



UL 1069

STANDARD FOR SAFETY

Hospital Signaling and Nurse Call Equipment

UL Standard for Safety for Hospital Signaling and Nurse Call Equipment, UL 1069

Eighth Edition, Dated February 8, 2024

Summary of Topics

This new edition of ANSI/UL 1069 dated February 8, 2024 includes the following:

- Added requirements for Class 2 Supply Equipment for use in UL 1069; [2.2.2](#), [3.38](#), [3.49](#), [4.4](#), [12.2](#), [18.1.5](#), Section [34.2.3](#), [46.9](#) – [46.12](#)***
- Update to Section [3](#), Glossary, to remove terms not used in the standard.***

This new edition also incorporates editorial changes including renumbering and reformatting to align with current style.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated December 8, 2023.

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ANNEX A Standards for Components



INTRODUCTION

1 Scope

1.1 The requirements in this Standard cover the individual units and equipment that operate within the context of a fundamental hospital signaling nurse call system (NCS).

1.2 A fundamental NCS provides audible and visual communication between patients and staff in a health care facility and conforms to the minimum requirements established in the Health Care Facilities Code, NFPA 99, and the National Electrical Code, NFPA 70.

1.3 Accessory equipment or devices which are intended to be interfaced with a fundamental NCS to initiate routine calls or supplementary operation and which do not initiate emergency or code call signaling can be evaluated for compliance with applicable requirements described in this Standard.

1.4 A minimal fundamental NCS performs the following operations:

- a) Call Initiation – Activation of a staff or patient request for assistance via fixed or portable call initiation station,
- b) Notification – Call annunciation (audible and visual) at a primary call notification station,
- c) Notification – Call-placed indicator (visual) on the call initiation station,
- d) Notification – Call annunciation at a corridor dome light,
- e) Notification – Zone annunciation (audible and visual) on a zone dome light, and
- f) Call reset/cancellation.

1.5 A fundamental NCS may employ a wireless interface to perform fundamental operations or a supplementary operation such as notification at a redundant portable nurse's station.

1.6 The units comprising a fundamental NCS covered by this Standard are intended to be installed in patient care areas, staff areas, and support areas of a health care facility in accordance with the National Electrical Code, NFPA 70, and the Health Care Facilities Code, NFPA 99.

1.7 These requirements do not cover medical and dental equipment, line isolation monitors, X-ray equipment, electrically heated pads, therapeutic lamps, refrigerated oxygen therapy equipment, food warming cabinets and carts, equipment employed in inhalation anesthetizing or hazardous locations, office intercoms, or similar equipment and products covered by individual requirements.

1.8 These requirements do not cover equipment employed in an area of hyperbaric oxygenation, in which a patient is exposed during oxygen therapy to pressures greater than ambient atmosphere.

2 Fundamentals

2.1 General

2.1.1 A fundamental NCS shall comply with all the requirements in this Standard, unless otherwise stated.

2.1.2 If wireless devices or wireless system capabilities are not part of the fundamental NCS then Section [49](#), Wireless Devices, General, shall not apply.

2.1.3 Pillow speakers, power supplies and signaling equipment intended to perform fundamental operation shall be tested for compatibility with at least one fundamental NCS.

2.1.4 For the purposes of enabling a proprietary communications interface for accessory equipment or devices, the protocol of the fundamental NCS can be uniquely tested as a software device in accordance with [16.2](#).

2.1.5 When a communications interface is enabled as described in [1.3](#) and [2.1.4](#), the NCS installation instructions shall include at least the following:

- a) The manufacturer's name or private labeler's name, trademark, or other descriptive marking by which each accessory organization can be identified.
- b) Make, model or identifiable name of each accessory.
- c) Any special conditions required for use with each accessory.

2.1.6 Any device or operation which has not been evaluated to the requirements of this Standard shall not replace or substitute a fundamental device or operation that was evaluated and tested to the requirements of this Standard, except as specified in [16.2](#).

2.2 Nurse call system (NCS) fundamentals

2.2.1 General

2.2.1.1 The fundamental operation of an NCS includes the essential and required functions of providing notification and reset/cancellation of staff initiated or patient initiated call signals. The following functions shall be provided:

- a) A fundamental NCS is deployed on a dedicated wired, or a dedicated wireless network, or a combination of these networks, for the notification and annunciation of patient initiated or staff initiated calls. A clinical IT network may be used to connect two or more segments of a NCS as per [2.2.1.5](#).
- b) A fundamental NCS shall provide signaling for one or more of the following call types: staff emergency calls, code calls, and staff or patient requests for help or assistance.

2.2.1.2 A fundamental NCS shall provide all of the following capabilities:

- a) Call initiation – Activation of a call event via fundamental call initiation station or device. A fundamental NCS must include the following equipment for call initiation:
 - 1) A call initiation station that provides the fundamental call types described in [2.2.1.1\(b\)](#). It is permissible for a call initiation station to activate a single call type or a combination of call types. It is also permissible for a call initiation station to be equipped to provide supplementary two way voice communication.
 - i) If the call initiation station described in [2.2.1.2\(a\)\(1\)](#) is intended to serve one or more patient beds, each bed shall be uniquely identified and discretely accessed.
 - 2) A call initiation station intended to be mounted in space considered to be a bath area. A call initiation station mounted in a patient shower or bath area shall provide a means to be accessible to a patient lying on the floor. A pull cord is permitted to enable such access.
 - 3) A call initiation station shall provide a call placed visual indicator.

- b) Call Notification – A fundamental NCS must include the following equipment for call notification:
- 1) Audible and visual annunciation at a wired-primary call notification station where wiring includes both signal and power.
 - 2) Audible and visual annunciation at a nurse's duty station which is intended for installation at a fixed location.
 - 3) Visual annunciation at a wired or wireless corridor dome light. Audible annunciation at the corridor dome light is permitted.
 - 4) Visual annunciation at a wired or wireless zone dome light. Audible annunciation at a zone dome light is permitted.
 - 5) The nurse call system shall identify the location of the staff or patient initiated call.
 - 6) Visual and audible signals for a code call and staff emergency call shall be individually identifiable and distinct from all other nurse call signals.
- c) Call reset or cancellation – The ability to return the nurse call system to a normal quiescent state upon restoration of a call event. Calls initiated by fundamental NCS equipment may only be canceled at the originating patient care area or room of origin. The following means of call cancellation shall be permitted:
- 1) When two or more stations are located in the same area and all are visible from any call location, the call event may be canceled at any station in the same area.
 - 2) A routine call may be canceled remotely if two-way audio communication has been established, with the end-to-end connection verified prior to hang-up, between the calling patient care area or room of origin and the remote location.
 - 3) A code call or an emergency call annunciated on a Call Notification Device or Portable Annunciation Device must be canceled by an action separate and unique from terminating communication.
 - 4) A routine call may be canceled upon detection of staff presence in the patient care area or room of origin by the NCS directly or communicated by a supplementary system.

2.2.1.3 It is permissible to use a wireless interface with the fundamental NCS for the following:

- a) Call initiation as described in [2.2.1.2\(a\)](#) via fixed location station or portable call initiation device.
- b) Call notification as described in [2.2.1.2\(b\)](#).
- c) [2.2.1.3\(a\)](#) and (b) shall be evaluated for fundamental NCS operation as fundamental NCS equipment.
- d) A code call or an emergency call that originates from a portable call initiating device shall be canceled at an associated fixed location call initiation or notification station as described in [2.2.1.2\(c\)](#).

2.2.1.4 Provision for the interface and signaling of medical device alerts or any signaling not included in [2.2.1.2\(a\)](#) or [2.2.1.2\(b\)](#) is permitted and shall be considered supplementary operation and shall meet the (a) or (b) below:

- a) Provision for two-way audio (voice) communications is permitted and shall be considered supplementary operation. A call initiation station that provides supplementary two way voice communication shall provide a visual or aural signal to indicate voice circuit operation.

b) It is permissible for the fundamental NCS to perform supplementary operation with wired or wireless equipment such as:

- 1) Supplementary notification at a redundant portable annunciation device or redundant portable nurse's station, or
- 2) Supplementary call initiation of a routine call such as housekeeping or maintenance via supplementary call initiation device.

2.2.1.5 If a Nurse Call System is deployed using a clinical IT network per [2.2.1.1\(a\)\(1\)](#) where either (a) or (b) below applies, no segment of the clinical IT network shall be considered as part of the fundamental NCS, or evaluated as such, provided.

- a) Two or more segments of a Nurse Call System are connected using one or more segments of a clinical IT network where each NCS segment is operating on their own dedicated network that is capable of independently performing fundamental NCS operation as defined in [2.2.1.2](#).
- b) Two or more segments of a Nurse Call System are connected using one or more segments of a clinical IT network where the NCS segments are not capable of independently performing fundamental NCS operation as defined in [2.2.1.2](#) and the system meets the requirements of [17.24](#), [18.3](#), and [46.1\(k\)](#).

2.2.2 Class 2 power sources not evaluated to UL 1069 (non-evaluated sources)

2.2.2.1 Non-evaluated sources shall be permitted to supply power to permitted components for nurse call systems that comply with [2.2.2.2](#).

2.2.2.2 Nurse Call Systems intended to utilize non-evaluated sources to power permitted components that are evaluated to UL 1069 shall:

- a) Provide system documentation that identifies permitted components as required in [46.10](#);
- b) Electrically supervise functionality of permitted components [identified as per [2.2.2.1\(a\)](#)] as required by [18.1.4](#);
- c) Include NCS manufacturer submitted example of non-evaluated source equipment that complies with [12.2](#), to be utilized in the evaluation of permitted components;
- d) Provide system documentation that includes a risk assessment(s) and NCS manufacturer recommendations for the use of non-evaluated sources in compliance with [46.12](#); and
- e) Construct permitted components (identified as per [2.2.2.1](#)) to comply with [4.4](#).

2.3 Components

2.3.1 Except as indicated in [2.3.2](#), a component of a product covered by this Standard shall comply with the requirements for that component. See Annex [A](#) for a list of standards covering components generally used in the products covered by this Standard.

2.3.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this Standard, or
- b) Is superseded by a requirement in this Standard.

2.3.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.3.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

2.4 Units of measurement

2.4.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

2.4.2 Unless otherwise specified, all voltages are rms.

2.5 Undated references

2.5.1 Any undated reference to a code or standard appearing in the requirements of this Standard shall be interpreted as referring to the latest edition of that code or standard.

2.6 Maximum voltage and power

2.6.1 The maximum distribution voltage available to equipment intended to be installed in areas accessible to a patient or persons touching a patient shall not exceed 30 volts AC (42.4 volts peak), 42.4 volts peak for nonsinusoidal AC, or 60 volts continuous DC.

2.6.2 The maximum power available to low-voltage equipment intended to be installed in areas accessible to a patient or persons touching a patient shall not be greater than 100 volt-amperes.

2.6.3 The maximum voltages to a control circuit where wet location contact is likely to occur shall not exceed 15 volts, 60 hertz sinusoidal, 30 volts continuous DC, 21.2 volts peak for nonsinusoidal ac, and 12.4 volts for DC that is interrupted at a rate of 10 – 200 hertz.

2.7 Manufacturer documentation of devices and operations

2.7.1 As part of each product submittal, the manufacturer shall provide documentation that depicts and describes all elements which are conceivably capable of being connected to the fundamental NCS, with core elements specifically identified, and with the interconnection and function of each device also identified and described.

3 Glossary

3.1 For the purposes of this Standard the following definitions apply.

3.2 ACCESSORY EQUIPMENT / DEVICES – Non-fundamental equipment or devices which can be connected to or interfaced with a fundamental NCS for the purposes of initiating routine calls or performing supplementary operation only.

3.3 ANNUNCIATOR – An electrically operated appliance containing one or more visual indicating means, such as identifying lamps, LEDs, targets, or visual displays, each of which indicates a circuit condition or location, or both. It may also contain a means for an audible signal.

3.4 ANNUCIATION STATION – A basic type of call notification station used in a tone-visual system that signals the presence and locations of calls or signals in the system. It typically provides both audible and visual indications.

3.5 AUDIO-VISUAL SYSTEM – A nurse call system that incorporates voice intercom between the nurse control stations and the patient-care areas (e.g., patient rooms, nurse lounges).

3.6 BATH AREA – Any patient bathing or toilet area.

3.7 BATTERY BACK-UP – A battery source to power the nurse call system during power outages. Outages include complete failure or brown-out of the ac and the brief periods during switching between the main ac source and the hospital's standby power source. The battery back-up can be an integral part of the system or an optional add-on. The duration for which it will supply power is specified by the manufacturer.

3.8 CALL ASSURANCE INDICATOR – Visual or audible indication on a call initiation station or device that signifies placement of a call.

3.9 CALL CORD – A cord with a switch at one end and a connector at the other that typically plugs into a patient station. The patient places a call to the nursing staff by momentarily pressing the switch. A call is automatically placed when the cord is removed from the station receptacle.

3.10 CALL INITIATION DEVICE – Any of several types of devices that can initiate a staff emergency call, code call, and/or staff or patient requests for help or assistance, or to communicate a change in status, including reset or call cancellation within a fundamental NCS. A call initiation device connects to a fundamental NCS via wired or wireless means and may be portable.

3.11 CALL INITIATION STATION – Any of several types of devices that can initiate a staff emergency call, code call, and/or staff or patient requests for help or assistance, or to communicate a change in status, including reset or call cancellation within a fundamental NCS. A call initiation station is intended for installation at a fixed location and connects to a fundamental NCS via wired or wireless means.

3.12 CALL NOTIFICATION DEVICE – Any of several types of devices that audibly and/or visually notify staff that a a staff emergency call, code call, and/or staff or patient requests for help or assistance, or a change in status including reset or call cancellation has occurred within a fundamental NCS. A call notification device connects to a fundamental NCS via wired or wireless means and may be portable.

3.13 CALL NOTIFICATION STATION – Any of several types of devices that audibly and/or visually notify staff that a staff emergency call, code call, and/or staff or patient requests for help or assistance, or a change in status, including reset or call cancellation has occurred within a fundamental NCS. A call notification station is intended for installation at a fixed location and connects to a fundamental NCS via wired or wireless means.

3.14 CALL NOTIFICATION STATION, PRIMARY – Any of several types of devices that audibly and/or visually notify staff that a staff emergency call, code call, and/or staff or patient requests for help or assistance, or a change in status, including reset or call cancellation, has occurred within a fundamental NCS. A call notification station is intended for permanent installation at the main nurses' station of each nursing unit and connects to a fundamental NCS using wired signal and power that must be permanently located.

3.15 CENTRALIZED SYSTEM – A system whose operations are monitored and controlled from a central operator's console. It includes peripheral stations installed in patient and staff rooms and related areas that are not normally visible from the central control point.

3.16 **CIRCUIT, HIGH-VOLTAGE** – A circuit having characteristics in excess of those of a low-voltage, power-limited circuit as defined in [3.17](#).

3.17 **CIRCUIT, LOW-VOLTAGE (POWER-LIMITED)** – A circuit involving a potential of not more than 30 volts AC, rms (42.4 volts AC peak or 60 volts continuous DC) and not providing more than 100 volt-amperes rated output.

3.18 **CLASS 2 CIRCUITS** – Circuits that conform to the Class 2 circuit requirements of Article 725 of NFPA 70, the National Electrical Code. Class 2 circuits are power-limited, either inherently or by a combination of protections against excessive current at the power source and in the circuit itself.

3.19 **CLASS 2 WIRING** – Wiring that conforms to the Class 2 circuit requirements of Article 725 of NFPA 70, the National Electrical Code.

3.20 **CLINICAL IT NETWORK** – An information technology video, voice, and data communication network that is dedicated for shared use by medical devices, nurse call, clinical information systems, patient-critical applications, and clinical wireless communication equipment.

3.21 **CODE CALL** – A distinctive audible and visual signal representing a life-threatening situation that requires immediate action. For example, a Code Blue Call.

3.22 **CONVENTIONAL SYSTEM** – A system containing one or more nurse master stations (typically one per floor or wing) that is attended by nursing personnel and installed in an area in which each patient room related to a particular nurse master is visible or readily accessible from that nurse master.

3.23 **CORRIDOR DOME LIGHT** – A visual annunciator, mounted on the wall (or ceiling) outside a room, that indicates calling activities and the presence of staff members. It may have a single light source or several light sources of different colors to indicate the types of calls and staff members. Also referred to as a dome light.

3.24 **DUTY STATION** – A station that uses an annunciator with visual and audible indications to identify calls by their type or priority. It is normally installed in a location where nurses tend to be when they are not at the primary call notification station or in patient rooms (e.g., clean linens, soiled linens, nurses' lounge).

3.25 **ELECTROSTATIC DISCHARGE (ESD)** – The discharge of a voltage that is developed on both human bodies and objects with respect to a local electrostatic ground.

3.26 **EMERGENCY CALL** – An audible and visual signal that requires immediate action, but does not necessarily indicate a life threatening situation. When preceded by "staff" (i.e Staff Emergency), this indicates that the call was initiated by a member of the facility staff to request emergency-level help or assistance often pertaining to the needs of a patient.

3.27 **FIXED** – Equipment that is intended to be permanently connected electrically.

3.28 **FUNDAMENTAL DEVICE** – A device which performs a fundamental operation. Devices which perform fundamental operations will not be evaluated as being capable of performing supplementary operations.

3.29 **FUNDAMENTAL OPERATION** – An essential and required operation of an NCS with the primary functions of providing notification and reset/cancellation of staff-initiated or patient-initiated call signals.

3.30 **GROUND FAULT** – An unintended electrical connection to ground.

- 3.31 **GROUNDING CONDUCTOR** – A system or circuit conductor that is intentionally grounded.
- 3.32 **GROUNDING** – A system of conductors that provides a low-impedance return-path for leakage and fault currents.
- 3.33 **GROUNDING CONDUCTOR** – A conductor used to connect equipment or the grounded circuit of a wiring system to a grounded electrode or electrodes.
- 3.34 **GROUNDING CONDUCTOR, EQUIPMENT** – The conductor used to connect the noncurrent-carrying metal parts of equipment, raceways, and other enclosures to the system grounded conductor or the grounding electrode conductor, or both, at the service equipment or at the source of a separately derived system.
- 3.35 **LEAKAGE CURRENT** – Any current, including capacitively coupled currents, that may be conveyed from accessible parts of a product to ground or to other accessible parts of the product.
- 3.36 **MAIN CONTROL EQUIPMENT** – The components needed to process and route signals among nurse and patient stations and other peripheral devices. Typical components are low-voltage power supplies, logic and control circuits, and terminal blocks. This equipment is typically enclosed in a wall-mounted electrical enclosure that has been evaluated as suitable for this purpose and is located in an equipment room or closet.
- 3.37 **MESSAGE** – Communicated data that contains specific information relating to the status of the product and is transmitted via a wired or wireless pathway from an origin to a destination.
- 3.38 **NON-EVALUATED SOURCE** – Class 2 wired power sources not additionally evaluated to UL 1069.
- NOTE: These sources are required to comply with other standards as outlined in applicable requirements.
- 3.39 **NURSE CALL SYSTEM** – A system of components that provides audible and visual communication between patients and healthcare facility staff.
- 3.40 **NURSE CONTROL STATION** – A type of call notification station, intended to be permanently located at a nurses' station, which provides audible tones and visual annunciation of incoming calls. Typically, it also provides audio communication between the nurse and the patient. Many other features are optionally available. Also called nurse console or master station.
- 3.41 **NURSING UNIT** – An area of the facility that includes rooms for patients and the specific group of personnel dedicated to those beds.
- 3.42 **OVERCURRENT** – Any current in excess of the rated current of equipment or the ampacity of a conductor. It may be caused by an overload, a short circuit, or a ground fault.
- 3.43 **OVERLOAD** – The operation of equipment in excess of its normal, full-load rating, or of a conductor in excess of its rated ampacity to the degree that, when persisted for a sufficient length of time, will damage or dangerously overheat the equipment or wiring. A fault, such as a short circuit or a ground fault, is not an overload.
- 3.44 **OVERVOLTAGE** – Any voltage that exceeds its rated or intended value.
- 3.45 **OXYGEN** – An element that, at atmospheric temperature and pressures, exists as a colorless, odorless, tasteless gas.

NOTE: Its outstanding property is its ability to sustain life and to support combustion. Materials that burn in air will burn much more vigorously and create higher temperatures in oxygen or in oxygen-enriched atmospheres.

3.46 OXYGEN-ENRICHED ATMOSPHERE – As defined in the Standard for Health Care Facilities, NFPA 99, it is an atmosphere in which oxygen comprises more than 23.5 % of the volume.

3.47 PATIENT CARE AREA – Those areas, designated as follows, in accordance with the type of patient care anticipated.

a) **Critical Care Area** – Special care units, intensive care units, coronary care units, angiography laboratories, cardiac catheterization laboratories, delivery rooms, operating rooms, and similar areas in which patients are intended to be subjected to invasive procedures and connected to line-operated, electro-medical devices.

b) **General Care Area** – Patient bedrooms, examining rooms, treatment rooms, clinics, and similar areas in which it is intended that the patient come in contact with ordinary products such as a nurse call system, electrical beds, examining lamps, telephone, and entertainment devices. In such areas, it may also be intended that patients be connected to electro-medical devices such as heating pads, electrocardiographs, drainage pumps, monitors, otoscopes, ophthalmoscopes, and peripheral intravenous lines.

c) **Bath Area** – Patient-care areas that are commonly wet while patients are present. These include standing water on the floor or drenching of the work area where the fluids would likely come in contact with the patient or the staff. Routine housekeeping procedures and incidental spillage of liquids does not constitute a bath area.

3.48 PATIENT STATION – A type of call initiation station located on the wall behind the patient bed that allows patients or staff to summon help. It is typically activated by a call cord or pillow speaker. It normally has a call-assurance lamp, which lights when a call is placed, and a reset switch for canceling a call. Common supplemental options include an intercom speaker/microphone and entertainment circuits for television control.

3.49 PERMITTED COMPONENTS – Nurse call components (such as patient stations) that are evaluated to UL 1069 and manufacturer-specified and evaluated for connection to non-evaluated sources.

3.50 PILLOW SPEAKER – A pendant control similar to a call cord but with additional features such as a speaker for personal-entertainment audio (TV or programmed audio) and nurse communication, a volume control, an entertainment-channel selector, and lighting controls.

3.51 PORTABLE – Equipment that is capable of being carried or conveyed.

3.52 PORTABLE ANNUNCIATION DEVICE – A wireless, portable component intended for supplementary use only which provides audible tones and visual annunciation of incoming calls for mobile staff members. Other features are optionally available.

3.53 POWER SUPPLY – A unit that is used to condition the power for a nurse call system.

3.54 PULL CORD – A type of call initiation station typically located in a bath area that allows patients or staff to summon help. It is typically activated by a pull string that hangs from the station to just above the floor. It normally has a call-assurance lamp, which lights when a call is placed, and a reset switch for canceling a call.

3.55 QUALIFIED PERSON – One who is trained in the construction, system design, installation, testing, trouble-shooting, maintenance, and operation of the equipment and the hazards involved.

3.56 RESPONSIBLE ORGANIZATION – The entity accountable for the use and maintenance of a Clinical IT network. For example, a hospital, a private clinician, a long term care facility or a telehealth organization.

3.57 ROUTINE CALLS – An audible and visual signal that requires action but does not necessarily indicate a life threatening situation, and is of lower priority than emergency or code call signals.

3.58 SHOWER STATION – A water resistant call initiation station that can be installed inside a shower stall and used by a patient to summon help. A pull cord is usually provided to facilitate access by a patient lying on the floor.

3.59 SIGNALING UNIT – Patient stations, dome lights, nurse master stations, duty stations etc.

3.60 STATIONARY – A cord-connected product intended to be fastened in place or located in a dedicated space.

3.61 SUPPLEMENTARY DEVICE – Any device that is electrically isolated, and not evaluated as a fundamental device.

3.62 SUPPLEMENTARY OPERATION – An operation that is adjunct to the fundamental operation, that failure of such will have no effect on the fundamental operation of the NCS.

3.63 ZONE DOME LIGHT – This is similar to a corridor dome light, but it visually annunciates calls from a group of rooms in a particular area. Normally a zone dome light is located at corridor intersections where the observer cannot see the room corridor dome lights.

CONSTRUCTION

4 General

4.1 Except where indicated otherwise, the construction requirements specified in this Standard as applying to nurse call system equipment, shall also apply to miscellaneous signaling equipment as defined in the Scope, Section [1](#).

4.2 Isolation shall be provided (see Abnormal Tests, Section [34](#)) between any equipment, such as CRTs, printers, pocket page, telephone, and similar devices, and circuits extending into the patient care area stations so that, in the event of a breakdown between primary and secondary windings, the high-voltage does not appear on the patient circuits and the sum of leakage currents from the nurse call system and supplementary equipment does not exceed the limits of the leakage current test. See the Leakage Current Test, Section [28](#). The isolation shall be provided by physical separation, the use of optical isolators, or equivalent means.

4.3 Products that currently meet all the requirements of the Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1 or the Standard for Audio/video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1, fulfill the requirements of [Table 4.1](#).

Table 4.1
Construction safety requirements met by compliance with UL 60950-1 or UL 62368-1

Requirement	Paragraph(s)
Enclosures – sheet metal	5.3.1 – 5.3.6
Enclosures – non-metallic	5.4.1 – 5.4.5
Enclosures – ventilating openings involving perforated sheet metal and/or expanded metal mesh	5.5.5
Enclosures – covers	5.6.1 – 5.6.4
Enclosures – observation opening covers	5.7.1 – 5.7.4
Electric Shock	6.1 – 6.4
Corrosion Protection	7.1 , 7.2
Field wiring system connections – general	8.1.1 , 8.1.2
Field wiring system connections – terminals	8.2.1.1 , 8.2.2.2
Field wiring system connections – equipment grounding connection	8.5.1 – 8.5.3
Field wiring system connections – supply connections	8.6.1.1 – 8.6.2.2
Field wiring system connections – grounded supply connector connection	8.7.1 , 8.7.2
Field wiring system connections – compartments	8.8.1
Field wiring system connections – strain relief	8.9.1
Internal wiring	9.1.1 – 9.5.6
Bonding for ground	10.1 – 10.10
Components – printed-wiring boards	11.1.1
Components – coil windings	11.2.1 , 11.2.2
Components – switches	11.3.1
Components – lamp holders and lamps	11.4.1 – 11.4.4
Components – connectors and receptacles	11.6.1
Components – current carrying parts	11.9.1 , 11.9.2
Components – insulating material	11.10.1 – 11.10.6
Components – mounting of parts	11.11.1 – 11.11.4
Components – operating mechanisms	11.12.1 – 11.12.5
Spacings	14.1 – 14.5

4.4 Permitted components identified in [46.10](#) for use with non-evaluated sources intended to be installed in patient care areas, shall provide, and be evaluated with one or more of the following protections:

- a) Circuit isolation between the product input from the non-evaluated source and the internal circuitry of products utilizing transformer(s) that comply with [11.8](#);
- b) Spacing between the circuits and accessible surfaces in compliance with [14.1](#), point of application with barriers, rated for 151 – 300 volts; or,
- c) Complies with the abnormal test of [34.2.3](#).

5 Enclosures

5.1 General

5.1.1 Nurse call equipment shall be formed and assembled so that it has the strength and rigidity necessary to resist the abuses expected in service without:

- a) Impairing its operation,
- b) Total or partial collapse with resulting reduction of spacings,
- c) Loosening or displacement of parts, or
- d) Other serious defects.

5.1.2 All electrical parts of nurse call equipment shall be enclosed to reduce the chance of contact with uninsulated live parts. Functional openings, such as on receptacles and jacks, shall not be enclosed.

5.1.3 An enclosure shall have means for mounting. The means for mounting shall be accessible without disassembling any operating part of the unit. Removal of a completely assembled panel to mount the enclosure is not considered to be disassembly of an operating part.

5.1.4 A compartment enclosing electrical parts shall not be open to the floor or other support on which the unit rests.

Exception: This requirement does not apply to a nurse master station that rests on a table top.

5.1.5 Equipment shall be constructed so that spillage of foods or beverages, cleaning, and similar occurrences will not wet internal electrical parts.

5.1.6 An enclosure intended for recessed mounting and having a panel intended to be flush with the surface of a wall shall have no nonfunctional openings.

5.1.7 If a backbox is not provided with the unit, the minimum dimensions of the backbox in which the unit is intended to be mounted, as well as the minimum spacings from current-carrying parts of the unit to internal dead metal parts of the backbox, shall be specified in the installation instructions. The instructions shall specify the model number or minimum dimensions of custom backboxes intended to be used in the system.

5.2 Cast metal

5.2.1 The thickness of cast metal for an enclosure shall be as specified in [Table 5.1](#).

Exception: Cast metal having a thickness 1/32 inch (0.8 mm) less than that indicated in [Table 5.1](#) is to be used only if the surface under consideration is curved, ribbed, or otherwise reinforced, or if the shape or size of the surface is such that equivalent mechanical strength to an enclosure of the thickness specified in the table is provided.

5.2.2 When threads for the connection of conduit are tapped all the way through a hole in an enclosure wall, or when an equivalent construction is employed, there shall be at least 3-1/2 threads but no more than five threads in the metal, and the construction shall permit a standard conduit bushing to be attached.

5.2.3 When threads for the connection of conduit are tapped part way through a hole in an enclosure wall, there shall be at least five full threads in the metal, and there shall be a conduit stop having smooth,

rounded edges for the protection of the conductors. The conduit stop shall have an inside diameter equal to that specified for a standard conduit bushing of the appropriate size.

Table 5.1
Minimum Thicknesses for Cast-Metal Electrical Enclosures

Use, or dimensions of area involved	Die-cast metal		Cast metal of other than the die-cast type	
	inch	(mm)	inch	(mm)
Area of 24 square inches (155 cm ²) or less and having no dimension greater than 6 inches (152 mm)	1/16	(1.6)	1/8	(3.2)
Area greater than 24 square inches or having any dimension greater than 6 inches	3/32	(2.4)	1/8	(3.2)
At a threaded conduit hole	1/4	(6.4)	1/4	(6.4)
At an unthreaded conduit hole	1/8	(3.2)	1/8	(3.2)

5.3 Sheet metal

5.3.1 The thickness of sheet metal employed for the enclosure of nurse call equipment shall be as specified in [Table 5.2](#).

Exception: Sheet metal of two gage sizes less in thickness is not prohibited when the surface under consideration is curved, ribbed, or otherwise reinforced, or when the shape or size of the surface is such that equivalent mechanical strength to an enclosure of the thickness specified in the table is provided.

Table 5.2
Minimum Thicknesses for Sheet Metal Enclosures

Maximum enclosure dimensions				Minimum thicknesses								
				Steel						Brass or aluminum		
Any linear dimension		Area of any surface		Zinc-coated			Uncoated					
inches	(mm)	inches ²	(cm ²)	inch	(mm)	GSG	inch	(mm)	MSG	inch	(mm)	AWG
12	(305)	90	(584)	0.035	(0.86)	20	0.032	(0.81)	20	0.045	(1.14)	16
24	(610)	360	(2322)	0.045	(1.14)	18	0.042	(1.07)	18	0.058	(1.47)	14
48	(1219)	1200	(7742)	0.056	(1.42)	16	0.053	(1.35)	16	0.075	(1.91)	12
60	(1524)	1500	(9678)	0.070	(1.78)	14	0.067	(1.70)	14	0.095	(2.41)	10
Over 60	(1524)	Over 1500	(9678)	0.097	(2.46)	12	0.093	(2.36)	12	0.122	(3.10)	8

5.3.2 At any point where conduit or metal-clad cable is to be attached, sheet metal shall be of such thickness or shall be so formed or reinforced that it will be equivalent in strength to any of the following:

- a) Uncoated flat steel not less than 0.032 inch (0.81 mm) thick,
- b) Galvanized steel not less than 0.034 inch (0.86 mm) thick, or
- c) Nonferrous metal not less than 0.045 inch (1.14 mm) thick,

and the construction shall permit a standard conduit bushing to be attached.

5.3.3 A plate or plug for an unused conduit opening or other hole in the ultimate enclosure, for a hole having a 1-3/8-inch (34.9-mm) maximum dimension, shall not be less than 0.027 inch (0.66 mm) thick when steel, or 0.032 inch (0.81 mm) thick when nonferrous metal.

5.3.4 A closure for a hole larger than 1-3/8 inch (34.9 mm) shall have a thickness equal to that required for the ultimate enclosure or a standard knockout seal shall be used. Such plates or plugs shall be securely mounted.

5.3.5 A knockout in a sheet metal enclosure shall be secured but shall be capable of being removed without undue deformation of the enclosure.

5.3.6 A knockout shall be provided with a flat surrounding surface for seating of a conduit bushing, and shall be located so that installation of a bushing at any knockout used during installation shall not result in spacings between uninsulated live parts and the bushing of less than those required in this Standard.

5.4 Nonmetallic

5.4.1 An enclosure, or parts of an enclosure, of nonmetallic material shall have the mechanical strength and durability and be formed so that operating parts are protected against damage. The enclosure parts shall resist the abuses encountered during installation and use. The mechanical strength shall be at least equivalent to a sheet metal enclosure of the minimum thickness specified in [Table 5.2](#). See also the Polymeric Materials Tests, Section [36](#).

5.4.2 Polymeric materials used for an enclosure shall comply with the following requirements:

- a) Enclosures containing parts involving a risk of fire: flammability rating of 5V; or flammability rating of V-0 and compliance with the 5-inch Flame Test as described in [36.4.1](#) – [36.4.6](#).
- b) Enclosures containing Class 2 and/or Class 3 circuits with a voltage not exceeding 30 volts AC, 42.2 volts peak, or 60 volts DC: flammability rating of V-2 or better; or flammability rating of HB, and compliance with the 3/4-inch Flame Test as described in [36.3.1](#) – [36.3.6](#).
- c) Enclosures containing circuits powered by batteries or with energy limited to 15 watts: flammability rating of HB or better.

5.4.3 The continuity of the grounding system of the equipment shall not rely on the dimensional integrity of the nonmetallic material.

5.4.4 If wood is used as the overall enclosure of equipment employed as part of a nurse call system, such as a bedside table, the current-carrying components shall be mounted on a metal chassis, box, plate, or similar mounting surface. All exposed live parts shall be totally enclosed and shall be inaccessible except for external user controls.

5.4.5 The thickness of the wood referenced in [5.4.4](#) shall be 1/4 inch (6.4 mm) minimum at the points of protection for current-carrying parts.

5.5 Ventilating openings

5.5.1 When ventilating openings are provided on an enclosure intended for recessed mounting with a front cover panel flush with the surface of the wall, the openings shall be on the front cover panel. When ventilating openings are provided on a surface-mounted enclosure, they shall be on the sides or front of the enclosure, or both.

5.5.2 Ventilating openings in an enclosure housing equipment other than that within reach of a patient or person touching a patient shall be of such size and shape that no opening will permit passage of a rod having a diameter of 5.0 mm. The ventilating openings include perforated holes, louvers, and openings protected by means of wire screening, expanded metal, or perforated covers.

5.5.3 Ventilating openings in an enclosure housing equipment that is intended to be installed within reach of a patient or a person touching a patient shall be of such size and shape that no opening permits passage of a rod having a diameter of 5/64 inch (2.0 mm).

5.5.4 An enclosure that houses fuses or any other overload protective device, and that is provided with ventilating openings, shall provide protection against the emission of flame or molten metal.

5.5.5 Perforated sheet metal and sheet metal employed for expanded-metal mesh shall be at least:

- a) 0.046 inch (1.14 mm) thick if zinc-coated or 0.042 inch (1.07 mm) thick if not zinc-coated if the mesh openings or perforations are 1/2 square inch (320 mm²) or less in area and
- b) 0.084 inch (2.13 mm) thick if zinc-coated, or 0.080 inch (2.03 mm) thick if not zinc-coated if the mesh openings or perforations are larger than 1/2 square inch.

Exception: If the indentation of a guard or enclosure wall does not alter the clearance between uninsulated live parts and grounded metal so as to affect the performance adversely or reduce spacings below the minimum values specified in Spacings, Section [14](#), the thickness shall not be less than 0.021 inch (0.53 mm) expanded metal mesh [0.024 inch (0.61 mm) if zinc coated] when:

- a) The exposed mesh on any one side or surface of the device so protected has an area of no more than 72 square inches (464 cm²) and has no dimension greater than 12 inches (305 mm) or*
- b) The width of an opening so protected is not greater than 3-1/2 inches (90 mm).*

5.5.6 The wires of a screen used in a ventilating opening shall not be smaller than 16 AWG (1.3 mm²) and the screen openings shall not be greater than 1/2 square inch (320 mm²) in area.

5.6 Covers

5.6.1 An enclosure cover shall be hinged, sliding, pivoted, or similarly attached to provide access to fuses or any other overcurrent protective devices, the intended protective functioning of which require renewal, or if it is necessary to open the cover in connection with the normal operation of the unit.

Exception: A hinged cover is not required when the fuse or fuses enclosed are intended to provide protection to portions of internal circuits, such as those employed on a separate printed-wiring board or circuit subassembly to prevent excessive circuit damage resulting from a fault. Such equipment shall be marked in accordance with [43.3](#).

5.6.2 With reference to [5.6.1](#), normal operation is considered to be operation of a switch for testing or for silencing an audible signal device, or operation of any other component of a unit that requires such action in connection with its intended performance.

5.6.3 A required hinged cover shall be provided with a latch, screw, or catch to hold it closed. The hinged cover of a unit intended to be installed where it will be accessible to other than authorized personnel shall be provided with a key lock or with a screw requiring a tool for removal.

5.6.4 An unhinged cover shall be securely held in place by screws or the equivalent.

5.7 Observation opening covers

5.7.1 A glass panel covering an observation opening of equipment not intended for location in a patient area shall be securely held in place so that it is not readily displaced in service and shall provide mechanical protection for the enclosed parts. The thickness of the glass panel shall be no less than that specified in [Table 5.3](#).

Table 5.3
Minimum Thickness of Glass Covers

Maximum size of opening				Minimum thickness of glass	
Length or width		Area			
inches	(mm)	square inches	(cm ²)	inch	(mm)
4	(102)	16	(103)	1/16	(1.6)
12	(305)	144	(928)	1/8	(3.2)
Over 12	(305)	Over 144	(928)	a	

^a 1/8 inch or more, depending upon the size, shape, and mounting of the glass panel.

5.7.2 A glass panel for an opening having an area of more than 144 square inches (928 cm²), or having any dimension greater than 12 inches (305 mm), shall be supported by a continuous flange minimum 3/16-inch (4.8-mm) deep along all four edges of the panel.

5.7.3 A glass panel covering an observation opening of equipment intended for use in a patient area shall be of shatter-resistant "safety" glass or of plastic.

5.7.4 A transparent material, other than glass, employed as a cover over an opening in an enclosure shall have mechanical strength equivalent to that of glass, and shall not distort or become less transparent at the temperature to which it is subjected under all conditions of intended use. See also the Drop Test, Section [32](#), and the Polymeric Materials Tests, Section [36](#).

6 Electric Shock

6.1 Any part that is exposed only during operator servicing shall not present a risk of electric shock. See the Electric Shock Current Test, Section [27](#).

6.2 Each terminal provided for the connection of an external antenna shall be conductively connected to the supply circuit grounded conductor. The conductive connection shall have a maximum resistance of 5.2 megohms, a minimum wattage rating of 1/2 watt, except for the construction described in [6.3](#), and shall be effective with the power switch in either the on or off position.

Exception: The conductive connection is not required to be provided when:

- a) Such a connection is established in the event of electrical breakdown of the antenna isolating means,*
- b) The breakdown does not result in a risk of electric shock, and*
- c) The resistance of the conductive connection between the supply circuit and chassis does not exceed 5.2 megohms, in a construction employing an isolating power transformer.*

6.3 The maximum value of 5.2 megohms specified in [6.2](#) is to include the maximum tolerance of the resistor value used; that is, a resistor rated 4.2 megohms with 20 % tolerance or a resistor rated 4.7

megohms with a 10 % tolerance is acceptable. A component comprised of a capacitor with a built-in shunt resistor that complies with the requirements in the Standard for Fixed Capacitors for Use in Electronic Equipment – Part 14: Sectional Specification: Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains, UL 60384-14, shall not be rated less than 1/4 watt.

6.4 The insertion in any socket of a plug-in component used in the product shall not result in a risk of electric shock.

7 Corrosion Protection

7.1 Iron and steel parts, other than bearings and similar parts for which such protection is impracticable, shall be protected against corrosion by enameling, galvanizing, sherardizing, plating, or other equivalent means.

7.2 The requirement of [7.1](#) applies to all enclosures made of sheet steel or cast iron, and to all springs and other parts upon which mechanical operation depends. Bearing surfaces shall be of material that prevents binding due to corrosion.

Exception No. 1: This requirement does not apply to minor parts, such as washers, screws, bolts, and similar parts, if the corrosion of such unprotected parts does not result in a risk of fire, electric shock, or unintentional contact with moving parts causing injury to persons, or impair the operation of the unit.

Exception No. 2: Parts made of stainless steel, polished or treated, when required, do not require additional protection against corrosion.

8 Field Wiring System Connections

8.1 General

8.1.1 Hospital signaling and nurse call equipment shall be provided with wiring terminals or leads for the connection of conductors corresponding to the voltage and ampere rating of the unit.

8.1.2 The wiring areas to which field installed conductors are made to both high- and low-voltage circuits shall be segregated or separated inside the enclosure by barriers, obvious or marked routing means, or equivalent, to reduce the risk of leakage current being imposed through the conductor insulation on internal circuit wires or components operating at the lower potential.

8.2 Terminals

8.2.1 High-voltage circuits

8.2.1.1 The following terminal configurations, or equivalent, shall be employed for high-voltage circuits of a control unit to which field wiring connections are to be made.

a) Connectors and Lugs – Nonferrous soldering lugs or solderless (pressure) wire connectors shall be used for 10 AWG (5.3 mm²) and larger wires. When the connectors or lugs are secured to a plate, the plate shall be no less than 0.050 inch (1.27 mm) thick. It is not prohibited that securing screws be plated steel.

b) Terminal Plates with Wire Binding Screws – A terminal plate tapped for a wire binding screw shall be of a nonferrous metal no less than 0.050 inch (1.27 mm) thick for a No. 8 (4.2 mm diameter) or larger screw, and no less than 0.030 inch (0.76 mm) thick for a No. 6 (3.5 mm diameter) screw. The plate shall engage no less than two full threads of the screw. It is not prohibited that the plate be extruded to provide this engagement. The terminal shall be returned

lugs, clamps, or the equivalent to hold the wires in position. If a wire binding screw is employed at a wiring terminal, the screw shall be no smaller than No. 8, except that a No. 6 screw may be employed for the connection of a 14 AWG (2.1 mm²) or smaller conductor. It is not prohibited that the screws be plated steel.

8.2.2 Low-voltage power-limited circuits

8.2.2.1 The following terminal configurations or equivalent shall be employed for the connection of field wiring to low-voltage, power-limited circuits. Also see [8.2.2.2](#).

- a) Terminal configurations specified in [8.2.1.1](#) (a) or (b).
- b) Telephone Type Terminals – Nonferrous terminal plates employing a narrow V-shaped slot for securing a conductor in a special post design. Such terminals require a special tool for wire connection.
- c) Solderless Wrapped Terminals – Nonferrous terminals that require a special tool and terminal post construction.
- d) Quick-Connect Terminals – Nonferrous quick-connect (push type) terminals consisting of male posts permanently secured to the device and provided with compatible female connectors for connection to field wiring. Such terminals require a special tool. Mating terminals shall be provided with the equipment and instructions for their installation.
- e) Push-In Terminals – Nonferrous (screwless) terminals of the type where solid conductors are pushed into slots containing spring type contacts. The leads can be removed by means of a tool inserted to relieve the spring pressure on the conductor. Equipment employing this type of terminal configuration shall be marked in accordance with [43.8](#).
- f) Solder Terminals – Conventional nonferrous solder terminals.

8.2.2.2 Equipment employing the terminal configurations specified in [8.2.2.1](#) (b) – (f) shall comply with all of the following. Also see the Tests for Special Terminal Assemblies, Section [35](#).

- a) If a special tool is required for the terminal connection, it shall be provided. See [46.3](#).
- b) The minimum field wire size to be employed shall be 22 AWG (0.36 mm²).
- c) The wire size to be employed shall be suitable for the current-carrying capacity of the circuit application.
- d) The terminal configurations shall not be used for leads intended to be removed for testing.

8.3 Leads

8.3.1 General

8.3.1.1 A lead provided for field connection shall be no less than 6 inches (152 mm) long and shall be provided with strain relief. See [8.9.1](#).

Exception: It is not prohibited that the free lead length be less than 6 inches if it is evident that the use of a longer lead results in damage to the lead insulation.

8.3.2 High-voltage circuits

8.3.2.1 A lead provided for field connection to a high-voltage circuit shall be no smaller than 18 AWG (0.82 mm²), and the insulation shall be no less than 1/32 inch (0.8 mm) thick.

8.3.3 Low-voltage power-limited circuits

8.3.3.1 A lead provided for field connection to a low-voltage power-limited circuit shall be no smaller than 22 AWG (0.36 mm²), and the insulation shall be no less than 1/64 inch (0.4 mm) thick. See also [8.4.3](#) and [8.9.1](#).

8.4 Interconnecting wiring

8.4.1 The wires of cable assemblies provided as part of hospital signaling and nurse call equipment shall have electrical ratings consistent with the voltage and ampacity of the application. The wires shall comply with the Standard for Thermoset-Insulated Wires and Cables, UL 44, or the Standard for Thermoplastic-Insulated Wires and Cables, UL 83.

8.4.2 Wires of high-voltage circuits shall be separated from wires of low-voltage circuits by being run in separate cable assemblies or separate jacketed assemblies of the same cable. The high-voltage wires or portion of cable shall be identified to prevent misapplication.

8.4.3 Cable assemblies, provided for field interconnection of hospital signaling or nurse call system units for use in low-voltage power-limited circuits, shall consist of conductors no smaller than 24 AWG (0.21 mm²) when provided with a connector or receptacle at either end, and 22 AWG (0.32 mm²) if terminated in splice leads. The insulation of the individual conductors in the cable assembly shall be at least 0.010 inch (0.25 mm) thick and the jacket shall be at least 0.030 inch (0.76 mm) thick. Both individual conductor insulation and cable jackets shall be rated for use at 300 volts and 60 °C (140 °F) minimum.

8.4.4 Conductors terminated in connectors or receptacles shall be provided with strain relief.

8.5 Equipment grounding connection

8.5.1 Hospital signaling and nurse call equipment shall be provided with a separate equipment grounding terminal or lead. The grounding means shall be connected to all exposed dead metal parts that are likely to become energized, and all dead metal parts within the enclosure that are exposed to contact during servicing or use.

8.5.2 The surface of an insulated lead intended solely for the connection of an equipment grounding conductor shall be green, with or without one or more yellow stripes. No other leads shall be so identified. The lead shall be at least 6 inches (152 mm) long and of a size equivalent to the supply conductors to the unit.

8.5.3 A field wiring terminal screw intended for the connection of an equipment grounding conductor shall have a green-colored head that is hexagonal, slotted, or both. A pressure wire connector intended for connection of such a conductor shall be plainly identified in accordance with [43.10](#). The field wiring terminal screw shall be located so that it is unremovable during servicing of the product and shall be of a size to secure a conductor the same size as the supply conductors to the unit.

8.6 Supply connections

8.6.1 Permanently connected equipment

8.6.1.1 Hospital signaling and nurse call equipment intended for permanent installation shall have provision for connection of metal-clad cable or conduit, or a nonmetallic-enclosed wiring system, for example, nonmetallic sheathed cable, suitable for the application under the provisions of the National Electrical Code, NFPA 70, except as provided in [8.6.1.2](#).

8.6.1.2 An enclosure without provision for the connection of metal-clad cable, conduit, or a nonmetallic-enclosed wiring system is not prohibited when specific instructions are provided indicating those sections of the unit intended to be punched or drilled in the field for the connections.

8.6.2 Cord-connected equipment

8.6.2.1 It is not prohibited that portable equipment, and equipment located in a dedicated or designated space requiring cord connections to facilitate use or disconnection for maintenance and repair, be provided with a flexible cord and attachment plug for connection to the supply source.

8.6.2.2 The type of cord and plug employed for the connection shall have the voltage and ampere rating for the maximum voltage and current in service. Types SE, SJ, SJE, SJT, S, ST, SJO, or the equivalent shall be employed. When high-voltage and low-voltage, power-limited conductors are employed in the same cable, a positive physical separation shall be maintained between conductors of the two circuits.

8.7 Grounded supply conductor connection

8.7.1 A field wiring lead intended for the connection of a high-voltage grounded power supply conductor shall be finished to show a white or gray color and shall be readily distinguishable from the other leads.

8.7.2 A field wiring terminal (for example, plate and screw) intended for the connection of a grounded power supply conductor shall be identified by means of a metallic plated coating that is substantially white in color and readily distinguishable from the other terminals, or proper identification of the terminal shall be clearly shown in some other manner, such as on an attached or referenced wiring diagram.

8.8 Compartments

8.8.1 A compartment provided for making field connections shall be of sufficient volume to allow connections to all field wiring terminals and leads without damage to wire insulation or internal components. Internal components and wire insulation shall be protected from sharp edges by insulating or metal barriers having smoothly rounded edges or by compliance with [43.9](#).

8.9 Strain relief

8.9.1 A strain relief means shall be provided to reduce the transmission of stress to terminals, internal connections, and components for any power supply cord, supply lead, internally connected wire, wire harness, and cable that is subject to movement in conjunction with the operation or servicing of any nurse call equipment. Inward movement of the cord or leads provided with a metal ring type of strain relief shall not damage internal connections or components or reduce electrical spacings. See the Strain Relief Test, Section [37](#).

9 Internal Wiring

9.1 General

9.1.1 The internal wiring in hospital signaling and nurse call equipment shall consist of insulated conductors having the mechanical strength, voltage rating, temperature rating, and current-carrying capacity for the service. See [11.7.2](#) for conductor size requirements for pendant controls. The wiring shall be routed away from moving parts and sharp projections and held in place with clamps, string ties, or equivalent, unless it is of sufficient rigidity to retain a shaped form. The wiring shall comply with the Standard for Thermoset-Insulated Wires and Cables, UL 44, or the Standard for Thermoplastic-Insulated Wires and Cables, UL 83.

9.1.2 A lead or a cable assembly connected to a part mounted on a hinged cover shall be of sufficient length to allow the full opening of the cover without applying stress to the lead or the connections. The lead shall be secured or equivalently arranged to reduce the occurrence of abrasion of the insulation and jamming of the leads between parts of the enclosure.

9.1.3 If the use of a short length of insulated conductor is not feasible (such as a short coil lead) the use of electrical insulating tubing is not prohibited. The tubing shall not be subject to sharp bends, tension, compression, or repeated flexing, and shall not contact sharp edges, projections, or corners. The wall thickness shall comply with the requirements for such tubing, except that the wall thickness at any point of polyvinyl chloride tubing 3/8 inch (9.5 mm) in diameter or less shall not be less than 0.017 inch (0.43 mm). For insulating tubing of other types, the thickness shall not be less than that required to provide mechanical strength, dielectric properties, and heat and moisture resistance characteristics at least equal to 0.017 inch thick polyvinyl chloride tubing.

9.1.4 Internal wiring between high- and low-voltage circuits shall be separated by barriers or shall be segregated. Segregation of insulated conductors shall be accomplished by clamping, routing, or equivalent means.

Exception: Segregation is not required if the insulation of all conductors is acceptable for the highest voltage involved.

9.1.5 A stranded conductor clamped under a wire-binding screw or similar part shall have the individual strands soldered together or equivalently arranged.

9.2 Wireways

9.2.1 A wireway shall be smooth and free from sharp edges, burrs, fins, moving parts, and similar defects that cause abrasion of the conductor insulation. See [9.5.1](#) – [9.5.6](#).

9.3 Splices

9.3.1 A splice or connection shall be mechanically secure and bonded electrically.

9.3.2 A splice shall be provided with insulation equivalent to that of the wires involved if permanence of spacings between the splice and uninsulated metal parts is not provided.

9.3.3 A splice shall be located, enclosed, and supported so it is not subject to damage, flexing, motion, or vibration.

9.4 Barriers

9.4.1 A metal barrier shall have a thickness at least equal to that specified in [Table 5.2](#), based on the size of the barrier. A barrier of insulating material shall be no less than 0.028 inch (0.71 mm) thick and shall be thicker if its deformation may be readily accomplished so as to defeat its purpose. Any clearance between the edge of a barrier and a compartment wall shall be no more than 1/16 inch (1.6 mm).

9.5 Bushings

9.5.1 Where a lead or wire harness passes through an opening in a wall, barrier, or enclosing case, there shall be a metal or insulating type bushing, or the equivalent, that is secured in place and has smoothly rounded surfaces against which the wire bears.

9.5.2 When the opening is in phenolic composition or other nonconducting material or in metal greater than 0.042 inch (1.07 mm) thick, a smooth surface having rounded edges shall be determined to be the equivalent of a bushing.

9.5.3 Ceramic materials and some molded compositions are suitable for insulating bushings, but separate bushings of wood and of hot-molded shellac are not.

9.5.4 Fiber shall be used where it is not subjected to temperatures higher than 90 °C (194 °F) under normal operating conditions, only when:

- a) The bushing is no less than 3/64 inch (1.2 mm) thick and
- b) It is formed and secured in place such that it is not affected by conditions of ordinary moisture.

9.5.5 If a soft-rubber bushing is employed in a hole in metal, the hole shall be free from sharp edges, burrs, projections, and similar defects that are capable of cutting into the rubber.

9.5.6 An insulating metal grommet is suitable in lieu of an insulating bushing, when the insulating material used is no less than 1/32 inch (0.8 mm) thick and completely fills the space between the grommet and the metal in which it is mounted.

10 Bonding for Grounding

10.1 An exposed dead metal part that becomes energized shall be bonded to the point of connection of the field equipment grounding terminal or lead and to the metal surrounding the knockout, hole, or bushing provided for field power supply connections.

10.2 An uninsulated metal part of a cabinet, electrical enclosure, or mounting bracket, capacitors, or other electrical component shall be bonded if it is capable of being contacted by the user or by a service person in servicing the equipment.

10.3 A metal part of a bedside table shall be conductively connected to the ground lead of the connecting cable or ground lug of a metal compartment intended to be connected by conduit or metal-clad cable.

Exception: This requirement does not apply to exposed small metal parts, such as screws, nails, hinges, knobs, and similar parts, that are not energized in the event of a fault condition.

10.4 A bonding conductor shall be of material suitable for use as an electrical conductor. If of ferrous metal, it shall be protected against corrosion by painting, plating, or the equivalent. The conductor shall not be smaller than the maximum size wire employed in the circuit wiring of the component or part. A separate bonding conductor or strap shall be installed so that it is protected from mechanical damage.

10.5 The bonding shall be by a positive means, such as by clamping, riveting, a bolted or screwed connection, brazing, or welding. The bonding connection shall penetrate nonconductive coatings, such as paint. Bonding around a resilient mount shall not depend on the clamping action of rubber or similar material.

10.6 A bolted or screwed connection that incorporates a star washer under the screwhead is suitable for penetrating nonconductive coatings as required in [10.5](#).

10.7 If the bonding means depends upon screw threads, either two or more screws or two full threads of a single screw engaging metal is suitable.

10.8 A metal-to-metal hinge-bearing member for a door or a cover is suitable as a means for bonding the door or cover for grounding of equipment not intended to be installed in a patient area, such as a power supply or control cabinet.

10.9 A conductor, such as a clamp or strap, used in place of a separate wire conductor as specified in [10.4](#) is suitable if the minimum cross-sectional conducting area is equivalent to the specified wire size.

10.10 A splice shall not be employed in a wire conductor used to bond electrical enclosures or other electrical components.

11 Components

11.1 Printed-wiring boards

11.1.1 A printed-wiring board shall comply with the applicable requirements in the Standard for Printed-Wiring Boards, UL 796. The spacings between circuits shall comply with the spacing requirements of this Standard. The board shall be mounted so that deflection of the board during servicing does not result in damage to the board or in a risk of fire or electric shock. All printed-wiring boards shall have a flammability rating of V-2 or better.

11.2 Coil windings

11.2.1 The insulation of a coil winding or relay, transformer, or similar component shall resist the absorption of moisture.

11.2.2 Film-coated wire is not required to be given additional treatment to resist moisture absorption.

11.3 Switches

11.3.1 A switch provided as part of nurse call equipment shall have a voltage and ampere rating of no less than that of the circuit it controls when the unit is operated under any condition of intended service. A single pole switching device shall not be connected to the identified (grounded) conductor. A switch intended to be under the control of a patient shall not be connected to high-voltage circuits.

11.4 Lampholders and lamps

11.4.1 A lampholder and lamp shall have a voltage and ampere rating for the circuit in which they are employed when the unit is operated under any condition of intended service. A lamp within the reach of a patient shall be protected by a jewel or equivalent means.

11.4.2 The screw shell of any Edison-base lampholder in the high-voltage circuit of a unit shall be connected to the identified (grounded) conductor.