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.

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, express 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.
CONTENTS

Foreword ........................................................................................................................................... iii

SECTION 1 GENERAL ....................................................................................................................... 1

1.1 Scope ........................................................................................................................................ 1

1.2 Purpose ...................................................................................................................................... 1

1.3 Standards that Apply .................................................................................................................. 1

1.4 Manufacturer’s Publications ....................................................................................................... 2

1.5 General Definitions .................................................................................................................... 2

SECTION 2 HOW SMOKE DETECTORS WORK .................................................................................. 8

2.1 Smoke Detector Sensor Technologies ......................................................................................... 8

2.2 How Ionization Smoke Detectors Work ...................................................................................... 8

2.3 How Photoelectric Smoke Detectors Work ................................................................................ 9

2.4 How Photoelectric Light Obscuration Smoke Detectors Work ................................................. 9

2.5 How Photoelectric Light Scattering Smoke Detectors Work ..................................................... 10

2.6 How Multi-Criteria Smoke Detectors Work .............................................................................. 11

2.7 How Video Image Detection (VID) Works .................................................................................. 12

2.8 Smoke Detector Design Considerations ..................................................................................... 13

2.9 Considerations in Selecting Detectors ....................................................................................... 13

2.10 Situations Where Other Types of Detectors May be Used ......................................................... 14

2.11 Smoke Detectors Have Limitations .......................................................................................... 14

SECTION 3 TYPICAL SYSTEM LAYOUT ........................................................................................... 15

3.1 Electrical Supervision ................................................................................................................ 15

3.2 Class B Circuits .......................................................................................................................... 15

3.3 Class A Circuits .......................................................................................................................... 15

3.4 Addressable Sensor Wiring ...................................................................................................... 17

3.5 Wireless Smoke Detection Systems ........................................................................................... 18

3.6 General Zoning Guidelines for Non-Addressable Smoke Detectors .......................................... 18

3.7 Building Control Functions ....................................................................................................... 19

3.8 Smoke Detector Installation ...................................................................................................... 19

3.8.1 Wiring Installation Guidelines ............................................................................................... 19

3.8.2 Typical Wiring Techniques .................................................................................................... 19

3.8.3 Wireless Systems .................................................................................................................. 23

3.9 Installation Do’s and Don’ts ........................................................................................................ 23

3.9.1 Do: ....................................................................................................................................... 23

3.9.2 Don’t: .................................................................................................................................. 24

3.10 Wiring and System Checkout ...................................................................................................... 24

SECTION 4 PROPER DETECTOR PLACEMENT AND SPACING .................................................... 25

4.1 Where to Place Detectors .......................................................................................................... 25

4.2 Where Not to Place Detectors ................................................................................................... 28

4.3 Detector Spacing ....................................................................................................................... 30

4.3.1 General Spacing Guidelines ................................................................................................. 30

4.3.2 Special Spacing Problems .................................................................................................... 32

4.4 Detectors in Air Handling and Air Conditioning Systems ....................................................... 34

4.5 Detectors in Ceiling Plenum Areas, Including Other Spaces Used for Environmental Air ....... 34

SECTION 5 TESTING AND MAINTENANCE AND SERVICE OF DETECTORS ....................... 35

5.1 General ...................................................................................................................................... 35

5.2 Notification of Authorities ........................................................................................................ 35

© Copyright 2011 by the National Electrical Manufacturers Association
5.3 Typical Inspection, Test, and Maintenance Practices.......................................................... 35
5.4 Maintenance.......................................................................................................................... 35
5.5 Testing.................................................................................................................................. 35

SECTION 6 NUISANCE ALARMS.............................................................................................. 37
6.1 Effects of Location or Environment ....................................................................................... 37
6.1.1 Inspect Detector for Dirt and Review Maintenance............................................................... 37
6.2 Effects of Other Systems on Alarm System Wiring................................................................. 37
6.3 Next Steps.................................................................................................................................. 38
6.4 Maintain an Alarm Log ............................................................................................................. 38

SECTION 7 RESPONSIBILITIES OF DETECTOR OWNERS AND INSTALLERS...................... 40
7.1 Reasons for Nuisance Alarms................................................................................................. 42
7.1.1 Miscellaneous Causes of Nuisance Alarms....................................................................... 43
7.1.2 What to Do About Nuisance Alarms............................................................................... 43
7.2 Where to Get Help if the Source of Nuisance Alarms Can’t be Found ................................... 43
Foreword

Proper Use of Smoke Detectors

Studies have shown that in the United States, an early fire warning and use of smoke detection systems has resulted in a significant reduction in overall fire deaths. The sooner a fire is detected, the better the chances are for the survival of lives in danger, and for the reduction of property damage.

A potential problem with smoke detectors, is unwanted (nuisance) alarms that can result in people being desensitized to the alarm system or, in severe cases, disconnecting the system. This is an industry-wide problem that in most cases is caused by improper application, installation, and/or maintenance of smoke detectors. It is hoped that the information in this guide will be used by those involved with the application, installation, and maintenance of automatic fire alarm systems to minimize these problems.

This Guide for Proper Use of System Smoke Detectors has been published by the National Electrical Manufacturers Association (NEMA) Fire Alarm Group of the Signaling Protection and Communication Section. This is known as 3-SB for the automatic fire detection and alarm industry.

This specific edition of the manual supersedes all prior versions of Guide for Proper Use of System Smoke Detectors.

About National Electrical Manufacturers Association (NEMA)

For more than 80 years, the National Electrical Manufacturers Association has been developing standards for the electrical manufacturing industry and is one of the leading standards development organizations in the world. NEMA contributes to marketplaces and helps ensure public safety.

NEMA has headquarters in Rosslyn, Virginia, just south of Washington, D.C. With about 450 member companies, NEMA’s members include large, medium, and small businesses. The organization’s nine divisions include: Industrial Automation, Lighting Systems, Electronics, Security Imaging and Communications, Building Systems, Insulating Materials, Wire and Cable, Power Equipment, and the Medical Imaging & Technology Alliance. Within these nine divisions are product-specific sections. The Signaling Protection and Communication Section is one such section in the Electronics Division.

About NEMA Signaling Protection and Communication Section (3-SB)

The objective of this 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, inspection, and maintenance.

The section currently represents more than 40 U.S., UK, and Japanese manufacturers in support of the automatic fire detection and alarm industry, and the healthcare communications industry. Fire detection and alarm products include life safety and fire alarm systems, and devices that provide early warning of an impending or actual fire, heat, or gaseous hazard. The products detect, notify, and initiate control functions in case of hazard to lives or property.

For more information on NEMA and the Signaling Section, visit www.nema.org/prod/elec/sig/

This standards publication was developed by the NEMA Signaling Protection and Communication Section. At the time it was approved, the section was composed of the following members:

Air Products and Controls Inc.
Apollo Fire Detectors Ltd.
Bosch Security Systems
BRK Brands Inc./First Alert
Cooper Notification
Edwards A UTC Fire & Security Company
Evax Systems, Inc.
Federal Signal Corporation
Figaro USA, Inc.
Gentex Corporation
Harrington Signal, Inc.
Honeywell Life Safety
Potter Electric Signal Company, LLC
SDi LLC
Siemens Industry, Inc.
SimplexGrinnell LP
Valcom
Xtralis Inc.
Section 1
GENERAL

1.1 SCOPE
This manual is developed by the Signaling Protection and Communication Section. It provides technical information on basic fire alarm systems with a focus on early-warning smoke detection devices. This document covers smoke detectors connected to a control panel.

1.2 PURPOSE
The purpose of this guide is to provide information concerning the proper application of smoke detectors used in conjunction with fire alarm systems. It outlines basic principles, which should be considered in the application of early-warning fire and smoke detection devices. Operating characteristics of detectors and environmental factors may aid, delay, or prevent their operation are presented.

Fire protection engineers, mechanical and electrical engineers, fire service personnel, fire alarm designers and/or installers will find this guide’s contents both educational and informative.

Though this information is based upon industry expertise and many years of experience, it is intended to be used only as a technical guide. The requirements of applicable codes and standards, as well as directives of the Authorities Having Jurisdiction (AHJs), should be followed. Importantly, NFPA 72 for installation of detectors and for testing of systems is a key element for the effectiveness of smoke detection systems.

1.3 STANDARDS THAT APPLY
There are many code writing groups that publish standards for the proper application, installation, and maintenance of automatic smoke detectors. The principal code writing bodies and applicable standards that should be reviewed before specifying or installing automatic smoke detectors are below:

International Code Council
500 New Jersey Avenue, NW
Washington, DC 20001

Local and state building officials are organized into a national code organization, the International Code Council (ICC), which writes model building codes that become law when adopted by local and state governments. These codes also specify smoke detector requirements based on building and occupancy type. Most local and state governments adopt versions of the following model codes:

*International Building Code* (IBC)
*International Fire Code* (IFC)
*International Residential Code* (IRC)

These codes are generally used throughout the United States and parts of Canada.

National Fire Protection Association (NFPA)
1 Batterymarch Park
Quincy, MA 02269