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Hospital Signaling and Nurse Call Equipment

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The following table lists the future effective dates with the corresponding reference.

Future Effective Dates	References
March 29, 2004	Paragraphs 42.1, 42.5, 42.6, 42.11, 43.1, and 44.1

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New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing, Recognition, and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

This Standard consists of pages dated as shown in the following checklist:

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March 29, 2001

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Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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APPENDIX A

Standards for Components A1

FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover the individual units employed to form a hospital nurse call system (NCS) intended to provide audible and visual communication between patients and hospital personnel. They also cover miscellaneous signaling equipment employed in hospitals. Some examples include bedside tables, annunciators, power supplies for nurse call systems, and gas monitoring units.

1.2 The units covered by these requirements are intended to be installed in either general or critical care areas in accordance with the National Electrical Code, NFPA 70, and the Standard for Health Care Facilities, NFPA 99.

1.3 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. 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.

1.4 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

2.1.2 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.

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

2.1.4 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.

2.2 Units of measurement

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

2.2.2 Unless otherwise specified, all voltages are rms.

2.3 Undated references

2.3.1 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.

2.4 Maximum voltage and power

2.4.1 The maximum distribution voltage available to equipment intended to be installed in areas accessible to a patient or persons touching a patient is not more than 30 volts AC (42.4 volts peak), 42.4 volts peak for nonsinusoidal AC, or 42.4 volts continuous DC. 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. The maximum voltages to a pendant control circuit, where wet contact is likely to occur, shall not be more than 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. See Voltage and Current Measurements, Section 19.

2.5 Manufacturer documentation of devices and operations

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

2.5.2 A fundamental device or operation, which has not been evaluated to the requirements of this standard, shall not replace a device that was evaluated and tested to the requirements of this standard as part of the NCS.

3 Glossary

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

3.2 ALARMS – A signal, typically generated automatically, which annunciates an abnormal condition (e.g., the opening of an emergency-exit door or an unauthorized entry to narcotics storage).

3.2 added March 29, 2001

3.3 ANESTHETIZING LOCATION – Any area of a health care facility that has been designated for the administration, by inhalation, of any flammable or nonflammable anesthetic agent.

3.3 added March 29, 2001

3.4 ANNUNCIATOR – An electrically operated visual indicating appliance containing one or more identified lamps or targets each of which indicates a circuit condition or location, or both.

3.4 revised March 29, 2001

3.5 ANNUNCIATOR PANEL – A device that signals the presence and locations of calls or alarms in the system. It typically provides both audible and visual indications.

3.5 added March 29, 2001

3.6 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 added March 29, 2001

3.7 BATH AREA – Any patient bathing or toilet area. See Wet Area, 3.94.

3.7 added March 29, 2001

3.8 BATH STATION – A call-initiating device located in a bath area to allow patients or staff to summon help. Typically activated by a pull cord.

3.8 added March 29, 2001

3.9 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.

3.9 added March 29, 2001

3.10 BEDSIDE STATION – See Patient Station, 3.66.

3.10 added March 29, 2001

3.11 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.

3.11 added March 29, 2001

3.12 CENTRAL EQUIPMENT – The components needed to process and distribute 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.

3.12 added March 29, 2001

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

3.13 revised March 29, 2001

3.14 CIRCUIT, HIGH-VOLTAGE – A circuit having characteristics in excess of those of a low-voltage, power-limited circuit as defined in 3.15.

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

3.16 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.

3.16 added March 29, 2001

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

3.17 added March 29, 2001

3.18 CODE-BLUE CALL – See Code Call, 3.19.

3.18 added March 29, 2001

3.19 CODE CALL – A distinctive audible and visual signal representing a life-threatening situation that requires immediate action.

3.19 revised March 29, 2001

3.20 CODE-CALL SWITCH – A switch (typically wall mounted) used to place a code call.

3.20 added March 29, 2001

3.21 CODE-CALL SYSTEM – A system used to alert the necessary staff to a life-threatening situation requiring immediate action. It can be either a stand-alone system or a part of a nurse call system.

3.21 added March 29, 2001

3.22 COMPUTERIZED SYSTEM – A nurse call system that is controlled by a computer or an embedded microprocessor.

3.22 added March 29, 2001

3.23 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.

3.24 CORONARY CARE AREA – An area designated for the care of cardiac patients.

3.24 added March 29, 2001

3.25 CORRIDOR LAMP – 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 bulb or several bulbs of different colors to indicate the types of calls and staff members. Also referred to as a dome light.

3.25 added March 29, 2001

3.26 CRITICAL BRANCH CIRCUIT – A subsystem of the facility's emergency electrical system. Its feeders and branch circuits carry energy for functions related to patient care. During power outages, this subsystem is automatically connected to an alternate power source through one or more transfer switches.

3.26 added March 29, 2001

3.27 CRITICAL CARE UNIT (CCU) – An area where patients are subjected to invasive procedures and connected to line-operated, electro-medical devices. Examples are special care units, intensive care units, coronary care units, angiography laboratories, cardiac catheterization laboratories, delivery rooms, and operating rooms. Also referred to as an Intensive Care Unit (ICU).

3.27 added March 29, 2001

3.28 DAY/NIGHT TRANSFER – A feature that allows the staff in one nursing unit to temporarily (e.g. at night) answer calls from patients in a nearby nursing unit, in addition to their normally assigned calls.

3.28 added March 29, 2001

3.29 DOME LIGHT – See Corridor Lamp, 3.25.

3.29 added March 29, 2001

3.30 DUMMY PLUG – A connector without an active device that is plugged into the patient station's call-cord receptacle to prevent the station from automatically calling to indicate the absence of a call cord or pillow speaker.

3.30 added March 29, 2001

3.31 DUTY STATION – A station that uses tones and lamps to annunciate calls by their type or priority. It is normally installed in a location where nurses tend to be when they are not at the nurse control station or in patient rooms (e.g., clean linens, soiled linens, nurses' lounge).

3.31 added March 29, 2001

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

3.32 added March 29, 2001

3.33 EMERGENCY SIGNAL – An audible and visual signal that requires immediate action, but does not necessarily indicate a life threatening situation.

3.34 EMERGENCY SYSTEM – A system of feeders and branch circuits that can supply, within 10 seconds of a power interruption, alternate power to a limited number of prescribed functions vital to the protection of life and patient safety. It must meet the requirements of NFPA 70, Article 700.

3.34 added March 29, 2001

3.35 FIRE ALARM ANNUNCIATION – Alarm annunciation by a fire-alarm system which is determined to be appropriate for the intended use. See Supplementary Fire-Alarm Annunciation, 3.87.

3.35 added March 29, 2001

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

3.37 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.

3.38 FUNDAMENTAL OPERATION – An essential/required operation whose primary function is to provide notification and/or reset/cancellation of a staff-initiated or patient-initiated call signal to alert the staff. These operations include all of the following:

a) Call annunciation at a nurse's station (audible and visual),

b) Call annunciation at the dome light,

c) Call-placed indicator on the patient station (visual),

d) Zone annunciation (audible and visual), and

e) Call reset/cancellation.

An NCS must contain devices that perform all of these fundamental operations.

3.38 revised March 29, 2001

3.39 GENERAL CARE AREA – Patient bedrooms, examining rooms, treatment rooms, clinics, and similar areas in which it is intended that the patient shall come in contact with ordinary appliances, such as a nurse call system, electrical beds, examining lamps, telephones, and entertainment devices. The patients may also be connected to electro-medical devices, such as heating pads, electrocardiographs, drainage pumps, monitors, otoscopes, ophthalmoscopes, and intravenous lines.

3.39 added March 29, 2001

3.40 GERIATRIC CALL CORD – A call cord designed for patients who cannot easily manipulate a push-button. It normally has a pressure-pad switch in lieu of a push-button switch.

3.40 added March 29, 2001

3.41 GROUND FAULT – An unintended electrical connection to ground.

3.41 added March 29, 2001

3.42 GROUNDED CONDUCTOR – A system or circuit conductor that is intentionally grounded.

3.43 GROUNDING – A system of conductors that provides a low-impedance return-path for leakage and fault currents.

3.43 added March 29, 2001

3.44 GROUNDING CONDUCTOR – A conductor used to connect equipment or the grounded circuit of a wiring system to a grounded electrode or electrodes.

3.45 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.

3.46 HEADWALL – An assembly, usually prefabricated, set into the wall at the head of a patient's bed. It provides connections for, and helps integrate, a variety of systems, including medical gas, vacuum, electrical power, lighting, communications, and emergency signaling.

3.46 added March 29, 2001

3.47 INTENSIVE CARE UNIT (ICU) – See Critical Care Unit (CCU), 3.27.

3.47 added March 29, 2001

3.48 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.

3.49 MASTER STATION (NURSE MASTER STATION) – See Nurse Control Station, 3.52.

3.49 added March 29, 2001

3.50 NITROUS OXIDE – A sweet-smelling gas used to induce the first and second stages of anesthesia. It can be a fire hazard.

3.50 added March 29, 2001

3.51 NURSE CALL SYSTEM – A system of components that provides audible and visual communication between patients and hospital personnel.

3.51 added March 29, 2001

3.52 NURSE CONTROL STATION – A component, intended to be located at the 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 master station.

3.52 added March 29, 2001

3.53 NURSING UNIT – An area of the facility that includes rooms for patients and the specific group of personnel dedicated to those beds.

3.53 added March 29, 2001

3.54 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.

3.54 added March 29, 2001

3.55 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.

3.55 added March 29, 2001

3.56 OVERVOLTAGE – Any voltage that exceeds its rated or intended value.

3.56 added March 29, 2001

3.57 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.

3.57 added March 29, 2001

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

3.58 added March 29, 2001

3.59 PABX – A Private Automated Branch Exchange is the on-site central equipment that controls a facility's telephone equipment.

3.59 added March 29, 2001

3.60 PAGING SYSTEMS – A public address system sometimes associated with the nurse call system. This is not to be confused with a Radio Paging System, 3.76.

3.60 added March 29, 2001

3.61 PARALLEL CALL – A system that provides for one or more patient stations to simultaneously annunciate at more than one nurse control station.

3.61 added March 29, 2001

3.62 PATIENT BED LOCATION – The location of an inpatient sleeping bed or the bed or procedure table used in a critical-care area.

3.62 added March 29, 2001

3.63 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) Wet Location Area – Work area that is normally subject to wet conditions including standing water on the floor or routine dousing or drenching. Routine housekeeping procedures and incidental spillage of liquids does not constitute a wet location area.

3.64 PATIENT-CONTROLLED LIGHTING – Room and reading lights that can be regulated from the patient's bed.

3.64 added March 29, 2001

3.65 PATIENT MONITORING – The use of a nurse control station to monitor the sounds from one or more patient rooms.

3.65 added March 29, 2001

3.66 PATIENT STATION – A device 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 options include an intercom speaker/microphone and entertainment circuits for television control.

3.66 added March 29, 2001

3.67 PATIENT VICINITY – In an area where patients are normally cared for, the patient vicinity is the space with surfaces likely to be contacted by the patient or an attendant who can simultaneously touch the patient. In a typical patient room, this encloses a space not less than six feet (1.83 m) beyond the perimeter of the bed in its normal location, and extends vertically not less than seven feet (2.29 m) above the floor.

3.67 added March 29, 2001

3.68 PENDANT CONTROL – See Pillow Speaker, 3.70.

3.68 added March 29, 2001

3.69 PHYSIOLOGICAL MONITORING – A feature that enables the nurse control station to automatically signal alarms generated by remote, properly equipped physiological monitoring equipment which has been evaluated as suitable for the purpose.

3.69 added March 29, 2001

3.70 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.

3.70 added March 29, 2001

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

3.72 POWER CONDITIONING – The process of regulating the 120-Vac electrical power to eliminate noise, hold the voltage within a specified tolerance, and hold the ac wave form within a specified tolerance, and hold the ac wave form to within a specified distortion limit.

3.72 added March 29, 2001

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

3.73 added March 29, 2001

3.74 PSYCHIATRIC STATION – The general term for stations designed for psychiatric areas. See under Secure Psychiatric, 3.77 – 3.79.

3.74 added March 29, 2001

3.75 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.

3.75 added March 29, 2001

3.76 RADIO PAGING SYSTEM – A system consisting of a radio-frequency encoder and a transmitter plus portable pagers (sometimes known as “beepers”).

3.76 added March 29, 2001

3.77 SECURE PSYCHIATRIC CEILING SPEAKER – A speaker, usually mounted in the ceiling with tamper-resistant hardware, that allows the staff to monitor the sounds in the room, especially when another staff member is attending the patient.

3.77 added March 29, 2001

3.78 SECURE PSYCHIATRIC EMERGENCY SWITCH – A temper-resistant switch mounted inside a secure psychiatric patient room. When enabled, it can be pressed by a staff member to signal an emergency. This switch cannot be reset from inside the patient room.

3.78 added March 29, 2001

3.79 SECURE PSYCHIATRIC HALL STATION – Located in the hall outside a psychiatric patient room, the hall station signals the nurse control station when a staff member is entering the psychiatric patient room so that it can be monitored. Frequently such a call also enables (i.e., arms) the psychiatric emergency switches in the room.

3.79 added March 29, 2001

3.80 SHOWER STATION – A pull cord activated and waterproof station that can be installed inside a shower stall and used by a patient to summon help.

3.80 added March 29, 2001

3.81 STAFF EMERGENCY STATION – A station that places “staff emergency” calls.

3.81 added March 29, 2001

3.82 STAFF LOCATOR STATION – A station at which hospital personnel (e.g. nurse, aide, or orderly) are intended to register their presence.

3.83 STAFF REGISTER STATION – A station that signals the type of staff (e.g. RN, LPN) present in a room.

3.83 added March 29, 2001

3.84 STAFF STATION – A station typically used by the staff to place calls to the nurse control station. It is typically located in staff areas but can also be located in areas used by ambulatory patients.

3.84 added March 29, 2001

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

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

3.87 SUPPLEMENTARY FIRE ALARM ANNUNCIATION – Annunciation not required by NFPA codes.

3.87 added March 29, 2001

3.88 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.

3.89 SWING ROOM – A room whose patient station can selectively annunciate at a different nurse control station, typically in response to a change in the facility’s patient load.

3.89 added March 29, 2001

3.90 TOILET STATION – A station in a toilet area that allows a patient to signal for help.

3.90 added March 29, 2001

3.91 UNGROUNDED SYSTEM – A system isolated from earth ground.

3.91 added March 29, 2001

3.92 UNINTERRUPTIBLE POWER SUPPLY (UPS) – A power supply that, when its input power is disrupted, will continue to supply power to the load for a prescribed period of time.

3.92 added March 29, 2001

3.93 VISUAL NURSE CALL SYSTEM – A nurse call system that annunciates calls by visually identifying the location or origin and sounding a tone, but which does not provide audio communication.

3.93 added March 29, 2001

3.94 WET AREA – Patient-care areas that are commonly wet while patients are present. These include standing fluids on the floor or the drenching of the work area where the fluids would likely come in contact with the patient or the staff. Areas that are routinely made wet by housekeeping procedures and incidental spills are not considered ”wet”.

3.94 added March 29, 2001

3.95 ZONE LAMP – This is similar to a corridor lamp, but it visually annunciates calls from a group of rooms in a particular area. Normally a zone lamp is located at corridor intersections where the observer cannot see the room corridor lamps.

3.95 added March 29, 2001

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 33) 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 ancillary 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.

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, inch	Die-cast metal, (mm)	Cast metal of other than the die-cast type, inch	Cast metal of other than the die-cast type, (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								
Any linear dimension,		Area of any surface,		Zinc-coated,			Uncoated,			Brass or aluminum,		
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 35.

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 9/64 inch (3.6 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 mm^2) 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 cm^2) 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 No. 16 AWG (1.3 mm^2) and the screen openings shall not be greater than 1/2 square inch (320 mm^2) 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 42.5.

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 (982 cm^2), 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 31, and the Polymeric Materials Tests, Section 35.

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 percent tolerance or a resistor rated 4.7 megohms with a 10 percent tolerance is acceptable. A component comprised of a capacitor with a built-in shunt resistor that complies with the requirements in the Standard for Capacitors and Suppressors for Radio- and Television-Type Appliances UL 1414, 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 No. 10 AWG (5.3 mm^2) 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 have upturned 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 No. 14 AWG (2.1 mm^2) 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 42.10.

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 45.3.

b) The minimum field wire size to be employed shall be No. 22 AWG (0.36 mm^2).

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 No. 18 AWG (0.82 mm^2), 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 No. 22 AWG (0.36 mm^2), 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 No. 24 AWG (0.21 mm^2) when provided with a connector or receptacle at either end, and No. 22 AWG (0.32 mm^2) 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 42.12. 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 natural 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 42.11.

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 and current-carrying capacity for the service. The wire size shall be at least No. 26 AWG (0.13 mm^2) single conductor wire or No. 28 AWG (0.8 mm^2) multi-conductor, jacketed wire, except as noted in 11.7.2. Wiring for supplementary features is not prohibited from being smaller than No. 26 AWG when it is rated for the application. The wiring shall be routed away from moving parts and sharp projections and held in place with clamps, string ties, or equivalent, unless 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.

11.4.3 If more than one lampholder is provided, the screw shells of all such lampholders in the high-voltage circuit shall be connected to the same conductor unless there is no risk of electric shock present when replacing the lamps.

11.4.4 A lampholder in a high-voltage circuit shall be installed so that uninsulated live parts other than a screw shell are not exposed to contact by persons removing or replacing lamps.

11.4.5 A lamp employed for signaling an emergency condition shall be red or flashing white, or equivalent.

11.4.6 A lamp that is required for compliance with the Normal Operation Test, Section 17, and that requires periodic replacement due to burnout, shall be replaceable without disassembly of a unit except for removal of a cover or opening of a door to gain access.

Exception: A lamp is not required to be accessible if it complies with a 100,000-cycle endurance test as specified in the Endurance Test, Section 24.

11.5 Protective devices

11.5.1 A fuseholder, fuse, or circuit breaker provided on a unit shall be rated for the application. A protective device, other than a fuse, employed to limit the output circuit of the main power supply providing energy to the equipment to be used by the patient, shall be of a manual or automatic resettable type. The maximum current rating of noninterchangeable overcurrent clarity protection employed with a transformer providing energy to a low-voltage power-limited circuit shall comply with the equation:

$$\frac{100\ VA}{V_{maximum}} \leq 5\ amperes$$

in which:

$V_{maximum}$ *is the maximum circuit voltage.*

11.6 Connectors and receptacles

11.6.1 A receptacle or connector of the multiple pin type shall be suitable for the current and voltage to which it will be subjected, and it shall include a grounding pin or lug having a current-carrying capacity equivalent to the maximum size conductor employed in the connected cable assembly.

Exception: The connecting plug leading to a pillow speaker is not required to have a grounding pin if the speaker is enclosed in an impact resistant nonmetallic enclosure.

11.7 Pendant controls

11.7.1 A current-carrying part of a pendant control intended to be used by the patient shall be totally enclosed in an impact-resistant, flame-retardant, or equivalent, insulating material. See the Drop Test, Section 32, and the Polymeric Materials Tests, Section 36. This does not apply to the openings of the enclosure that accommodate functional devices, such as switches, speakers, and control switch knobs. The enclosure shall be marked to caution the user against employing the equipment in an oxygen-enriched atmosphere, unless it has been determined to be acceptable for that type of use. See 42.1(i). A pendant control shall be provided with strain relief at each end of the point of connection to the cord assembly.

11.7.2 The wiring of a pendant control shall have the ampacity for the current involved and shall not be smaller than No. 22 AWG (0.32 mm^2) for 1 – 5 conductors, No. 24 AWG (0.21 mm^2) for 6 – 10 conductors, and No. 26 AWG (0.13 mm^2) for 11 or more conductors.

11.7.3 A plate having a hook, holder, or an equivalent arrangement shall be provided to support the pendant control when not in use.

11.8 Transformers

11.8.1 A transformer intended to supply energy to low-voltage signaling system components located in the patient care area shall be so constructed that the primary and secondary windings are physically separated to prevent the primary circuit potential from being impressed on the secondary circuits. The physical separation shall be accomplished in accordance with any one of the methods specified in (a) – (f). In all cases the transformer core shall be grounded to the enclosure.

a) Windings are wound on insulation on separate legs of a transformer core.

b) Separately-wound, end-to-end (not concentrically) primary and secondary windings, or adjacent secondary windings, are each wound on insulation, on the same leg of the transformer core, and the ends of each winding are separated by 1/32 inch (0.8 mm) thick barrier of insulation.

c) Concentrically-wound primary and secondary windings, or adjacent secondary windings, are separated by a grounded copper shield at least 0.13 mm (0.005 inch) thick or the equivalent. The copper shield is to completely isolate the adjacent windings, splices, and crossover leads. The shield shall extend the full width of the coil windings and be grounded to the core either directly or by a conductor.

d) Concentrically-wound primary and secondary windings, separated by two layers of mica having a total thickness of 0.18 mm (0.007 inch), or of other insulating material having equivalent characteristics. The same insulating material, type, and thickness is also provided for the splices and crossover leads.

e) Concentrically-wound primary and secondary windings, or adjacent secondary windings, separated by three layers of insulating material. Any combination of two layers of the insulation is to be capable of withstanding a 3500-volt, 60 hertz dielectric voltage-withstand test potential for 1 minute. The insulating material – type, combination, and thickness – is also to be provided for the splices and crossover leads.

f) Other constructions that are shown to be equivalent to those in (a) – (e) by examination and tests.

11.8.2 If a transformer of construction other than those described in 11.8.1 is employed, there shall be isolation between the transformer and the circuits extending to the patient care areas. See 4.2.

11.9 Current-carrying parts

11.9.1 A current-carrying part shall have the mechanical strength and current-carrying capacity for the service, and shall be of metal, such as silver, copper, copper alloy, or other material that provides equivalent performance.

11.9.2 A bearing, hinge, or similar part shall not be relied on for carrying current between interrelated fixed and moving parts.

11.10 Insulating material

11.10.1 An insulating material for the support or separation of live parts, and composed of porcelain, phenolic composition, cold-molded composition, or equivalent material, shall be formed to withstand the most severe conditions encountered in service.

11.10.2 Molded parts employed for the sole support of current carrying parts or as an enclosure shall have the mechanical strength and rigidity required for their intended application, as evidenced by compliance with the requirements of the Polymeric Materials – Temperature Test, 36.2.1 and 36.2.2.

11.10.3 Vulcanized fiber is not suitable for the sole support of live parts.

11.10.4 The thickness of a flat sheet of insulating material, such as phenolic composition employed for panel-mounting of parts, shall not be less than the applicable value specified in Table 11.1.

Table 11.1
Thickness of insulating material

Maximum dimension,		Maximum area,		Minimum thickness,	
inches	(mm)	square inches	(cm^2)	inches	(mm)
24	610	360	2323	3/8[a]	9.5
48	1219	1152	7432	1/2	12.7
48	1219	1728	11,148	5/8	15.9
Over 48		Over 1728		3/4	19.1

[a] Material less than 3/8 inch (9.5 mm) but not less than 1/8 inch (3.2 mm) thick is suitable for a panel if the panel is supported or reinforced to provide rigidity not less than that of a 3/8 inch sheet. Material less than 1/8 inch thick is suitable for subassemblies, such as supports for terminals for internal wiring, resistors, and other components.

11.10.5 A terminal block mounted on a metal surface that is grounded shall be provided with an insulating barrier between the mounting surface and all live parts on the underside of the base that are not staked, upset, sealed, or equivalently protected from loosening so as to prohibit such parts and the ends of replaceable terminal screws from coming in contact with the supporting surface.

11.10.6 A countersunk, sealed part shall be covered with a moisture-resistant insulating compound that does not melt at a temperature 15°C (27°F) higher than the maximum anticipated operating temperature of the assembly, and at no less than 65°C (149°F) in any case. The depth or thickness of sealing compound shall be no less than 1/8 inch (3.2 mm).

11.11 Mounting of parts

11.11.1 A part of nurse call and signaling equipment shall be securely mounted in position and prevented from turning or loosening if such motion impairs the intended performance of the unit, or reduces spacings below the minimum values specified in Spacings, Section 14.

11.11.2 A switch, lampholder, attachment-plug receptacle, plug connector, or similar electrical component shall be mounted securely and shall be prevented from turning.

Exception No. 1: A switch is not required to be prevented from turning if the construction complies with all of the following conditions:

a) The switch is of a push button or other type that does not tend to rotate when operated. A toggle switch is subject to forces that tend to turn the switch during operation of the switch.

b) The means of mounting the switch prohibits it from loosening during operation.

c) The spacings are not reduced below the minimum values as specified in Spacings, Section 14 if the switch rotates.

Exception No. 2: A lampholder of a type in which the lamp cannot be replaced, such as a neon pilot or indicator light in which the lamp is sealed by a nonremovable jewel, is not required to be prevented from turning if rotation does not reduce spacings below the minimum values, as specified in Spacings, Section 14.

11.11.3 Friction between surfaces shall not be the sole means of preventing a device from turning in its mounting. However, preventing the turning of a small stem-mounted switch or other device having a single hole mounting prevented with the use of a lock washer is not prohibited.

11.11.4 An uninsulated live part, including a terminal, shall be secured to the supporting surface by methods other than friction between surfaces, so that it is prevented from turning or shifting in position if such motion results in reduction of spacings to less than those required. The security of a contact assembly shall provide for the continued alignment of contacts.

11.12 Operating mechanisms

11.12.1 An operating part, such as an unenclosed switch, relay, or similar device, shall be protected against fouling by dust or by other material by an individual dust cover or the equivalent, or a dust-tight cabinet. The use of individual dust covers over operating mechanisms or a gasket between the enclosure and cover complies with this requirement.

Exception: A device employing contacts having a wiping action is not required to be provided with protection against fouling by dust.

11.12.2 A moving part shall have sufficient play at the bearing surfaces to reduce the chance of binding.

11.12.3 Provision shall be made to prevent adjusting screws and similar adjustable parts from loosening under the conditions of use.

11.12.4 A manually-operated part shall be constructed to withstand the stresses to which it is subjected in operation.

11.12.5 An electromagnetic device shall be constructed to provide positive electrical and mechanical performance under all conditions of intended operation.

12 Secondary Power Supply

12.1 If the product incorporates a secondary power supply, such as a battery, the supply shall be of sufficient capacity to provide 10 percent of maximum rated power for the time specified in the manufacturer's installation instructions. See 45.1(j).

13 Storage Batteries

13.1 A storage battery shall have sealed cells, or cells with spray-trap vents, and shall be charged by a rectifier. A rectifier that is part of the system control equipment assembly meets this requirement.

13.2 A battery shall not be cycle-charged while it is located in a system control equipment enclosure.

13.3 Batteries shall be located and mounted so that terminals of cells do not contact terminals of adjacent cells or metal parts of the battery enclosure as a result of shifting of the batteries. The mounting arrangement shall allow access to the cells for checking the specific gravity of the electrolyte.

13.4 A conditioning charge shall be limited so that, with the maximum rate of charge that is obtainable, the battery gases do not impair any part of the system equipment. The trickle and fast charge rates of a battery shall not exceed the battery manufacturer's recommended rates.

13.5 If a standby battery is employed, the circuit shall be power-limited as described in 19.3.1.

14 Spacings

14.1 Spacings between uninsulated live parts and dead metal parts and between uninsulated current-carrying parts of opposite polarity shall not be less than the applicable values specified in Table 14.1.

Table 14.1
Minimum spacings

Point of application	Voltage range, volts	Minimum spacings[a]			
		Through air,		Over surface,	
		inch	(mm)	inch	(mm)
To walls of enclosure:					
Cast metal enclosures	0 – 300	1/4	6.4	1/4	6.4
Sheet metal enclosures	0 – 300	1/2	12.7	1/2	12.7
Installation wiring terminals:[a]					
With barriers (See 11.3.1)	0 – 30	1/8	3.2	3/16	4.8
	31 – 150	1/8	3.2	1/4	6.4
	151 – 300	1/4	6.4	3/8	9.5
Without barriers	0 – 30	3/16	4.8	3/16	4.8
	31 – 150	1/4	6.4	1/4	6.4
	151 – 300	1/4	6.4	3/8	9.5
Rigidly clamped assemblies:[b]					
100 volt-amperes maximum	0 – 30	1/32	0.8[c]	1/32	0.8[c]
Over 100 volt-amperes	0 – 30	3/64	1.2	3/64	1.2
	31 – 150	1/16	1.6	1/16	1.6
	151 – 300	3/32	2.4	3/32	2.4
Other parts	0 – 30	1/16	1.6	1/8	3.2
	31 – 150	1/8	3.2	1/4	6.4
	151 – 300	1/4	6.4	3/8	9.5

[a] Measurements are to be made with solid wire having sufficient ampacity for the applied load connected to each terminal. In no case is the wire to be smaller than No. 18 AWG (0.82 mm^2), except that, if the maximum current input to the device is 1 ampere, measuring with a No. 22 AWG wire (0.32 mm^2) is not prohibited.

[b] Rigidly clamped assemblies include such parts as contact springs on relays or cam switches, printed-wiring boards, and similar parts.

[c] Spacings less than those indicated, but in no case less than 1/64 inch (0.4 mm) are suitable for the connection of integrated circuits and similar components where the spacing between the adjacent connecting wires on the component is less than 1/32 inch (0.8 mm).

14.2 The ″To walls of enclosure″ spacings specified in Table 14.1, apply between an uninsulated live part and a wall or cover of a metal enclosure, a fitting for conduit or metal-clad cable, and a metal piece attached to a metal enclosure, where deformation of the enclosure reduces spacings. They are not to be applied to an individual enclosure of a component part within an outer enclosure.

14.3 The spacings within a snap switch, lampholder, or similar wiring device supplied as part of a unit shall be evaluated on the basis of the requirements for the device.

14.4 A barrier or liner of insulating material employed where spacings are otherwise insufficient shall be of impregnated fiber, phenolic composition, or equivalent material and shall be no less than 0.028 inch (0.71 mm) thick.

Exception No. 1: A barrier or liner that is used in conjunction with no less than one-half the required ″Through air″ spacing as specified in Table 14.1 shall be no less than 0.013 inch (0.33 mm) thick. The barrier or liner shall be located so that it does not impair the operation of the unit.

Exception No. 2: It is not prohibited that insulating material having a thickness less than that specified be used if it has equivalent mechanical and electrical properties to a barrier of the specified thickness.

14.5 Film-coated wire is regarded as an uninsulated live part in determining compliance with the spacing requirements, but film-coating is suitable as turn-to-turn insulation in coils.

15 Testing, Servicing, and Maintenance Protection

15.1 An uninsulated live part or moving part that presents a risk of injury to persons shall be located, guarded, or enclosed to prevent contact by persons during servicing, such as relamping, fuse replacement, adjusting controls, and maintenance.

15.2 If the linear distance from a component requiring servicing and all uninsulated current-carrying parts in excess of 30 volts rms, 42.4 volts peak or DC, is less than 6 inches (152 mm), protection by insulating tape, barriers, or equivalent, shall be provided.

15.3 In lieu of the minimum 6-inch (152-mm) requirement, an interlock shall be provided on the cover to de-energize all live parts in the enclosure, or the construction shall comply with the marking requirements in 42.6.

PERFORMANCE

16 General

16.1 Unless otherwise specified, the performance of hospital nurse call equipment and other signaling equipment shall be investigated by subjecting a representative sample to the tests specified in Sections 17 – 39, and, as far as applicable, in the sequence presented unless otherwise indicated.

16.2 The following tests (at the manufacturer's request) shall be conducted in the order shown:

a) Leakage Current Test, Section 28;

b) Dielectric Voltage-Withstand Test, Section 30;

c) Humidity Test, Section 26;

d) Dielectric Voltage-Withstand Test (Repeated), Section 30; and

e) Leakage Current Test (Repeated), Section 28.

16.3 Unless specifically indicated otherwise, the test voltage for each test shall be as specified in Table 16.1, at rated frequency.

Table 16.1
Test voltages

Nameplate voltage rating	Test voltage
110 – 120	120
220 – 240	240
Other	Marked nameplate rating

16.4 Unless otherwise specified, the term ″signaling unit,″ as used in the following test requirements, refers to all the devices and appliances covered by this standard.

16.5 If a signaling unit or device, such as the devices of a nurse call system, is intended to be employed with a specific power supply to attain intended operation, it shall be connected to that power supply during each of the performance tests described in this standard.

16.6 The following samples and data are to be provided for testing:

a) For a nurse call system, at least one sample of each type of unit to be employed and a minimum of three patient stations. If similarities exist among units where components or features are omitted on some models only, the model containing all components is to be tested. The system units are to be mounted on panels of 3 by 2 feet (910 by 610 mm) maximum size, interconnected to form a system, and provided with disconnect plugs and receptacles for ease of handling. Simulated resistance or resistance-inductance loads are to be added to the respective circuits to represent a fully loaded system.

Note: Prior to fabricating the test setup, the manufacturer shall provide a description of all models to be covered, optional features, and differences among models. The description is to be used to determine samples for system interconnection. It would also be preferable if redundant samples are provided (not interconnected) to facilitate examination of marking and construction details.

b) One sample of each model of a signaling unit other than nurse call equipment.

c) One copy of the technical manual for a nurse call system or signaling unit.

d) Installation wiring diagram if separate from the technical manual.

e) Reliability data for any component where reliability is a factor.

f) Identification of all plastic materials employed.

g) General description of the system operation.

h) Identification of printed-wiring boards by name of manufacturer and type number(s).

i) Manufacturer’s drawing or construction specifications of the isolating transformer(s).

j) One sample of the standby power supply (battery), if applicable, together with a volt-ampere load curve from open circuit to the maximum volt-amperes that can be obtained from the battery (for use in the volt-amperes capacity test described in 19.3.6).

17 Normal Operation Test

17.1 Hospital signaling and nurse call equipment shall operate as intended when tested in conjunction with related signal initiating and indicating devices to form a system combination of the type indicated by the installation wiring diagram and any supplementary information provided.

17.2 The operation of a signaling unit shall result in the operation of related devices so as to produce a clearly defined signal of the type for which the combination is designed.

17.3 There shall be no loss of a signal(s) at nurse call receiving equipment when three units are operated simultaneously. The system shall operate as intended when calls are placed from 10 percent of the maximum number of stations that are capable of being connected to the nurse call receiving equipment (or three stations, whichever is greater). If the system has provision for connection of a single power supply only, the greatest capacity of nurse call receiving equipment is to be tested. If the system provides for multiple power supplies, the nurse call receiving equipment that has the smallest ″power supply to number of stations″ ratio is to be used.

17.4 To determine if a signaling unit complies with the requirements of 17.3, it is to be connected to a source of rated test voltage and to the devices with which it is intended to operate to form a typical combination.

17.5 The devices employed are to be those specified by the installation wiring diagram, except that substitute devices are suitable if they produce equivalent signal indication and circuit loading. Substitute load devices are to be those determined by investigation to provide the same loads as obtained with the devices designated to be used with the signaling unit.

17.6 A signaling system unit shall be in the standby condition and prepared for signaling operation when it is connected to related devices and circuits. See 17.1.

17.7 Operation to off-normal of a silencing switch that controls an audible signal that serves to alert an attendant of a patient call shall be indicated by a related visual indication, unless a subsequent incoming signal (nonemergency call) reenergizes the audible signal.

17.8 Receipt of an emergency call with the audible signal silencing switch in the silenced position shall result in reenergization of the audible signal.

17.9 Operation of a nurse call station shall result in an audible as well as a visual indication at the nurse call receiver unit. The visual indication shall identify the source of the signal. The visual signal shall be maintained continuously, locked in by either the unit from which the signal originated or by the unit receiving the signal, until reset manually. The audible signal shall be of at least 3 seconds duration for a continuous signal and repeated at least every 10 seconds for a pulsing type signal.

17.10 If less than 100 percent of calls are able to be displayed on a nurse master or central control unit annunciator, the system shall have a priority, retrieval, or alerting capability that displays high priority (emergency and code call) signals in lieu of or in addition to routine calls.

17.11 Pendant controls and nurse call switches extending remotely from signaling units or wall outlets shall be connected so that unintentional removal of the device from its socket is promptly indicated by a visual or audible signal at the nurse's station, or a restraining means shall be provided at the point of connection to prevent removal.

17.12 The visual indication required at a nurse master station or central control unit to identify the source of a patient call shall consist of any one of the following arrangements:

a) One lamp coupled with a lamp test switch. Operation of the lamp test switch shall identify a lamp that has burned out.

b) Two lamps in parallel.

c) A reliable lamp, such as a light emitting diode having a maximum predicted failure rate of 2.5 failures per million hours, or an incandescent lamp that withstands 100,000 cycles of operation (see Table 24.1).

d) One lamp coupled with a printed record.

e) Arrangement equivalent to (a), (b), (c), or (d).

Failure of a lamp that annunciates an emergency or code call signal shall not affect operation of the audible signal.

17.13 There shall be no loss of routine patient call, emergency, or code call signals while a signaling unit is energized by a standby power source and is operated under normal and signaling conditions. See 42.1(n).

17.14 Transfer of power from the main supply to standby shall not result in the loss of any call. This test is to be conducted while the unit is providing 10 percent of rated power.

17.15 Initiation of a code call signal shall result in energization of a distinctive audible signal and identified related light at the nurse master of a conventional nurse call system or the central annunciator panel of a centralized system. Silencing of the audible signal shall not result in de-energization of the related light. After the audible signal has been silenced, the light shall continue to be energized in either a steady state or flashing condition. These requirements also apply to an independent code call signaling circuit that is not connected to a conventional or centralized nurse call system.

17.16 De-energization of the main power supply of a programmable nurse call system shall not result in loss of any part of the program that is required for normal functional system response. See 42.1(n).

18 Electrical Supervision

18.1 General

18.1.1 Where field wiring conductors/circuits are identified as being supervised, a distinctive audible trouble signal and identification of the faulted circuit shall be indicated at attended nurse master or central control receiving equipment. The signal shall operate under any of the following fault conditions if the fault condition prevents the intended operation of the system. The fault conditions include a single open circuit, a single ground fault, and shorting of two or more conductors. See the Component Failure Test, Section 33.

18.1.2 A trouble signal shall be distinguishable from all nurse call signals and shall be indicated by operation of a sounding appliance. It is not prohibited that the sounding appliance be common to several supervised circuits. A switch for silencing the sounding appliance shall be provided only if a visual trouble indicator is provided that remains activated or is simultaneously activated when the sounding appliance is silenced. The visual indicator shall maintain its display until the silencing switch is restored to its nonsilenced position. The audible trouble signal shall sound if the switch is in its silenced position and no trouble exists. A visual indication is not required if the audible signal is re-energized upon restoration of the fault.

18.1.3 Use of a standby supply, such as a battery, to operate the trouble-signaling device to indicate failure of the alternating current supply circuit complies with the requirement in 18.1.1.

18.1.4 The fuses in a code call circuit and a centralized system control unit shall be electrically supervised to indicate rupture of the fuse by an audible trouble signal if the rupture prevents intended operation of the unit.

18.1.5 Failure of a cooling fan motor that would result in temperatures exceeding those in Table 22.1 during the normal temperature test shall be indicated by an audible trouble signal.

18.1.6 To determine if a signaling unit complies with the requirements in 18.1.1 – 18.1.5, the investigation is to start with the representative system combination in the normal standby condition. The type of fault to be detected is then to be introduced separately in each circuit conductor and the results noted.

18.1.7 The visual indicator referred to in 18.1.2 shall be located and identified so that the user recognizes the signal as soon as it is activated.

18.1.8 For supervision of program-controlled equipment, refer to the requirements in 47.2.

18.1.9 Circuits are not to be identified as supervised if running the wire through conduit is the method by which supervision is intended to be accomplished, unless the circuits have been determined to comply with the requirements of 18.1.1.

18.2 All centralized systems

18.2.1 When a patient-placed call of a centralized system is incapable of being received at the central operator's console as a result of a fault on a centralized system's main trunk when in a centralized mode of operation, a trouble signal and identification of the fault location shall be audibly and visually indicated at the central operator's console.

19 Voltage and Current Measurements

19.1 Input circuit

19.1.1 The input current or wattage of a signaling unit shall be no more than 110 percent of the unit rating when the unit is connected to a source of rated test voltage and operating at maximum intended load conditions.

19.2 Output circuit

19.2.1 The measured output voltage of a power supply not investigated in conjunction with specific devices intended to be connected, such as the components of a nurse call system, shall be no more than 110 percent of the rated test voltage of the unit at no-load conditions and no less than 100 percent of the rated test voltage of the unit at maximum rated load conditions. The same proportionate limits shall be maintained at the output circuits when the supply voltage is varied between 85 and 110 percent of rated test voltage. The rated loads are to be connected with the power supply unit connected to a source of rated test voltage.

19.2.2 The output voltage of a power supply investigated in conjunction with the specific devices intended to be connected to its output circuit(s) is not required to comply with the voltage requirements of 19.2.1, if acceptable operation is obtained for the devices tested as part of a complete system under maximum loading conditions of the output circuit(s).

19.3 Volt-ampere capacity – low-voltage power-limited circuits

19.3.1 A signaling circuit of hospital signaling and nurse call equipment or miscellaneous signaling appliances intended to be installed in patient care areas shall be of a low-voltage, power-limited type and shall be obtained, either directly or indirectly, from the output of an isolating step-down transformer or, when provided, a standby battery. For this purpose, there are two types of power limited circuits:

a) Those inherently limited by a reliable fixed impedance or reliable electronic circuitry requiring no overcurrent protection and

b) Those having power limited by a combination of a transformer or standby battery and overcurrent protection.

19.3.2 Power limitations shall be obtained by the use of any one of the following configurations:

a) Energy-limiting transformers [see 19.3.3 (a) – (c)].

b) Nonenergy-limiting transformer, standby battery, or both, coupled with a noninterchangeable overcurrent protective device in the output circuit [see 19.3.3 (a), (b), and (d)].

c) Combination of a transformer, standby battery, or both, and reliable fixed impedance [see 19.3.3 (a) – (c)].

d) Combination of a transformer, standby battery, or both, and reliable electronic circuit [see 19.3.3 (a) – (c)].

e) Arrangement equivalent to any of the above.

19.3.3 The capacity of a low-voltage, power-limiting circuit of hospital signaling and nurse call equipment, as well as miscellaneous hospital signaling equipment, shall not be greater than the following values:

a) 100 volt-amperes, 5 amperes maximum at the maximum rated voltage and frequency.

b) 30 volts, 60 hertz (42.4 volts peak), 42.4 volts peak for nonsinusoidal AC, or 42.4 volts continuous DC.

c) For a circuit whose power source is inherently limited by a reliable fixed impedance or a reliable electronic circuit and whose output voltage does not exceed 30 volts, the maximum output current measured after 1 minute, under any condition of loading including short circuit, shall not exceed 8.0 amperes. Any additional overcurrent protection (other than the reliable fixed impedance or electronic circuit) is to be shorted during the test.

Exception: For a continuous DC circuit whose output voltage is greater than 30 volts but less than or equal to 42.4 volts, the maximum output current measured after 1 minute, under any condition of loading including short circuit, shall not exceed 150 volt-amperes divided by V_{max}. Any additional overcurrent protection (other than the reliable fixed impedance or electronic circuit) is to be shorted during the test.

d) 250 volt-amperes under any condition of loading with the overcurrent protective device shorted, for a circuit whose power is limited by a combination of a nonenergy-limiting transformer, battery, or both, and noninterchangeable overcurrent-protective device.

Exception: If the maximum voltage from the circuit is 15 volts, 60 hertz or less, then the maximum volt-amperes shall not exceed 350 volt-amperes.

19.3.4 Components, circuits, or both shall be determined to be reliable by any one of the following methods:

a) The component has been previously investigated and determined to be suitable for the application.

b) The opening or short-circuiting (singly) of any unreliable component (electrolytic capacitor, transistor junction, diode, vacuum tube, or similar component) in the circuit in question does not cause the limits in this 19.3.3 to be exceeded.

c) The individual component or each component of the circuit has a predicted failure rate of 2.5 or less failures per million hours as determined for a ″Ground Fixed″ (GF) environment by MIL-HDBK 217B, or equivalent.

19.3.5 To determine if the capacity of a low-voltage, power-limited circuit complies with the requirements of 19.3.3, the output circuit is to be connected to a variable resistance load. With the unit connected to a rated source of supply voltage and frequency, the load resistor is to be varied from open circuit to short-circuit conditions in such a manner that the elapsed time is between 1-1/2 and 2-1/2 minutes. Voltage and current measurements are to be recorded for each value and the maximum volt-amperes (volts times amperes) capacity is to be calculated. The short-circuit current, open circuit voltage, and the current at the rated voltage value of the circuit are to be included in the measurements. The overcurrent protective device is to be shunted out during the test.

19.3.6 The output circuit of a power supply supplying a low-voltage, power-limited circuit, and complying with the limits of 19.3.3 shall not be interconnected with the output circuit of another power supply, either in series or parallel, unless the voltage and current measurements (volt-amperes) at the output terminals of the interconnected combination also comply with the requirements of 19.3.3. Two or more power supplies supplying low-voltage, power-limited circuits are to be treated as two separate circuits, each having its own separate output connections, and the output at each circuit shall be marked to warn that the separation shall be maintained. The presence of a fault condition in the interconnecting wiring is not to be considered in determining the energy capability of two or more power supplies in combination.

19.3.7 For units provided with a standby battery, the volt-ampere capacity test is to be conducted with the unit connected to:

a) Both a rated (AC) supply source and a fully charged battery,

b) A rated (AC) supply source (battery disconnected), and

c) A fully charged battery [(AC) supply source disconnected].

NOTE: To prevent possible shorting of the battery circuit and the resultant risk of explosion, precautions must be taken to provide acceptable overcurrent protection and physical protection during this test. See 16.6(j).

20 Overvoltage and Undervoltage Operation Test

20.1 Overvoltage operation

20.1.1 A high-voltage power supply or high-voltage signaling unit shall withstand the application of 110 percent of its rated input voltage continuously without damage. The system units connected to the output of the power supply shall perform their intended signaling operation at the increased voltage.

20.1.2 For this test, the unit is to be subjected to the increased voltage while in the standby condition for at least 16 hours and then the unit is to be tested for signaling operation.

20.2 Undervoltage operation

20.2.1 A unit connected to the output of a high-voltage power supply or high-voltage signaling unit shall perform its intended signaling operation while the power supply or signaling unit is energized at 85 percent of its rated input voltage.

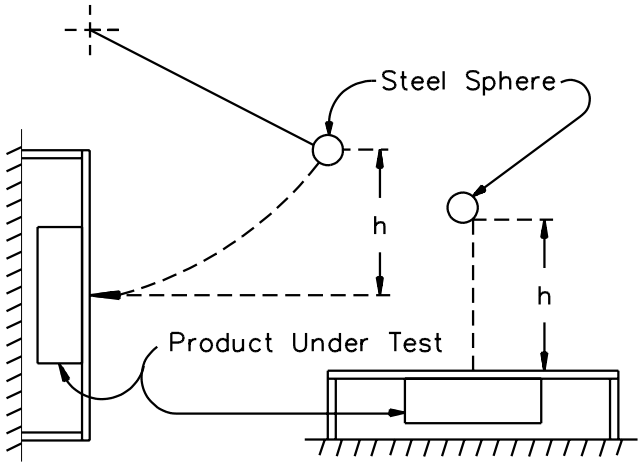
20.2.2 For this test the unit is to be energized from a rated source of supply in the standby condition for at least 3 hours, following which the voltage is to be reduced to 85 percent of its rated input voltage and the unit is to be tested for signaling performance.

21 Jarring Test

21.1 A signaling unit shall withstand jarring resulting from impact and vibration such as experienced in service, without causing signaling operation of any part and without impairing its subsequent operation.

21.2 The device is to be mounted in a position of intended use to the center of a 6- by 4-foot (1.8- by 1.2-m), nominal 3/4 inch (19.1 mm) thick plywood board that is secured in place at four corners. An impact is to be applied to the center of the reverse side of this board by means of a 1.18-pound (0.53-kg), 2-inch (50.89-mm) diameter steel sphere, sufficient to apply 3 foot-pounds (4.2 J) of energy. The impact is to be applied by swinging the sphere through a pendulum arc from a height (h) of 2.54 feet (0.77 m), or dropping the sphere from a height (h) of 2.54 feet, depending upon the mounting of the equipment. See Figure 21.1.

Figure 21.1
Jarring test



21.3 For this test, the unit is to be energized in the standby condition and connected to a rated source of supply. Following the jarring, the unit is to be tested for signaling operation.

22 Temperature Test

22.1 The materials employed in the construction of a unit shall not be adversely affected by the temperatures attained under any condition of intended operation, while connected to a source of rated voltage and frequency.

22.2 A material will be regarded as being adversely affected if it is subject to a temperature rise greater than the applicable values specified in Table 22.1.

Table 22.1
Maximum temperature rises

Device or material	°C	(°F)
Any point on rectifiers:		
a. Copper oxide	30	54
b. Germanium	50	90
c. Magnesium-copper sulphide	95	171
d. Selenium	50	90
e. Silicon	75	135
Rubber or thermoplastic insulation	35[a]	63[a]
Varnished-cloth insulation	60	108
Fuses	65	117
Surfaces adjacent to or upon which the unit may be mounted in service	65	117
Wood or other combustible material	65	117
Fiber used as electrical insulation	65	117
Class 105 insulation	65[c]	117[c]
Class 130 insulation	85[c]	153[c]
Phenolic composition used as electrical insulation	125	225
Capacitors	40	72
Solid-state devices (transistors, silicon-controlled rectifiers, integrated circuits)	See footnote d	
Wire-wound resistor	150[b]	302[b]
Carbon resistor	See footnote e	
Sealing compound	15°C (27°F) less than the melting point[b]	

[a] This limitation does not apply to an insulated conductor or a material that has been investigated and determined to be acceptable for a higher temperature.

[b] The specified values are limiting temperatures, not maximum temperature rises.

[c] 10°C (18°F) higher temperature rise is acceptable on coil insulation if measured by change-in resistance method.

Table 22.1 Continued on Next Page

Table 22.1 Continued

Device or material	°C	(°F)
[d] The temperature of a solid-state device shall not exceed 50 percent of its rating during the normal standby condition. The temperature of a solid-state device shall not exceed 75 percent of its rated temperature under any other condition of operation of the complete unit that produces the maximum temperature dissipation of its components. For reference purposes 0°C (32°F) is to be considered as 0 percent. For integrated circuits the loading factor shall not exceed 50 percent of its rating under the normal standby condition and 75 percent under any condition of operation. Both solid-state components and integrated circuits are to be operated up to the maximum ratings, under any one of the following conditions. 1) All components comply with the requirements in MIL-STD-883E. 2) A quality control program is established by the manufacturer consisting of inspection and test of 100 percent of all components, either on an individual basis, as part of a subassembly, or equivalent. 3) Each assembled production unit is subjected to a burn in test for 24 hours while connected to a source of rated nameplate voltage and frequency in an ambient of at least 49°C (120°F) followed by operational tasks. [e] The maximum temperature on a carbon resistor shall not be greater than 50°C (122°F) during the normal standby condition and not greater than 75°C (167°F) during a signaling condition.		

22.3 All values for temperature rises apply to equipment intended for use at ambient temperatures that usually are not higher than 25°C (77°F). If equipment is intended specifically for use at a prevailing ambient temperature consistently higher than 25°C, the test of the equipment is to be made at such higher ambient temperature, and the maximum temperature rises specified in Table 22.1 are to be reduced by the amount of the difference between the higher ambient temperature and 25°C.

22.4 Temperature measurements on equipment intended for recessed mounting are to be made with the unit installed in an enclosure of 3/4-inch (19.1-mm) plywood having clearances of 2 inches (50.8 mm) on the top, sides, and rear, and the front extended to be flush with the signaling unit cover.

22.5 Except at coils, temperatures are to be measured by thermocouples consisting of wires no larger than No. 24 AWG (0.21 mm^2). The temperature of a coil is to be measured by either the thermocouple or change-in-resistance method, except that the thermocouple method is not to be employed for a temperature measurement at any point where supplementary thermal insulation is employed.

22.6 If thermocouples are used in the determination of temperatures in connection with the heating of electrical devices, it is standard practice to employ thermocouples consisting of No. 30 AWG (0.05 mm^2) iron and constantan wires and a potentiometer-type indicating instrument. Such equipment is to be used whenever referee temperature measurements by thermocouples are required.

22.7 The temperature of a copper coil winding is able to be determined by the change-of-resistance method by comparing the resistance of the winding at the temperature to be determined with the resistance at a known temperature by means of the formula:

$$T = \frac{R}{r}(234.5 + t) - 234.5$$

in which:

T is the temperature to be determined in degrees C;

R is the resistance in ohms at the temperature to be determined;

r is the resistance in ohms at the known temperature; and

t is the known temperature in degrees C.

22.8 As it is generally required to de-energize the winding before measuring R, the value of R at shutdown is to be determined by taking several resistance measurements at short intervals, beginning as quickly as possible after the instant of shutdown. It is possible to extrapolate the value of R at shutdown by plotting a curve of the resistance values and time.

22.9 A temperature is regarded as constant when three successive readings, taken at 5-minute or greater intervals, indicate no change.

22.10 To determine compliance with this test, a unit and related devices are to be connected to a supply circuit of rated voltage and frequency and operated under each of the following conditions:

a) Standby – 16 hours or until constant temperatures are reached,

b) Normal Signaling, 20 Percent of Maximum Rated Load, Discharged Battery – 1 hour, and

c) Abnormal Signaling, Maximum Rated Load – 7 hours.

22.11 For a signaling unit having provision for the connection of multiple patient stations, 20 percent of the total number of stations, but in no case less than three, are to be energized during the normal signaling condition. Prior to conducting this test, a rechargeable battery is to be discharged as described in 45.1(j) with 100 percent of the maximum rated load connected and with the main AC supply disconnected. During the abnormal signaling condition, all stations are to be actuated. It is not prohibited that the temperatures specified in Table 22.1 be exceeded, but there shall be no risk of fire or electric shock and the unit shall operate in its intended manner following the test. If an overcurrent protective device is employed, the loading specified in 22.10(c) is to be 110 percent of the protective device rating. For this test it is not prohibited that the overcurrent protective device be shunted.

23 Overload Test

23.1 Signaling unit

23.1.1 A signaling unit shall operate as intended following 50 cycles of signal operation at a rate of not more than 6 cycles per minute with the supply circuit energized at 115 percent of rated test voltage and at rated frequency. Each cycle is to consist of starting with the unit energized in the standby condition, actuation for a signal, and restoration to standby.

23.1.2 Rated test loads are to be connected to the output circuits of the unit that are energized from the unit power supply. The test loads are to be those devices intended to be connected, or the equivalent. If an equivalent load is employed for a device consisting of an inductive load, a power factor of 60 percent is to be employed. The rated test loads are to be established initially with the unit connected to a source of rated test supply voltage and frequency, following which the voltage is to be raised to 115 percent of the rated test voltage.

23.1.3 For a DC signaling circuit, an equivalent inductive test load is to have the required DC resistance for the test current and the inductance is to be calibrated to obtain a power factor of 60 percent when connected to a 60 hertz potential equal to the rated DC test voltage. When the inductive load has both the required DC resistance and the required inductance, the current measured with the load connected to an AC circuit is to be equal to 0.6 times the current measured with the load connected to a DC circuit when the voltage of each circuit is the same.

23.2 Separately energized circuits

23.2.1 Each signaling unit shall operate as intended following 50 cycles of signal operation at a rate of not more than 6 cycles per minute while connected to a source of rated test voltage and frequency and 150 percent rated loads applied to output circuits (dry contacts) that are not energized from the unit power supply. There shall be no electrical or mechanical failure of any of the components.

23.2.2 The test loads are to be set at 150 percent of rated current at 0.6 power factor while connected to a separate power source of rated voltage and frequency.

24 Endurance Test

24.1 A signaling unit shall operate as intended after being subjected to the number of test cycles specified in Table 24.1. There shall be no electrical or mechanical malfunction or breakdown, or evidence of such malfunction or breakdown of the components.

Table 24.1
Endurance test cycles

Type of device	Number of signaling operations[a]
Main control equipment	1,000,000
Nurse's console (one station)	100,000
Patients' stations	100,000
Emergency communication stations	100,000
Any emergency signaling device	30,000
Dome lights	6,000
Nurse-doctor communication stations	6,000
Any nonemergency supplementary stations	6,000
Reliable visual indicating lamp	100,000
Nurse locator station	100,000

[a] For solid-state switching devices, used within their rated voltage and current. It is not prohibited that the number of signaling operations be reduced to 50,000 cycles after the device has reached thermal equilibrium during the test.

24.2 The individual devices are to be operated by an automatic switching device at a rate of 6 cycles per minute while connected to rated test voltage and frequency and maximum normal load. See 23.1.2.

Exception: It is not prohibited that a test rate greater than 6 cycles per minute be used if requested by the equipment manufacturer, but the rate shall not exceed 30 cycles per minute.

25 Variable Ambient Temperature Test

25.1 A signaling unit shall operate as intended when the temperature of the ambient air is within the range of 10°C to 49°C (50°F to 120°F).

25.2 The unit is to be maintained at each appropriate temperature extreme (or higher operating temperatures as specified by the product's operating manual), until thermal equilibrium is reached, but at least 3 hours, and then tested at that temperature for operation while connected to a source of rated test voltage and frequency.

26 Humidity Test

26.1 A signaling unit shall operate as intended while energized from a source of rated test voltage and frequency following exposure for 24 hours to air having a relative humidity of 85 percent at a temperature of 30 ±2°C (86 ±4°F). The performance is to be determined with the unit in the high humidity ambient.

26.2 Leakage current measurements are to be recorded following the 24-hour exposure to the humidity environment in accordance with the Leakage Current Test, Section 28.

27 Electric Shock Current Test

27.1 If the open circuit potential, between any part that is exposed only during operator servicing and either earth ground or any other exposed accessible part, exceeds 42.4 volts peak, the part shall comply with the requirements of 27.2 and 27.4, as applicable.

27.2 The continuous current flow through a 500-ohm resistor shall not exceed the values specified in Table 27.1 when the resistor is connected between any part that is exposed only during operator servicing and either earth ground or any other exposed accessible part.

Table 27.1
Maximum current during operator servicing

Frequency, hertz[a]	Maximum current through a 500-ohm resistor, milliamperes peak
0 – 100	7.1
500	9.4
1000	11.0
2000	14.1
3000	17.3
4000	19.6
5000	22.0
6000	25.1
7000 or more	27.5

[a] Linear interpolation between adjacent values may be used to determine the maximum allowable current corresponding to frequencies not shown. The table applies to repetitive nonsinusoidal or sinusoidal waveforms.

27.3 The duration of a transient current flowing through a 500-ohm resistor connected as described in 27.2 shall not exceed the following:

a) The value determined by the following equation:

$$T \leq \left(\frac{20\sqrt{2}}{I}\right)^{1.43}$$

in which:

T is the interval, in seconds, between the time that the instantaneous value of the current first exceeds 7.1 milliamperes and the time that the current falls below 7.1 milliamperes for the last time;

I is the peak current in milliamperes; and

b) 809 milliamperes, regardless of duration.

The interval between occurrences shall be equal to or greater than 60 seconds if the current is repetitive. Typical calculated values of maximum allowable transient current duration are shown in Table 27.2.

Table 27.2
Maximum transient current duration

Maximum peak current (I) through 500-ohm resistor, milliamperes	Maximum duration (T) of waveform containing excursions greater than 7.1 milliamperes peak, seconds
7.1	7.22
8.5	5.58
10.0	4.42
12.5	3.21
15.0	2.48
17.5	1.99
20.0	1.64
22.5	1.39
25.0	1.19
30.0	0.919
40.0	0.609
50.0	0.443
60.0	0.341
70.0	0.274
80.0	0.226
90.0	0.191
100.0	0.164
150.0	0.092
200.0	0.061
250.0	0.044
300.0	0.034
350.0	0.027
400.0	0.023
450.0	0.019
500.0	0.016
600.0	0.013
700.0	0.010
809.0	0.0083

27.4 The maximum capacitance between the terminals of a capacitor that is accessible during operator servicing shall comply with the following equations:

$$C = \frac{88{,}400}{E^{1.43}(\ln E - 1.26)} \quad for \quad 42.4 \leq E \leq 400$$

$$C = 35{,}288E^{-1.5364} \quad for \quad 400 \leq E \leq 1000$$

in which:

C is the maximum capacitance of the capacitor in microfarads and

E is the potential in volts across the capacitor prior to discharge; E is to be measured 5 seconds after the capacitor terminals are made accessible, such as by the removal or opening of an interlocked cover, or the like.

Typical calculated values of maximum capacitance are shown in Table 27.3.

Table 27.3
Electric shock

Potential across capacitance prior to discharge, volts	Maximum capacitance, microfarads
1000	0.868
900	1.02
800	1.22
700	1.50
600	1.90
500	2.52
400	3.55
380	3.86
360	4.22
340	4.64
320	5.13
300	5.71
280	6.40
260	7.24
240	8.27
220	9.56
200	11.2
180	13.4
160	16.3
140	20.5
120	26.7
100	36.5
90	43.8

Table 27.3 Continued on Next Page

Table 27.3 Continued

Potential across capacitance prior to discharge, volts	Maximum capacitance, microfarads
80	53.8
70	68.0
60	89.4
50	124.00
45	150.00
42.4	169.00

27.5 With reference to the requirements in 27.2 and 27.3, the current is to be measured while the resistor is connected between ground and each accessible part individually or all accessible parts collectively if the parts are simultaneously accessible. The current also is to be measured while the resistor is connected between one part or group of parts and another part or group of parts, if the parts are simultaneously accessible.

27.6 With reference to the requirements in 27.5, parts are considered to be simultaneously accessible if they are able to be contacted by one or both hands of a person at the same time. For the purpose of these requirements, one hand is to be considered to be able to contact parts simultaneously if the parts are within a 4- by 8-inch (102- by 203-mm) rectangle; and two hands of a person are considered to be able to contact parts simultaneously if the parts are not more than 6 feet (1.83 m) apart.

27.7 Electric shock current refers to all currents, including capacitively coupled currents.

27.8 If the product has a direct-current rating, measurements are to be made with the product connected in turn to each side of a 3-wire, direct current supply circuit.

27.9 Current measurements are to be made with any operating control, or adjustable control that is subject to user operation, in all operating positions, and either with or without a vacuum tube, separable connector, or similar component in place. These measurements are to be made with controls placed in the position that causes maximum current flow.

28 Leakage Current Test

28.1 The leakage current of a signaling unit shall not exceed the values specified in Table 28.1 when measured under all of the following conditions after being subjected to the Humidity Test, Section 26. All grounding connections to the unit being tested are to be disconnected prior to making the measurement. See Figure 28.1.

a) Between any exposed surface of any fixed or stationary equipment and earth ground.

b) Between any exposed surface of any portable equipment that is not intended to be contacted by a patient and earth ground.

c) Between any exposed surface of any stationary or portable equipment that cannot be placed in bed with a patient but would normally be contacted by a patient and earth ground.

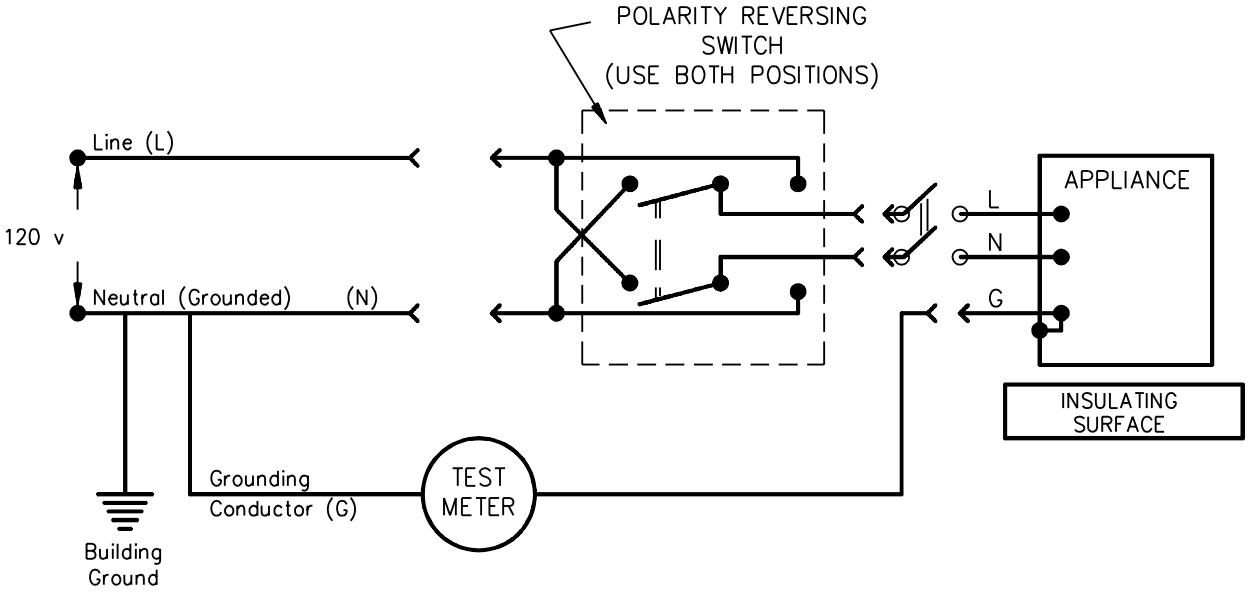
d) Between any current-carrying part of a remote control device that rests on a bed with the patient, such as a pendant control assembly, and earth ground.

Table 28.1
Maximum leakage current

Test[a]	Maximum leakage current – microamperes (AC or DC)
a	5,000
c	500
d	300
e	300

[a] Letter corresponds to applicable item of 28.1.

Figure 28.1
Leakage current measurement circuit



S2489

28.2 For this test the signaling unit is to be de-energized, removed from the humidity environment, placed on a dry insulating surface, and immediately reenergized from a rated source of supply. The leakage current measurement is then to be made within 5 minutes of energization while in the standby and signaling conditions. The leakage current values specified in Table 28.1 are rms values for essentially DC (nonfiltered rectified AC) and sinusoidal waveforms up to 1 kilohertz. For frequencies above 1 kilohertz the leakage current shall not be more than the applicable value specified in Table 28.1 multiplied by the frequency in kilohertz up to a maximum multiplier of 100.

28.3 The test meter employed to measure the leakage current is to be an average responding AC milliammeter that indicates the rms value of a pure sine wave, having an error of not greater than 5 percent, and a maximum input impedance of 1,000 ohms. For DC measurements, a DC milliammeter having a maximum impedance of 1,000 ohms is to be employed.

28.4 As an alternative to the test meter described in 28.3, the measurement may be taken by a peak reading voltmeter having an input impedance of 1 megohm or greater, and shunted by a parallel combination of a 1,000-ohm, ±1 percent, resistor in parallel with a series combination of a 10-ohm, ±1 percent or less, resistor and a 0.15 microfarad, ±5 percent or less, capacitor. Both resistors are to be metal-film type, and the capacitor is to be a plastic-dielectric (extended foil) type. See Figures 28.2 and 28.3.

Exception: If the voltages are sinusoidal, use of an rms-or average-reading meter is not prohibited. The peak value shall then be calculated.

Figure 28.2
Test load

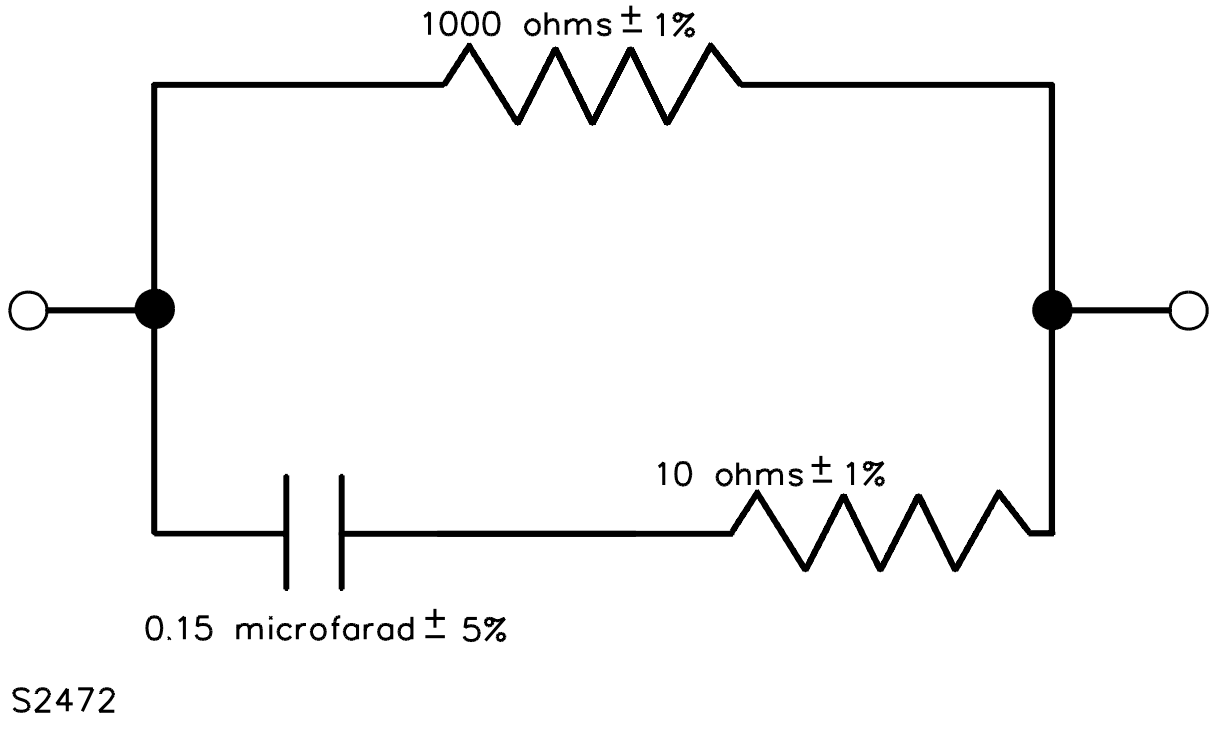
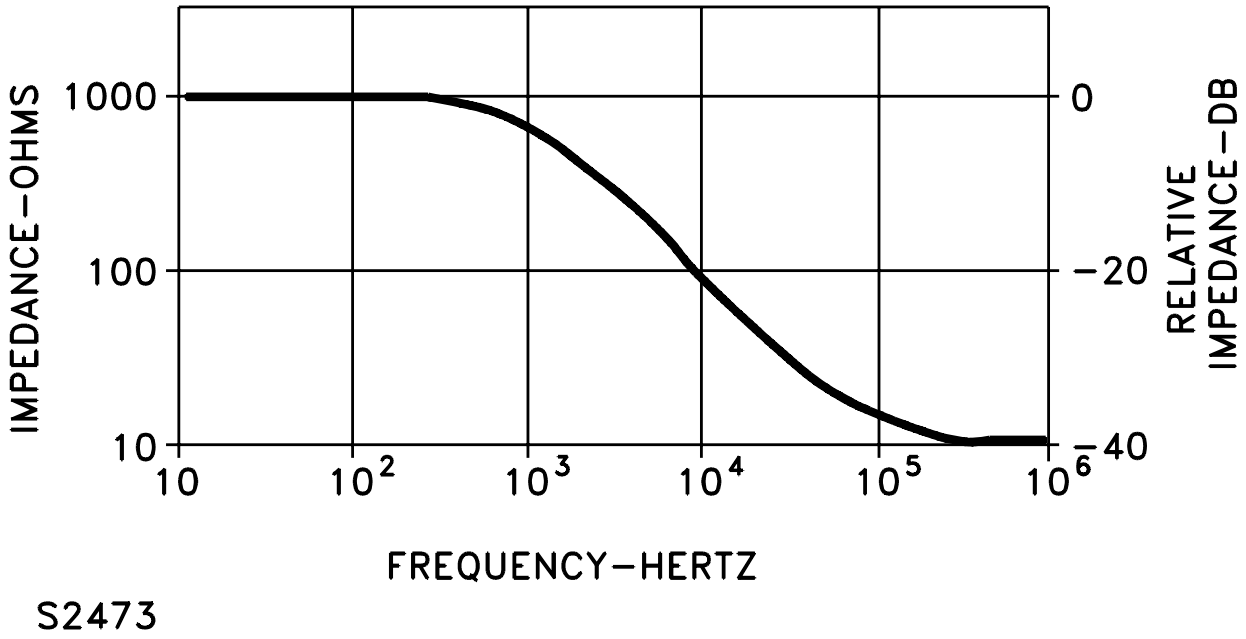


Figure 28.3
Impedance-frequency characteristics



28.5 If a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current is to be measured using metal foil with an area of 100 by 200 mm (3.9 by 7.8 inches) placed in contact with the surface. If the surface is less than 100 by 200 mm, the metal foil is to be the same size as the surface. The metal foil is not to be pressed into openings and is not to remain in place long enough to affect the temperature of the sample.

29 Transient Test

29.1 General

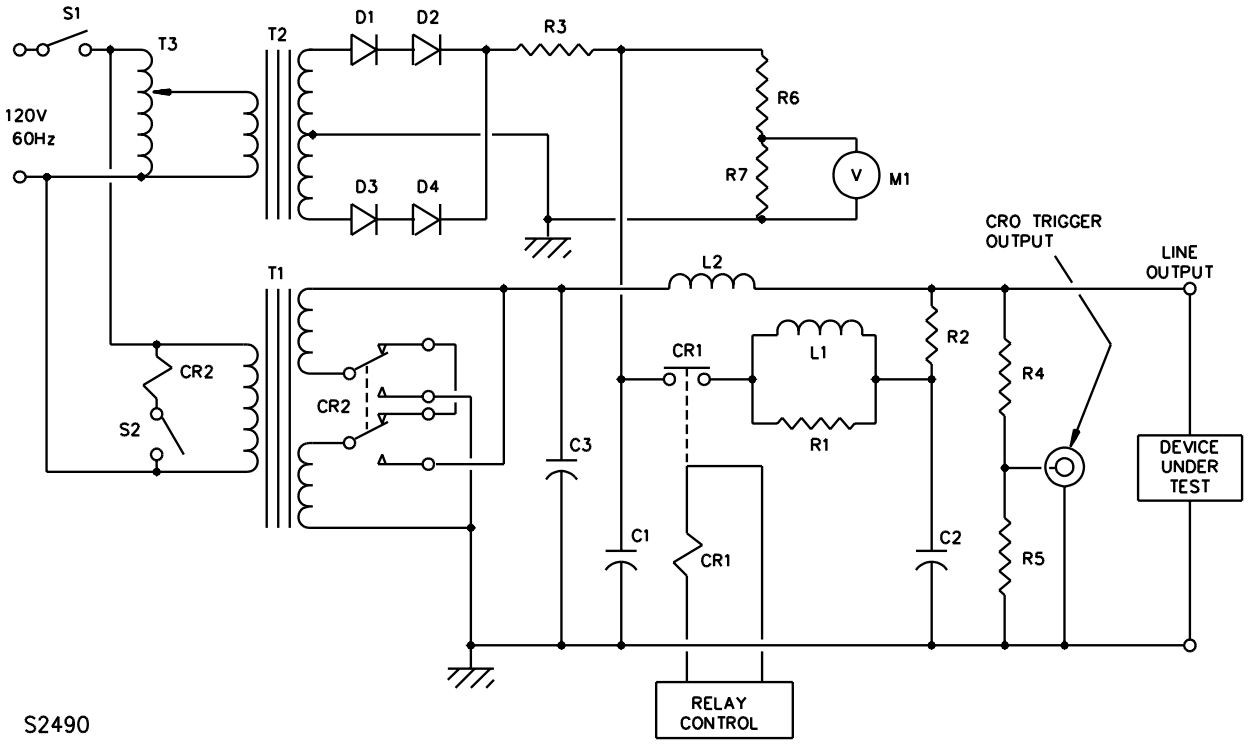
29.1.1 A signaling unit shall operate for its intended signaling performance after being subjected to 500 supply line transients and 500 internally induced transients while energized from a source of supply in accordance with 16.3.

29.2 Supply line transients – high-voltage units

29.2.1 A high-voltage AC-operated unit shall operate as intended, and shall not be adversely affected when subjected to supply line transients induced directly into the power supply circuit conductors of the equipment under test.

29.2.2 For this test, the supply circuit of the unit under test is to be connected to a transient generator, consisting of a 2-kilovolt-ampere isolating power transformer and control equipment that produces the transients described in 29.2.3. See Figure 29.1. The output impedance of the transient generator is to be 50 ohms.

Figure 29.1
Transient surge generator circuit



C1 – Capacitor, 0.025 µF, 10 kV

C2 – Capacitor, 0.006 µF, 10 kV

C3 – Capacitor, 10 µF, 400 V

CR1 – Relay, coil 24 VDC. Contacts, 3-pole, single throw, each contact rated 25 A, 600 VAC maximum: All three poles wired in series

CR2 – Relay, coil 120 VAC. Contacts DPDT. Provides either 120 V or 240 V test circuit.

D1 – D4– Diodes, 25 kV PIV each

L1 – Inductor, 15 µH [33 turns, No. 22 AWG wire, wound on 0.835 inch (21.2 mm) diameter PVC tubing]

L2 – Inductor, 70 µH [45 turns, No. 14 AWG wire, wound on 2.375 inch (60.33 mm) diameter PVC tubing]

M1 – Meter, 0 – 20 VDC

R1 – Resistor, 22 Ohms, 1 W, composition

R2 – Resistor, 12 Ohms, 1 W, composition

R3 – Resistor, 1.3 Megohms (12 in series, 110 k Ohms each, 1/2 W)

R4 – Resistor, 47 k Ohms (10 in series, 4.7 k Ohms each, 1/2 W)

R5 – Resistor, 470 Ohms, 1/2 W

R6 – Resistor, 200 Megohms, 2 W, 10 kV

R7 – Resistor, 0.2 Megohms (2 in series, 100 k Ohms each, 2 W, carbon)

S1– Switch, SPST

S2 – Switch, SPST, key-operated, 120 VAC, 1 A

T1 – Transformer, 2 kVA, 120 V primary, 1:1 (120 V or 240 V output)

T2 – Transformer, 90 VA, 120/15,000 V

T3 – Variable autotransformer, 2.5 A

29.2.3 The transients produced are to be oscillatory and are to have an initial peak voltage of 6,000 volts. The rise time is to be less than 1/2 microsecond. Successive peaks of the transient are to decay to a value of not more than 60 percent of the value of the preceding peak.

29.2.4 The unit under test is to be subjected to 500 oscillatory transient pulses induced at a rate of 6 pulses per minute. Each transient pulse is to be induced 90 degrees into the positive half of the 60 hertz cycle. A total of 250 pulses are to be applied so that the polarity of the transients is positive with reference to earth ground, and the remaining 250 pulses are to be negative with respect to earth ground.

29.3 Internally induced transients – all units

29.3.1 The unit under test is to be energized while in its standby condition from a rated test source of supply which is to be interrupted a total of 500 times. Each interruption is to be for 1 second at a rate of not more than 6 interruptions per minute. Standby power is to be connected if it is provided.

30 Dielectric Voltage-Withstand Test

30.1 A signaling unit shall withstand for 1 minute, without breakdown, the application of an essentially sinusoidal AC potential of a frequency within the range of 40 – 70 hertz, or a DC potential, between live parts and the enclosure, live parts and exposed dead metal parts, and live parts of circuits operating at different potentials or frequencies. The test potential is to be (also, see 30.2):

a) For a signaling unit rated 30 volts AC rms (42.4 volts DC or AC peak) or less – 500 volts (707 volts, if a DC potential is used).

b) For a signaling unit rated between 31 and 250 volts AC rms – 1,000 volts (1,414 volts, if a DC potential is used).

c) For a signaling unit rated more than 250 volts AC rms – 1,000 volts plus twice the rated voltage (1,414 volts plus 2.828 times the rated AC rms voltage, if a DC potential is used).

30.2 For the application of a potential between live parts of circuits operating at different potentials or frequencies, the voltage is to be the applicable value specified in 30.1 (a), (b), or (c), based on the highest voltage of the circuits under test instead of the rated voltage of the signaling unit. Electrical connections between the circuits are to be disconnected before the test potential is applied.

30.3 If an autotransformer is in the circuit, the primary of the transformer is to be disconnected and an AC test potential in accordance with 30.1(c) is to be applied directly to all wiring involving more than 250 volts.

30.4 If the charging current through a capacitor or capacitor type filter connected across the line, or from line to earth ground, is sufficient to prevent maintenance of the specified AC test potential, the capacitor or filter is to be tested using a DC test potential in accordance with 30.1.

30.5 The test potential shall be obtained from any convenient source having sufficient capacity to maintain the specified voltage. The output voltage of the test apparatus is to be monitored. Starting at zero, the potential is to be increased at a rate of approximately 200 volts per minute until the required test value is reached and is to be held at that value for 1 minute.

30.6 A printed-wiring assembly or other electronic circuit component that is capable of being damaged by the application of the test potential, or is capable of short-circuiting the test potential, is to be removed, disconnected, or otherwise rendered inoperative before the test. It is not prohibited that a representative subassembly be tested instead of an entire signaling unit or that rectifier diodes in the power supply be individually shunted before the test to avoid destroying them in the case of a malfunction elsewhere in the secondary circuits.

30.7 With regard to 11.8.1(e), the windings shall withstand a 3,500-volt, 60-hertz test potential for 1 minute.

31 Static Discharge Test

31.1 The components of a signal initiating unit shall be shielded so that their operation is not impaired, nor is a false signal obtained, when subjected to stated electric discharges. CAUTION: Potentially lethal voltages are used in this test. Precautions shall be taken to avoid risk of electric shock.

31.2 Each type of signal initiating unit is to be mounted in the intended position on a 3/4 inch (19 mm) thick unpainted exterior grade plywood surface and connected to a source of supply in accordance with Table 16.1. When a unit is intended to be installed in a metal electrical junction box the box is to be connected to earth ground. An electrostatic discharge simulator is to be charged to 8,000 volts for a minimum of 2 seconds before each discharge. A simulator suitable for use is Electro-Metrics ESD-200 Electrostatic Discharge Control Unit and Model D-30 Probe Assembly.

31.3 Ten contact discharges are to be applied to different points on the exposed surface of each signal initiating unit. The simulator is to be recharged as indicated in 31.2 prior to each discharge. Five discharges are to be made with the ground lead connected to earth ground and the probe in contact with the unit surface followed by five discharges with polarity reversed.

31.4 Following the discharges the unit is to be tested for normal operation. See the Normal Operation Test, Section 17.

32 Drop Test

32.1 The enclosure of a device intended to be hand held, such as a pendant control or switch, shall withstand dropping without exposure of live parts, and the device shall continue to operate as intended. Cracking of the enclosure without exposure of live internal parts is acceptable.

32.2 Each of three samples is to be dropped 100 times from a height of 4 feet (1.2 m) onto an asbestos-filled concrete surface. The distance of the drop is to be measured from the asbestos tiled concrete surface to the bottom-most part of the device. Each sample of the device is to be positioned to impact on the weakest point that can be contacted in the drop. The device shall be operational following the test.

33 Component Failure Test

33.1 Opening or shorting of capacitors shall either not impair the operation of the equipment or be indicated by some form of an audible or visual signal. For this test the fault is to be applied, and the results noted, while the equipment is energized in the standby condition and connected to a rated supply.

33.2 If it is not practical to have a component failure indicated, it is not prohibited that a reliable component be employed if its reliability is attained by derating or it is evaluated by supporting reliability data.

34 Abnormal Tests

34.1 Abnormal operation test

34.1.1 A signaling unit that is intended to be operated only for a limited period shall operate continuously under abnormal conditions without resulting in a risk of fire or electric shock.

34.1.2 The unit is to be operated under the most severe abnormal conditions encountered in service. There shall be no emission of flame or molten metal, or any other manifestation of a fire, and leakage current measurements following the test shall be within the values specified in Table 28.1.

34.1.3 A fault condition (see 34.1.5) is to be maintained continuously until constant temperatures are attained or, if the fault does not result in the operation of an overload protective device, until burnout occurs.

34.1.4 The test is to be conducted with the unit connected to a rated test source of supply. A single layer of cheesecloth is to be loosely draped over the entire unit with the cloth within 1/8 inch (3.2 mm) of openings in the overall enclosure.

34.1.5 Shorting or opening of electrolytic filter capacitors connected in the output circuit of a power supply are abnormal test conditions.

34.2 Burnout test

34.2.1 Powered-limited circuit

34.2.1.1 There shall be no emission of flame or molten metal when an inherently limited circuit, as described in 19.3.1, is operated with all output leads short-circuited. Immediately following the test, the unit shall comply with requirements in the Dielectric Voltage-Withstand Test, Section 30.

34.2.1.2 For this test, the supply circuit is to be connected to a source of rated voltage and frequency and all leads of the power-limited circuit are to be shorted. If a fuse is employed in the primary supply circuit, the maximum fuse current rating is to be used in the fuseholder employed. The supply circuit is to be energized and operated until either burnout occurs or steady temperatures (at least 6 hours of operation) are obtained.

34.2.2 Externally connected cords

34.2.2.1 There shall be no emission of flame or molten metal when all leads of an external cord of a pendant control, pillow speaker, or similar device, are shorted. Immediately following the test the leakage current is to be measured and shall comply with the requirements in 28.1(d).

34.2.2.2 For this test, the supply circuit of the system is to be connected to a source of rated voltage and frequency and the external cord leads shorted. The maximum fuse current rating is to be used in any fuseholder employed. The supply circuit is then to be energized and operated until either burnout occurs or steady state temperatures (at least 6 hours of operation) are obtained.

34.3 Circuit isolation – ancillary equipment

34.3.1 The unit is to be operated under the most severe abnormal conditions encountered in service. There shall be no emission of flame or molten metal, or any other manifestation of a fire, and leakage current measurements during and after the test shall be within the values specified in Table 28.1. The intended operation of the nurse call system shall be unaffected as a result of this test.

34.3.2 A fault condition (see 34.3.5) is to be maintained continuously until constant temperatures are attained or, if the fault does not result in the operation of an overload protective device, until burnout occurs.

34.3.3 The test is to be conducted with the unit connected to a rated branch circuit source of supply. A single layer of cheesecloth is to be loosely draped over the entire unit with the cloth within 1/8 inch (3.2 mm) of openings in the overall enclosure.

Exception: If the manufacturer identifies a specific device to be connected to the ancillary circuit, it is not prohibited that the test be conducted using the available source of supply to the ancillary circuit connections while the device is operated under normal conditions.

34.3.4 Immediately following the test, the unit shall comply with the requirements in the Dielectric Voltage-Withstand Test, Section 30.

34.3.5 Individually shorting ancillary circuits to earth ground and then separately shorting ancillary circuits together are abnormal test conditions.

34.3.6 Prior to fault applications, any device which is capable of being taken into a patient's bed shall be immersed for a period of 24 hours in a solution containing 1/2 gram of common table salt per liter of distilled water. Immediately following the conditioning, the device shall be subjected to the conditions described in 34.3.1– 34.3.5.

34.3.7 Devices that provide isolation to equipment that has not been determined to comply with the requirements in this standard shall include the information specified in 45.8 in the installation instructions.

35 Tests for Special Terminal Assemblies

35.1 General

35.1.1 Terminal assemblies employed as field wiring connections, see 8.2.2.1 (b) – (f), shall comply with the Mechanical Secureness Test, Section 35.2; the Flexing Test, Section 35.3; the Millivolt Drop Test, Section 35.4; and the Terminal Temperature Test, Section 35.5.

35.2 Mechanical secureness test

35.2.1 A terminal connection shall withstand the application of an average straight pull of 3 pounds (13.3 N), but in no case less than 2 pounds (8.9 N), applied for 1 minute to the wire in the direction that would most likely result in pullout, without separating from the wire.

35.2.2 Six samples of the terminal are to be connected to the wire size(s) with which they are intended to be employed in accordance with the manufacturer's instructions. If a special tool is required to assemble the connection, it is to be employed. Each sample is to be subjected to a gradually increasing pull on the wire until the test value of 3 pounds (13.3 N) is reached. The average pull is to be calculated with the high and low values discarded.

35.3 Flexing test

35.3.1 The wire attached to a terminal shall withstand an average of five right-angle bends without breaking.

35.3.2 Six terminal assemblies employing the maximum wire size and six with the minimum wire size are to be subjected to this test. The wire is to be connected to the terminals using a special tool, if required, in accordance with the manufacturer's instructions. The tension on the wire is to be of sufficient force to keep the wire rigid during the flexing trials. The terminal is to be held in a rigid position and the wire bent at right angles from the wire position when initially installed.

35.4 Millivolt drop test

35.4.1 The millivolt drop across a terminal junction connection, using the maximum and minimum wire sizes intended to be employed, shall not exceed 300 millivolts with the maximum current of the circuit flowing through the terminal connection at the rated voltage of the circuit.

35.4.2 Six terminal assemblies employing the maximum wire size and six employing the minimum wire size are to be subjected to this test. The wires are to be assembled to the terminals using a special tool, if required, in accordance with the manufacturer's instructions. The millivolt drop is then to be measured using a high impedance millivoltmeter with the maximum current flowing through the connection.

35.5 Terminal temperature test

35.5.1 The maximum temperature rise on a terminal junction connection, using the maximum and minimum wire sizes intended to be employed, shall not exceed 30°C (54°F) based on an ambient temperature of 25°C (77°F).

35.5.2 Six terminal assemblies employing the maximum wire size and six employing the minimum wire size are to be subjected to this test. The wires are to be connected to the terminals using a special tool, if required, in accordance with the manufacturer's instructions. The maximum current anticipated in service is then to be passed through the terminal connection. The temperature rise is to be measured by the thermocouple method in accordance with the Temperature Test, Section 22, after temperatures have stabilized.

36 Polymeric Materials Tests

36.1 General

36.1.1 Polymeric materials intended for the sole support of current-carrying parts or as an enclosure of a signaling unit are to be subjected to the following tests. If possible, a complete unit is to be used. Nonfunctional dress plates or covers are not required to be subjected to the flame test described in the Flame Test, Section 36.3. Corridor lamp domes are evaluated as nonfunctional covers unless they house live parts other than glass envelopes of lamps.

36.2 Temperature test

36.2.1 There shall be no warping to the extent that operation is impaired or high-voltage uninsulated current-carrying parts are exposed when representative samples of a polymeric material are aged for 7 days in a circulating-air oven maintained at 70°C (158°F).

36.2.2 For this test, at least three representative samples are to be placed in the oven. Following the 7-day aging period, the samples are to be removed, permitted to cool to room temperature, and examined for warping and part exposure.

36.3 3/4-inch flame test

36.3.1 When equipment is tested as described in 36.3.2 – 36.3.6, the material shall not flame for more than 1 minute after two 30-second applications of a test flame, with an interval of 1 minute between applications of the flame. The sample shall not be completely consumed.

Exception: Parts that are molded from materials that are classed as 5VA, 5VB, V-0, V-1, or V-2, by the 500-w (125-mm) or 20-mm vertical burning tests described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, are not required to be subjected to the flammability test described in 36.3.2 – 36.3.6.

36.3.2 Three samples of the equipment are to be placed in a forced draft air-circulating oven maintained at a uniform temperature not less than 10°C (18°F) higher than the maximum temperature of the material measured under normal operating conditions, and not less than 70°C (158°F) in any case. The samples are to remain in the oven for 7 days. After cooling to room temperature for a minimum of 4 hours, the samples are to be tested as described in 36.3.3 – 36.3.6.

Exception: It is not prohibited for testing to be conducted on three unconditioned test samples when both of the following conditions are met:

a) The material does not exhibit a reduction in its flame-resistance properties as a result of long-term thermal aging and

b) The thermal-aging program used for such determination included specimens having a thickness equal to or less than the wall thickness of the polymeric part.

36.3.3 Three samples of the part are to be subjected to the Flame Test described in 36.3.5. In the performance of the test, the equipment is to be supported in its normal operating position in a draft-free location. Nonpolymeric portions are not to be removed and insofar as possible, the internal mechanism of the equipment is to be in place. The flame is to be applied to an inside surface of the sample at a location judged as capable of becoming ignited because of its proximity to a source of ignition. Each sample is to be tested with the flame applied to a different location.

36.3.4 With reference to 36.3.3, the sections judged capable of becoming ignited are to be those adjacent to coil windings, splices, open-type switches, or arcing parts.

36.3.5 The flame of a Bunsen or Tirrill burner having a tube with a length of 100 ±10 mm (3.94 ±0.39 inches) and an inside diameter of 9.5 ±0.3 mm (0.374 ±0.12 inch) is to be adjusted to have a 3/4-inch (19-mm) height of blue flame. Two 30-second applications of the tip of the flame are to be made to each section of the equipment specified as indicated above, with a 1-minute interval between the applications. A supply of technical-grade methane gas is to be used with a regulator and meter for uniform gas flow.

Exception: Natural gas having a heat content of 1000 Btu/ft^3 (37 MJ/m^3 at 23°C) has been found to provide similar results and is appropriate for use.

36.3.6 When one sample from a set of three does not comply with 36.3.1, an additional set of three samples shall be tested. All samples from the second set shall comply with 36.3.1.

36.4 5-inch flame test

36.4.1 When equipment is tested as described in 36.4.1 – 36.4.6, all of the following results shall be obtained:

a) The material shall not continue to burn for more than 1 minute after the fifth 5-second application of the test flame, with an interval of 5 seconds between each application of the flame;

b) Flaming drops or flaming or glowing particles that ignite surgical cotton placed 12 inches (305 mm) below the test specimen shall not be emitted by the test sample at any time during the test; and

c) The material shall not be destroyed in the area of the test flame to such an extent that the integrity of the part is affected with regard to containment of fire or exposure of high voltage parts.

Exception: Parts that are molded from materials that are classed as 5VA by the 500 w (125 mm) vertical burning test described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, are not required to be subjected to the flammability tests described in 36.4.1 – 36.4.6.

36.4.2 Three samples of the complete equipment or three test specimens of the molded part shall be subjected to this test. Components and other parts that influence the performance are to be left in place. The test samples are to be conditioned in a full draft air-circulating oven for 7 days, at 10°C (18°F) greater than the maximum use temperature and not less than 70°C (158°F) in any case. Prior to testing, the samples are to be conditioned for a minimum of 40 hours at 23.0 ±2.0°C (73.4 ±3.6°F) and 50 ±5 percent relative humidity. The flame is to be applied to an inside surface of the sample at a location judged as capable of becoming ignited because of its proximity to a source of ignition. When more than one part is near a source of ignition, each sample is to be tested with the flame applied to a different location.

Exception: It is not prohibited for testing to be conducted on three unconditioned test samples when both of the following conditions are met:

a) The material does not exhibit a reduction in its flame-resistance properties as a result of long-term thermal aging and

b) The thermal-aging program used for such determination included specimens having a thickness equal to or less than the wall thickness of the polymeric part.

36.4.3 The three samples shall perform as described in 36.4.1. When one sample does not comply, the test is to be repeated on a set of three new samples with the flame applied under the same conditions as for the unsuccessful sample. All the new specimens shall comply with 36.4.1.

36.4.4 The Bunsen or Tirrill burner with a tube length of 100 ±10 mm (3.94 ±0.39 inches), and an inside diameter of 9.5 ±0.3 mm (0.374 ±0.12 inch), is to be placed remote from the specimen, ignited, and adjusted so that when the burner flame is 5 inches (127 mm), the height of the inner blue cone is 1-1/2 inches (38 mm). The tube is not to be equipped with end attachments, such as stabilizers.

36.4.5 When a complete enclosure is used to conduct the flame test, the sample is to be mounted as intended in service, as long as it does not impair the flame testing, in a draft-free test chamber, enclosure, or laboratory hood. A layer of surgical cotton is to be located 12 inches (305 mm) below the point of application of the test flame. The 5-inch (127-mm) flame is to be applied to any portion of the interior of the part judged as capable of being ignited (by its proximity to live or arcing parts, coils, wiring, or other possible sources of ignition) at an angle of 20 degrees from the vertical so that the tip of the blue cone touches the specimen. The test flame is to be applied to three different locations on each of the three samples tested. A supply of technical-grade methane gas is to be used with a regulator and meter for uniform gas flow.

Exception No. 1: The flame is to be applied to the outside of an enclosure when the equipment is of the encapsulated type, or of a size that prohibits the flame being applied inside.

Exception No. 2: Natural gas having a heat content of 1000 Btu/ft^3 (37 MJ/m^3 at 23°C) has been found to provide similar results and is appropriate for use.

36.4.6 The flame is to be applied for 5 seconds and removed for 5 seconds. The operation is to be repeated until the specimen has been subjected to five applications of the test flame.

37 Strain Relief Test

37.1 Power supply cord

37.1.1 The strain relief means provided on a flexible cord shall withstand for 1 minute, without significant displacement, a pull of 35 pounds (156 N) applied to the cord with the connections within the control unit disconnected.

37.1.2 A 35-pound (15.9-kg) weight is to be suspended on the cord and supported by the control unit so that the strain relief means will be stressed from any angle that the construction of the unit permits. At the point of disconnection of the conductors there shall not be movement of the cord so as to indicate that stress would have resulted on the connections.

37.2 Field wiring leads

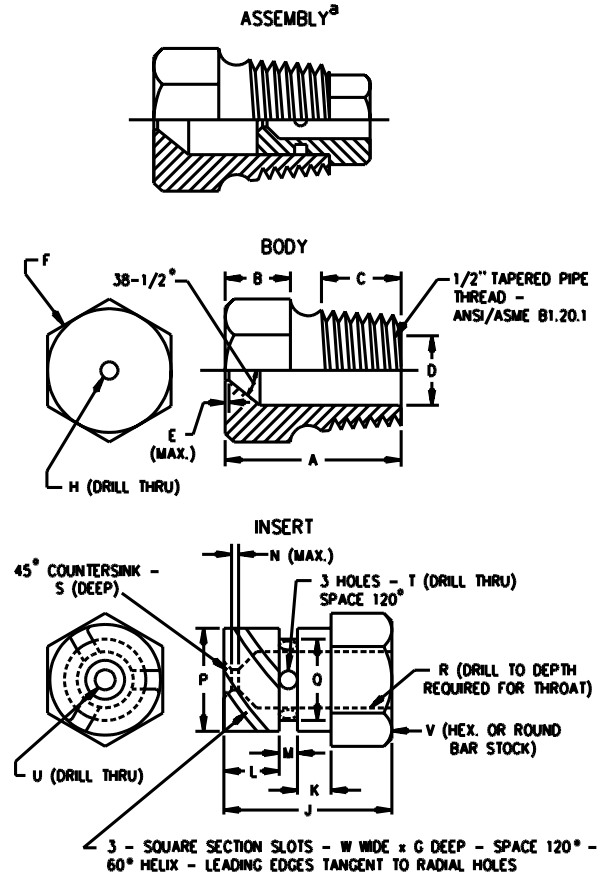
37.2.1 Each lead employed for field connections shall withstand for 1 minute a pull of 10 pounds (4.5 kg) without any evidence of damage or of transmittal of stress to internal connections.

38 Water Spray Test

38.1 A signaling unit intended for use within a shower stall shall withstand a water spray exposure without wetting of electrical parts. After the exposure, the unit shall comply with the leakage current requirements in 28.1(d).

38.2 The test apparatus is to consist of three spray heads mounted in a water supply pipe rack as shown in Figure 38.1. Spray heads are to be constructed in accordance with the details shown in Figure 38.2. The water pressure for all tests is to be maintained at 5 psi (34 kPa) at each spray head. The distance between the center nozzle and the unit is to be 5 feet (1.5 m). The unit is to be brought into the focal area of the three spray heads in such a position and under such conditions that the greatest quantity of water enters the unit while mounted within the appropriate back box on a vertical surface in a position of intended use. The spray is to be directed at an angle of 45 degrees to the vertical toward the unit or openings closest to current-carrying parts. The total exposure time is 1 hour. Two samples are to be subjected to this test.

Figure 38.1
Rain-test spray-head piping



Item	inch	mm	Item	inch	mm
A	1-7/32	31.0	N	1/32	0.80
B	7/16	11.0	P	.575	14.61
C	9/16	14.0		.576	14.63
D	.578	14.68	Q	.453	11.51
	.580	14.73		.454	11.53
E	1/64	0.40	R	1/4	6.35
F	c	c	S	1/32	0.80
G	.06	1.52	T	(No. 35)[b]	2.80
H	(No.9)[b]	5.0	U	(No. 40)[b]	2.50
J	23/32	18.3	V	5/8	16.0
K	5/32	3.97	W	0.06	1.52
L	1/4	6.35			
M	3/32	2.38			

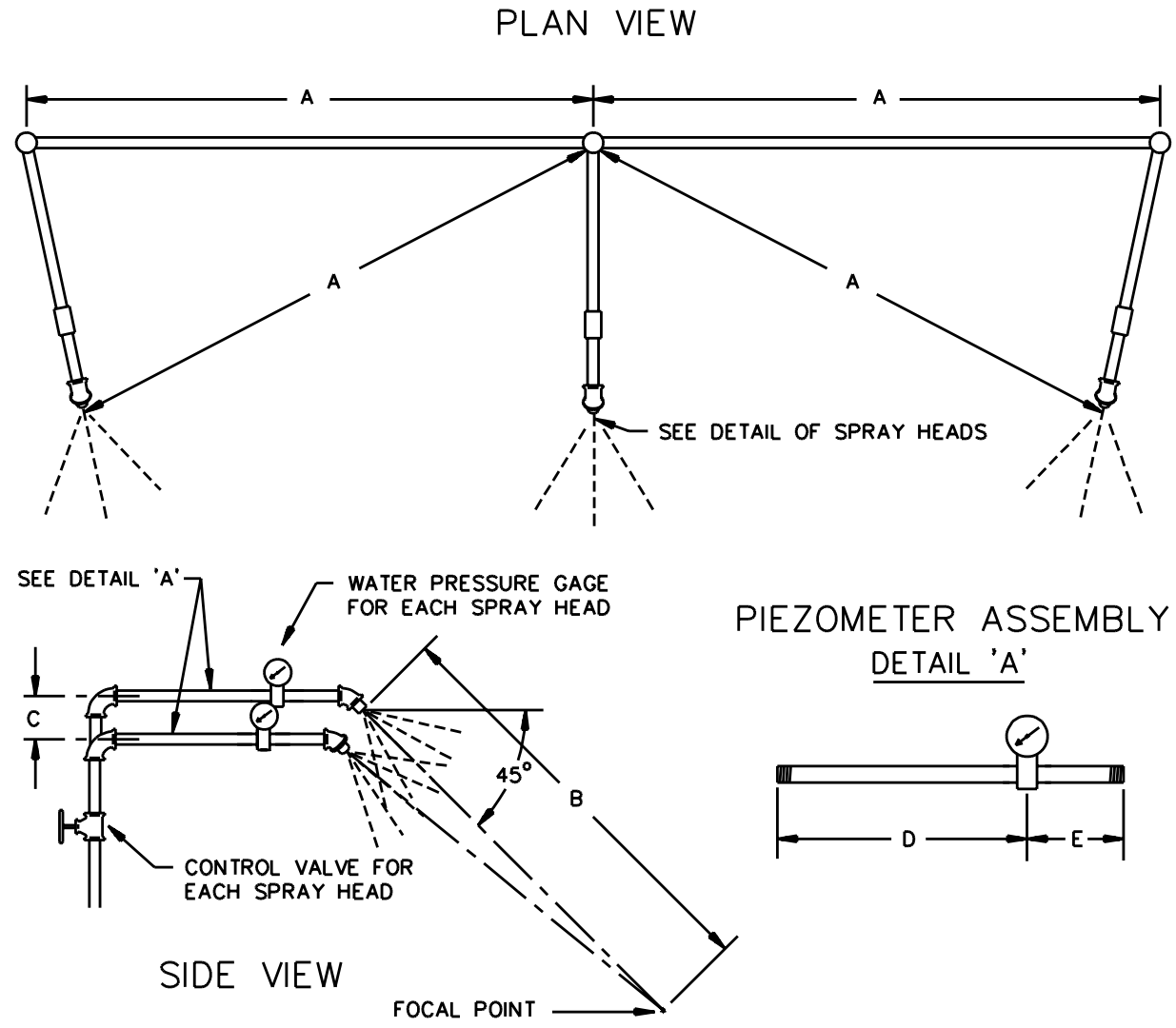
[a] Nylon Rain-Test Spray Heads are available from Underwriters Laboratories

[b] ANSI B94.11M Drill Size

[c] Optional - To serve as a wrench grip.

RT100E

Figure 38.2
Rain-test spray head



Item	inch	mm
A	28	710
B	55	1400
C	2–1/4	55
D	9	230
E	3	75

RT101E

38.3 Following exposure, the unit is to be subjected to the Leakage Current Test, Section 28. After the test, the outside of each sample is to be carefully wiped clear of water, removed, and a visual examination made to determine if any water has entered and wetted current-carrying parts.

39 Impact Test

39.1 Equipment employing a nonmetallic enclosure shall withstand one 5-foot-pound (22.2-N) impact without exposure of live parts, impairment of operation, or creation of a risk of electric shock.

39.2 The equipment is to be mounted securely in a position of intended use on a surface representative of a typical installation. A 1.18-pound (535-g), 2-inch (50.8-mm) diameter steel sphere is to be dropped from a height of 51 inches (1,300 mm) or swung through a pendulum arc from a sufficient height to apply 5-foot-pounds (22.2-N) of energy to the weakest section of the enclosure.

39.3 Following the impact, the equipment is to be examined for damage and energized from a source of rated voltage and frequency and checked for the intended operation. Cracking of the enclosure is acceptable if it does not impair the primary operation.

Exception: A visual-indicating device for the nurse control station, when intended to be installed and operated in the vertical plane, and when evaluated to the requirements in the Standard for Audio-Video Products and Accessories, UL 1492; Information Technology Equipment, UL 1950; or Audio/Video and Musical Instrument Apparatus for Household, Commercial, and Similar General Use, UL 6500, is not required to be subjected to this test.

MANUFACTURING AND PRODUCTION TESTS

40 Production-Line Dielectric Voltage-Withstand Test

40.1 Each hospital signaling unit rated at more than 30 volts AC rms (42.4 volts DC or AC peak) shall withstand without breakdown, as a routine production-line test, the application of an essentially sinusoidal AC potential of a frequency within the range of 40 – 70 hertz, or a DC potential, between high-voltage live parts and the enclosure, high-voltage live parts and exposed dead metal parts, and live parts of circuits operating at different potentials or frequencies. The test potential is to be:

a) For a unit rated at 250 volts AC rms or less – either 1,000 volts (1,414 volts, if a DC potential is used) applied for 60 seconds, or 1,200 volts (1,697 volts, if a DC potential is used) applied for 1 second.

b) For a unit rated at more than 250 volts – either 1,000 volts plus twice the rated AC rms voltage (1,414 volts plus 2.828 times the rated AC rms voltage, if a DC potential is used) applied for 60 seconds, or 120 volts plus 2.4 times the rated voltage (1,697 volts plus 3.394 times the rated AC rms voltage, if a DC potential is used) applied for 1 second.

40.2 If the unit employs both high- and low-voltage circuits, the test is to be conducted with the low-voltage circuits connected to the cabinet, chassis, or other dead metal parts so that the potential that is applied between the high-voltage live parts and dead metal parts will simultaneously be applied between high-voltage live parts and low-voltage circuits.

40.3 A printed-wiring assembly or other electronic circuit component that would be damaged by the application of, or would short-circuit, the test potential, is to be removed, disconnected, or otherwise rendered inoperative before the test. It is not prohibited for a representative subassembly to be tested instead of an entire unit or for rectifier diodes in the power supply to be individually shunted before the test to avoid destroying them in the case of a malfunction elsewhere in the secondary circuits.

40.4 A 500-volt-ampere or larger transformer capable of varied output voltage is to be used to determine compliance with 40.1. A 500-volt-ampere or larger transformer is not required if the high potential testing equipment used is such that it maintains the specified voltage at the unit during the test.

40.5 The test equipment is to include a visible indication of application of the test potential and an audible or visible indication, or both, of breakdown. In the event of breakdown, manual reset of an external switch is required, or an automatic reject of the product under test is to result. Other arrangements are not prohibited if found to achieve the results contemplated.

40.6 If the charging current through a capacitor or capacitor type filter connected across the line, or from line to earth ground, prevents maintenance of the specified AC test potential, the signaling unit is to be tested using a DC test potential in accordance with 40.1.

41 Production-Line Grounding Continuity Test

41.1 The manufacturer shall test each signaling unit that has a power supply cord to verify that the maximum resistance between the device and the grounding pin of the attachment plug is not more than 0.15 ohm.

41.2 For this test, the manufacturer is to employ a resistance-indicating instrument with leads and terminals by which the grounding circuit resistance is determined.

41.3 If an investigation of the product has shown all exposed dead metal parts capable of becoming energized and all dead metal parts within the enclosure that are exposed to contact during servicing to be suitably bonded to the frame and enclosure of the product, a test to verify electrical continuity between the grounding blade and the frame or enclosure is considered to be sufficient.

MARKING

42 General

42.1 A signaling unit shall be plainly and permanently marked where the marking is readily visible after installation, with the following information. Except as indicated otherwise, the information shall appear directly on the unit or on a separate installation diagram referenced in the marking:

a) Manufacturer’s or private labeler’s name or identifying symbol. (The marking shall be on the unit.)

b) Model number and date code or equivalent. (The marking shall be on the unit.)

c) Electrical rating in volts, amperes or watts, and frequency. (The marking shall be on the unit.) It is not prohibited that input ratings to low-voltage products be marked on the installation wiring diagram.

d) Correct mounting position if a unit is intended to be mounted in a definite position.

e) Identification of lights, switches, meters, and similar parts regarding their function. Located adjacent to the component. This is not required if their operation is obvious.

f) Maximum rating of fuse on each fuseholder. Located adjacent to the fuseholder.

g) Reference to an installation wiring diagram, if not attached to unit, by drawing number and issue date. (The marking shall be on the main terminal cabinet or power supply.)

h) Only a pendant control or call cord that has been investigated and found suitable for use in oxygen-enriched atmospheres, is permitted to have the following marked on the device: ″Note – May Be Used by Patients Undergoing Oxygen Therapy – Hang On Hook (In Holder) When Not In Use.″ See 42.2. The letter height shall be no less than 3/32 inch (2.4 mm) for the notice.

1) The signal word “CAUTION”:

i) Shall appear in black, upper-case letters in a sans serif font of Folio Medium, New Gothic Bold, Helvetica Bold, or equivalent fonts, on a yellow background;

ii) Shall be at least 50 percent larger than the remaining text of the marking, and be of a size that is sufficient to be seen from a distance allowing a user/ service person an adequate amount of time to take action to avoid the hazard specified in the marking after viewing the label;

iii) Is to appear in a separate, distinct area within the marking label.

2) The Safety Alert Symbol, ⚠ , is to appear next to the signal word and is to be no smaller than the height of the signal word with the base of the triangle on the same horizontal line as the base of the signal word. The solid portion of the triangle (within the lines of the triangle, around the exclamation mark) shall be the same color as the signal word letters, and the exclamation mark shall be the same color as the signal word background.

i) For a pendant control provided with connections to control circuits, such as radio, television, drapery hardware, and similar devices, the electrical ratings of these circuits. (Marked on the control.) In addition, the word ″CAUTION″ and the following or equivalent text shall be marked on the control: ″Make periodic leakage current measurements of all pendant control/pillow speaker circuits to verify the values are appropriate for the installation location.″

1) The signal word “CAUTION”:

i) Shall appear in black, upper-case letters in a sans serif font of Folio Medium, New Gothic Bold, Helvetica Bold, or equivalent fonts, on a yellow background;

ii) Shall be at least 50 percent larger than the remaining text of the marking, and be of a size that is sufficient to be seen from a distance and allowing a user/service person an adequate amount of time to take action to avoid the hazard specified in the marking after viewing the label;

iii) Is to appear in a separate, distinct area within the marking label.

2) The Safety Alert Symbol, ⚠ , is to appear next to the signal word and is to be no smaller than the height of the signal word with the base of the triangle on the same horizontal line as the base of the signal word. The solid triangle portion (within the lines

of the triangle, around the exclamation mark) shall be the same color as the signal word letters, and the exclamation mark shall be the same color as the signal word background.

Exception: The cautionary marking is not required to be included on the pendant control if it is included on or in all of the following locations:

1) On the patient station to which the pendant control is connected.

2) On the system control unit.

3) In the installation manual.

j) For a device, such as a switch, intended for emergency service, the word ″EMERGENCY″ or an equivalent wording describing an emergency condition, such as ″PULL FOR HELP.″ The marking shall be permanent, in a distinctive color (preferably red), and on the front of the device. Other type units shall be marked regarding their function.

k) Identification of high-voltage wires of a cable assembly containing both high- and low-voltage circuit connections. It is not prohibited that the marking be included in the installation diagram.)

l) For a patient station incorporated as part of a prefabricated wall panel, the following or equivalent text: ″The Compatibility Of The Patient Station And Faceplate With The Back Box Or The Acceptability Of Any Device Installed In The Side Compartment Has Not Been Investigated.″ (The marking shall be on the patient station.)

m) For a custom enclosure or faceplate, the manufacturer's name, model number, and date of manufacture, or equivalent. (The marking shall be on the enclosure or faceplate.)

n) Description of normal operational features that are functional while the main AC power is connected but that do not function while the signaling unit is operated from a standby battery.

o) For a patient station intended to be installed in a shower stall, or an equivalent location where water spray would be encountered, the words ″SHOWER STATION.″ (The marking shall be on the station.)

p) For a power supply and nurse master intended for use in a centralized system, the following or equivalent text: ″For Use In A Centralized System.″ (The marking shall be on the power supply/nurse master.)

Revised 42.1 effective March 29, 2004

42.2 An oxygen-enriched atmosphere is an atmosphere in which the oxygen content exceeds 23-1/2 percent by volume or 179 Torr partial pressure. The addition of nitrous oxide to an atmosphere will create an oxygen-enriched atmosphere for purposes of this standard.

42.3 An oxygen administration site is all points within 1 foot (0.30 m) of oxygen administration equipment (including oxygen-powered aspirators) except that if the equipment contains, or is intended to contain an oxygen-enriched atmosphere larger than 2 liters (0.56 gallon) in volume (measured at atmospheric pressure), the site of administration shall include all points within 5 feet (1.5 m) of the equipment.

42.4 The removal or opening of an enclosure cover or a plate, without disturbing installation wiring or handling interior components to view the marking, is considered to comply with the requirements regarding visibility after installation.

42.5 With respect to the Exception to 5.6.1, the following or equivalent marking, in letters 1/8 inch (3.2 mm) in height, shall be indicated on the cover: ″CAUTION – Risk of Electric Shock – Circuit Fuse(s) Inside – Disconnect Power Prior To Servicing.″ See Testing, Servicing, and Maintenance Protection, Section 15.

a) The signal word “CAUTION”:

1) Shall appear in black, upper-case letters in a sans serif font of Folio Medium, New Gothic Bold, Helvetica Bold, or equivalent fonts, on a yellow background;

2) Shall be at least 50 percent larger than the remaining text of the marking, and be of a size that is sufficient to be seen from a distance allowing a user/service person an adequate amount of time to take action to avoid the hazard specified in the marking after viewing the label;

3) Is to appear in a separate, distinct area within the marking label.

b) The Safety Alert Symbol, ⚠ , is to appear next to the signal word and is to be no smaller than the height of the signal word with the base of the triangle on the same horizontal line as the base of the signal word. The solid triangle portion (within the lines of the triangle, around the exclamation mark) shall be the same color as the signal word letters, and the exclamation mark shall be the same color as the signal word background.

c) The risk identification “Risk of Electric Shock – Circuit Fuse(s) Inside″ and risk avoidance statements “Disconnect Power Prior To Servicing”:

1) Shall appear in upper- or mixed-case in a sans serif font of Folio Medium, New Gothic Bold, Helvetica Bold, Medium, or equivalent fonts;

2) Shall appear in separate, distinct areas within the marking label; and

3) Shall be either white lettering on a black background or black lettering on a white background

Revised 42.5 effective March 29, 2004

42.6 With respect to the marking requirements referenced in 15.3, a permanent and prominent marking shall be provided on the cover front that includes the word ″CAUTION″ and the following or equivalent: ″To Reduce the Risk of Electric Shock, De-Energize Unit Prior to Servicing.″

a) The signal word “CAUTION”:

1) Shall appear in black, upper-case letters in a sans serif font of Folio Medium, New Gothic Bold, Helvetica Bold, or equivalent fonts, on a yellow background;

2) Shall be at least 50 percent larger than the remaining text of the marking, and be of a size that is sufficient to be seen from a distance allowing a user/service person an adequate amount of time to take action to avoid the hazard specified in the marking after viewing the label;

3) Is to appear in a separate, distinct area within the marking label.

b) The Safety Alert Symbol, ⚠ , is to appear next to the signal word and is to be no smaller than the height of the signal word with the base of the triangle on the same horizontal line as the base of the signal word. The solid triangle portion (within the lines of the triangle, around the exclamation mark) shall be the same color as the signal word letters, and the exclamation mark shall be the same color as the signal word background.

c) The risk identification “To Reduce the Risk of Electric Shock” and risk avoidance statements “De-Energize Unit Prior to Servicing”:

1) Shall appear in upper- or mixed-case in a sans serif font of Folio Medium, New Gothic Bold, Helvetica Bold, Medium, or equivalent fonts;

2) Shall appear in separate, distinct areas within the marking label; and

3) Shall be either white lettering on a black background or black lettering on a white background.

Revised 42.6 effective March 29, 2004

42.7 All markings shall be permanent. Markings affixed to a unit shall resist the deleterious effects of handling, cleaning agents, and the like expected in the intended use.

42.8 Good contrast shall be maintained between the lettering and the background material and, in the absence of a specified minimum dimension, the height of the letters shall be such that the information will be clear and legible under actual conditions of use.

42.9 If a manufacturer produces units at more than one factory, each such assembly shall have a distinctive marking to identify it as the product of a particular factory.

42.10 With respect to the requirement in 8.2.2.1(e), equipment employing push-in terminals shall be marked adjacent to the terminals to indicate that only copper conductors are to be used.

42.11 With respect to the requirements referenced in 8.8.1, a marking shall be located in the wiring area that specifies the statement: ″CAUTION – Risk of Electric Shock″ and the following or equivalent instructions: ″When Making Installation, Route Field Wiring Away From Sharp Projections, Corners, And Internal Components.″

a) The signal word “CAUTION”:

1) Shall appear in black, upper-case letters in a sans serif font of Folio Medium, New Gothic Bold, Helvetica Bold, or equivalent fonts, on a yellow background;

2) Shall be at least 50 percent larger than the remaining text of the marking, and be of a size that is sufficient to be seen from a distance allowing a user/service person an adequate amount of time to take action to avoid the hazard specified in the marking after viewing the label;

3) Is to appear in a separate, distinct area within the marking label.

b) The Safety Alert Symbol, ⚠ , is to appear next to the signal word and is to be no smaller than the height of the signal word with the base of the triangle on the same horizontal line as the base of the signal word. The solid triangle portion (within the lines of the triangle, around the exclamation mark) shall be the same color as the signal word letters, and the exclamation mark shall be the same color as the signal word background.

c) The risk identification “Risk of Electric Shock” and risk avoidance statements “When Making Installation, Route Field Wiring Away From Sharp Projections, Corners, And Internal Components”:

1) Shall appear in upper- or mixed-case in a sans serif font of Folio Medium, New Gothic Bold, Helvetica Bold, Medium, or equivalent fonts;

2) Shall appear in separate, distinct areas within the marking label; and

3) Shall be either white lettering on a black background or black lettering on a white background.

Revised 42.11 effective March 29, 2004

42.12 With respect to 8.5.3, a pressure wire intended for connection of an equipment-grounding conductor shall be plainly marked ″G,″ ″GR,″ ″Ground,″ ″Grounding,″ or the equivalent, or by a marking on a wiring diagram provided on the product.

43 Label Design

Added 43 effective March 29, 2004

43.1 The Panel is the area of the marking having a distinctive background and which is set apart by a line or border. The marking label shall include two or three separate panels (each separated from each other by single lines): one for the signal word and safety alert symbol, another for the text of the warning marking, and one for any pictorial (optional).

Added 43.1 effective March 29, 2004

44 Label Colors

Added 44 effective March 29, 2004

44.1 The background of the panel in which the signal word appears shall be a specific color. The color of the panel depends on the signal word used for the marking of the label. The background color of the panel for each signal word is as follows: yellow for “CAUTION”, orange for “WARNING”, and red for “DANGER”. Also, there are specific color requirements for the text and background of the message portion (risk identification and risk avoidance) of the marking.

Added 44.1 effective March 29, 2004

INSTRUCTIONS AND INSTALLATION DRAWINGS

45 Details

45.1 A manual shall be provided with each nurse call system. If not clearly indicated on the unit the manual shall include the following information:

a) Instructions and wiring diagrams showing proper installation of each unit. If a signaling unit is to be mounted in a definite position in order to function as intended, the installation instructions or marking on the unit shall so specify.

b) Illustrations that show locations of controls.

c) Explanation of the function of each control.

d) Step-by-step procedures for proper use of the device.

e) Recommendations for periodic maintenance and servicing on each unit.

f) Safety considerations in application and in servicing.

g) Circuit diagrams for the particular device shipped.

h) Functional description of the circuit.

i) Name of manufacturer and model number of any backbox or trim plate intended to be used with hospital signaling or nurse call equipment and shipped separately for installation. Information correlating the models of enclosure and trim plate with the equipment with which it is intended to be used shall be indicated on the installation drawing referenced in the equipment marking. It is not prohibited that this information also be included on the equipment in lieu of the installation instructions.

j) If a battery standby is provided by the manufacturer, the maximum duration for 10 percent and 100 percent of maximum signaling capability shall be included.

45.2 An installation wiring diagram or diagrams shall be provided with each nurse call system or signaling unit indicating the field connections to be made. The diagram or diagrams shall be attached to the main control unit or, if separate, shall be referenced in the marking attached to the main control unit with the diagram number and issue number or date.

45.3 The installation wiring diagram shall show a pictorial view or equivalent of the installation terminals or leads to which field connections are made as they would appear when viewed from the front or normal connecting position. The terminal numbers on the unit shall agree with the numbers on the diagram. If a special tool is required for any terminal connection, its use shall be indicated by tool manufacturer and model number or equivalent. See 8.2.2.2(a). The range of wire sizes shall be indicated for low-voltage power-limited circuit terminals as described in 8.2.2.1 (b) – (f). An unattached diagram shall be marked with the name or trademark of the manufacturer, drawing number, and issue number or date.

45.4 The following marking information shall appear on the installation wiring diagram for the applicable circuits to which field connections are made:

a) Main Supply Circuit – Voltage, frequency, and maximum current or wattage input. A terminal or lead for the connection of a grounded conductor shall be identified.

b) Patient Connected Circuits – Circuit connections to specific devices shall be shown as well as an indication of the maximum number of units or maximum load that are able to be connected to a specific circuit.

c) Pendant Control Circuits – Circuits not intended specifically for nurse call signaling shall be marked to show connection either to a specific device by name of manufacturer and model number or by an electrical rating in volts, amperes, or watts, and frequency in hertz. The word ″CAUTION″ and the following or equivalent marking shall be provided at the terminals: ″CONNECT ONLY TO CLASS 2 CIRCUITS. MAKE PERIODIC LEAKAGE CURRENT MEASUREMENTS OF ALL PENDANT CONTROL/PILLOW SPEAKER CIRCUITS TO VERIFY THE VALUES ARE APPROPRIATE FOR INSTALLATION LOCATION.″ See 42.1.

45.5 The installation wiring diagram shall specifically identify circuits that are electrically supervised and comply with the requirements for Electrical Supervision, Section 18.

45.6 If low-voltage, power-limited circuit terminal configurations are used that require a special tool for connection, the tool shall be referenced in the instructions. See 8.2.2.2.

45.7 For program controlled signaling equipment or system, a section shall either be included in the installation instructions or a separate user's manual provided which describes the program changes permitted by the user as part of normal system operation. See 47.1.

45.8 The following information shall appear in the installation manuals covering system units that comply with the requirements specified in 34.3.1 – 34.3.7 and that include connections to ancillary equipment that has not been investigated to requirements in this standard: ″WARNING – THE EQUIPMENT THAT IS CONNECTED TO THIS INTERFACE IS NOT CONSIDERED TO BE PART OF THE SYSTEM CONFIGURATION UNLESS THE EQUIPMENT IN QUESTION COMPLIES WITH THE STANDARD FOR HOSPITAL SIGNALING AND NURSE CALL EQUIPMENT, UL 1069.″

Exception: This marking is not required for system units that comply with the requirements specified in 34.3.1– 34.3.7 and that have been investigated and are marked for use with a specific manufacturer and model number of ancillary equipment.

PROGRAM-CONTROLLED SIGNALING EQUIPMENT AND SYSTEMS

46 General

46.1 These requirements cover signaling equipment and systems controlled or influenced by a stored program. The word ″program,″ as used here, refers to a set of instructions that is carried out in a sequential and repetitive manner and that determines the system output signal resulting from a specific system input signal. ″Stored″ refers to the action provided by memory devices in which the memory is either transient or permanent and that are used for retaining information, instruction, status, and similar tasks.

Exception: These requirements do not apply to signaling equipment where the operating program is determined by hardware and any function changes requiring hardware modification.

47 Program Access and Control

47.1 The operating program that is capable of being changed by the user shall be included in the instructions or a separate user's manual and its operation is to be verified. Program options include assignment of input points, such as initiating devices, with regard to type of signal, priority of signal, and type of patient station. Another option is assignment of inputs and outputs that are of a supplementary nature, such as patient file information.

47.2 As part of the program-controlled system, an audible trouble signal shall activate within 90 seconds if the central (main) microprocessor in a control unit or master station fails to execute its program as intended.

Exception: Supervision is not required if malfunction results only in loss of supplementary information or features and if the system is still capable of indicating the nature and location of any status change.

47.3 A hospital signaling and nurse call system shall not be affected if the system fails to execute any supplementary program.

47.4 Where program information is stored in volatile memory (see 47.5) the system shall contain equipment or have provision for connection to equipment that is capable of reloading the program. The means provided or specified shall allow the complete stored program (operating program plus user-entered program) to be reloaded. Means shall also be provided for generating a permanent copy of all user-entered data for the purpose of reloading the program.

47.5 With reference to the requirements of 47.4, volatile memory is that type of memory wherein any interruption of power results in loss of information content in the storage medium.

47.6 Compliance with the requirements of 47.4 shall not rely upon a device that utilizes a memory storage medium that is subject to continuous wear during the course of normal operation and is not sealed against atmospheric contaminants.

Exception: Memory-storage devices of the type described are suitable for initial loading of the operating system, data base down loading where system operation is not inhibited, or providing enhancements to basic system descriptors.

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APPENDIX A

Standards for Components

Standards under which components of the products covered by this standard are evaluated include the following:

Title of Standard − UL Standard Designation

Attachment Plugs and Receptacles – UL 498
Capacitors and Suppressors for Radio- and Television-Type Appliances – UL 1414
Class 2 and Class 3 Transformers – UL 1585
Plastic Materials for Parts in Devices and Appliances, Tests for Flammability of – UL 94
Polymeric Materials – Fabricated Parts – UL 746D
Polymeric Materials – Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials Used in Printed-Wiring Boards – UL 746E
Polymeric Materials – Long Term Property Evaluations – UL 746B
Polymeric Materials – Short Term Property Evaluations – UL 746A
Polymeric Materials – Use in Electrical Equipment Evaluations – UL 746C
Printed-Wiring Boards – UL 796
Signaling Equipment, Home Health Care – UL 1637
Transformers, Specialty – UL 506
Wires and Cables, Thermoplastic-Insulated – UL 83
Wires and Cables, Thermoset-Insulated – UL 44

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Superseded requirements for
the Standard for
Hospital Signaling and Nurse Call Equipment

UL 1069, Sixth Edition

The requirements show are the current requirements that have been superseded by requirements in revisions issued for this Standard. To retain the current requirements, do not discard the following requirements until the future effective dates are reached.

41.1 (42.1) A signaling unit shall be plainly and permanently marked where it will be readily visible after installation with the following information. Except as indicated otherwise, the information shall appear directly on the unit or on a separate installation diagram referenced in the marking:

a) Manufacturer's or private labeler's name or identifying symbol. (The marking shall be on the unit.)

b) Model number and date code or equivalent. (The marking shall be on the unit.)

c) Electrical rating in volts, amperes or watts, and frequency. (The marking shall be on the unit.) Input ratings to low-voltage products may be marked on the installation wiring diagram.

d) Correct mounting position if a unit is intended to be mounted in a definite position.

e) Identification of lights, switches, meters, and similar parts regarding their function. Located adjacent to the component. This may be omitted if their operation is obvious.

f) Maximum rating of fuse on each fuseholder. Located adjacent to the fuseholder.

g) Reference to an installation wiring diagram, if not attached to unit, by drawing number and issue date. (The marking shall be on the main terminal cabinet or power supply.)

h) For a pendant control that has not been investigated and found acceptable for use in oxygen-enriched atmospheres, the word ″CAUTION″ and the following or equivalent: ″Not for Use by Patient Undergoing Oxygen Therapy – Hang On Hook (In Holder) When Not In Use.″ See 41.2. The letter height shall be no less than 7/64 inch (2.8 mm) for the word ″CAUTION″ and no less than 3/32 inch (2.4 mm) for the remainder of the notice.

i) For a pendant control provided with connections to control circuits, such as radio, television, drapery hardware, and similar devices, the electrical ratings of these circuits. (Marked on the control.) In addition, the word ″CAUTION″ and the following or equivalent text shall be marked on the control: ″Make periodic leakage current measurements of all pendant control/pillow speaker circuits to verify the values are appropriate for the installation location.″

Exception: The cautionary marking is not required to be included on the pendant control if it is included on or in all of the following locations:

1) On the patient station to which the pendant control is connected.

2) On the system control unit.

3) In the installation manual.

j) For a device, such as a switch, intended for emergency service, the word ″EMERGENCY″ or an equivalent wording describing an emergency condition, such as ″PULL FOR HELP.″ The marking shall be permanent, in a distinctive color (preferably red), and on the front of the device. Other type units shall be marked regarding their function.

k) Identification of high-voltage wires of a cable assembly containing both high- and low-voltage circuit connections. (The marking may be included in the installation diagram.)

l) For a patient station incorporated as part of a prefabricated wall panel, the following or equivalent text: ″The Compatibility Of The Patient Station And Faceplate With The Back Box Or The Acceptability Of Any Device Installed In The Side Compartment Has Not Been Investigated.″ (The marking shall be on the patient station.)

m) For a custom enclosure or faceplate, the manufacturer's name, model number, and date of manufacture, or equivalent. (The marking shall be on the enclosure or faceplate.)

n) Description of normal operational features that are functional while the main AC power is connected but that do not function while the signaling unit is operated from a standby battery.

o) Deleted

p) For a patient station intended to be installed in a shower stall, or an equivalent location where water spray would be encountered, the words ″SHOWER STATION.″ (The marking shall be on the station.)

q) For a power supply and nurse master intended for use in a centralized system, the following or equivalent text: ″For Use In A Centralized System.″ (The marking shall be on the power supply/nurse master.)

41.5 (42.5) With respect to the Exception to 5.6.1, the following or equivalent marking, in letters 1/8 inch (3.2 mm) in height, shall be indicated on the cover: ″CAUTION – Risk of Electric Shock – Circuit Fuse(s) Inside – Disconnect Power Prior To Servicing.″ See Testing, Servicing, and Maintenance Protection, Section 15.

41.6 (42.6) With respect to the marking requirements referenced in 15.3, a permanent and prominent marking shall be provided on the cover front that includes the word ″CAUTION″ and the following or equivalent: ″To Reduce the Risk of Electric Shock, De-Energize Unit Prior to Servicing.″

41.11 (42.11) With respect to the requirements referenced in 8.8.1, a marking shall be located in the wiring area that specifies the statement: ″CAUTION – Risk of Electric Shock″ and the following or equivalent instructions: ″When Making Installation, Route Field Wiring Away From Sharp Projections, Corners, And Internal Components.″