

INSPECTION AND TESTING OF FIRE ALARM SYSTEMS

Introduction

Early warning plays a key role in a health care facility's ability to safely evacuate its residents during a fire emergency. As a result, a lot is riding on your fire alarm system's ability to operate and function properly. So much so, in fact, that state law prohibits the occupancy of any portion of a building until the required fire alarm and detection system has been tested and approved – see MSFC(15), Sec. 901.5.1. Further, MSFC(15), Sec. 901.6 requires that such systems be maintained in an operative condition at all times and be repaired or replaced when defective.

In order to meet both federal certification requirements and state licensure requirements, fire alarm systems are required to be inspected, tested and maintained in accordance with NFPA 72, *National Fire Alarm Code*. For federal certification, NFPA 101(12), Sec. 2.2 references the 2010 edition of NFPA 72. For state licensure, MSFC(15), Sec. 901.6.1, as amended, and Table 901.6.1, also reference the 2010 edition of NFPA 72 (see Chapter 80, *Referenced Standards*).

Note: *In accordance with MSFC(15), Sec. 901.6, nonrequired fire protection systems and equipment must also be inspected, tested and maintained or be removed. A similar requirement can be found in NFPA 101(12), Sec. 4.6.12.3.*

Application

It must be noted that this document is intended to serve as a quick-reference guide only and is **not** intended to be exhaustive. It covers most, but not all, of the inspection, testing and maintenance requirements applicable to fire alarm systems. Some facilities may have additional equipment not covered in this guide. It is important, therefore, that the user have access to, and become familiar with all the requirements found in, NFPA 72. The standard can be ordered from NFPA at 1-800-344-3555 or [NFPA Catalog \(http://catalog.nfpa.org/\)](http://catalog.nfpa.org/).

Definitions

In order to follow the requirements of NFPA 72, it is helpful to have a good understanding of what is meant by “inspection”, “testing” and “maintenance”. While the terms “inspection” and “testing” are not separately defined in the standard, the definitions of “inspection personnel” and “testing personnel” serve as a good indicator of what is meant by the use of the two terms:

- o NFPA 72(10), Sec. 3.3.177.1 defines *inspection personnel* as, “Individuals who conduct a visual examination of a system or portion thereof to verify that it appears to be in operating condition, in proper location, and is free of physical damage or conditions that impair operation.”
- o NFPA 72(10), Sec. 3.3.177.3 defines *testing personnel* as, “Individuals who perform procedures used to determine the status of a system as intended by conducting acceptance, reacceptance, or periodic physical checks on systems.”

NFPA 72(10), Sec. 3.3.140 defines *maintenance* as, “Work including, but not limited to, repair, replacement, and service, performed to ensure that equipment operates properly.”

Personnel qualifications

It is the facility's responsibility to ensure that only properly trained and competent persons perform inspections, testing and maintenance on its fire alarm system [see NFPA 72(10), Sec.10.4.3]. Typically, facility personnel are limited to performing inspection and some basic testing activities only. The amount of testing that can be performed will depend on the level of training received. One of the best sources for such training would be the

fire alarm contractor that performs the facility's annual service. Evidence of any training received will need to be maintained in each employee's personnel file.

System history

A number of requirements applied to a health care facility's fire protection systems are based on the age and date of installation of those systems. Without an accurate written history of the fire protection system(s) in your facility, it can be difficult to prove to a state or federal life safety surveyor that those systems are being maintained in accordance with applicable state and federal standards. This can result in fire/life safety deficiencies being cited. Turnover of administrative and/or maintenance personnel only serves to compound the problem.

Many authorities having jurisdiction (AHJs) require that a "record of completion" form be provided before they will give final approval of the initial installation or subsequent modification of a fire alarm system.

- o NFPA 72(10), Sec. 10.18.2.1.2.5 requires that one copy of the *record of completion* be stored at the fire alarm control unit or other approved location.
- o All system modifications made after the initial installation are expected to be recorded on a revised version of the original *record of completion*, which is expected to be maintained current at all times – see NFPA 72(10), Sections 10.18.2.1.2.6 and 10.18.2.2.
- o If not kept at the main fire alarm control unit, the location of these documents must be identified at the main fire alarm control unit – see NFPA 72(10), Sec. 10.18.2.1.2.7. The enclosure or cabinet in which the documents are stored must be prominently labeled FIRE ALARM DOCUMENTS – see NFPA 72(10), Sec. 10.18.2.1.2.8.

Note: A sample record of completion form is provided in NFPA 72 – see Figure 10.18.2.1.1. An example of a filled out record of completion form can be found in Annex A – see Figure A.10.18.2.1.1.

Unfortunately, not all systems have a record of completion, or the document may have gotten lost over the years. If such is the case at your facility, it is recommended that you create and maintain your own historical record on your system(s). As with just about anything, the hardest part of creating an historical record is getting started – after that, it's a matter of keeping it up-to-date. You should find the fire alarm contractor that provides your annual service to be an excellent source of information about your system. Basic questions that need to be answered include:

- o When was the system initially installed? Who installed it?
- o Were any additions, modifications or repairs made to the system? When? Who did the work?
- o What means of communication is used to transmit a fire alarm signal between your facility and the supervising station (e.g. DACT)?
- o What type of batteries, if any, serve as a secondary power supply for the fire alarm system?

It is important to note that certain changes made to your building could necessitate changes or additions to your fire alarm system. Things to watch for include construction or removal of walls, change in use of an area, installation or removal of fire sprinkler protection, and the installation of egress door locking arrangements.

Specific Requirements

The inspection, testing and maintenance requirements that apply to your building's fire alarm system start from the date of initial installation and continue on at specific intervals throughout the life of the system. What follows is a brief synopsis of some of the major requirements you need to be aware of.

New installations

In order to meet both federal certification requirements and state licensure requirements, fire alarm systems are required to be installed in accordance with NFPA 72 and the requirements of the Minnesota State Fire Code (MSFC) and NFPA 101 applicable to I-2 or healthcare occupancies [see MSFC(15), Sections 907.2 and 1103.7; NFPA 101(12), Sections 18.3.4.1/19.3.4.1 and 9.6.1.3]. All newly installed systems are required to be acceptance tested in accordance with the requirements of Chapter 14 of NFPA 72(10). MSFC(15), Sec. 901.5 requires that the fire code official be notified prior to such testing.

Notifications

In order to avoid unnecessary occupant response and potential injury to emergency response personnel, it is very important that all affected parties be notified **prior to** any scheduled testing of the fire alarm system [see NFPA 72(10), Sec. 14.2.3.1]. Those notified should include, but not be limited to, building occupants (e.g. visitors, staff and patients/residents) and the monitoring company or agency.

System modifications

1. Reacceptance testing is required after any of the following occur [see NFPA 72(10), Sec. 14.4.1.2]:
 - o Addition or deletion of system components
 - o Any modification, repair or adjustment to system hardware or wiring
 - o Any change to site-specific software
2. Again, MSFC(15), Sec. 901.5 requires that the fire code official be notified prior to such testing.
3. The extent of testing necessary is determined as follows – see NFPA 72(10), Sec. 14.4.1.2:
 - o When an initiating device, notification appliance or control relay is added, it must be functionally tested.
 - o When an initiating device, notification appliance or control relay is deleted, another device, appliance or control relay on the circuit must be operated.
 - o When modifications to control equipment hardware are made, the control equipment must be tested in accordance with Table 14.4.2.2, items 1(a) and 1(d).
 - o When changes are made to site-specific software, all functions known to be affected by the change, or identified by a means that indicates changes, must be 100 percent tested. In addition, 10 percent of initiating devices that are not directly affected, up to a maximum of 50 devices, must also be tested and proper operation verified.
 - o Whenever there are changes to control units connected or controlled by the system executive software, a 10 percent functional test of the system is required, including a test of at least one device on each input and output circuit to verify critical system functions such as notification appliances, control functions and off-premises reporting.

Semiannually

1. Certain fire alarm system components need to be visually inspected semiannually [see NFPA 72(10), Table 14.3.1]. These visual inspections can be performed by facility staff and include:
 - a. Control unit trouble signals – verify that they are readily visible
 - b. Remote annunciators – verify that they are in proper operating condition and free of damage
 - c. Initiating devices (e.g. duct detectors, manual fire alarm boxes, heat detectors, smoke detectors, etc.) – verify that they are in place, unobstructed and free of damage.
 - d. Notification appliances – verify that they are unobstructed and free of damage
 - e. Magnetic hold-open devices – verify that they are free of damage and function properly
2. A visual inspection of fire alarm interconnect switches on kitchen hood extinguishing systems is also required.

3. As an alternate means of compliance, components and systems are allowed to be inspected under a performance-based program, subject to the approval of the AHJ – see NFPA 72(10), Sec. 14.2.8.
4. Inspection and testing of batteries, smoke detectors (both hard-wired and battery-operated) and equipment used to transmit signals to a supervising station are covered later on in this guide.

Annually

1. The entire system is required to be thoroughly inspected, tested and maintained each year by an approved servicing company in accordance with Chapter 14 of NFPA 72 [see NFPA 72(10), Tables 14.3.1 and 14.4.5; see also: NFPA 90A(12), Sec. 6.4.1]. Testing must include control equipment, remote annunciators, initiating devices, HVAC shutdown devices and alarm notification appliances.
2. Fire alarm interconnect switches on kitchen hood extinguishing systems are also required to be tested annually.
3. Inspection, testing and maintenance of batteries, smoke detectors (both system-connected and battery-operated) and equipment used to transmit signals to a supervising station are covered later on in this guide.
 - o **Note:** Depending on the size of your building, the annual check of the fire alarm system can take anywhere from a few hours, a day, a week, or even longer. If the process takes longer than 4 hours in a 24-hour period, this oftentimes leads to questions about whether the system should be considered “out of service” as far as application of NFPA 101(12), Sec. 9.6.1.6 (i.e. evacuation of building or implementation of a fire watch).
 - o A fire alarm or fire/smoke detection system is typically not considered to be out of service or impaired during scheduled and controlled events involving testing of such systems (e.g. “walk test” or “alarm bypass”) so long as a properly trained person is present at the main fire alarm control panel for the full duration of the test that can immediately restore the system to proper operation on receipt of a signal at the panel from an initiating device other than the specific device being tested and the person at the panel and the person conducting the actual testing are in constant communication with each other (e.g. via 2-way radio or cell phone). Under these circumstances, the person at the panel and the person conducting the testing are, in effect, the “fire watch”. It must be noted, however, that this is a judgment call on the part of the AHJ.
 - o This method of testing is supported by an Annex note to NFPA 72(10), Sec. 14.4.2 – see NFPA 72(10), Sec. A.14.4.2:
 - o “Fire alarm system testing can be conducted using silent testing and the bypassing of emergency control functions. All input signals should be verified according to the system matrix of operation to ensure they create the appropriate outputs. Tests of audible notification appliances and emergency control functions should be conducted at the conclusion of satisfactory tests of all inputs.
 - o The intent is to reduce the amount of time spent causing audible and visible occupant notification during tests in an occupied building. This reduction will help reduce the negative (cry wolf) impact on occupants caused by excessive operation of notification appliances. System print-outs or history logs are an effective way of verifying the correct receipt of signals. However, many inputs such as occupant notification and emergency control functions are tested for correct operation, because logs do not necessarily verify operation of the system output. Operation of audible and visible notification appliances could be accomplished in a lump sum fashion after all inputs are proven correct by silent testing. All inputs tested in this manner must be proved to cause the appropriate signal by verifying alarm receipt at the controls as each device is actuated. Manufacturer-specific protocols such as “walk test” or

“alarm bypass” are an acceptable means of testing under this section. Other methods of mitigating the negative impact include off-hours tests when the building is not occupied.”

- o *As a reminder, it must be pointed out that Annex A is not part of the requirements of NFPA 72. It is included for informational purposes and provides guidance on the application and intent of the standard, so it must be noted that how and when this information might be used is a judgment call on the part of the AHJ.*

Long term

1. Nonrestorable fixed-temperature, spot-type heat detectors are required to be replaced after 15 years from initial installation [see NFPA 72(10), Table 14.4.2.2, Item 14.d.3]. As an alternate, 2 detectors per 100 must be laboratory tested (the two detectors must be replaced with new devices). If these detectors fail when tested, additional detectors must be tested to determine if the problem is a general or localized one.
 - o If detectors are tested instead of replaced, tests must be repeated at 5-year intervals.
2. For restorable fixed-temperature, spot-type heat detectors, 2 or more detectors must be tested on each initiating circuit annually [see NFPA 72(10), Sec. 14.4.5.5]. Different detectors must be tested each year, with records kept specifying which detectors were tested. Within 5 years, each detector must have been tested.

Specific Requirements (continued)

Batteries

1. Batteries serving as a secondary power supply for fire alarm systems must be *visually inspected* at the following intervals to verify that they are free of damage* [see NFPA 72(10), Table 14.3.1, Item 3]:
 - a. Lead-acid and primary (Dry Cell) batteries – monthly
 - b. Nickel-Cadmium and sealed lead-acid batteries – semiannually
(*You'll also want to: check electrolyte (fluid) levels and tightness of connections; check for corrosion or leakage; and, if necessary, clean the terminals.)
2. Batteries serving as a secondary power supply for fire alarm systems must be *tested* semiannually, to include [see NFPA 72(10), Table 14.4.5, Item 6]:
 - a. Load voltage tests on lead-acid, Nickel-Cadmium and sealed lead-acid type batteries
 - o Monthly load voltage tests, conducted in accordance with NFPA 72(10), Table 14.4.2.2, Item 6(a), are required on primary (Dry Cell) batteries
 - b. 30-minute discharge tests on lead-acid type batteries
 - c. Testing of specific gravity on lead-acid type batteries
3. An annual discharge test Nickel-Cadmium and sealed lead-acid type batteries.
4. An annual charger test, conducted in accordance with NFPA 72(10), Table 14.4.2.2, Items 6(b)1, 6(c)1 and 6(d)1, is required for lead-acid, Nickel-Cadmium and sealed lead-acid type batteries (this involves the use of a voltmeter or ampere meter).
 - o Batteries must be replaced as needed, but typically last 3 years or more. Sealed lead-acid type batteries, however, are required to be replaced every 4 years.

Smoke detectors

1. Battery-operated smoke alarms

Some facilities have had battery-operated smoke alarms installed in sleeping rooms to meet past federal certification requirements of the 2000 *Life Safety Code*® and/or 42 CFR Part 483.70(a)(7)(ii) – requirements that apply to buildings that are either unsprinklered or only partially sprinklered. Similar requirements

appear in NFPA 101(12), Sections 19.7.5.3 and 19.7.5.5, but again, only apply to buildings that are either unsprinklered or only partially sprinklered. In some cases, smoke alarms have been installed voluntarily or as an alternate method of meeting other local, state and/or federal code requirements. Hospitals are expected to have smoke alarms in staff on-call rooms to meet the requirements of NFPA 101(12), Sec. 26.3.4.5.1.

Whatever the reason for their installation, these smoke alarms must be tested and maintained in accordance with manufacturer's instructions (as mentioned earlier in this guide, nonrequired alarms may be removed in lieu of being tested and maintained). This means that:

- o Smoke alarms must be tested on a weekly or monthly basis as specified.
- o Smoke alarms must be cleaned monthly in accordance with manufacturer's instructions [NOTE: Some manufacturers may recommend less frequent cleaning intervals].
- o Batteries must be replaced annually or semiannually as specified by the manufacturer.
- o Smoke alarms must be sensitivity tested as required for smoke detectors (see next page).

2. *Hard-wired detectors*

- a. Hard-wired (including low voltage) automatic smoke detectors, including duct smoke detectors, must be visually inspected semiannually [see NFPA 72(10), Sec. 14.3.1 and Table 14.3.1, Items 9(b) and 9(h)].
 - o As an alternate means of compliance, components and systems are allowed to be inspected under a performance-based program, subject to the approval of the AHJ – see NFPA 72(10), Sec. 14.2.8.
- b. Hard-wired (including low voltage) smoke detectors must be sensitivity tested in accordance with NFPA 72(10), Sec. 14.4.5.3.
 - o Detector sensitivity must be checked within 1 year after installation and every other year thereafter.
 - o Detectors found to have a sensitivity outside their listed and marked sensitivity range must be cleaned and recalibrated or be replaced.
 - o If, after the second test, detectors are found to have remained within their listed and marked sensitivity range (or 4 percent obscuration light gray smoke, if not marked), the length of time between sensitivity tests may be extended to a maximum of 5 years. *It must be noted, however, that if the frequency is extended, records of nuisance alarms and the trends of these alarms must be maintained. In zones or areas where nuisance alarms show an increase over the previous year, sensitivity tests must be performed.*
- c. Detector (or smoke alarm) sensitivity is not allowed to be tested or measured using any device that administers an unmeasured concentration of smoke or other aerosol into the detector (or smoke alarm).
- d. Something to keep in mind about detector testing: Smoke entry tests are required for functional and sensitivity testing of smoke detectors. Magnet tests do **not** replace smoke entry tests.

Alarm transmission equipment

An introduction

NFPA 101(12), Sec. 18.3.4.3.2.1/19.3.4.3.2.1 requires automatic fire department notification on activation of the building fire alarm system. This is typically accomplished by contracting with a company or agency that provides what's called a central supervising station service. On receipt of a fire alarm signal from your facility, operators at the supervising station turn around and retransmit the signal to the local 9-1-1 communications center. In some locations, the local 9-1-1 communications center will accept fire alarm signals directly (this is called remote supervising station service).

The means of communication between your facility and the supervising station is required to be inspected and tested to ensure its reliability. The kind of testing required is based on the method of communication employed. NFPA 72 allows the use of a number of transmission technologies. The method of communication most

commonly employed at health care facilities is the Digital Alarm Communicator Transmitter (DACT) – also called an automatic dialer. For that reason, this guide will not address the other transmission technologies except to say that:

- o Information about them can be found in NFPA 72(10), Chapter 26, and
- o Inspection and test intervals for other transmission technologies are outlined in NFPA 72(10), Table 14.3.1, Item 15 and Table 14.4.5, Item 22.

The DACT is a component at the facility that, upon receipt of a signal from the fire alarm control panel, seizes a connected telephone line, dials one of two pre-selected numbers to connect to the supervising station and transmits the necessary alarm, trouble or supervisory signal. One of the easiest ways to tell if you have a DACT is to check the communicator to see how many outgoing connections it has – a DACT requires two paths for transmitting fire alarm signal information.

Note: NFPA 72(10), Sec. 26.6.3.2.1.1 only allows a DACT to be connected to a loop start telephone circuit and not to a ground start telephone circuit. Such circuits employ copper lines that allow the local phone company to provide back-up power in case of a failure of the public utility power. The use of fiber-optic cable is, however, becoming more and more common. *A DACT cannot use fiber-optic cable and be code-compliant – in other words, if your facility's phone system employs fiber-optic cable only, a different transmission technology will need to be used to communicate with the supervising station.* For more information about DACTs, see NFPA 72(10), Sec. 26.6.3.2.

Inspection and Testing

DACTs are required to be visually inspected semiannually to verify that they are free of obvious damage and tested annually [see NFPA 72(10), Table 14.3.1, Item 15(a) and Table 14.4.5, Item 22]. DACT testing requirements are detailed in NFPA 72(10), Table 14.4.2.2, Item 18(b) and include:

- Testing for line seizure capability
- Disconnect of the primary line from the DACT to confirm a trouble signal on-site and transmission of a trouble signal to the supervising station within 4 minutes
- Disconnect of the secondary line (as above)
- Simulation of a fault in the primary telephone number

Documentation Requirements

Almost as important as conducting required inspections, testing and maintenance is documenting the fact that they occurred. NFPA 72(10), Sec. 14.6.2.4 requires that a record be kept of all inspections, testing and maintenance performed on a fire alarm system. What follows is a brief synopsis of some of the major documentation requirements you need to be aware of.

Initial Installation Records

As mentioned earlier, MSFC(15), Sec. 901.5.1 makes it unlawful to occupy any portion of a building until the required fire alarm and detection system has been tested and approved. Before approving and accepting a fire alarm system, the AHJ will want written proof that operational acceptance tests have been completed. Information about a *record of completion* can be found on page 2 of this guide.

The installing contractor is required, at a minimum, to provide you with the following [see NFPA 72(10), Sec. 10.18.2.3; MSFC(15), Sec. 901.6.2.1]:

1. Name of installation contractor
2. Record of Completion
3. Owner's manual and manufacturer's instructions covering all system equipment. This should include:
 - a. A detailed narrative description of the system

- b. Operator instructions for basic system operations
 - c. A detailed description of routine maintenance and testing as required and recommended, including:
 - Listing of the individual system components that require periodic testing and maintenance
 - Step-by-step instructions detailing the requisite testing and maintenance procedures, and the intervals at which these procedures need to be performed, for each type of device installed
 - A testing and maintenance schedule
 - d. Detailed troubleshooting instructions
 - e. A service directory that includes a list of the names and telephone numbers of those who provide service for the system
4. Record drawings

Inventories

In order to ensure that all system components are inspected and tested as required, you need to know where they are...and you may be asked to prove that at time of survey. One way to do this is to have an inventory of all initiating devices (e.g. smoke detectors, heat detectors, manual pull stations) and notification appliances connected to the building fire alarm system. It is possible that you may be asked for your inventory at time of survey – or – a surveyor may pick out a specific device and ask for documentation showing when it was last tested.

Semiannual/annual records

You should have logs on which to record the required semi-annual inspections and the inspection and testing of the system batteries.

A sample *annual inspection and testing form* can be found in NFPA 72 – see NFPA 72(10), Figure 14.6.2.4. An example of a filled out inspection and testing form can be found in Annex A – see Figure A.14.6.2.4. This form used to be 4 pages in length, but now consists of 11 pages. While some fire alarm companies simply photocopy this sample for use in documenting their annual visits, many others will create their own forms. That's okay as far as NFPA 72 is concerned, so long as all the applicable information requested in Figure 14.6.2.4 is included in their form.

A word of caution would be in order here. Use of a form that does not include ALL of the information requested in Figure 14.6.2.4 and/or failure to completely fill out all portions of the form (including marking non-applicable portions "N/A" in some fashion) could very likely result in the issuance of a fire alarm testing/maintenance deficiency at time of survey.

Smoke detector sensitivity testing

Sensitivity tests must be properly documented to include detector location, the listed sensitivity range of the detector, tested sensitivity range, pass/fail, date of test, and name of person performing the testing.

Battery-operated smoke detectors – testing/maintenance

Documentation must be provided to show that battery-operated smoke detectors are being tested and maintained in accordance with the manufacturer's instructions. This documentation should include:

- o A copy of the manufacturer's instructions that accompanied the detectors at time of purchase, and
- o A log showing the tests and maintenance performed in accordance with those instructions.

It is important that at least two people in your facility know where your records are kept to help ensure that they can be readily provided when requested during an inspection. MSFC(15), Sec. 901.6.2 requires that these records be maintained on the premises for at least three years (longer if smoke detector sensitivity testing is extended out to 5-year intervals) and must be copied for the fire code official upon request.