access panels shall include the following:

- Switches – for audio (page or alarm) message initiation and destination selection. Momentary, illuminated push-button switches shall be used. Switch functions shall be configurable with one switch to be dedicated to “Lamp Test.”
- Light Emitting Display LEDs (integrated into pushbuttons) – for operation or status indication. LEDs shall be configurable.
- Optional handset with pressbar – provides additional input such as paging and live voice messages and party line communication.
- Optional microphone with page initiate switch – provides additional input such as paging and live voice messages.
- Optional Display – allows the user to view text messages indicating the system status. Types of displayed messages shall include alarm receipt, alarm activation, Initiating Device Circuit (IDC) activation and restore, Notification Appliance Circuit (NAC) activation and restore, page status, trouble warning, trouble restore, and acknowledge Message.
- Buzzer – provides an audible signal to alert control room personnel of any change in system status that is displayed in the optional display.
- Integral low-power audio output for direct loudspeaker connection.

7. Field Stations:

The following station types shall be provided:

a. Intelligent distributed paging/alarm amplifier stations

Intelligent distributed paging/alarm amplifier stations shall be used to reproduce paging audio over attached speakers.

The intelligent distributed paging/alarm amplifier stations shall include a high-efficiency Class D speaker amplifier with a minimum output of 30W into an 8 Ω load or 15W into a 16 Ω load with a 1.5V_{RMS} input level. The speaker amplifier shall have a minimum frequency response of 250 to 6,500Hz, +0/-3dB referenced to 1,000Hz. Distortion shall be no greater than 1% THD at 1,000Hz up to a 24W output or no greater than 3% THD at 1,000Hz up to a 30W output. Input impedance shall be 16,000 Ω .

The intelligent distributed paging/alarm amplifier stations will include ambient noise sensing circuitry such that the speaker amplifier shall automatically adjust the station's loudspeaker volume to compensate for changing ambient noise levels. Ambient noise monitor range shall be 62 to 100dB. Offset level adjustment range shall be 0 to 30dB above ambient (provided this does not exceed the maximum output of the speaker amplifier or speaker). Offset level shall be set by the head-end central control cabinet (where used) or at the field station.

The intelligent distributed paging/alarm amplifier stations shall include self-diagnostic facilities for speaker amplifier and loudspeaker and shall report problems to the head-end central control cabinet (where used).

Intelligent distributed paging/alarm amplifier stations shall be provided for use in indoor or outdoor UL Division 1 or 2 areas (as specified in section 4).

Intelligent distributed paging/alarm amplifier stations for indoor/outdoor UL Division 1 areas shall have the following maximum dimensions:

- 14.5 x 13.5 x 9.0 inches (height x width x depth)
- 47 lbs. net weight

Intelligent distributed paging/alarm amplifier stations for indoor UL Division 2 areas shall have the following maximum dimensions:

- 12.0 x 8.0 x 5.0 inches (height x width x depth)
- 11 lbs. net weight

Intelligent distributed paging/alarm amplifier stations for outdoor UL Division 2 areas shall have the following maximum dimensions:

- 15.0 x 11.0 x 10.5 inches (height x width x depth)
- 12.5 lbs. net weight

b. Intelligent distributed intercom/paging/alarm amplifier stations

Intelligent distributed intercom/paging/alarm amplifier stations shall be used to produce one-way page announcements over system loudspeakers, support two-way party line communications and reproduce paging audio over attached speakers.

The intelligent distributed intercom/paging/alarm amplifier stations shall include a handset amplifier with a nominal output level of $1.5V_{RMS}$ into a 33Ω load. The handset amplifier shall include an automatic gain control circuit, and have a frequency response of 250 to 6,500Hz, $\pm 0/-3dB$ referenced to 1,000Hz. Distortion shall be no greater than 1.5% THD at 1,000Hz. The handset shall be constructed of ABS and include a 10 ohm, pressure differential, noise canceling dynamic transmitter, a 130 ohm, high efficiency dynamic receiver, and a pressbar page switch for one-hand operation. Transmitter gain, receiver volume, and sidetone controls shall all be adjustable through access on the rear surface of the unit.

The intelligent distributed intercom/paging/alarm amplifier stations shall include a high-efficiency Class D speaker amplifier with a minimum output of 30W into an 8Ω load or 15W into a 16Ω load with a $1.5V_{RMS}$ input level. The speaker amplifier shall have a minimum frequency response of 250 to 6,500Hz, $\pm 0/-3dB$ referenced to 1,000Hz. Distortion shall be no greater than 1% THD at 1,000Hz up to a 24W output or no greater than 3% THD at 1,000Hz up to a 30W output. Input impedance shall be $16,000\Omega$.

The intelligent distributed intercom/paging/alarm amplifier stations will include ambient noise sensing circuitry such that the speaker amplifier shall automatically adjust the station's loudspeaker volume to compensate for changing ambient noise levels. Ambient noise monitor range shall be 62 to 100dB. Offset level adjustment range shall be 0 to 30dB above ambient (provided this does not exceed the maximum output of the speaker amplifier or speaker). Offset level shall be set by the head-end central control cabinet (where used) or at the field station.

The intelligent distributed intercom/paging/alarm amplifier stations shall include self-diagnostic facilities for handset amplifier, hook switch, page switch, speaker amplifier and loudspeaker, and shall report problems to the head-end central control cabinet (where used).

Intelligent distributed intercom/paging/alarm amplifier stations shall be provided for use in indoor or outdoor UL Division 1 or 2 areas (as specified in section 4).

Intelligent distributed intercom/paging/alarm amplifier stations for indoor/outdoor UL Division 1 areas shall have the following maximum dimensions:

- 14.5 x 13.5 x 12.0 inches (height x width x depth)
- 47 lbs. net weight

Intelligent distributed intercom/paging/alarm amplifier stations for indoor UL Division 2 areas shall have the following maximum dimensions:

- 14.5 x 8.0 x 8.5 inches (height x width x depth)
- 11 lbs. net weight

Intelligent distributed intercom/paging/alarm amplifier stations for outdoor UL Division 2 areas shall have the following maximum dimensions:

- 15.0 x 11.0 x 10.5 inches (height x width x depth)
- 12.5 lbs net weight

c. Intelligent distributed remote intercom/paging/alarm amplifier stations with subset

Intelligent distributed remote intercom/paging/alarm amplifier stations shall be used to produce one-way page announcements over system loudspeakers, support two-way party line communications and reproduce paging audio over attached speakers. The unit shall be used with a separate subset which will include the handset and cradle, as well as party line selector switch (5 party systems only) and speaker (desktop subsets only).

The intelligent distributed remote intercom/paging/alarm amplifier stations shall include a handset amplifier with a nominal output level of $1.5V_{RMS}$ into a 33Ω load. The handset amplifier shall include an automatic gain control circuit, and have a frequency response of 250 to 6,500Hz, $\pm 0/-3dB$ referenced to 1,000Hz. Distortion shall be no greater than 1.5% THD at 1,000Hz. Transmitter gain, receiver volume, and sidetone controls shall all be adjustable through access on the rear surface of the unit.

The intelligent distributed remote intercom/paging/alarm amplifier stations shall include a high-efficiency Class D speaker amplifier with a minimum output of 30W into an 8Ω load or 15W into a 16Ω load with a $1.5V_{RMS}$ input level. The speaker amplifier shall have a minimum frequency response of 250 to 6,500Hz, $\pm 0/-3dB$ referenced to 1,000Hz. Distortion shall be no greater than 1% THD at 1,000Hz up to a 24W output or no greater than 3% THD at 1,000Hz up to a 30W output. Input impedance shall be $16,000\Omega$.

The intelligent distributed remote intercom/paging/alarm amplifier stations will include ambient noise sensing circuitry such that the speaker amplifier shall automatically adjust the station's loudspeaker volume to compensate for changing ambient noise levels. Ambient noise monitor range shall be 62 to 100dB. Offset level adjustment range shall be 0 to 30dB above ambient (provided this does not exceed the maximum output of the speaker amplifier or speaker). Offset level shall be set by the head-end central control cabinet (where used) or at the field station.

The intelligent distributed remote intercom/paging/alarm amplifier stations shall include self-diagnostic facilities for handset amplifier, hook switch, page switch, speaker amplifier and loudspeaker, and shall report problems to the head-end central control cabinet (where used).

Intelligent distributed remote intercom/paging/alarm amplifier stations shall be provided for use in indoor safe areas (as specified in section 4) and shall have the following maximum dimensions:

- 14.5 x 8.0 x 5.0 inches (height x width x depth)
- 11 lbs. net weight

The following subsets shall be provided:

i. Desktop subset

Desktop subset shall be constructed of black ABS with an aluminum front panel and have maximum dimensions of 9.0 x 8.0 x 5.0 inches (height x width x depth.) It shall include a black ABS handset with a 10 ohm, pressure differential, noise-canceling dynamic transmitter, a 130 ohm, high efficiency dynamic receiver and a pressbar page switch for one-hand operation. All connections to the subset are to be made through a ten foot multi-conductor cable terminated by a DB25 connector, which plugs into the bottom of the associated remote amplifier enclosure. A loudspeaker and volume control shall be located on the front panel. The hook switch mechanism shall be an electronic proximity detection circuit utilizing a sealed relay to eliminate exposed contacts.

ii. Desk-edge subset

Desk-edge subset shall be constructed of 0.60 thick aluminum with a safety orange powder coat finish and have maximum dimensions of 5.0 x 4.0 x 7.0 inches (height x width x depth). It shall secure to either side of a desk through sets of 13/64" (5.16mm) diameter holes in the mounting bracket. It shall include a gray ABS handset with a 10 ohm, pressure differential, noise-canceling dynamic transmitter, a 130 ohm, high efficiency dynamic receiver and a pressbar page switch for one-hand operation. All connections to the subset are to be made through a 10-foot multi-conductor cable terminated by a DB25 connector which plugs into the bottom of the associated remote amplifier enclosure. The hook switch mechanism shall be of an electronic proximity detection circuit utilizing a sealed relay in the amplifier to eliminate exposed contacts.

iii. Flushmount subset

Flushmount subset shall be constructed of 16-gauge cold rolled steel with a safety orange powder coat finish and have maximum dimensions of 6.0 x 6.0 x 6.0 (height x width x depth). It shall be mounted in a cutout with maximum dimensions of 5.0 x 5.0 x 3.0 (height x width x depth). It shall include a gray ABS handset with a 10 ohm, pressure differential, noise-cancelling dynamic transmitter, a 130 ohm, high efficiency dynamic receiver, and a pressbar page switch for one handed operation. All connections to the subset are to be made through a ten foot multi-conductor terminated by a DB25 connector which plugs into the bottom of the associated remote amplifier enclosure. The hook switch mechanism shall be an electronic proximity detection circuit utilizing a sealed relay in the amplifier to eliminate exposed contacts.

8. Field Station Options:

a. Auxiliary Jack

Auxiliary jack option shall add a connector to the front panel of field stations. This connector shall allow a headset to be used instead of the handset for hands-free operation.

Auxiliary jack option shall be available on indoor and outdoor safe-area and UL Division 2 area field handset stations.

b. Remote Terminal Unit

Remote Terminal Unit (RTU) option shall add two supervised input circuits and a remotely controlled double pole form "C" relay contact to field stations. A head-end central control

cabinet (as specified in Section 6) shall be required for RTU operation. RTU option shall be configurable as follows:

- One supervised input circuit and one supervised relay output
- Two supervised input circuits and one non-supervised relay output
- Two supervised input circuits and no relay output

RTU option shall be available on all station types, provided alternate page, Incident Reporting or 70/100V speaker output options are not present.

c. Alternate Page

Alternate page option shall add a four-position selector switch to the front panel of field stations. This selector switch shall enable the user to select from four pre-configured paging destinations. A head-end central control cabinet (as specified in Section 6) shall be required for RTU operation.

Alternate Page option shall be available on all handset station types (except remote intercom/paging/alarm amplifier stations with subset), provided RTU or Incident Reporting options are not present.

d. Incident Reporting (Emergency Party Line)

Incident Reporting option shall add the ability for a field station to report an off-hook condition to master stations and system status displays. This option will allow an operator to quickly identify that a field station designated as an emergency unit is in use. A head-end central control cabinet (as specified in Section 6) shall be required for Incident Reporting operation.

Incident Reporting option shall be available on all handset station types (except remote intercom/paging/alarm amplifier stations with subset), provided alternate page or RTU options are not present.

e. 70/100V Speaker Output

70/100V speaker output option shall replace the standard 30W, 8Ω speaker output with a 24W, 70/100V speaker output suitable for driving multiple low power 70/100V speakers. Ambient noise sensing feature shall be disabled with this option.

70/100V speaker wiring shall be monitored, provided the speaker wires are looped back to the field station.

70/100V speaker output option shall be available on indoor safe-area and Division 2 area field speaker amplifier stations.

9. Ancillary devices and cable:

The following ancillary devices and cable shall be provided (where required):

a. Voice/tone generator/telephone interface

A voice/tone generator assembly shall be provided when no head-end central control cabinet is present. The voice/tone generator shall be available with an optional analog telephone interface.

The voice/tone generator and analog telephone interface shall require power input of 12-26V dc. The unit shall be housed in a non-metallic enclosure with non-intrusive mounting holes and measure approximately 9.5 x 13.0 x 4.0 inches (height x width x depth.) The unit shall be suitable for use in indoor safe-area locations.

i. Voice/tone generator

The voice/tone generator shall be a self-contained unit and shall be activated by use of dry contacts. It shall provide a supervisory dry contact output upon activation.

The voice/tone generator shall be configurable by use of a Microsoft Windows compatible software tool. The user shall be able to set all parameters of the unit as well as create and program both tones and speech messages. The unit's configuration shall be stored on a minimum 128mB Compact Flash card.

The voice/tone generator shall provide dual audio outputs; a $33\Omega/1.5V_{RMS}$ output and a $600\Omega/0dBm$ output. The unit shall accept up to eight voltage-free input contacts. These contacts shall be programmed by use of the software tool for either normally open (NO) or normally closed (NC) contacts with either momentary or maintained operation. The user shall be able to configure the priority of the input, the output combination to be initiated by the input and the message to be played by the input.

The voice/tone generator shall provide 8 voltage-free output contacts. These contacts shall be configured by use of the configuration software tool for maintained, momentary or cycled initiation. The user shall create output combinations that groups outputs and these combinations are mapped to initiate to specific inputs.

The unit shall include an onboard real-time clock. The clock shall allow the voice/tone generator to play scheduled events at specific times or intervals such as daily, weekly, monthly or specific days or dates. The user shall be able to program up to 29 scheduled events in addition to the eight input messages.

User controls shall include an LCD display, and scroll up, scroll down, select and enter buttons. The user shall be able to initiate or cancel messages by use of these controls. The LCD shall display current time and indicate current message playing. A microphone input shall be included to allow live speech broadcast from the voice/tone generator.

The voice/tone generator shall include a supervisory output. This output shall remain active (closed) when the unit's processor is healthy. The contact shall be opened if the processor fails.

ii. Optional analog telephone interface

An optional analog telephone interface shall be available to allow users to access the system via a telephone network. The analog telephone interface shall auto-answer and may either provide a live audio path to the system or be programmed by the user for record and playback to avoid acoustical feedback.

b. Line balance

- i. A line balance assembly shall be provided when no head-end central control cabinet is present.
- ii. The line balance shall provide correct loading of the page and party lines.

- iii. Line balance assembly shall consist of a cast aluminum two-gang outlet box with a dust-tight cover, approximately 5.0 x 5.5 x 2.5 inches (height x width x depth) overall. Barrier-type terminal strips for connection of field wiring, an adjustable control for the page line, and fixed resistance across the party line circuits shall be included.
- iv. Line balance assembly shall be approved by listed/approved for non-incendive Class I, Division 2, Group A, B, C and D locations and CSA suitable for Class I, Division 2, Group A, B, C, and D locations.

c. Headset and extension cable

i. Headset

Headset assembly shall be suitable for use with or without a hardhat and shall have liquid-filled earcups, a gooseneck noise-cancelling boom microphone and a noise reduction rating of a minimum of 24db. The headset assembly shall permit intelligible communications in areas with ambient noise levels of up to 110dB. Connector shall be included to mate with extension cable. The shipping weight shall not exceed 2 lbs. Equipment shall be listed/approved for Class I, Div. 2, Groups A, B, C & D; Class II, Div. 2, Groups F & G; Class III.

ii. Extension cable

Extension cable shall be provided with a connector to mate with headset assembly and another connector to mate with a suitably-equipped field station. The thirty-foot straight cord shall include a belt clip to act as strain relief for headset and a push-to-page switch. Shipping weight shall not exceed 2 lbs.

d. Terminal boxes

i. Indoor terminal box

Indoor terminal box shall be constructed of 16-gauge steel with gray polyurethane finish, approximately 8.0 x 8.0 x 5.5 inches (height x width x depth) overall, with a neoprene gasketed cover attached with four screws. It shall have two 11-point terminal strips for field wiring connections. Shipping weight shall be approximately 6 lbs.

ii. Indoor/outdoor terminal box

Indoor/outdoor terminal box shall be high-impact, glass-reinforced polyester, approximately 9.5 x 8.0 x 4.0 inches (height x width x depth) overall, a modular assembly that allows the front panel to be separated from the rear enclosure. The front panel shall be secured to the rear enclosure using four captive screws. It shall have two 11-point terminal strips for field wiring connections. It shall have two drill spots on the top and two drill spots on the bottom for locating conduit entry. The shipping weight shall not exceed 5 lbs. Equipment shall be listed/approved for Class I, Div. 2, Groups A, B, C & D; Class II, Div. 2, Groups F & G; Class III

iii. Weatherproof terminal boxes

Weatherproof metallic terminal box shall be cast aluminum alloy with gray baked enamel finish, approximately 11.5 x 9.5 x 5.3 inches (height x width x depth) overall, with a neoprene gasketed cover attached with four stainless steel screws. It shall have two 11-point terminal strips for field wiring connections. Also furnished shall

be a hubplate for 1.25-inch conduit entrances (top and bottom). Shipping weight shall be approximately 10 lbs.

Weatherproof non-metallic terminal box shall be injection molded thermoplastic (PVC), approximately 12.0 x 10.0 x 7.0 inches (height x width x depth) overall, meeting NEMA 1, 2, 3, 3R, 3S, 3R, 12, 13. Components are UL-listed and CSA-certified. It shall have two 19-point terminal strips for field wiring connections. Shipping weight shall be approximately 6 lbs.

e. Speakers and horns

i. Weatherproof re-entrant horn

Weatherproof re-entrant horn shall be constructed of spun aluminum with a gray epoxy coating. The horn shall be reflexed, with a minimum air column length of 3.5 feet. Overall length shall not exceed 16 inches, and diameter shall not exceed 21 inches. Dispersion angle shall be 65° nominal, and efficient frequency range shall be at least 440 to 3,400Hz. Sound pressure level shall be at least 120dB at 30W rated power when used with a Class I, Division 2 driver. Threaded throat area to accommodate screw-in driver shall have standard 1 $\frac{3}{8}$ inch - 18 UNEF thread. Horn shall include a U-type mounting bracket. Shipping weight shall not exceed 13 lbs.

Weatherproof re-entrant horn shall be used with either of the following drivers:

- Class I, Division 2 driver:

Class I, Division 2 driver shall be NRTL approved for use in Class I, Division 2 areas. The driver shall have a power handling capacity of 30 watts with a frequency response of 300 to 4,500 Hz. Voice coil shall have an impedance of 8Ω. Sound pressure level shall be 111 dB at 1 watt, 1 meter (swept sine average) when used with a suitable re-entrant horn. Complete housing assembly shall be weatherproof (type 4X) molded black VALOX equipped with standard 1 $\frac{3}{8}$ inch - 18 UNEF threads for screw-in connection to horn. An electro-formed metal mesh screen shall be integral in the throat of unit to prevent the entrance of foreign particles. Electrical connections shall be made to a 3-foot cable pre-connected to the driver. Dimensions of unit shall not exceed 5 inches in diameter and 5.5 inches in length. Shipping weight shall not exceed 3.1 lbs.

- Class I, Division 1 driver:

Class I, Division 1 driver shall be NRTL approved for use in Class I, Division 1, Groups B, C and D areas. The driver shall have a power handling capacity of 30 watts with a frequency response of 320 to 3,580 Hz. Voice coil shall have an impedance of 16Ω. Sound pressure level shall be 110 dB at 1 watt, 1 meter (swept sine average) when used with a suitable re-entrant horn. Case shall be heavy die-cast aluminum, epoxy coated with standard 1 $\frac{3}{8}$ inch - 18 UNEF threads for screw-in connection to horn. Rear of case shall be made removable to facilitate wiring and provisions made for connection of standard ½ inch pipe conduit. Dimensions of unit shall not exceed 8.0 inches in diameter and 9.0 inches in length. Shipping weight shall not exceed 12.8 lbs.

ii. Class I Division 2 integral driver loudspeaker

Class I, Division 2 integral driver loudspeaker shall be NRTL approved for use in Class I, Division 2 areas. The loudspeaker shall have a power handling capacity of 25 watts with a frequency response of 300 to 8,000 Hz. Voice coil shall have an impedance of 8Ω. Sound pressure level shall be 111 dB at 1 watt, 1 meter (pink noise). Housing assembly shall be weatherproof (type 4X) molded black UL94VO PPS and ABS with a single ½ inch NPT cable gland entry. Electrical connections shall be made to 19 inch flying leads pre-connected to the loudspeaker. Dimensions of unit shall not exceed 9 inches in diameter and 13 inches in length. Shipping weight shall not exceed 6.1 lbs.

iii. Safe area integral driver loudspeaker

Safe area integral driver loudspeaker shall have a power handling capacity of 30 watts with a frequency response of 310 to 8,000 Hz. Voice coil shall have an impedance of 8Ω. Sound pressure level shall be 110 dB at 1 watt, 1 meter. Housing assembly shall be weatherproof (IP67) molded gray polycarbonate with two cable gland entries. Electrical connections shall be made to internal screw terminals. Dimensions of unit shall not exceed 9.5 inches in diameter and 10.5 inches in length. Shipping weight shall not exceed 4.0 lbs.

iv. Safe area cabinet loudspeaker

Safe area cabinet loudspeaker shall have a power handling capacity of 6 watts with a frequency response of 180 to 14,000 Hz. Voice coil shall have an impedance of 8Ω. Sound pressure level shall be 90 dB at 1 watt, 1 meter. Housing assembly shall be molded gray ABS. Electrical connections shall be made to internal spring clamp terminals. Dimensions of unit shall not exceed 8.5 x 8.5 x 3.0 inches (height x width x depth.) Shipping weight shall not exceed 2.7 lbs.

v. Safe area ceiling speaker

Safe area cabinet loudspeaker shall have a power handling capacity of 6 watts with a frequency response of 130 to 20,000 Hz. Voice coil shall have an impedance of 8Ω. Sound pressure level shall be 90 dB at 1 watt, 1 meter. Housing assembly shall be aluminum with white finish. Electrical connections shall be made to internal spring clamp terminals. Dimensions of unit shall not exceed 9.5 inches in diameter and 5.0 inches in depth. Shipping weight shall not exceed 3.3 lbs.

f. Cable

i. System cable (multi-party)

- Sixteen conductor cable shall be provided for distributed amplifier systems with five party lines. Cable to include power and communication conductors.
- Basic cable shall consist of 16 conductors, as follows:
 - One 14 AWG twisted pair for power
 - One 14 AWG conductor for ground
 - One 18 AWG twisted pair for page line
 - Five 18 AWG twisted pairs for party lines
 - One 18 AWG conductor for control
- Conductors shall be color coded to match terminals at head-end central control cabinet and field stations.
- Basic cable construction shall be PVC/nylon insulation and PVC jacket, rated 600V, 90°C type TC.

- Basic cable to be UL listed (Subject 1277) for indoor/outdoor installations in cable tray, trough, channel, duct, wireways, direct burial and aerial (where supported by messenger); Class I, Division 2 applications. Basic cable to meet IEEE-45, CSA C22.2 No. 239 and NEC article 501.
- Basic cable shall be provided with the following armor: (SELECT IF REQUIRED)
 - Bronze braid
 - Aluminum braid
 - Corrugated aluminum sheath
- Marine cable shall be as basic cable with the following upgrades:
 - Construction to include bronze braid armor and Low Smoke Zero Halogen (LSZH) jacket.
 - Marine cable to be for Class I, Division 1 and Zone 1 applications.
 - Marine cables to be UL listed and meet ABS requirements.
 - Marine cables to be fire resistance rated per IEC 60331.
 - Marine cables to be flame rated per IEC 332-2 Cat. A and IEC 331
- Crush and Impact resistant cable shall be as basic cable with the following upgrades:
 - Power twisted pair shall be 12 AWG
 - Construction to include crush and impact resistant jacket.
 - Crush and Impact resistant cables to be UL listed per UL 2225.
 - Crush and Impact resistant cables to be flame rated per IEC 332-2 Cat. A, IEC 331 and IEEE 1202/FT-4.

ii. System cable (single-party)

- Eight conductor cable shall be provided for distributed amplifier systems with a single party line. Cable to include power and communication conductors.
- Basic cable shall consist of eight conductors, as follows:
 - One 14 AWG twisted pair for power
 - One 14 AWG conductor for ground
 - One 18 AWG twisted pair for page line
 - One 18 AWG twisted pairs for party line
 - One 18 AWG conductor for control
- Conductors shall be color coded to match terminals at head-end central control cabinet and field stations.
- Basic cable construction shall be PVC/nylon insulation and PVC jacket, rated 600V, 90°C type TC.
- Basic cable to be UL listed (Subject 1277) for indoor/outdoor installations in cable tray, trough, channel, duct, wireways, direct burial and aerial (where supported by messenger); Class I, Division 2 applications. Basic cable to meet IEEE-45, CSA C22.2 No. 239 and NEC article 501.
- Basic cable shall be provided with the following armor: (SELECT IF REQUIRED)
 - Bronze braid
 - Corrugated aluminum sheath
- Marine cable shall be as basic cable with the following upgrades:
 - Construction to include bronze braid armor and Low Smoke Zero Halogen (LSZH) jacket.
 - Marine cable to be for Class I, Division 1 and Zone 1 applications.
 - Marine cables to be UL listed and meet ABS requirements.
 - Marine cables to be fire resistance rated per IEC 60331.

- Marine cables to be flame rated per IEC 332-2 Cat. A and IEC 331.

iii. Speaker cable (with ground conductor)

- Three conductor cable shall be provided for ICS SmartSeries systems.
- Basic cable shall consist of one 18 AWG twisted triplet for speaker audio and ground.
- Conductors shall be color coded to match terminals at field stations.
- Basic cable construction shall be PVC/nylon insulation and PVC jacket, rated 600V, 90°C type TC.
- Basic cable to be UL listed (Subject 1277) for indoor/outdoor installations in cable tray, trough, channel, duct, wireways, direct burial and aerial (where supported by messenger); Class I, Division 2 applications. Basic cable to meet IEEE-45, CSA C22.2 No. 239 and NEC article 501.
- Basic cable shall be provided with the following armor: (SELECT IF REQUIRED)
 - Bronze braid
 - Aluminum braid

iv. Speaker cable (without ground conductor)

- Two conductor cable shall be provided for ICS SmartSeries systems.
- Basic cable shall consist of one 18 AWG twisted pair for speaker audio.
- Conductors shall be color coded to match terminals at field stations.
- Basic cable construction shall be PVC/nylon insulation and PVC jacket, rated 600V, 90°C type TC.
- Basic cable to be UL listed (Subject 1277) for indoor/outdoor installations in cable tray, trough, channel, duct, wireways, direct burial and aerial (where supported by messenger); Class I, Division 2 applications. Basic cable to meet IEEE-45, CSA C22.2 No. 239 and NEC article 501.
- Basic cable shall be provided with the following armor: (SELECT IF REQUIRED)
 - Bronze braid
 - Aluminum braid
- Marine cable shall be as basic cable with the following upgrades:
 - Construction to include bronze braid armor and Low Smoke Zero Halogen (LSZH) jacket.
 - Marine cable to be for Class I, Division 1 and Zone 1 applications.
 - Marine cables to be UL listed and meet ABS requirements.
 - Marine cables to be fire resistance rated per IEC 60331.
 - Marine cables to be flame rated per IEC 332-2 Cat. A and IEC 331.