NEMA Installation Guide

for Nurse Call Systems

Published by

National Electrical Manufacturers Association
1300 North 17th Street
Rosslyn, Virginia 22209

© Copyright 2002 by the National Electrical Manufacturers Association. All rights including translation into other languages, reserved under the Universal Copyright Convention, the Berne Convention for the Protection of Literary and Artistic Works, and the International and Pan American Copyright Conventions.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

NOTICE AND DISCLAIMER

The information in this publication was considered technically sound by the consensus of persons engaged in the development and approval of the document at the time it was developed. Consensus does not necessarily mean that there is unanimous agreement among every person participating in the development of this document.

The National Electrical Manufacturers Association (NEMA) standards and guideline publications, of which the document contained herein is one, are developed through a voluntary consensus standards development process. This process brings together volunteers and/or seeks out the views of persons who have an interest in the topic covered by this publication. While NEMA administers the process and establishes rules to promote fairness in the development of consensus, it does not write the document and it does not independently test, evaluate, or verify the accuracy or completeness of any information or the soundness of any judgments contained in its standards and guideline publications.

NEMA disclaims liability for any personal injury, property, or other damages of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, application, or reliance on this document. NEMA disclaims and makes no guaranty or warranty, expressed or implied, as to the accuracy or completeness of any information published herein, and disclaims and makes no warranty that the information in this document will fulfill any of your particular purposes or needs. NEMA does not undertake to guarantee the performance of any individual manufacturer or seller's products or services by virtue of this standard or guide.

In publishing and making this document available, NEMA is not undertaking to render professional or other services for or on behalf of any person or entity, nor is NEMA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances. Information and other standards on the topic covered by this publication may be available from other sources, which the user may wish to consult for additional views or information not covered by this publication.

NEMA has no power, nor does it undertake to police or enforce compliance with the contents of this document. NEMA does not certify, test, or inspect products, designs, or installations for safety or health purposes. Any certification or other statement of compliance with any health or safety–related information in this document shall not be attributable to NEMA and is solely the responsibility of the certifier or maker of the statement.

--`,,`-`-`,,`,,`,`,,`---

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

CONTENTS

Foreword iii

Section 1 GENERAL 1

1.1 Scope 1

Section 2 GLOSSARY 3

Section 3 INTRODUCTION 11

Section 4 NURSE CALL SYSTEMS 13

4.1 General Information 13
4.2 Visual Nurse Call Systems 13
4.3 Audio-Visual Systems 14
4.4 Computer Based Audio-Visual Systems 14
4.5 Centralized Systems 14
4.6 Specialty Systems 14
4.7 Section Summary 14

Section 5 SYSTEM CONFIGURATIONS 15

5.1 Types of System Configurations 15
5.2 External Devices 15
5.2.1 Central Equipment 15
5.2.2 Patient-Room Equipment 16
5.3 System Interfaces 16
5.3.1 Entertainment Audio 16
5.3.2 Pocket-Paging System 16
5.3.3 Staff-Location Equipment 17
5.3.4 Audio Paging System 17
5.3.5 Telephone System 17
5.3.6 Staff Registry 17
5.3.7 Management System 18
5.3.8 Management Information System (MIS) 18
5.3.9 Clock System 19
5.3.10 Fire-Alarm System 19
5.3.11 Security System 19
5.4 Section Summary 20

Section 6 POWER DISTRIBUTION 21

6.1 Types of Power Distribution 21
6.1.1 Local Power 21
6.1.2 Centralized Power 21
6.1.3 Simplex Power 21
6.1.4 Distributed Power 22
6.2 Section Summary 22

Section 7 INSTALLATION REQUIREMENTS 23

7.1 General Information 23
7.2 AC Power Input 23
7.2.1 General Requirements 23
7.2.2 Earth Ground 23
7.2.3 Surge Suppressers 23
7.2.4 Line Conditioners 23
7.2.5 Uninterruptible Power Sources (UPS) 23

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

7.2.6 FCC Part 15 Conducted Emissions 23
7.3 Equipment Mounting 23
7.3.1 General Requirements 23
7.3.2 Back Boxes 24
7.3.3 Grounding 24
7.3.4 Mounting Heights 24
7.4 Cabling 24
7.4.1 General Requirements 24
7.4.2 Recommended Types 24
7.4.3 Conduit 24
7.4.4 Cable Trays 25
7.4.5 Connection Techniques 25
7.4.6 Length Requirements 25
7.4.7 Ground Loops 25
7.5 Section Summary 25

Section 8 ELEMENTS OF SYSTEM LAYOUT AND COMPONENT INSTALLATION 27

8.1 General Information 27
8.2 Nurse Call System Components 27
8.2.1 Call-Initiating Stations 27
8.2.2 Call-Annunciating Stations 27
8.2.3 Power and Control Equipment 27
8.3 Installation of System Components 27
8.4 Elements of Proper System Layout 28
8.5 Installation Requirements 28
8.6 Installation Documentation 28

Section 9 INTERCONNECTION CABLING 29

9.1 General Information 29
9.2 Cable Planning 29
9.3 Code Requirements 29
9.3.1 ANSI/NFPA 70, National Electric Code 29
9.3.2 ANSI/NFPA 99, Health Care Facilities 29
9.3.3 ANSI/UL 1069 Hospital Signaling and Nurse Call Equipment 29
9.3.4 CSA Standard C22.2 No. 125, Electromedical Equipment 30
9.4 AC Requirements 30
9.4.1 Emergency Power Systems 30
9.4.2 Battery or Other Back-up Power 30
9.4.3 Dedicated AC Circuit 30
9.4.4 Proper Labeling for Breaker Locations 30
9.5 Low-Voltage Wiring 30
9.5.1 Wire Gauge Versus Distance 30
9.5.2 Routing of Cables 30
9.5.3 Splicing of Interconnections 31
9.6 Building-to-Building Wiring 31
9.6.1 Transient Protection 31
9.6.2 Signal Loss 31
9.7 Testing 31
9.7.1 Voltage Drop 31
9.7.2 Leakage in Patient Rooms 31
9.8 Section Summary 32

Section 10 PROPER CONNECTIONS 33

10.1 Types of Connections and Their Uses 33
10.1.1 Wire-Nut Connector 33
10.1.2 Crimp-Type Closed-End Connector 33

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

10.2 Power Connections 33
10.3 Proper Ground Connections 33
10.4 System Terminations 34
10.5 Connections for Supervised Circuits 34
10.6 Regulatory Compliance for Connections 34
10.7 Labeling System Connections 35
10.8 Nurse Call System Connections 35
10.8.1 Control Equipment 35
10.8.2 Patient Room Equipment 35
10.9 Connection of Ancillary Equipment 36
10.9.1 Patient-Room Smoke Detectors 36
10.9.2 Patient-Room Audio-Video Equipment 36
10.9.3 Telephone System 37
10.9.4 Patient-Monitoring Equipment 37
10.9.5 Pocket-Paging Systems 37
10.9.6 Staff Location Equipment 37
10.9.7 Other Ancillary Equipment 37
10.10 Section Summary 38
10.11 Additional Connection Information 38
10.11.1 Connector Types and Uses 38
10.11.2 Preparing Wire for Connections 38

Section 11 SEPARATION FROM OTHER CIRCUITS AND EQUIPMENT 39

11.1 General Information 39
11.2 Conduit and Cable-Tray Systems 39
11.3 Other Equipment 39
11.3.1 Power Circuits 39
11.3.2 Class 2 Circuits 39
11.3.3 RF Considerations 40
11.3.4 Head Walls 41
11.4 EMI and Transients on AC Feeds 41
11.5 Section Summary 41

Section 12 ENVIRONMENTAL CONSIDERATIONS 43

12.1 General Information 43
12.2 Central Equipment 43
12.2.1 Temperature and Humidity 43
12.2.2 Dust and Dirt 43
12.2.3 Ambient Noise Level 43
12.2.4 Service Considerations 43
12.3 Nurse's Station Equipment 43
12.3.1 Ambient Lighting Level 43
12.3.2 Temperature and Humidity 43
12.3.3 Ambient Noise Level 44
12.3.4 Accessibility to Staff 44
12.3.5 ESD or Other Transients 44
12.4 Patient-Room Equipment 44
12.4.1 Ambient Lighting Levels 44
12.4.2 Temperature and Humidity 44
12.4.3 Ambient Noise Level 44
12.4.4 Accessibility to Staff Members 44
12.4.5 ESD or Other Transients 44
12.5 Section Summary 44
12.6 Section Diagrams 44

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS Not for Resale

Section 13 AS-BUILT DOCUMENTATION 45
13.1 General Information 45
13.2 Risers 45
13.2.1 120 VAC Wiring 45
13.2.2 Low-Voltage Wiring 45
13.3 Interconnect Drawings 45
13.4 Marking Home-Run Cables 45
13.5 System Programming Records 46
13.6 Test Records 46
13.7 In-Service Training 46
13.8 Service Procedures 46
13.9 Section Summary 46
13.10 Section Diagrams 46

Section 14 INSPECTION AND SYSTEM TESTING 47
14.1 General Information 47
14.2 Electrical Inspection 47
14.2.1 Earth Ground 47
14.2.2 AC Supply 47
14.2.3 Conformity with the Manufacturer's Installation Manual 47
14.2.4 Connected Equipment 47
14.3 Electrical Testing 47
14.3.1 AC Input Voltage 47
14.3.2 Power Supply Test 47
14.3.3 Testing for Leakage Current 47
14.3.4 NFPA 70 Tests 48
14.3.5 NFPA 99 Tests 48
14.4 Functional Testing 48
14.5 Load Testing 48
14.6 Section Summary 48

Section 15 MAINTENANCE AND SERVICE 49
15.1 General Information 49
15.2 Documentation and Parts 49
15.2.1 As-Built Documentation 49
15.2.2 Manufacturer's Installation Manual 49
15.2.3 Manufacturer's User Operation Manual 49
15.2.4 Manufacturer's Service Manual 49
15.2.5 ANSI/UL 1069 Nurse Call Standard 49
15.2.6 NEMA SB10 Audibility Standard for Nurse Call Systems 50
15.2.7 Spare Parts 50
15.3 Test Equipment Required 50
15.4 Periodic Testing 50
15.5 Problem Investigation 51
15.6 Corrective Action 51
15.7 Technical Assistance 52
15.8 Section Summary 52

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Foreword

These guidelines cover the proper physical installation of nurse call systems. This publication describes system types, the basic theory of operation, the use of ancillary devices, installation requirements, the isolation of circuits, system environmental considerations, inspection, testing, maintenance, and service.

The content will be helpful to those preparing for proficiency or certification in the design, installation, service, and maintenance of nurse call systems. Although it has been written primarily as a stand-alone guide, it can also serve as a text for apprentices and journeymen taking a class with a qualified instructor.

The publication emphasizes the installation of basic nurse call systems. For information on applying the myriad choices of systems or equipment available, the reader should follow the specific instructions provided by the manufacturers.

The information is presented as Authorized Engineering Information—a technical guide, as distinct from the mandatory requirements of a NEMA standard. This publication will be updated to keep abreast of new technology and the new requirements set forth in the referenced publications of other organizations.

This Installation Guide for Nurse Call Systems is published by the National Electrical Manufacturers Association (Signaling, Protection, and Communication Section -3SB).

About the NEMA Signaling, Protection, and Communication Section (3-SB):
The objective of the Section is to be the principal source of technical, training, and educational materials essential for the specification and manufacture of reliable life safety products, their installation, performance, and inspection.

The Section currently represents over 40 U.S., U.K., and Japanese manufacturers. The products are life safety/fire alarm products that provide early warning of an impending or actual fire or gaseous hazard as well as communications systems in health care facilities, such as hospitals, clinics, etc. The products detect, notify and initiate control functions in case of hazard to life or property.

About the National Electrical Manufacturers Association (NEMA):

For more than 75 years, the National Electrical Manufacturers Association has been developing standards for the electrical manufacturing industry and is today one of the leading standards development organizations in the world. NEMA contributes to an orderly marketplace and helps ensure the public safety.

NEMA, with headquarters in Rosslyn, Virginia, has nearly 500 member companies, including large, medium, and small businesses. The organization is divided into eight divisions: Industrial Automation, Lighting Equipment, Electronics, Building Equipment, Insulating Materials, Wire and Cable, Power Equipment, and Diagnostic Imaging and Therapy Systems. Within these divisions are over 50 product-specific sections. The Signaling Section is one such section in the Electronics Division.

For more information on NEMA and the Signaling Section, go to www.nema.org and search for the “Signaling Section.”

Comments, questions, or recommendations are invited and should be addressed to:

Vice President of Engineering
National Electrical Manufacturers Association
1300 North 17th Street
Rosslyn, Virginia 22209

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

<This page is intentionally left blank>

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 1
GENERAL

1.1 SCOPE

This Publication, developed by the Health Care Communications Group of the Signaling, Protection, and Communications Section, provides technical information on basic nurse call systems and their installation. It will be continually expanded as new technologies are adapted to nurse call systems.

Referenced Organizations and Standards

Copies of the following standards, which are applicable to nurse call systems, may be obtained from the indicated organization:

Title III *ADA, Americans with Disabilities Act of 1990, Title III*

American National Standards Institute
11 West 42nd Street
New York, NY 10036:

ANSI/IEEE 602--1986, Electric Systems in Health Care Facilities

American Society for Hospital Engineering (ASHE)
840 North Lake Shore Drive
Chicago, IL 60611-2431

Building Officials and Code Administrators International, Inc. (BOCA)
4501 W. Flossmoor Road
Country Club Hills, IL 60477:
National Building Code

Canadian Department of Communications
1241 Clyde Avenue
Ottawa, Ontario, Canada K2C1Y3
Industry Canada CS-03 Registration of Equipment

Canadian Standards Association
178 Rexdale Boulevard
Rexdale, Ontario, Canada M9W 1R3:
UL1069, Hospital Signaling and Nurse Call Equipment
C22.2 No. 125-M1984 (Reaffirmed 1992) Equipment
Canadian Electrical Code Part 1 (C22.1199)
C22.2 No. 225--Telecommunication Equipment

Federal Communications Commission
1919 M Street, NW
Washington, DC 20554
“Code of Federal Regulations” Title 47, Part 15, Subpart B, Class A, Radio Frequency Devices
“Code of Federal Regulations” Title 47, Part 68, Connection Of Terminal Equipment to the Network

Health Information Management System Society (HIMSS)
230 East Ohio Street, Suite 500
Chicago, IL 60611-3269
Health Level 7 (HL7) Version 2.4, ANSI-approved October 2000

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Institute of Electrical and Electronic Engineers
445 Hoes Lane
Piscataway, NJ 08854-4150:
IEEE Recommended Practice for Electric Systems Health Care Facilities (IEEE White Book)

International Conference of Building Code Officials (ICBO)
5360 South Workman Mill Road
Whittier, CA 90601:
Uniform Building Code (UBC)

Joint Commission on Accreditation of Health Care Organizations (JCAHCO)
1 Renaissance Boulevard
Oak Brook Terrace, IL 60181-4294:
Accreditation Manual For Hospitals (AMH)

National Electrical Manufacturers Association
1300 North 17th Street, Suite 1847
Rosslyn, VA 22209:
SB 10, Audio Standard for Nurse Call Systems
SB 29,Impact of Electrostatic Discharge in the Hospital Environment

National Fire Protection Association (NFPA)
1 Batterymarch Park
PO Box 9101
Quincy, MA 02269-9101:
NFPA 70, National Electrical Code
NFPA 99, Health Care Facilities
NFPA 101, Safety to Life from Fire in Buildings and Structures

Southern Building Code Congress International (SBCCI)
900 Montclair Road
Birmingham, AL 353213:
Standard Building Code

Underwriters Laboratories, Inc.
333 Pfingsten Road
Northbrook, IL 60062:
ANSI/UL 864-1992, Control Units for Fire Systems
ANSI/UL 1069-1990, Hospital Signaling and Nurse Call Equipment
ANSI/UL 1459-1992, Telephone Equipment

US Department of Health and Human Services
200 Independence Avenue, S. W.
Washington, DC 20201:
Guidelines for Construction and Equipment of Hospital and Medical Facilities

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 2
GLOSSARY

For the purposes of this document, the following definitions apply:

AHJ: Authority Having Jurisdiction.

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

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.

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

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.

ANSI: American National Standards Institute.

ANSI/UL 1069: The Standard for Safety for Hospital-Signaling and Nurse Call Equipment.

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).

authority having jurisdiction: (AHJ).

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.

bath area: Any patient bathing or toilet area. See "Wet Area."

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.

bedside station: See patient station.

building codes: Any of a variety of model construction codes. They prescribe the minimum construction features for a given facility type.

cable: Insulated electrical conductors covered by a sheath.

cable loss: Signal degradation and power loss caused by a cable's physical properties, such as electrical resistance, capacitance, and inductance. Properly applied cables cause only negligible losses.

call cord: A cord with a switch at one end and, at the other, a connector 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.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Canadian Standards Association (CSA): A Nationally Recognized Testing Laboratory in Canada that tests and approves nurse call equipment.

cannula nasal: Two short tubes that are inserted into the nostrils to administer oxygen or other therapeutic gases.

cardiac fibrillation: Uncoordinated, chaotic contractions of the heart muscle, reducing or effectively stopping the pumping function.

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, Listed electrical enclosure that is located in an equipment room or closet.

central processing unit (CPU): The computer which controls a system.

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

circuit breaker: A protection device that automatically disconnects the load from the power source when the current exceeds a specified value for a specified period of time.

class 2 circuits: Circuits that conform to the Class 2 circuit requirements of Article 725 of ANSI/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.

class 2 wiring: Wiring that conforms to the Class 2 circuit requirements of Article 725 OF ANSI/NFPA 70, "The National Electrical Code."

CO: The "Central Office"

code-blue call: See code call.

code call: A distinctive audible and visual signal representing a life-threatening situation that requires immediate action.

code-call switch: A switch (typically wall mounted) used to place a code call.

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.

computerized system: A nurse call system that is controlled by a computer or an embedded microprocessor.

conduit, metallic: Metal tubing used to contain and protect the nurse call system cable.

coronary care area: An area designated for the care of cardiac patients.

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.

CPU: See Central Processing Unit.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

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.

critical care unit (CCU): An area where patients are subjected to invasive procedures and connected to line-operated, electromedical 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).

CSA: See Canadian Standards Association.

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.

dome light: See Corridor Lamp.

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.

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).

electrical magnetic interference (EMI): Radiated electrical or magnetic fields which can interfere with electronic systems.

electrical power: The AC power that provides the primary power for the nurse call system. It is derived from the facility's life-safety or critical branch of the emergency system.

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

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 ANSI/NFPA 70, Article 700.

EMI: See Electrical Magnetic Interference.

ESD: See Electrostatic Discharge.

fire alarm annunciation: Alarm annunciation by a fire-alarm system which is Listed for the intended use by a Nationally Recognized Testing Laboratory (NRTL). See Supplementary Fire-Alarm Annunciation.

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 electromedical devices, such as heating pads, electrocardiographs, drainage pumps, monitors, otoscopes, ophthalmoscopes, and intravenous lines.

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.

ground fault: An unintended electrical connection to ground.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

grounding: A system of conductors that provides a low-impedance return-path for leakage and fault currents.

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, communication, and emergency signaling.

IDC: See Insulation Displacement Connector.

insulation displacement connector: A connector that penetrates the insulation of a conductor to create a gas-tight connection. It does away with the need to remove some insulation (i.e., wire stripping) before attaching the connector.

intensive care unit (ICU): See Critical Care Unit (CCU).

leakage current: Any current, including capacitively coupled current, that may be conveyed from accessible parts of a product to a ground or to other accessible parts of the product.

master station: See Nurse Control Station.

MATV: "Master Antenna Television" systems receive broadcast signals from one or more antennas and distribute them via coaxial cable to television receivers within a building or facility.

microshock: A condition wherein current levels that would be imperceptible were they applied to the skin are potentially lethal when applied to the heart.

National Electrical Code: ANSI/NFPA 70. A consensus standard governing electrical construction, wiring methods, special occupancy requirements, etc.

National Electrical Manufacturers Association (NEMA): A voluntary association of manufacturers of electrical and electronic products. NEMA publishes a wide variety of standards and technical engineering documents.

National Fire Protection Association (NFPA): Publishers of the ANSI/NFPA 70, "The National Electrical Code," ANSI/NFPA 99, "The Standard for Health Care Facilities," etc.

Nationally Recognized Testing Laboratory (NRTL). A testing laboratory that is certified by OSHA to List equipment as suitable for the intended use.

NEC: See National Electrical Code.

NEMA: See National Electrical Manufacturers Association.

NFPA: See National Fire Protection Association.

Nitrous Oxide: A sweet-smelling gas used to induce the first and second stages of anesthesia. It can be a fire hazard.

NRTL: See Nationally Recognized Testing Laboratory.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

nurse call system: A system of components that provides audible and visual communication between patients and hospital personnel. It must be Listed for the intended use and interconnected according to the manufacturer's instructions.

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.

nursing unit: An area of the facility that includes rooms for patients and the specific group of personnel dedicated to those beds.

Occupational Safety and Health Administration (OSHA): Part of the US Department of Labor responsible for the safety of employees in the workplace.

OSHA: See Occupational Safety and Health Administration.

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.

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.

overvoltage: Any voltage that exceeds its rated or intended value.

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.

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.

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

paging systems: A public address system sometimes associated with the nurse call system. This is not to be confused with Radio Paging Systems (cf.).

parallel call: A system that provides for one or more patient stations to simultaneously annunciate at more than one nurse control station.

patient bed location: The location of an inpatient sleeping bed or the bed or procedure table used in a critical-care area.

patient care areas: Any portion of a health care facility devoted to examining or treating patients.

patient-controlled lighting: Room and reading lights that can be regulated from the patient's bed.

patient monitoring: The use of a nurse control station to monitor the sounds from one or more patient rooms.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

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.

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.

pendant control: See Pillow Speaker.

physiological monitoring: A feature that enables the nurse control station to automatically signal alarms generated by remote, properly equipped, Listed physiological monitoring equipment.

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.

plenum: A compartment or chamber connected to one or more air ducts that forms part of the air-distribution system.

plenum cabling: System interconnecting cable that is Listed for installation in plenum spaces.

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 to within a specified distortion limit.

power supply: A unit that is used to condition the power for a nurse call system.

psychiatric station: The general term for stations designed for psychiatric areas. See under Secure Psychiatric.

qualified person: One who is trained in the construction, system design, installation, testing, troubleshooting, maintenance, and operation of the equipment and the hazards involved.

raceway: An enclosed channel designed expressly for holding wires and cables.

radio paging system: A system consisting of a radio-frequency encoder and a transmitter plus portable pagers (sometimes known as “beepers”).

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.

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.

secure psychiatric emergency switch: A tamper-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.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

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. A unit shall be considered a shower station if it is Listed under ANSI/UL1069 as a “shower station” as a result of passing the appropriate water resistance testing.

smoke detector: A Listed smoke detector that is part of a fire-alarm system meeting code requirements may have isolated contacts that activate when smoke is detected. These contacts, when connected in accordance with the manufacturers’ instructions to a nurse call system Listed for the purpose, can provide signaling supplementary to that required of the fire-alarm system.

staff emergency station: A station that places “staff emergency” calls.

staff register station: A station that signals the type of staff (e.g., RN, LPN) present in a room.

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.

Standard for Health Care Facilities: ANSI/NFPA 99 is a consensus safety standard with criteria for minimizing the hazards of fire, explosion, and electricity in health care facilities. These criteria include performance, maintenance, testing, and safe practices for facilities, material, equipment, and appliances; it also addresses other hazards associated with the primary ones. The standard is frequently adopted, in whole or in part, by Federal entities, states, counties, cities, and other Authorities Having Jurisdiction (AHJ).

supplementary fire alarm annunciation: Annunciation not required by NFPA codes.

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.

television system: A system supplying program signals and sometimes power to televisions in patient care areas.

toilet station: A station in a toilet area that allows a patient to signal for help.

transient voltage suppresser: A device that prevents surges above a certain voltage level and below a certain energy level from passing through.

UL: See Underwriters Laboratories, Incorporated.

ungrounded system: A system isolated from Earth ground.

Underwriters Laboratories, Incorporated (UL): A Nationally Recognized Testing Laboratory (NRTL) that tests and lists nurse call equipment for the intended use.

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.

UPS: See Uninterruptible Power Supply.

visual nurse call system: A nurse call system that annunciates calls by visually identifying the location of origin and sounding a tone, but which does not provide audio communication.

voltage regulation: The degree to which the voltage of a circuit varies with changes in the input voltage and the output load current.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

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.”

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.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 3
INTRODUCTION

This *NEMA Installation Guide for Nurse Call Systems* is a guide for the design, engineering, and installation of safe nurse call systems. A system installed in accordance with this document, the manufacturers' instructions, and the applicable codes will meet all the currently accepted engineering principles for such systems.

This Guide is intended for use by:

a. Architects, engineers, consultants, and health care facilities, for designing and specifying nurse call systems and their installation;
b. Technically trained installers who are familiar with nurse call systems and their applications;
c. Authorities Having Jurisdiction (AHJ), for inspecting nurse call installations.
d. Owners and end users, for determining the acceptability and appropriateness of installations and maintenance practices in meeting their requirements.

This material is intended to be in conformance with all applicable codes and standards, which include: NFPA 70, The National Electrical Code; NFPA 99, the Health Care Facilities Code; and ANSI/UL 1069. Where any conflict exists, the requirements of the applicable codes and laws take precedence.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

<This page is intentionally left blank>

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 4
NURSE CALL SYSTEMS

4.1 GENERAL INFORMATION

Nurse call systems are available in a number of types. The appropriate type for a given hospital or nursing unit within it is generally determined by the level of care required by the patients. Some other determinants are the cost of equipment and its installation, the value of its features, and the need to interface with other systems.

All the system components must be Listed by a Nationally Recognized Testing Laboratory (NRTL) for the intended use under the appropriate ANSI Standard (e.g., ANSI/UL 1069). They must be installed, used, and serviced in accordance with the manufacturer's installation manual, which was used by the testing laboratory in determining the suitability and safety of the equipment for the intended use. Modifications and unintended uses may be unsafe.

4.2 VISUAL NURSE CALL SYSTEMS

Visual nurse call systems, the most basic form of nurse call system, provide only tone and lamp annunciation of patient-to-staff and staff-to staff calls.

Calls are generally indicated by lights and tones. The systems may vary these signals to indicate different types of calls (e.g., routine patient calls, bath calls, emergency calls).

There are three basic types of equipment: call-initiating stations, call-annunciating equipment, and power and control equipment. Some systems offer optional features.

Call-initiating devices, such as patient stations, pull-cord, bath, and toilet stations, emergency stations, and staff stations, signal for help from any patient or staff member within sight of the room or at a staff location that has a call-annunciating device.

Call-annunciating devices indicate the existence of calls. Nurse control stations and corridor lamps indicate the call's point of origin. Duty stations and zone lamps generally indicate only that a given call type has been placed somewhere in the system.

Corridor lamps are located outside patient rooms, central bath areas, examination rooms, solariums, etc. Whenever a call is placed from a room, its corridor lamp illuminates. If the system can handle multiple call priorities, the corridor lamp generally indicates the priority level.

Nurse control stations are normally located at the nurses' station. They indicate the calling room by illuminating a lamp associated with it (e.g., near a label) or by showing the room number on a display. A tone sounds to alert the attendant. The station can also indicate a call's priority by varying the frequency with which it flashes the lamp and repeats the tone.

Duty stations are normally located where the staff may work when they are away from the nurses' station (e.g., linen storage, prep room, office, nurses' lounge). They sound a tone and usually illuminate a lamp to indicate the highest priority level among the calls in the system. This alerts the staff to the presence of calls that may require their attention.

Power and control equipment, such as power supplies, optional battery back-up, central logic assemblies, and terminal panels, are usually centrally located. This equipment supplies the power, logic signals, and tones required for signaling.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

4.3 AUDIO-VISUAL SYSTEMS

In ways similar to those of tone-visual systems, audio-visual systems annunciate calls in the corridor, at duty stations, and at the nursing station. In addition, audio-visual systems allow the staff at the nurses' station to communicate with the calling patient or staff member.

This two-way audio communication permits the person at the nursing station to answer patient questions without sending someone to the calling room. When personal attention is required, the staff can assess what equipment, material, or staff is needed before going to the room.

4.4 COMPUTER BASED AUDIO-VISUAL SYSTEMS

Computer based Audio-Visual systems utilize microprocessors to replace conventional hard-wired logic. Under software control, the microprocessors direct various control and signaling functions. It is often possible to improve old features and add new ones by updating the software, without expensive hardware and wiring changes.

4.5 CENTRALIZED SYSTEMS

These audio-visual systems handle all the calls in a facility through logic and control equipment installed at a single location. This location is necessarily remote from some, if not all, patient-care areas, and may utilize more than one console for answering calls and dispatching the appropriate staff.

Because of the remote location of the call annunciation, the ANSI standard places additional signaling requirements on systems and components Listed for centralized use (ANSI/UL1069 Section 19.1 and Section 42.1.Q.)

4.6 SPECIALTY SYSTEMS

Health care facilities frequently have special communications and signaling needs in some areas. These include nursery systems that allow the nurse to communicate with visitors viewing babies from outside the nursery, secure psychiatric systems that provide staff-protection, and alarms on emergency exit doors. These features can be provided by either stand-alone systems or special equipment and features integrated into the nurse call system. All special equipment and software must be Listed for their intended uses.

4.7 SECTION SUMMARY

The selection of system type should be made based upon the needs of patients and hospital staff. If patients are critically ill or optimum staff utilization is important, systems with more sophisticated features should be considered. If patients normally need supervision rather than medical attention, systems with less flexibility may be acceptable. Before selecting a system type, the AHJ should be consulted on minimum requirements.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 5
SYSTEM CONFIGURATIONS

5.1 TYPES OF SYSTEM CONFIGURATIONS

Visual nurse call systems shall have, at a minimum, central equipment, including system power supplies; a nurse control station or annunciator panel; and call-origination stations. Optional equipment includes such items as emergency stations, corridor lamps, duty stations, and staff stations.

Audio-visual nurse call systems shall have, at a minimum, central equipment, including system power supplies; a nurse control station; patient stations, emergency stations; corridor lamps; and staff or duty stations. Optional equipment includes such items as staff emergency stations and code-blue stations. A unique tone signal must distinguish the staff emergency call and the code-blue call from all other types of calls.

Microprocessor-based nurse call systems, including multiplex-based systems, shall have, at a minimum, central equipment, including system power supplies; at least one nurse control station; patient stations; emergency stations; corridor lamps; and staff or duty stations. Optional equipment includes such items as staff emergency, code-blue, and staff-presence (locator) stations. A unique tone signal must distinguish the staff-emergency call and the code-blue call from all other types of calls. Other optional enhancements include system centralization, and interfaces to pocket-page, telephone, reporting and management, and hospital mainframe systems.

5.2 EXTERNAL DEVICES

5.2.1 Central Equipment

Systems may interface with telephone systems for convenience in placing and answering both telephone calls and nurse calls, and, via a modem, for using remote diagnostics, monitoring, and programming the system. Interfaces may be a centrally located, shared system resource. A direct connection to one or more Central Office lines requires FCC approval for the nurse call system. The nurse call system may include a PABX or equivalent switching system. FCC part 68 still applies at the points where the CO lines connect to the system. More commonly, a system will interface with one or more extensions of the facility's existing PABX. The PABX may isolate the system from the CO line, eliminating the requirement for FCC approval of the nurse call system's telephone-interface circuit. All ANSI/UL1069 requirements for isolation apply to the nurse call system's external-equipment interfaces (ANSI/UL1069 Section 4.2.).

One or more printers may be connected, permanently or temporarily, to the nurse call central equipment. Such printers are typically used to record system activities for statistical or liability reasons, system diagnostic and maintenance data, and configuration settings. The configurations may include data buffers, splitters, multiplexers, and repeaters. Either the printers must be Listed for use with the system, or the system interface must be Listed for connection to any ancillary equipment. All ANSI/UL1069 requirements for isolation apply to the printers.

In a similar manner, one or more personal computers may be connected to the system—instead of printers, together with them, and as part of a networked system. In addition to collecting system data, the PCs may be used for configuring, backing up, and restoring the system status, reprogramming it, displaying auxiliary information, and multitasking with related, non-nurse call programs. All restrictions for printer configurations and all ANSI/UL1069 requirements for isolation also apply to personal computers.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

5.2.2 Patient-Room Equipment

Patient-room equipment can be divided into two categories; equipment *controlled* by the nurse call system, and equipment *monitored* by it. Unless this equipment has been specifically tested with the system and is Listed as such, it must be installed in compliance with the standards for circuit isolation from the nurse call system.

Controlled equipment includes bed, light, drape, and environmental controls as well as television sets and radios. The nurse call system manuals must indicate the acceptable types of connections for these devices, include wiring diagrams, and list the voltage and current limits.
Monitor equipment that interfaces with the nurse call system at the patient room can include smoke detectors, door monitors, bed-exit monitors, and a variety of patient-monitoring equipment. They annunciate at some other point within the nurse call system. As was the case with controlled outputs, the system manuals must indicate the types of interfaces for these devices, include wiring diagrams, and state the voltage and current limits on the inputs. The manuals must also specify the standard types of annunciation for these inputs (audible and visual) and, for any custom annunciation, the limitations and procedures. Unless these circuits are specifically tested with the nurse call system and Listed as such, they must comply with standards for circuit isolation from it. Another key point, particularly with fire-alarm systems (or other systems that may be regulated by or subject to local codes), is whether the system can be tied in as a primary means of annunciation. If so, the annunciation must occur whenever the equipment activates a call or is disconnected.

NOTE– A nurse call system that is used as the primary annunciation for a smoke detector must be Listed for this intended use under UL864.

5.3 System Interfaces

5.3.1 Entertainment Audio

Any television set that is connected to the nurse call system must be approved for hospital use and must be compatible with the system's TV and nurse call pillow speakers. Most older television sets use a three-wire control: audio, channel change, and common. Most newer television sets have electronic tuners and a five-wire control: audio, channel up, channel down, on and off, and common.

The nurse call manufacturer will typically specify that only a UL-Listed Hospital-Grade Television Receiver be connected to the system. In the installation manual or on the system pillow speaker, the manufacturer will mark the rated voltage and current for the television interface. The installer must verify that the connected television does not exceed these limits.

Modulated radio programming includes a number of program sources (e.g., AM-FM tuners, cassette players, and CD players) in or near the television distribution rack. Each program source is modulated and sent over the unused channel of a closed-circuit MATV or SMATV system.
Wired radio programming amplifies the output of several program sources (AM-FM tuners, cassette players, CD players, etc.) that are in a central distribution rack. This output is carried via several (usually two to five) 25-volt program lines to a radio stepper switch (electronic or mechanical) associated with each patient bed.

5.3.2 Pocket-Paging System

Nurse call systems installed with an interface to pocket-paging systems must be UL Listed for either (a) operating with those specific paging systems or (b) providing an electronically isolated interface that will prevent a failure in the pocket-paging system from affecting the nurse call operation. Its literature should specifically state that the nurse call system's listing includes both the features associated with its pocket-page interface and the pocket-page system itself.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

The nurse call system manuals must either (a) list specific pagers that will work with the system and tell how to install them, or (b) specify feature and interface requirements for a paging system, including possible configurations, features, limitations, data-integrity measures, connections, and protocols. To verify proper installation, the pager manuals must include instructions for installing and configuring the pocket-page system in conformity with these requirements. Maintenance procedures, diagnostic and trouble indicators, and repair procedures should be described in the nurse call manuals.

Instructions for using the nurse call system with a paging system which is not Listed for nurse call use, should clearly indicate that the paging system must only be used as a secondary means of call annunciation. Pocket paging must reach all applicable areas of the hospital.

5.3.3 Staff-Location Equipment

Staff-Location stations are special stations that inform the nurse call system where staff members are physically located.

Manual stations have two or three mechanical switches, usually colored red and green or red, amber and green. The station is usually located in the alcove of each patient room or, occasionally, just outside the room door.

Automatic stations are usually two-level devices that keep track of the nurse and nurse assistant (aide) through the use of small ultrasonic, infrared, or radio-frequency (RF) transmitters (carried by the staff members) and receivers (located in the patient rooms and, if desired, other areas).

5.3.4 Audio Paging System

An audio paging system, when interfaced with a nurse call system, gives the staff a means of making announcements from their control stations to overhead speakers in various areas.

The audio systems are usually configured for making local (departmental) announcements, and are interconnected to the main building's audio system. All ANSI/UL1069 Section 4.2 requirements for isolation apply to the interfaces for audio overhead paging systems.

5.3.5 Telephone System

Connections with telephone systems should employ one of the following methods:
a. Standard telephone-line connectors (RJ-11)
b. Telephone-style punch-down blocks
c. Screw terminals, if provided

The system shall be registered, under FCC Part 68, for any connection to the outside telephone network.

The telephone-switch manufacturer should provide the line type required by the nurse call system (ground-start or loop-start trunk or station line).

The polarity of TIP and RING must be observed. The ring current supplied from the nurse call system, if applicable, should not exceed the ring-current capability of the telephone system.

All ANSI/UL1069 Section 4.2 requirements for isolation apply to telephone-system interfaces.

5.3.6 Staff Registry

A staff-registry system is an information storage and retrieval system that keeps track of staff members. It allows them to register into the system so that other personnel can determine if they are within the facility.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

This system may also send messages to and from personnel and may include information about the staff members' status as well as their locations.

A central processor located near its administrative console is interfaced to remote stations. Access to the administrative console should be restricted in order to protect this sensitive information and the system programming. These access provisions should be integral to the processor. An activity report printer may be located near the central processor.

Remote stations are used for registering, and possibly retrieving, staff status. Some systems may use telephones as remote stations and therefore are connected to the telephone system. Otherwise, registration stations should be easily accessible as the staff enter and leave the building. Therefore, they are logically located near building entrances.

Stations that display staff status should be located where the authorized personnel may retrieve the data but away from public view, since staff location (and other information) may be confidential. A printer to provide hard-copy of information may be located near a staff-status display.

Stations that display "silent" message-paging or other non-sensitive information should be in public areas and highly visible.

A pocket-pager system may be used in conjunction with the staff-message features of a staff-registry system. The pocket-pager system is interfaced to the central processor but is located elsewhere.

All ANSI/UL1069 Section 4.2 requirements for isolation apply to the interfaces for staff-registry systems.

5.3.7 Management System

A Management System connects to a nurse call system (or several systems) to monitor the system activities. The data are stored and processed to help the administration determine the care-response levels in a facility.

The typical system consists of a processor, an administrative terminal, a printer, and connections to the nurse call central equipment.

The processor, the administrative terminal, and the printer should be located close together in the working area of the administrative staff. In a multi-tasking environment, this equipment may be shared with other applications. Provisions for protecting and archiving the activity data are necessary and should be integral to the processor. The administrative terminal will display activities and direct the processing of their histories. A printer will create a hard copy of real-time activities and processed data.

For typical connections, the distance between the management-system processor and the nurse call central equipment should remain within specified limits. To exceed these limits, install data-repeater equipment at the processor and at the central equipment. Some systems will require data-buffer equipment at the processor. This buffer is needed when simultaneous activity messages from multiple nurse call systems are channeled to one data-input port of the processor.

All ANSI/UL1069 Section 4.2 requirements for isolation apply to management-system interfaces.

5.3.8 Management Information System (MIS)

To interface with a facility's MIS systems, a nurse call system must either be UL-Listed for operation with those specific systems, or provide an electronically isolated interface to protect its operations from their failures. The nurse call system's literature shall specifically state that the MIS system and the features associated with the interface to it are not part of the Listed nurse call system.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

All interface requirements, including possible configurations, features and limitations, data-integrity measures, connections, and protocols, shall be specified in the nurse call system's manuals. To verify proper installation, the MIS manuals must include instructions for installing and configuring the MIS system in conformity with these requirements. Maintenance procedures, diagnostic and trouble indicators, and repair procedures should be described in the nurse call manuals.

All ANSI/UL1069 Section 4.2 requirements for isolation apply to management-system interfaces.

5.3.9 Clock System

The connection between a nurse call system and an elapsed timer must be made through a UL-Listed elapsed-timer interface. These units' equipped with a SPDT relay contact, can energize an external code-blue relay to start an elapsed-time clock or other signaling device.

When installing the interface, take appropriate measures in accordance with NFPA 70, the National Electrical Code, to separate Class 2 nurse call wiring from wiring of other Classes and power wiring. No Class 1 wiring is allowed in the back box of any nurse call device.

Make all connections to pigtails, using closed end crimp connectors, or to screw terminals.

All ANSI/UL1069 Section 4.2 requirements for isolation apply to management-system interfaces.

5.3.10 Fire-Alarm System

The smoke detector in a patient room **must** be connected to the hospital fire-alarm system; the nurse call system must **not** be used as its primary means of annunciation unless it is Listed as a Fire Alarm system. The smoke detector's auxiliary normally open, dry-make-contacts may operate an isolated lamp in the nurse call corridor lamp to provide an activation signal for zoned smoke detectors. However, this will not cause a signal to appear on the nurse call system.

On microprocessor-based nurse call systems, the smoke detector may be connected to a dedicated port on the patient station as long as this generates a unique signal when the smoke detector activates. These circuits must comply with the standards for circuit isolation from the nurse call system unless they are specifically tested with the system and Listed as such.

All ANSI/UL1069 Section 4.2 requirements for isolation apply to management-system interfaces.

5.3.11 Security System

The door-security system, when connected to the nurse call system, signals when an unauthorized person has opened a monitored door. This type of call must have a high priority and remain in the system until it is canceled at the point of origination. Bypass switches may be provided for egress by authorized personnel.

The elevator-security system, when connected to the nurse call system, signals when an unauthorized person has entered a monitored elevator. This type of call should have a high priority and remain in the system until it is canceled at the point of origination. The monitoring device may be interlocked with the elevator to prevent its door from closing.

The narcotic-cabinet magnetic proximity switch or interlock switch, when connected to the nurse call system, signals when someone has opened the cabinet. This type of call should have a high priority and remain in the system until it is canceled at the point of origination. There may be a bypass key switch to allow an authorized person access into the cabinet without placing a call on the nurse call system.

The above circuits must comply with standards for circuit isolation from the nurse call system unless they are specifically tested with the system and Listed as such.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

All ANSI/UL1069 Section 4.2 requirements for isolation apply to management-system interfaces.

5.4 Section Summary

Given the variety of nurse call system types as well as external devices and systems that can integrate with the nurse call system, the nurse call system becomes the “hub” for all patient and staff communications within the healthcare facility. Care must be taken to be sure that the nurse call manufacturer’s installation instructions are followed accurately, that regulatory standards are followed accurately and thoroughly, and that all compatible interfaces to external devices and systems do not compromise the regulatory approval of the nurse call system.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 6
POWER DISTRIBUTION

6.1 TYPES OF POWER DISTRIBUTION

6.1.1 Local Power

The nurse call system must derive its power from a Critical Branch Circuit in accordance with NFPA 70, Article 517. Primary local power for a nurse call system is obtained via its own branch circuit and breaker from the building's 120-volt power-distribution network. The breaker will have the rating specified in the nurse call installation manual.

To assure that the nurse call system continues to operate during power interruptions, it is required to be connected to the hospital's standby power system.

The back-up power may come from a local battery-powered UPS (uninterruptible power supply) installed between the normal power source and the nurse call system. Primary local power is wired to the UPS and normally passes through it to the nurse call system. The UPS will store power during normal operation and transfer power to the nurse call system during a power failure. The UPS must be properly rated.

Some systems may have integral secondary batteries to back up their secondary or low-voltage power. These batteries recharge during normal operation and switch-on to supply power during a power failure. Essential supplies can be selectively backed up.

The nurse call system will provide a means of periodically testing or monitoring the back-up batteries without disrupting the system operation.

The power must be brought to the equipment via large-diameter conductors with as few splices as possible, so that transient power loads will not cause input voltage fluctuations. Wire conductor size must meet the requirements of NFPA 70 based on the rated load of the equipment to be attached.

The power distribution wires must be brought through metal conduit and into specified knock-out locations to be directly connected within barriered sections of the back boxes. To facilitate interconnections, the back boxes must be spaced far enough apart to accommodate the conduit. Furthermore, the knock-outs used for these interconnections must align with each other to avoid extra conduit bends. The conduit facilitates pulling the wires, secures them, and provides an electrical path to earth ground. Follow the instruction in the manufacturer's installation manual regarding the routing of Class 1 wiring into the control equipment. Proper separation of Class 1 and Class 2 cabling must be maintained.

6.1.2 Centralized Power

Systems designed for centralized power normally require a regulated power supply. Large systems with centralized power may need a second power supply and may have an optional battery back-up supply. Both supplies must be connected to the Critical Branch of the building's Essential Electrical System in accordance with NFPA 70, Article 517 (see 517.33(a)(4)(5)). If a battery back-up supply is provided, no system communication will be lost during the transfer between normal power and emergency power.

6.1.3 Simplex Power

Simplex power is a means of supplying nurse call system power and system control signals via the same pair of wires. Hence, the cable needs to be of sufficient size to power all the devices, and connections should be treated as data connections in accordance with NFPA 70, Article 725. Normally, these wires are

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

attached with crimp-lugs to the stations' pig-tails. Note that, with simplex power, the maximum current capability on any cable run is 8 Amps.

6.1.4 Distributed Power

Distributed power supplies high-current power to the nurse call system from power sources located throughout the facility. The advantage of this method is that it can deliver the proper current to the devices via smaller-gauge conductors than are needed to distribute power from a central source.

6.2 Section Summary

When making the power connections for the nurse call system, care must be taken to be sure that the nurse call manufacturer's installation instructions are followed accurately and that regulatory standards and local codes are followed accurately and thoroughly.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 7
INSTALLATION REQUIREMENTS

7.1 GENERAL INFORMATION

The uniqueness of each health care facility and nurse call system requires a custom approach to each system installation. Planning well in advance of the actual installation will significantly reduce installation time and costs. Careful planning can also mean flexibility for future changes, expansion at a minimum cost, and efficient maintenance. Such detailed planning includes preparation of the location and the equipment, and careful coordination of the various stages of the installation.

Planning is critical for the AC power input, the equipment mounting, and the system cabling.

7.2 AC POWER INPUT

7.2.1 General Requirements

The central equipment needs a dedicated, computer-grade, 120-volt, 60-Hz, 20-Amp power line.

7.2.2 Earth Ground

The central equipment and power supply must be properly grounded for proper operation of the system. The dedicated grounding wire should be as short as possible and #10 AWG or larger.

7.2.3 Surge Suppressers

It is recommended that a surge suppressor be installed at each AC power input of the nurse call system, to help prevent power surges on the AC line from damaging the system. The surge suppressers must be UL-Listed and be rated for the appropriate load.

7.2.4 Line Conditioners

It is recommended that a line conditioner be installed at each AC power input of the nurse call system, to maintain a clean, regulated power source. The line conditioners must be UL-Listed and be rated for the appropriate load.

7.2.5 Uninterruptible Power Sources (UPS)

An uninterruptible power source is recommended to provide the nurse call system with back-up power for a maximum amount of time or until the hospital's emergency back-up power comes on-line. The uninterruptible power source must be UL-Listed and be rated for the appropriate load.

7.2.6 FCC Part 15 Conducted Emissions

If applicable, the nurse call system shall be reviewed and in compliance with FCC "Code of Federal Regulations" Title 47, Part 15, Subpart J, Class A related to conducted emissions.

7.3 EQUIPMENT MOUNTING

7.3.1 General Requirements

To minimize system cable requirements, the central equipment should be installed in a location that is central with respect to the nurse stations and the system zones.

--`,,`,,`,`,,`,,`---
© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

7.3.2 Back Boxes

The type and size of each back box is determined by the piece of equipment it is to house. The back boxes must be UL-Listed metal back boxes and must mate with the conduit diameters selected.

7.3.3 Grounding

Each back box must be properly grounded in accordance with the appropriate sections of NFPA 70 (e.g.: Sections 250-95 and 513-17).

7.3.4 Mounting Heights

The mounting heights vary with the equipment. The following are the recommended heights for various units, as measured from the center of the back box to the floor:

Equipment Type	Mounting Height English/Metric
Central Equipment	4.5 ft. / 1.37m.
Patient Stations	4.5ft. / 1.37m.
Code-Blue Stations	3.5 ft. / 1.07m.
Emergency Stations	3.5 ft. / 1.07m.
Dome Lights	7.5 ft. / 2.29m.

Consult the nurse call manufacturer's installation manual for specific mounting heights. All nurse call equipment must be mounted at a height where it can be easily used, but cannot be easily damaged. Consideration must be given to impact with movable equipment in the facility such as gurneys, beds (flat and raised back), wheelchairs, IV poles, portable X-ray units, etc.

NOTE–The mounting heights given above **do not** apply to units in hazardous anesthetizing locations. Consult the local code requirements for the mounting heights in these areas.

NOTE–In accordance with the American with Disabilities Act, ADA, any device mounted below 84 inches (2.13 m.) cannot protrude more than 4 inches (10.6 cm) from the wall.

7.4 CABLING

7.4.1 General Requirements

Since a large portion of a nurse call installation consists of interconnecting various equipment, meeting all wiring and cable requirements is very important. Using incorrect wire and cable is likely to result in improper system performance and decreased reliability.

7.4.2 Recommended Types

Use only the cable types specified in the nurse call system manufacturer's installation manuals.

7.4.3 Conduit

It is recommended that all the system cabling be run through metallic conduit. This will help prevent accidental cable damage as well as provide increased protection from fire and EMI (ESD and RFI) sources.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

7.4.4 Cable Trays

If the system cabling is run in an open cable tray instead of through metallic conduit, it should be partitioned off from any other cables in the tray or separated to the greatest extent possible. The cable and wire shall be Listed for use in cable trays.

7.4.4.1 Cable Separation

If the system cabling is run without conduit or cable tray, it should be spaced away from other Class I, Class II or Class III wiring. Interference or leakage could occur if cables from other systems are bundled with Nurse Call wire.

7.4.5 Connection Techniques

Proper cable termination is essential for proper installation. The system power should be turned off while any connections are made. All the cables should be marked to facilitate future trouble-shooting and servicing. Refer to the nurse call manufacturer's installation manual for specific techniques.

7.4.6 Length Requirements

Adhere to the cable-length requirements in the nurse call manufacturer's installation manual. No cable should exceed the maximum length specified by the manufacturer.

7.4.7 Ground Loops

Ground loops must be avoided and proper grounding must be provided in the nurse call system. A ground loop results when two or more points in an electrical system, which are nominally at ground potential, are connected by a conducting path in such a way that they are not at the same ground potential.

7.5 Section Summary

Because of the differences among nurse call systems and facilities, a system installation requires careful, custom planning. Detailed planning includes preparation of the location and the equipment, and careful coordination of the various stages of the installation. Such planning helps minimize the time and costs of the installation and enhances the system's effectiveness.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

<This page is intentionally left blank>

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 8
ELEMENTS OF SYSTEM LAYOUT AND COMPONENT INSTALLATION

8.1 GENERAL INFORMATION

Without proper system layout and installation, the nurse call system is unlikely to reliably function as intended.

The manufacturer of a specific nurse call system device should specify the location and interconnection method for it.

Although manufacturers and contractors can apply national standards when specifying the physical locations and electrical connections of the system components, they must also ensure that the installation complies with any local or state regulations that may pertain to that specific application.

System layouts and installation procedures should be completed and discussed with the end user and manufacturer well in advance of the equipment's arrival at the site. This will help avoid installation delays.

8.2 NURSE CALL SYSTEM COMPONENTS

All nurse call systems comprise three categories of devices:

8.2.1 Call-Initiating Stations

There are three general types of call-initiating stations; the patient-activated devices for calling the nurse, such as a call cord; the staff-activated devices, such as staff locators; and the self-controlled devices, such as smoke alarms and door monitors.

8.2.2 Call-Annunciating Stations

Call-annunciating stations indicate when a nurse call has been made. Examples are nurse control stations, duty stations, pagers, and corridor and zone lamps.

8.2.3 Power and Control Equipment

These are devices that electrically operate the nurse call system. Examples are power supplies, transformers, flashers, and system control equipment.

8.3 Installation of System Components

Call-initiating stations should be placed where they are accessible to the caller. A station that uses a call cord should be reasonably close to the patient bed.

The recommended locations for call-initiating stations are as follows:
1. Nurse master annunciator stations should be placed where they can be easily seen and accessed by the nursing staff.
2. Duty, staff, and nurse-follower stations should be placed where they can be easily accessed by the staff—normally near the entrance to the room.
3. Power and control equipment should be located where they can be readily serviced and are protected from conditions that could affect the electrical performance of the system (e.g., high humidity, accidental damage, temperature, and devices generating high levels of electrical noise).

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

8.4 Elements of Proper System Layout

The following items should be considered to ensure a proper system layout:
1. Equipment location, including its height above the floor.
2. Back-box requirements—type and size.
3. Conduit runs and sizes.
4. Cable types, sizes, colors, and identification.
5. Wiring diagrams for the central equipment connections to each device.
6. Typical room-wiring diagram.
7. Individual device-wiring diagrams.

8.5 Installation Requirements

The installing contractor must be sure to understand not only the installation of the individual devices, but also the system interconnections and the procedures for starting up the system. This may include error detection instructions and procedures.

8.6 Installation Documentation

All major manufacturers of nurse call equipment that comply with ANSI/UL 1069 Standard publish installation and instruction manuals for their products. Following these installation and instruction manuals, meeting the local codes, and satisfying the AHJ (Authority Having Jurisdiction) will provide a system that is reliable, durable, and easy to service.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 9
INTERCONNECTION CABLING

9.1 GENERAL INFORMATION

Choosing and routing the nurse call system cable is one of the installing contractor's most important duties. This portion of the system most directly affects the quality and safety of a system.

9.2 CABLE PLANNING

A defect-free installation requires careful planning. It must take into account such factors as applicable codes and manufacturers' requirements, voltage drops, usage, cross-talk, interference, the separation of Class 2 nurse call wiring from power, lighting, and circuits of other systems, existing conduit and cable trays, and leakage currents.

Before the cable is selected, each system should be carefully mapped. This includes a site-specific system riser that shows the routing and cable fill, including splice drawings for each unique interconnection. The splice drawings should show the cable designations (to match the tagging of the cable risers), the specific color codes of the spliced wires, and detailed notes where necessary (e.g., about the taping of audio shields, or any site modifications or exceptions). These drawings and notes should be retained for the as-built documentation. (See section 13, below.)

9.3 CODE REQUIREMENTS

The installing contractor has the responsibility of making sure that the nurse call system meets all the code requirements applicable to the site. The local authority having jurisdiction (AHJ) has the final approval on the installation. The codes may include provisions from national, state, provincial, and local requirements. Below are some applicable codes and regulations for THE UNITED STATES and CANADA.

9.3.1 ANSI/NFPA 70, National Electric Code

The National Electric Code (NEC) has been adopted by many states and municipalities. Several items from it relate to nurse call systems:

a. *Article 90-7, Introduction:*
This article implies that any device must be tested and approved by a Nationally Recognized Testing Laboratory (NRTL) for its intended use.
b. *Article 725, Class 1, Class 2, and Class 3 Remote Control, Signaling, and Power-Limited Circuits.*
c. *Article 517, Section F, Nurse Call Systems.*

9.3.2 ANSI/NFPA 99, Health Care Facilities

a. *Section 3-4.2.2, Essential Electrical Distribution Requirements—Type I Systems.*
b. *Section 3-4.2.3, Essential Electrical Distribution Requirements—Type II Systems.*
c. *Section 3-4.2.4, Essential Electrical Distribution Requirements—Type III Systems.*

9.3.3 ANSI/UL 1069 Hospital Signaling and Nurse Call Equipment

CSA Standard C22.1, Canadian Electrical Code
a. *Section 24- Patient Care Areas:*
Section 24-108 states that the shower stations of an emergency-signaling system must comply with the additional water-tight requirements of CSA *22.2 No. 125, Electromedical Equipment*.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

b. *Section 60- Electrical Communication Systems.*

9.3.4 CSA Standard C22.2 No. 125, Electromedical Equipment.

9.3.4.1 Cabling Separation

When planning Nurse Call cable runs, care should be taken to properly separate and isolate cable from other Class I, Class II or Class III wiring systems.

9.4 AC Requirements

9.4.1 Emergency Power Systems

Since the nurse call system is considered emergency or life-safety equipment, nurse call system power supplies must be connected to the Critical Branch of the building's Essential Electrical System in accordance with NFPA 70, Article 517.33(a)(4)(5) and ANSI/NFPA 99, Section 3-4.2.2.2.(c)(5).

If the facility has an emergency back-up system, it will be tested periodically, causing a predictable loss of AC power at the nurse call system.

9.4.2 Battery or Other Back-up Power

Most nurse call manufacturers supply battery back-up, at least as an option. The general intent is to bridge the interval between the loss of regular power and the commencement of hospital emergency power. In some systems, this interim back-up supports full system functionality, In others it only holds whatever activities were occurring at the time the power was lost. The manufacturer's installation manual will detail the operation and expected duration of this battery back-up. The installing contractor must determine whether this back-up meets the user's requirements.

Warning: In a new installation (a new floor or the total rehabilitation of an existing system), the AC circuit is likely to be interrupted by other contractors. Do not enable the battery circuits until continuous power can be expected. Extended power interruptions will fully discharge the back-up batteries.

9.4.3 Dedicated AC Circuit

All nurse call system equipment should be connected to an independent AC circuit with a dedicated (non-shared) breaker.

9.4.4 Proper Labeling for Breaker Locations

All cord-connected and permanently wired control equipment should be marked with the location and number of each AC circuit breaker that feeds it power.

9.5 Low-Voltage Wiring

9.5.1 Wire Gauge Versus Distance

Each manufacturer has a chart or formula for calculating the proper gauge of low-voltage wire for each cable drop. These charts will factor the projected current draw (based on the anticipated number of possible calls on the wiring run) and the number of stations and corridor lamps. The manufacturer's instructions shall be followed.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

9.5.2 Routing of Cables

Determining a logical pattern for laying out the low-voltage cables begins with the manufacturer's recommendation for the maximum number of stations on a single cable run. The pattern should also take into account the physical layout of the rooms and the ease of trouble-shooting the system cabling. For example, a "T" shaped floor might lend itself to three runs (one for each leg of the "T") or, if there are a large number of stations in these corridors, six runs (one for each side of each leg).

9.5.3 Splicing of Interconnections

NFPA 70 recommends using butt splices or equivalent crimp-style connectors for splicing the low-voltage wires. Electric tape and wire nuts are not recommended. Each manufacturer will specify a preferred splicing method.

9.6 Building-to-Building Wiring

Special care must be taken in running low-voltage wiring between buildings because its location is subject to potentially large transients and its length may result in large voltage drops. In addition, proper consideration of ground water leakage should be taken. Wiring shall conform to NFPA 70, Article 725-42.

9.6.1 Transient Protection

Building-to-building wiring should be run in an underground conduit system. Wiring in an above-ground conduit system must have transient protectors (as specified by the manufacturer).

9.6.2 Signal Loss

The length of wiring between buildings may contribute to signal losses (from voltage drops) or signal degradation (from accumulated wire capacitance). Follow the manufacturers' guidelines regarding the length of such runs.

9.7 Testing

9.7.1 Voltage Drop

Typically, 1-16 rooms may be on a power riser. The voltage drop should be tested on each power cable as follows:

a. Take the measurement at the splice point of the last splice box on the riser.
b. Attach the voltmeter leads across the positive and negative power wires (as specified by the manufacturer).
c. Load the system by placing enough calls to represent 20% of the riser's calling capacity.
d. The voltage measured should be within the specified input range for the station in the room. A reading that is too low indicates the need for additional or higher-gauge power wires.

9.7.2 Leakage in Patient Rooms

NFPA 99, Section 9-2.1.13 defines leakage current limits and testing modes for cord-connected appliances in the patient room. ANSI/UL1069, Paragraph 29.1.E (which is based on the NFPA 99 requirements), specifies that there must be less than 100 microamperes leakage between any current-carrying part of a pendant control (pillow speaker) and earth ground. Although the equipment as manufactured will comply with this requirement, current induced in the cabling system can push the leakage over the limit. Leakage current can come from two sources: internal (leakage within the device or system) and external (capacitively coupled from cables close to the nurse call system's wiring).

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Under NFPA 99, it is the responsibility of the installer to confirm that the nurse call system, *as installed* complies with the leakage-current limits. Accordingly, the installer must plan the installation properly to prevent or at least limit capacitively coupled leakage and then to confirm that any leakage in the patient room complies with the 100 micro-ampere limit.

The installer should measure the leakage current using the method described in NFPA 99, Section 9-2.1.13.4(a), which is included in the appendix to this document.

Thereafter, it is the responsibility of the hospital to test for this leakage and make sure that it does not increase over time.

The balance of this section illustrates the effect of capacitive coupling:

In this example, there is 120-vac cable in the same conduit or lying adjacent in the same cable tray (this could be a low-voltage system, like a master clock, where there is 120-vac because of an electrical fault).

The side-by-side run extends 400 feet, and the wire capacitance is 10 pF per foot (typical for communications-grade, low-voltage cable). The total system wire capacitance will be:
10 pF/ft $\times$ 400 ft = 4000 pF

The leakage current from this external system to the nurse call system would be:
120 vac/ Zc = I leak

Zc is the reactance of the capacitor formed by the two cables; that is:
Zc = 1/ (2 $\times$ I $\times$ F $\times$ C)

Zc = 1/ (2 $\times$ 3.14 $\times$ 60 cycles/sec. $\times$ 4000 pF)

Zc = 663 kΩ, therefore:

I leak =120 V / 663 kΩ = 181 microamperes

Thus, only 400 feet of total cable produced a value of 181 microamperes, which is 81% higher than the allowable limit!

Other factors that can affect the leakage are cable capacitance, the length of the run, the-frequency (e.g., a 1000-Hertz system would increase the leakage in the above example by 16%), and resistive shorts (rather than the full 120-volt short used in the example).

9.8 Section Summary

The quality and reliability of a nurse call installation are directly related to the planning and implementation of the interconnection wiring and cabling. The proper selection of wire and cable routing, in accordance with the manufacturer's recommendations and the applicable codes, will prevent system faults and potentially hazardous leakage currents.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 10
PROPER CONNECTIONS

10.1 TYPES OF CONNECTIONS AND THEIR USES

10.1.1 Wire-Nut Connector

This screw-on connector can be removed and reused. Its primary use is for connections to pigtail wires. Although it is not recommended for Class 2 connections, it may be used for Class 1 connections.

10.1.2 Crimp-Type Closed-End Connector

This connector is installed, manually or automatically, with a compression tool. It is not reusable. It is recommended when the equipment is supplied with a pigtailed plug or receptacle. The equipment may be removed without cutting or shortening the wiring.

10.2 POWER CONNECTIONS

The most important attribute of a power connection is high conductivity. There must be a large mating surface between conductors, and the connection method must offer both a long-term gas seal and mechanical strength.

A gas seal is assured when the conductors are brought into contact with enough force to make the wires' metal surfaces conform and eliminate air gaps. Long-term seal stability is achieved when the mechanical memory of the connection maintains force on the contact.

In making the connection, it is necessary to use abrasive action for breaking through any oxide or other film on the conductors' surfaces

Since it is not a permanent, insulating, and full covering, the connection must be secured from any condition that would allow spurious contact with another conductor.

High-voltage connections should be completely covered so that they cannot be touched by a person. These covered areas must be labeled as dangerous or be sufficiently difficult to access.

Low-voltage connections should be covered so that they cannot connect with another circuit. They can be made accessible to authorized personnel.

All connections should be documented with a layout schematic that includes cable identifications and descriptions.

10.3 PROPER GROUND CONNECTIONS

Nurse call systems must have proper ground (or earth-ground) connections to provide high-conductivity paths for shunting any charge imbalances that may occur. Ideally, a perfect ground will provide an infinite "sink" for electrical charges and provide a universal reference for zero volts.

A good ground connection at an exposed metal surface may also afford some safety. Should inadvertent voltages become present on the surface, the resulting flow to ground could trigger protection devices.

However, if an exposed metal surface can be absolutely insulated from ground, then it should not be connected to a ground or it will serve as a path for uncontrolled currents introduced from outside the system. Highly conductive discharge paths to ground may attract large currents that could damage the equipment

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

being discharged. All nurse call wiring shall be ungrounded as required by ANSI/NFPA 99, Section 3-4.1.2.2. If dead-metal surfaces are not grounded, it may be possible to meet the test requirements in NFPA 99, Section 3-5.2.1 (ANSI/UL 1069 requires such surfaces to be grounded).

Each system layout should document all the ground connections.

Ground connections should not be used to carry any nurse call signal or power current.

10.4 SYSTEM TERMINATIONS

System terminations are the connections between the system's components. They involve Class 2 wiring only. As with all electrical connections, gas-tightness, isolation between circuits, and mechanical stability are essential.

Connections should be enclosed in back boxes, away from view and the possibility of tampering.

If the equipment cannot be mounted in a back box, it should be connected to the system wiring with a connector designed to make multiple connects/disconnects. This connector should make a verifiably positive and retentive connection and incorporate cable strain relief.

Since nurse call system terminations require the use of hand tools by field personnel, the connection location must be easily accessible, facilitating the easy installation and quick replacement of the equipment.

The layout of the facility installation should document all connections within the system. It should give color coding and cable designations for the connecting points and describe each cable (gauge, type, number of wires, etc.).

10.5 CONNECTIONS FOR SUPERVISED CIRCUITS

Connections for supervised circuits must be made using screw terminals, locking connectors, or butt splices. Using screw terminals, the wires must be stripped and placed under the screw head or clamp. On other locking connectors, the wires must be stripped and crimped. All unused wires in back boxes should be cut and taped to prevent their being pinched. Cables running outside the conduit should have a strain relief at either end so that cable movement does not affect the connection or the system's operation.

10.6 REGULATORY COMPLIANCE FOR CONNECTIONS

Equipment that provides some type of ancillary or supplementary function (computers, printers, television sets, etc.) may be connected to nurse call system devices as stipulated in the manufacturer's installation manual. The key requirement is that the nurse call system remains electrically isolated so that it is not rendered inoperative and cannot conduct dangerous voltages into the patient care area as a result of a fault condition in the ancillary system equipment.

Any nurse call unit that is employed to direct the hospital staff to the patient rooms (as outlined in the operator's manual) shall be connected to the system in accordance with the manufacturer's installation manual. All equipment employed for this purpose shall be Listed by an NRTL (Nationally Recognized Testing Laboratory) in keeping with ANSI/UL 1069 Section 4.2.

All connections must be in agreement with the wiring diagrams that are included in the manufacturer's installation manual and as part of the Listing and Certification requirements. Failure to do so will render any regulatory compliance void.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

10.7 LABELING SYSTEM CONNECTIONS

An installation wiring diagram or diagrams showing the field connections shall be provided with each nurse call system installed. All such diagrams shall be either attached to the main control unit or, if they are stored separately, they must at least be referenced at the main control unit with each diagram's number and issue number or date. Any unattached diagram shall be marked with the name or trademark of the manufacturer, the drawing number, and the issue number or date.

The installation wiring diagrams shall include a pictorial or equivalent view of the installation terminals or leads to which the field connections are made. The terminals should be shown from the front or normal connecting position. The terminal numbers on the unit shall agree with the numbers on the diagram.

The wiring diagrams shall also give the manufacturer and model number (or equivalent) for any special tool that is required for any terminal. It shall also list the range of wire sizes for low-voltage, power-limited circuit terminals (except for those constructions employing terminal plates with wire-binding screws).

10.8 NURSE CALL SYSTEM CONNECTIONS

10.8.1 Control Equipment

central equipment cabinet: All connections from system devices (audio components; patient, staff, and duty stations; nurse control stations; annunciators; interfaces for ancillary-equipment; etc.) must have strain reliefs where they enter the central equipment cabinet or inside it. The connections must also withstand any stress from internal moving parts (hinged doors, swing-out racks, etc.).

wires and connectors: The system manufacturer's color code must be followed. All wiring should be dressed away from the printed circuit boards and the edges of the enclosure. All shields on audio and data cables should be carefully dressed so that as little as possible of the conductors are left unshielded.

Recommended connectors include screw terminal blocks, cam-lock connectors, to existing pigtails, or telephone type blocks. On screw terminals, the wires must be stripped and placed under the screw head or clamp. Since some cam-lock connectors can accept unstripped wires, their installation instructions should specify whether or not it is necessary to strip the wire. On other locking connectors, the wires must be stripped and crimped. All unused wires should be cut and taped to prevent accidental shorting.

The connectors must be clearly labeled, as described in Section 10.7.

audio communications equipment: All such equipment must be installed in a professional manner and in accordance with the applicable standards and approved specifications.

nurse control station: The connections must be made to screw or locking terminals. "Central Equipment Cabinet," immediately above, details the requirements for making the connections and providing strain relief.

visual and audio annunciators: These should be connected to the nurse call system via screw terminals or Quick Disconnect connectors. "Central Equipment Cabinet," immediately above, details the requirements for making the connections and providing strain relief.

10.8.2 Patient Room Equipment

patient station audio wiring connections: All audio connections should be made with shielded wire (unless the manufacturer specifies otherwise). The wires should be dressed away from any high-level interference or entertainment audio to help eliminate hum and data noise. When making splices, keep the unshielded portions of the cable as short as possible.

--`,,`,,`-`-`,,`,,`,`,,`--- © Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS Not for Resale

patient station control connections: Control connections (for television sets, lighting, curtains, bed, etc.) should be completely isolated from the nurse call system and be installed as recommended by the manufacturer. It is advisable that these types of devices be snubbed to prevent any type of radio frequency (RF) spikes. This type of snubbing is normally done with diodes or low-voltage MOVs rated slightly above the controls' operating voltage.

patient station power connections: These should be made via permanent or locking connectors in such a fashion as to prevent any shorting to the back box, each other, or the station itself. The lines should be checked for the proper polarity and voltage before they are connected to the stations. This practice should prevent any stations from being damaged.

peripheral connections: Any connections for external devices (printers, information-gathering systems, non-system annunciators, etc.) should provide electrical isolation from the nurse call system to prevent it from being damaged by any defect in the peripheral equipment.

remote station connections: These are normally used in lavatories or for the remote placement of high-priority calls. They should be wired per the manufacturer's specifications. Lavatory stations that are not waterproof should not be placed where spray from the shower will hit them directly. They should be installed as specified by the manufacturer. Any external activating device should be isolated from the nurse call system by either a passive device (relay contacts) or an active one (opto coupler).

bed-side control connections: Connections to beds with bed-side controls shall be non-locking, and capable of withstanding a pull of 5 pounds without disconnecting or affecting the system's operation. At a pull of 35 pounds, perpendicular to the wall, the connector should pull apart without damage to either end. It should re-engage at a force of less than 35 pounds and be keyed to prevent misconnection.

The wall connections should be mounted within two feet of the floor, and wired in conduit to the nurse call station. Disconnection shall produce audible and visual indications at the nurse control station within 15 seconds. The electrical ratings of the connector shall be clearly specified and consistent with the ratings of any device wired to the connector.

pillow speaker connections: These have the same connecting requirements as bed-side controls, detailed in the preceding paragraph. The connections should be readily accessible to maintenance, nursing, and housekeeping personnel. Disconnection shall produce audible and visual indication at the nurse control station within 10 seconds.

10.9 Connection of Ancillary Equipment

10.9.1 Patient-Room Smoke Detectors

Patient-room smoke detectors **must** be connected to the hospital fire alarm system. The nurse call system is **not** to be used as the primary means of annunciation for any fire alarm-initiating device unless it is Listed, under ANSI/UL 864, for this use.

For secondary annunciation, the smoke detector's normally open auxiliary dry contacts may be connected to (a) an isolated lamp in the nurse call corridor lamp which will annunciate for zoned smoke detectors, or (b) a dedicated port on a microprocessor-based patient station to initiate a "smoke detector" call on the nurse call system.

10.9.2 Patient-Room Audio-Video Equipment

The hospital-grade television set's coaxial cable must plug into the wall, and its multi-conductor control cable must be connected to the nurse call patient station.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

The cabling for a wired radio stepper switch must be integral to the stepper switch, and the stepper output must match the impedance of the pillow speaker.

All ASNI/UL 1069 requirements for isolation from the nurse call system apply to the interfaces for audio-video equipment.

10.9.3 Telephone System

These connections should be made with wire approved for the telephone system (normally 24-gauge solid). The usual connectors are screw terminals, punch blocks, and cam-lock type connectors. Systems that use a standard RJ-11 type jack may require only a standard telephone cord with a male RJ-11 connector on each end.

Care should be taken to completely isolate these from the normal nurse call wiring to prevent any interference. All ANSI/UL 1069 requirements for isolation from the nurse call system apply to the interfaces for telephone equipment.

10.9.4 Patient-Monitoring Equipment

The patient-monitoring device must provide an isolated, normally open, dry make relay contact for the nurse call connection. **Never** connect monitoring devices with a switch output voltage to the nurse call system.

Devices like IV monitors will provide a maintained dry-make relay contact. Ventilator alarms can also provide a dry-make relay contact.

Devices connected into the system via a separate call-point input can initiate a higher-priority call than a standard call placed by the patient.

10.9.5 Pocket-Paging Systems

A pocket-page system should be permanently connected as an ancillary device, normally via a shielded data cable from each central-equipment cabinet to the pocket-page interface or, if allowed, directly to the pocket-page equipment. The two systems shall be isolated from each other for patients' safety and for the protection of the two systems. With multiple central equipment cabinets, separate the ground connections to avoid ground loops. Use only the cable recommended by the manufacturer.

10.9.6 Staff-Location Equipment

All such equipment must be installed in a professional manner and in accordance with the applicable standards and approved specifications. All ANSI/UL 1069 requirements for isolation apply to the interfaces for staff-location equipment.

10.9.7 Other Ancillary Equipment

Low-voltage relays for lighting controls must be a DC type operating at 30 volts or less. AC relays are not recommended for controls on pillow speakers.

Any DC relay, other than a solid-state, optically coupled (energy-limited) type, and any device controlled from a pillow speaker must have a suppresser network across the relay coil and be electrically isolated from the nurse call system by an interface device, usually a normally open dry-make contact.

A bed-exit or bed-monitoring device must place an isolated, normally open, dry-make contact closure to the nurse call system.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

10.10 SECTION SUMMARY

When making connections for the nurse call system, care must be taken to be sure that the nurse call manufacturer's installation instructions are followed accurately and that regulatory standards and local codes are followed accurately and thoroughly.

10.11 ADDITIONAL CONNECTION INFORMATION

10.11.1 Connector Types and Uses

wire nuts: Wire nuts are normally used to connect the AC source to the system's power supplies. Use wire nuts only if the nurse call manufacturer's instructions state that they are appropriate for use with the system. However, closed-end crimp connectors (see below) are preferred for this application.

closed end crimp connectors: Closed-end crimp connectors are a preferred way of connecting the field wiring to patient stations.

insulation-displacement connectors: Insulation-displacement connectors are supplied with some patient stations and, at times, with factory-installed pigtails. They require a special installation tool for inserting the wires.

quick-disconnect connectors: Quick-disconnect connectors are used to splice field wiring to some annunciator-lamp fields. This type of connector requires a special crimping tool.

screw-clamp and cam-lock connectors: These connectors are used mainly for connecting the field wiring to the central equipment cabinet. Because they come in several sizes, to accept wire sizes from 10 AWG to 28 AWG, they must be selected in accordance with the connector manufacturer's specifications and the specific application.

10.11.2 Preparing Wire for Connections

stripping: Avoid making nicks in the unstripped insulation or the actual conductors (the latter could eventually lead to conductor breakage).

shielded cable: When preparing this cable for a connection, remove as little of the shield as possible to minimize the amount of internal conductors left exposed (normally ½ to 1 inch). The shield should be kept contiguous unless otherwise specified by the manufacturer. The shield, if unconnected, should be taped or insulated from the other conductors and any area to which it could short. In multiplexed systems, the data and audio cables should be separated.

tools: Use the proper wire-stripping tools, sized for the gauge of wire involved. Pocket knives and wire cutters are not recommended for stripping.

extra conductors: All extra conductors should be insulated to prevent shorting to back box.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 11
SEPARATION FROM OTHER CIRCUITS AND EQUIPMENT

11.1 GENERAL INFORMATION

As detailed in section 9.7.2 of this guide, it is both a potential hazard and a safety-code violation to have leakage or a direct connection from any other system (low- or high-voltage) to the nurse call system's wiring or components.

11.2 CONDUIT AND CABLE-TRAY SYSTEMS

Article 725-38 of NFPA 70, the National Electrical Code, specifically details the restrictions in proximity between Class 1 circuits being run in the same conduit or cable tray as Class 2 or 3 circuits (most nurse call systems use Class 2 wiring for the load side of the wiring). Although the code does allow other Class 2 circuits in the same conduit or cable tray, this can create unacceptable leakage. (See Section 9.7.2 of this guide.)

11.3 OTHER EQUIPMENT

Nurse call equipment is often required to be interconnected with other low-voltage systems. However, such interconnections may violate the energy-limited requirement (100 va) or leakage requirements of NFPA 70, NFPA 99, and ANSI/UL1069. In particular, UL restricts manufacturers in what interconnections they will permit. The installer must comply with the manufacturer's limitations as stated in their installation manuals.

A manufacturer has two ways of obtaining authorization for interconnecting an external system. The usual method is to have the interface Listed with a NRTL (Nationally Recognized Testing Laboratory). This requires that the interface inputs and outputs will isolate the nurse call system from any violation of the leakage or energy-limiting standards even if the interconnected systems were to have a 120-VAC fault. Less commonly, the manufacturer may make an exception for certain products that are known to be in compliance with ANSI/UL 1069 equivalent standards.

Here are examples of some common interconnections:

11.3.1 Power Circuits

The nurse call system should receive its 120-VAC power from a dedicated feed. Even though nurse call systems are tested for resistance to line noise and transients, sharing a power line could still subject them to failure. Other devices on the same feed could cause the shared breaker to open.

11.3.2 Class 2 Circuits

fire alarm system: Most of the model building codes now require that a single-station smoke detector annunciate at a lamp outside the patient room and at the nurse's station. Obviously, a nurse call system can provide both forms of annunciation.

California has already adopted such a code, and the NFPA is likely to incorporate it into NFPA 101, Life Safety For Hospitals. This would mandate that all hospital construction include this code, since, without it, the facility could not get reimbursement from the federal government (e.g., Medicaid).

Although these annunciation requirements can be met by a stand-alone fire alarm system, architects and engineers often specify that the smoke detector be connected to the nurse call system. They are not

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

aware that such an interconnection may not comply with ANSI/UL1069, which states that a nurse call system cannot provide the primary annunciation for fire-alarm devices.

UL has stated that each manufacturer must submit its smoke-detector for listing, and that a combined system must meet all the requirements of ANSI/UL1069 (nurse call) and UL864 (fire-alarm systems).

IMPORTANT NOTE–Before connecting a smoke detector to a nurse call system, the installer must verify that the system manufacturer allows such an interface.

pendant controls (pillow speakers): Pillow speakers are often required to control low-voltage systems, such as control circuits for television sets, radios, lighting, and curtains. Because these systems meet the code's leakage and energy-limiting requirements, they should only be connected in accordance with the manufacturer's instructions. The manufacturer's interconnection method must be ANSI/UL1069-Listed.

11.3.3 RF Considerations

FCC Title 47 Part 15, Subpart J, Class A restricts RF radiation and conducted emissions from nurse call systems per the following:

Category and Freq. (MHz)	Distance between Test Item and Antenna (Meters)	Field Strength
Radiated 30-88	10	90 μv/M
Radiated 88-216	10	150 μv/M
Radiated 216-960	10	210 μv/M
Radiated Above 960	10	300 μv/M
Conducted .45-1.705	N.A.	1000 μv
Conducted 1.705-30	N.A.	3000 μv

These interference limits essentially define whether or not a nurse call system will interfere with other communication devices. For example, a system complying with FCC Part 15 should not interfere with an MATV or CATV distribution system, but it may affect reception from television antennae (as are commonly used in nursing homes and rural hospitals), particularly if there is a long distance to the transmitting tower.

A nurse call system could affect a telemetry system that cannot withstand FCC Part 15 Class A units in proximity. If there is any doubt, the installer should consult the nurse call and telemetry systems manufacturers.

A local RF source, such as a pocket-page transmitter or a nearby high-wattage (i.e., 50,000+ watt) AM transmitter, could cause audio interference or even a malfunction in a nurse call system. Although each manufacturer has included protective measures in its installation instructions, it is recommended that, if there is a high-power transmitting antenna near the nurse call wiring, that conduit or overall shielded wire be used.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

11.3.4 Head Walls

Head walls are of particular concern to nurse call installers. Because they typically accommodate other power, light, Class 1, 2, or 3 equipment as well as gas-distribution systems, it is very important that they be Listed and have the proper barriers and spacing to comply with NFPA 70 Article 725-38.

11.4 EMI AND TRANSIENTS ON AC FEEDS

ANSI/UL1069 stipulates that nurse call equipment be tested for transients on the 120-vac feed. Since this test does not include all possible line transients, the installer may want to provide expanded protection by installing a computer-grade surge suppresser. In selecting the current rating of the surge suppresser, careful consideration must be paid to the unit's location.

11.5 SECTION SUMMARY

Although nurse call systems are designed for stand-alone operation, providing communications between nurses and patients, they commonly operate with many interfaces and types of interference that can affect their safety and reliability. Therefore, the manufacturer's installation information must be carefully reviewed and followed. ANSI/UL1069 regulates which devices can be interconnected and how they are to be interconnected.

Transients are a site-specific problem. Good planning, including a careful survey of the proposed installation, will prevent such problems.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

<This page is intentionally left blank>

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 12
ENVIRONMENTAL CONSIDERATIONS

12.1 GENERAL INFORMATION

This section covers both visual only and audio-visual nurse call systems designed for hospitals, nursing homes, and assisted-living facilities. The equipment covered is for use with interior wiring systems in accordance with the National Electrical Code, NFPA 70.

12.2 CENTRAL EQUIPMENT

Central equipment comprises all of the electrical and electronic equipment that controls the operation and communication functions of remote devices within the facility.

12.2.1 Temperature and Humidity

Install central equipment in locations which meet the temperature and humidity requirements specified by the nurse call equipment manufacturer. Do not install central equipment near other sources of heat.

12.2.2 Dust and Dirt

The equipment's environment should be free of dust and airborne particulate matter. Whenever equipment uses continuous air moving devices, such as fans, its filters should be replaced at the intervals recommended by the manufacturer.

12.2.3 Ambient Noise Level

Install central equipment in a location which is appropriate for the noise it generates. Contact the manufacturer if in doubt.

12.2.4 Service Considerations

Equipment should be placed where qualified personnel can access it without interfering with the facility's normal operation. The system layout should allow easy access to its internal components, especially to those parts that need routine maintenance, such as fan filters. Wiring terminations should be clearly identified with the proper labeling, and the facility engineering staff should be given a complete set of installation wiring diagrams.

12.3 Nurse's Station Equipment

12.3.1 Ambient Lighting Level

Install the display (CRT, LCD, LEDs, etc.) at the nursing station so that it can be easily read in ambient lighting at levels up to 100 foot-candles. The nursing station display should be carefully placed to minimize glare.

12.3.2 Temperature and Humidity

See Section 12.2.1, above.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

12.3.3 Ambient Noise Level

Nurse's station equipment should not be mounted near other equipment that can generate high noise levels (speakers, alarm-signaling devices, etc.). To be masked, the ambient noise should be at least 8 dB less than the output of the nurse control station's speaker.

12.3.4 Accessibility to Staff Members

Nurse′s station equipment should be installed in an area free of obstructions and easily accessible to its authorized users. These stations are typically located on desks and walls.

12.3.5 ESD or Other Transients

Consideration should be given to electrostatic discharges and other transients, which can seriously damage system equipment. See the sections of the National Electrical Code relating to transient suppression and *Impact of Electrostatic Discharges in the Hospital Environment*, published by the NEMA Health Care Communications Group of the Emergency Signaling, Protection, and Communications Section.

12.4 PATIENT-ROOM EQUIPMENT

12.4.1 Ambient Lighting Levels

Install patient stations in such a manner so that LEDs, LCDs, lighted push buttons, and any other part of the station that provides information can be easily read in ambient lighting at levels up to 50 foot-candles. If there is a display (LCD, electroluminescent, etc.), it should be carefully placed to minimize glare.

12.4.2 Temperature and Humidity

The environmental considerations for patient-room equipment are the same as those for central equipment. In addition, remote room stations should not be mounted in an air-handling plenum. Any equipment mounted in a bath, shower, whirlpool-therapy room, or wet area should have waterproof construction and be ANSI/UL1069-Listed for use in wet locations.

12.4.3 Ambient Noise Level

Remote room devices intended for audio communications should not be mounted near other equipment that can generate high noise levels (speakers, alarm-signaling devices, etc.). To be masked, the ambient noise should be at least 8 dB less than the output of the room station's speaker.

12.4.4 Accessibility To Staff Members

A remote room station shall be placed where the staff members can easily reset and place calls. It shall be clearly labeled in accordance with ANSI/UL1069.

12.4.5 ESD or Other Transients

Refer to section 12.3.5 above.

12.5 SECTION SUMMARY

12.6 SECTION DIAGRAMS

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 13
AS-BUILT DOCUMENTATION

13.1 GENERAL INFORMATION

As-built documentation facilitates proper service over the life of the installed system. This documentation must come from the installer. The manufacturer's installation manuals have only typical connection drawings that do not include cable-routing, colors, and other pertinent information.

It is recommended that all pertinent as-built information be placed in a pouch inside the central equipment cabinet of each system.

13.2 RISERS

13.2.1 120 VAC Wiring

If the 120 VAC feed breaker trips, this could shut down the nurse call system. Even if there is standby power, it will only last a short time. To reset the breaker, the maintenance personnel need to find it. Hence, the location of the breaker box and the number of the breaker should be marked on the central equipment cabinet. In addition, the AC riser should be included in the as-built pouch.

13.2.2 Low-Voltage Wiring

Nurse call systems typically use low-voltage (Class 2 or 3) wiring. In order to trace any future problems, the service personnel need diagrams of the system's physical layout, including the routing of the cable (conduit, cable tray, or open cabling) and the locations of the splice boxes. These low-voltage wiring risers should be included in the as-built pouch.

13.3 INTERCONNECT DRAWINGS

The manufacturer will supply typical connection drawings for interconnecting each unit of the system. Typical splice drawings may be included, but they will not give the actual connections or color codes of the spliced wires for a specific site.

The as-built pouch should contain the following typical interconnection drawings specific to a site:
Terminations and color-coding of the central equipment wiring.
Typical splice-box interconnections.
Typical splices at each room (including patient stations, corridor lamps, staff stations, duty stations, emergency stations, and bath stations).

There should also be an as-built wiring layout and interconnection, sometimes referred to as a point-to-point wiring diagram, that shows:
How every component in the system is interconnected.
The physical location of all system components.
The interconnections that are made at all junction boxes and splice points.
The physical location of all junction boxes and splice points.
The conduit routing and distances.
The physical location of the central equipment.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

13.4 MARKING HOME-RUN CABLES

Most installations have multiple low-voltage cables connected to the central equipment or central splice locations. To help the service personnel, the installer should label these cables to identify each run and its corresponding low-voltage riser drawing. (See Section 13.2.2 of this manual.)

13.5 SYSTEM PROGRAMMING RECORDS

Most microprocessor-based nurse call systems can be programmed to match the physical layout of the facility and meet the needs of the users (e.g., with room numbers, zone assignments, pocket-page assignments, and custom feature configuration). The service personnel may need details of this programming when they service a CPU card (with memory) or central equipment, or when they change the programming (e.g., by adding or changing room numbers, or by changing a feature).

A record of this programming (either written or in media form, as specified by the manufacturer) should be included in the as-built pouch for each system.

13.6 TEST RECORDS

As part of the installation, the installer must do a walk-through test to verify the safety and operation of the system. Since any significant service may require the service personnel to duplicate these tests, a record of the tests and the test results should be included in the as-built pouch for each system. These records should include:

The room-by-room walk-through results.
Leakage current test results.
Standby power test results.
Audio level measurements and adjustments as well as ambient noise level measurements.
Ambient temperature, humidity, and light measurements.

13.7 IN-SERVICE TRAINING

The installing contractor shall ensure in-service training is provided for the facility staff. The training shall include any material specified by the manufacturer.

These materials should be included in the as-built pouch, together with records of those who have been trained. Among those who should be trained are:

Nursing staff.
Secretarial staff.
Maintenance staff.
Biomedical staff.

13.8 SERVICE PROCEDURES

The manufacturer's or installer's recommended service procedures should be included in the as-built pouch. In addition, some preliminary information should be posted at or near the operator's console. This information includes:

A check list of procedures to try for a specific system problem before calling for service.
Who to call for service.
A form on which the user can record pertinent data regarding a system problem for the service personnel.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

13.9 SECTION SUMMARY

Each system requires as-built documentation for service and maintenance. This information should be included in a pouch (or an equivalent form) at the central equipment.

13.10 SECTION DIAGRAMS

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

>This page is intentionally left blank.>

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 14
INSPECTION AND SYSTEM TESTING

14.1 GENERAL INFORMATION

Although Listed nurse call system components have been tested by an independent Nationally Recognized Testing Laboratory (NRTL) to assure that they meet the safety and reliability requirements of the appropriate ANSI standards, the completed system must also be tested to verify that it has been installed in accordance with the manufacturer's manual. Any system that does not conform to the installation manual used by the NRTL in its testing may pose dangers to the patients and the staff. This section describes the minimum proper system testing.

14.2 ELECTRICAL INSPECTION

14.2.1 Earth Ground

All system power supplies must be grounded in conformance with the manufacturer's installation manual, the appropriate chapters of the National Electrical Code (NFPA 70), and the applicable state and local codes.

14.2.2 AC Supply

Verification is made that the system's power supplies are connected to a dedicated branch circuit that is derived from the appropriate electrical system in the facility. See the requirements in the manufacturer's installation manual and Article 517 of the National Electrical Code.

14.2.3 Conformity with the Manufacturer's Installation Manual

The location, application, and wiring of the system components are checked to be sure they comply with the manufacturer's installation manual.

14.2.4 Connected Equipment

Verification is made that all equipment connected to the nurse call system is Listed and regulatory labeled appropriately for the intended use and shown in the manufacturer's manual.

14.3 ELECTRICAL TESTING

14.3.1 AC Input Voltage

The AC input voltage is tested to make sure it is within the ratings of the nurse call power supplies.

14.3.2 Power-Supply Test

The output voltage of the system's power supply is tested to make sure it lies within the range specified by the manufacturer.

14.3.3 Testing for Leakage Current

Because patients might be harmed by current levels that are not normally hazardous to healthy people, manufacturers must specify low leakage currents for their systems' power supplies. The manufacturer's ratings and installation instructions must be followed when testing the power supplies for leakage current.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

14.3.4 NFPA 70 Tests

Tests are made that verify that the installed system conforms to applicable chapters of the National Electrical Code (e.g., 250, 517, 725).

14.3.5 NFPA 99 Tests

After performing the manufacturer's recommended tests, tests are performed as described in the Health Care Facilities Code (ANSI/NFPA 99).

14.4 FUNCTIONAL TESTING

Each call-initiating and annunciating station in the installed system must be tested for proper operation.

14.5 LOAD TESTING

In accordance with the instructions in the manufacturer's installation manual, the maximum number of call-initiating stations, that the system is specified to support simultaneously, are activated. Verify that the system functions properly under this load.

14.6 SECTION SUMMARY

Sound engineering principles in product design, quality manufacturing processes, third party NRTL safety testing, and good installation practices are all important to the safety and reliability of a nurse call system. However, equally important is proper inspection and testing. These last steps provide a verification that the system, as it was installed, electrically conforms to applicable codes and standards as well as the manufacturer's instructions. They also verify that the system, as it was installed, functions according to the manufacturer's specifications. Failure to perform these steps could result in the existence of potentially lethal hazards when the system is put into use.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 15
MAINTENANCE AND SERVICE

15.1 GENERAL INFORMATION

It is imperative to follow the nurse call system manufacturer's instructions for maintenance and service.

The following is a broad outline of general maintenance and servicing procedures that should be followed. These are not intended to replace the manufacturer's documentation.

15.2 DOCUMENTATION AND PARTS

To properly maintain and service a nurse call system, it is vital that the following be available:

15.2.1 As-Built Documentation

This important documentation combines the manufacturer's general system information with project-specific details on system cabling and interconnections. The creation of this documentation is normally the responsibility of the installer and should be considered an integral part of the installation contract. (See Section 13.)

15.2.2 Manufacturer's Installation Manual

This document provides the installer with product-specific installation information, including:
Descriptions of all system devices.
Typical applications of each system device.
Suggested location of each system device.
Typical interconnection diagrams.
Typical block wiring diagrams.
The type and gauge of the system wires and cables that must be used.
The maximum cable lengths, as appropriate.

15.2.3 Manufacturer's User Operation Manual

This manual is normally a two-part document. One part, the *Quick Reference Guide,* will apply only to the nurse control station and focus on the functions that are most commonly used in normal operation.

The second part will describe the operation of the entire system, including all its peripheral devices. For programmable or user configurable systems, this part of the manual will include all programming and configuration instructions. For other systems, it will include initial set-up instructions.

15.2.4 Manufacturer's Service Manual

This manual will include both system servicing and trouble-shooting instructions as well as a list of spare parts recommended by the manufacturer. It is important to remember that the servicing and trouble-shooting portions of this manual are written for trained personnel.

15.2.5 ANSI/UL1069 Nurse Call Standard

This ANSI standard, published and maintained by Underwriters Laboratories, primarily deals with safety-related issues. It specifies operational and technical characteristics that every nurse call system must meet to insure safe use.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

15.2.6 NEMA SB10 Audibility Standard for Nurse Call Systems

This industry standard provides technical specifications related to the audio portion of an audio-visual nurse call system.

15.2.7 Spare Parts

It is recommended that a facility with a nurse call system maintain an inventory of the following spare parts:

Call Cords (an inventory of each type used at the facility).
Pillow Speakers (an inventory of each type used at the facility).
Patient Room Stations.
Staff Stations.
Duty Stations
Emergency Stations.
Code-Call Stations.
Corridor Lamps.
Zone Lamps.
Bulbs for Corridor and Zone Lamps.
Power Supplies (a sample of each type used at the facility).
Amplifiers (audio-visual systems only) (a sample of each type used at the facility).
Control Circuits (a sample of each type used at the facility).

As the above list clearly implies, when a system device fails, it must be immediately replaced. Circuit boards should be repaired only by the manufacturer. In most cases, performing circuit-level repairs elsewhere will void the manufacturer's warranty and render any NRTL listing void.

It is also important to keep the spare-part inventory current with any changes or updates made to the system.

15.3 TEST EQUIPMENT REQUIRED

Every facility with a nurse call system should have the following basic test equipment on-hand for system service and trouble-shooting:

Multi-Meter: For checking voltage levels, electrical current measurements, and circuit continuity.
Sound-Level Meter (audio-visual systems only): For checking the nurse call system's audio levels. (See the NEMA Audio Standard and Section 15.2.6.)
Pink-Noise Generator (audio-visual systems only): A signal source used for testing the nurse call system's audio levels. (See the NEMA Audio Standard and Section 15.2.6.)

Again, the manufacturer's service manual should be consulted.

15.4 PERIODIC TESTING

The nurse call system's operations should be tested periodically, and the results should be recorded.

All of the system's components should be tested for proper operation. The manufacturer's operation manual should be used during these tests.

The system should also be tested for meeting the ANSI/UL 1069 standard.

The audio portion of the system (audio-visual system only) should be tested against the NEMA Audio Standard.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

All installed systems must be tested in accordance with the requirements of ANSI/NFPA 99, Chapter 7.

15.5 PROBLEM INVESTIGATION

If there is a suspicion that a nurse call system failure has occurred, the following procedure should be followed:

1. *Confirm that the operation in question has failed:* This is especially important, given the diversity of nurse call systems. For example, some systems will flash **red** lights to signify emergency calls, whereas others will flash **white** lights. Obviously, making sure that there is a problem before beginning troubleshooting or corrective action will save both time and money.

2. *Pinpoint the problem to a specific area of the facility and the system*.

3. *Locate the Malfunctioning Device:* If the device that appears to be malfunctioning is a patient station, make sure the station itself is failing and not the pillow speaker or the call cord attached to it. Conversely, if a particular device appears faulty (e.g., a call cord or a pillow speaker), make sure that it is the problem rather than the station it is connected to, the wiring to the station, etc.

If a patient call does not register on the system, check whether it registers at any annunciation point (corridor lamp, nurse control station, duty stations, remote annunciators, zone lamps, etc.). If it registers anywhere in the system, the calling device (e.g., a call cord or a pillow speaker) is probably not at fault.

15.6 CORRECTIVE ACTION

After determining which device is malfunctioning, the following procedure applies:

Call Cord: Replace it.

Pillow Speaker: Repair or replace it.

Patient Room Station: Follow this procedure:

1. Turn the nurse call system off.
2. In removing the malfunctioning station, be sure to note the wiring colors and the terminal identifications.
3. Verify that the wiring to the station is not shorted, grounded, or open.
4. If no wiring faults are found, replace the station.
5. If this procedure does not solve the problem, contact the manufacturer's representative or the manufacturer directly.

Emergency-Call Station: Use the same procedure as above for patient room station.

Corridor Lamps and Bulbs: Follow this procedure:

1. Verify that all the bulbs light. Replace any defective ones.
2. If this doesn't solve the problem, turn the nurse call system off.
3. In removing the malfunctioning corridor lamp, be sure to note the wiring colors and the terminal identifications.
4. Check the wiring to the corridor lamp for shorts, grounds, or opens.
5. If no wiring faults are found, replace the corridor lamp.
6. If this procedure does not solve the problem, contact the manufacturer's representative or the manufacturer directly.

Staff Station: Replace it.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Duty Station: Replace it.

Code-Call Station: Replace it.

Zone Lamp: Replace bulbs only. For any other problem, replace the entire unit.

Nurse Control Station: Contact the manufacturer's representative or the manufacturer directly.

Central Equipment: Contact the manufacturer's representative or the manufacturer directly.

15.7 TECHNICAL ASSISTANCE

Directions for contacting the nurse call system manufacturer's representative or the manufacturer's service department should be prominently displayed at the nurse control stations, the central equipment, and in the facility maintenance department.

Seek technical assistance in the following order:
1. System Installer.
2. System Distributor.
3. System Manufacturer's Representative.
4. System Manufacturer's Service Department.

A contact person should be identified with the company's name and telephone number. Be sure to periodically update this list.

Technician requiring factory support should note equipment model numbers and have that information available when contacting the factory.

15.8 SECTION SUMMARY

Thorough and periodic testing is the key to maintaining a nurse call system and preventing any major problems from occurring.

© Copyright 2002 by the National Electrical Manufacturers Association.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale