Second Revision No. 5148-NFPA 72-2020 [Global Comment]

[Insert new Annex I using Word file attached.]

Annex I Color-Coded Tagging Program

Supplemental Information

File Name	Description	Approved
PC_9_-_ANNEX_I_RJR.docx	New Annex I. Renumber present Annex I to be Annex J. Annex I Color-Coded Tagging Program - for staff use	
72_SIG_TMS_Global_SR-5148_Annex_I.pdf	for balloting	

Submitter Information Verification

Committee: SIG-TMS

Submittal Date: Wed Jul 08 21:38:07 EDT 2020

Committee Statement

Committee Statement: The Technical Committee creates and promotes a fire alarm system tagging process so AHJs, owners, and service providers see the last known condition of the system as well as recent service activity. Knowing a system's condition, service history, and service provider information can be valuable during an emergency or periodic reviews and a tagging process provides this.

Response Message: SR-5148-NFPA 72-2020

Public Comment No. 9-NFPA 72-2020 [New Section after 14.6.4]

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[Global SR-5148]

Annex I Color-Coded Tagging Program

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

To assist with the enforcement and application of NFPA 72, some authorities having jurisdiction (AHJs) adopt color-coded system status tagging programs. The purpose of these programs varies, but the typical goal is to provide a readily accessible means of determining the status of a system following its most current inspection or test.

While NFPA 72 does not mandate system status tagging, it is desirable that a certain level of consistency exist between programs. With that in mind, AHJs using a color-coded system status tagging program should consider the tagging information provided in this annex.

I.1 Fire Alarm System Installation, Maintenance, and Service Tagging.

After successful completion of acceptance testing approved by the AHJ or periodic inspection or testing, the recommendations in I.1.1 through I.1.5 should apply to fire alarm systems, except household fire alarm systems installed in accordance with Chapter 29.

I.1.1 Installation Tagging.

I.1.1.1

After the completion of an installation of new fire alarm equipment or a new system, or the extension, alteration, or modification to a fire alarm system already in place, an installation label should be affixed to the inside of the control unit cover. The tag should not cover or conceal installation or wiring instructions, testing laboratory listings, or control unit displays. If the system has no control unit, the tag should be placed in a permanent location.

I.1.1.2

The installation tag should be in accordance with the following recommendations:

(1) Installation tags should be white with black lettering.

(2) Installation tags should be approximately 3 in. (70 mm) high and approximately 3 in. (70 mm) wide and should have an adhesive on the back.

(3) Installation tags should contain the following information:

(a) DO NOT REMOVE BY ORDER OF THE AUTHORITY HAVING JURISDICTION (all capital letters in at least 10-point boldface type)

(b) INSTALLATION RECORD (all capital letters in at least 10-point boldface type)

(c) The registered firm's name, address, and telephone number and the certification number of the firm performing the installation

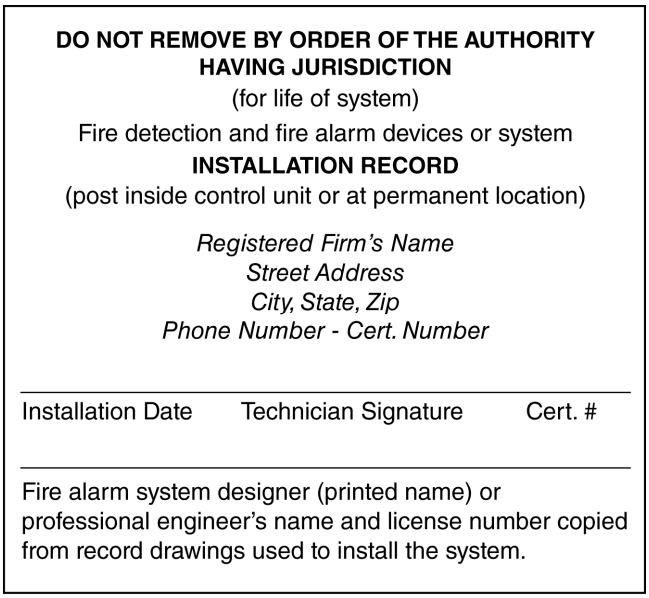
(d) The installation date, the technician’s signature (a stamped signature is not recommended to be permitted) and certification number

(e) The name and certification number (if applicable) of the fire alarm system designer who designed the system

An example of an installation tag is shown in Figure I.1.1.2.

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Figure I.1.1.2 Installation Tag Example.



Color: Black text on white background.

I.1.2 Service Tagging.

I.1.2.1

After any service, to certify that the service performed complies with requirements of this code, a fire alarm service tag should be completed in detail and affixed to the inside or outside of the control unit cover. The tag should not cover or conceal installation or wiring instructions, testing laboratory listings, or control unit displays. If the system has no control unit, the tag should be placed in a permanent location.

I.1.2.2

The service tag should be in accordance with the following recommendations:

(1) The service tag should be white in color with printed black lettering.

(2) The service tag should be approximately 3 in. (70 mm) high and 3 in. (70 mm) wide and should have an adhesive on the back that allows for tag removal.

(3) Approximately ½ in. (13 mm) of the adhesive on the top back of the tag should be used to attach the tag over the previous service tag to permit viewing of the previous tag and the maintaining of a brief history.

(4) Service tags should contain the following information:

(a) DO NOT REMOVE BY ORDER OF THE AUTHORITY HAVING JURISDICTION (all capital letters in at least 10-point boldface type)

(b) SERVICE RECORD (all capital letters in at least 10-point boldface type)

(c) The registered firm's name, address, and telephone number and the license number of the firm performing the service

(d) The date of service performed, the technician's signature (a stamped signature is not recommended to be permitted) and certification number

(e) A list of services performed

(f) The type of service performed, either general service or the correction of conditions that resulted in a red tag or yellow tag

An example of an installation tag is shown in Figure I.1.2.2.

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Figure I.1.2.2 Service Tag Example.



Color: Black text on white background.

I.1.2.3

If the service performed corrects all conditions noted on a yellow tag or red tag, the color and date of the tag should be marked on the service tag and the respective yellow tag or red tag removed in accordance with I.1.4.4 or I.1.5.4.

I.1.2.4

If, during any service, deficiencies are noted, the system is inoperable, has a fault condition, or is impaired from normal operation, both of the following should apply:

(1) The system owner or the owner's designated representative and the local AHJ should be notified of the condition.

(2) The servicing personnel should attach, in addition to the service tag, the appropriate yellow tag or red tag, following the procedures in I.1.4 or I.1.5.

I.1.2.5

Service tags should remain in place for a period of 2 years from the date of service.

I.1.3 Inspection and Testing Tagging.

I.1.3.1

After the inspection and testing of a fire alarm system, a fire alarm inspection and testing tag should be completed in detail and affixed to either the inside or outside of the control unit cover. The tag should not cover or conceal installation or wiring instructions, testing laboratory listings, or control unit displays. If the system has no control unit, the tag should be placed in a permanent location.

I.1.3.2

The inspection and testing tag should be in accordance with the following recommendations:

(1) The inspection and testing tag should be blue with printed black lettering.

(2) The inspection and testing tag should be approximately 3 in. (70 mm) high and 3 in. (70 mm) wide and should have an adhesive on the back that allows for tag removal.

(3) Approximately a 1/2 in. (13 mm) of the adhesive on the top back of the tag should be used to attach the tag over the previous inspection and testing tag to permit viewing of the previous tag and the maintaining of a brief history.

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(4) Inspection and testing tags should contain the following information:

(a) DO NOT REMOVE BY ORDER OF THE AUTHORITY HAVING JURISDICTION (all capital letters in at least 10-point boldface type)

(b) INSPECTION AND TESTING RECORD (all capital letters in at least 10-point boldface type)

(c) The registered firm's name, address, and telephone number and the license number of the firm performing the inspection and testing

(d) The date of the inspection and testing performed, the technician's signature (a stamped signature is not recommended to be permitted) and certification number

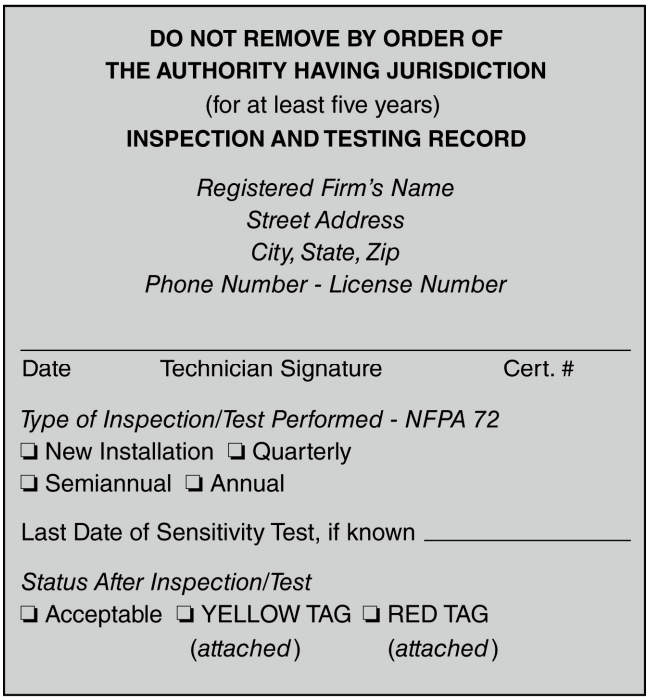
(e) The type of inspection and testing performed to be marked as new installation, semi-annual, quarterly, or annual

(f) The last date of sensitivity test, if known

(g) The status after the inspection and testing if acceptable or, if yellow tag attached or if red tag attached

An example of an inspection and testing tag is shown in Figure I.1.3.2.

Figure I.1.3.2 Inspection and Testing Tag Example.



Color: Black text on blue background.

I.1.3.3

If any service is performed during the inspection and testing, a service tag, in addition to the inspection and testing tag, should be completed and attached according to the procedures of I.1.2.

I.1.3.4

For a new installation, an inspection and testing tag should only be applied after the system has been accepted by the local AHJ.

I.1.3.5

If, during any inspection and testing, deficiencies are noted, the system is inoperable, has a fault condition, or is impaired from normal operation, both of the following should apply:

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(1) The system owner or the owner's designated representative and the AHJ should be notified of the condition.

(2) The inspection and testing personnel should attach, in addition to the inspection and testing tag, the appropriate yellow tag or red tag, in accordance with the procedures of I.1.4 or I.1.5.

I.1.3.6

Inspection and testing tags should remain in place for a period of 3 years from the date of service.

I.1.4 Yellow Tags.

I.1.4.1

If, after any service, inspection, or test, one or more deficiencies are noted by the technician, a completed yellow tag should be attached to the outside of the control unit cover to indicate that corrective action is necessary. The tag should not cover or conceal installation or wiring instructions, testing laboratory listings, or control unit displays. If the system has no control unit, the tag should be placed in a permanent location.

I.1.4.2

The yellow tag should be in accordance with the following recommendations:

(1) Yellow tags should be approximately 3 in. (70 mm) high and 3 in. (70 mm) wide and should have an adhesive on the back that allows for tag removal.

(2) Tags should be yellow with printed black lettering.

(3) Yellow tags should contain the following information:

(a) DO NOT REMOVE BY ORDER OF THE AUTHORITY HAVING JURISDICTION (all capital letters in at least 10-point boldface type)

(b) SYSTEM DEFICIENCY(IES) REQUIRES CORRECTIVE ACTION (all capital letters in at least 10-point boldface type)

(c) The registered firm’s name, address, and telephone number and the license number of the firm attaching the yellow tag

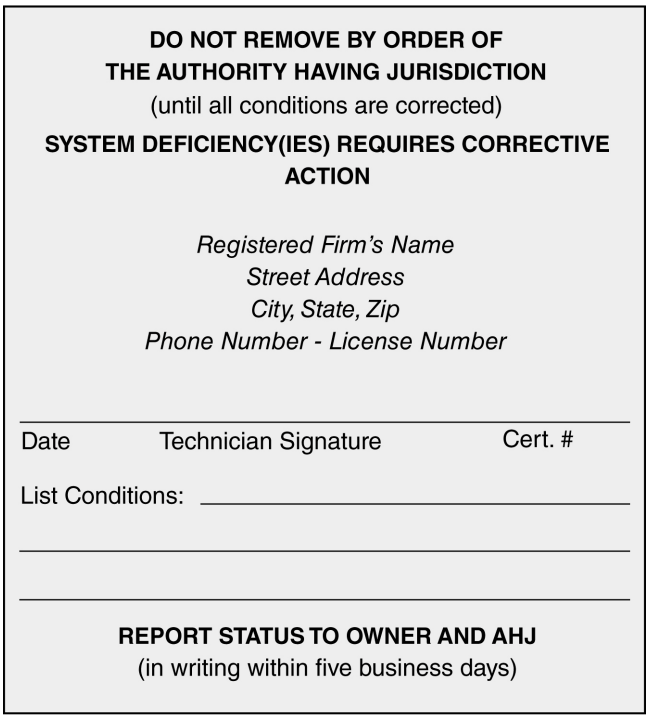
(d) The date the tag was attached, the technician’s signature (a stamped signature is not recommended to be permitted) and certification number

(e) A list of conditions resulting in the yellow tag

An example of a yellow tag is shown in Figure I.1.4.2.

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Figure I.1.4.2 Yellow Tag Example.



Color: Black text on yellow background.

I.1.4.3

After attaching a yellow tag, the inspection, testing, or servicing personnel or their organization should notify the system owner or the owner's designated representative and the AHJ in writing within five business days of the attachment of the yellow tag, indicating the conditions requiring corrective action.

I.1.4.4

Yellow tags should remain in place until the conditions are corrected and a service tag is attached certifying that the corrections were made in accordance with I.1.2.1.

I.1.4.4.1

The yellow tag should be removed only by an inspection, testing, or service personnel qualified in accordance with 10.5.3 or the AHJ.

I.1.4.4.2

The AHJ should be notified in writing within five business days of the removal of the yellow tag.

I.1.5 Red Tags.

I.1.5.1

If, after any service, inspection, or test, a system or any part thereof is inoperable, has a fault condition, or is impaired from normal operation, excluding the area(s) of a building under construction, a completed red tag should be attached to the outside of the control unit cover to indicate the nature of the condition(s) requiring immediate action. The tag should not cover or conceal installation or wiring instructions, testing laboratory listings, or control unit displays. If the system has no control unit, the tag should be placed in a permanent location.

I.1.5.2

The red tag should be in accordance with the following recommendations:

(1) Red tags should be approximately 3 in. (70 mm) high and 3 in. (70 mm) wide and should have an adhesive on the back that allows for tag removal.

(2) Tags should be red with printed black lettering.

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(3) Red tags should contain the following information:

(a) DO NOT REMOVE BY ORDER OF THE AUTHORITY HAVING JURISDICTION (all in capital letters, at least 10-point boldface type)

(b) Status of the system to be marked as inoperable or impaired or fault

(c) The registered firm's name, address, and telephone number and the license number of the firm attaching the red tag

(d) The date the tag was attached, the technician's signature (a stamped signature is not recommended to be permitted) and certification number

(e) List of conditions resulting in the red tag

An example of a red tag is shown in Figure I.1.5.2.

Figure I.1.5.2 Red Tag Example.

DO NOT REMOVE BY ORDER OF
THE AUTHORITY HAVING JURISDICTION
(until all conditions are corrected)

System ❑ INOPERABLE ❑ IMPAIRED ❑ FAULT

Registered Firm's Name
Street Address
City, State, Zip
Phone Number - License Number

Date Technician Signature Cert. #

List Conditions: _____

REPORT INOPERABLE TO OWNER AND AHJ
(orally immediately and in writing within next business day)
REPORT ALL OTHER TO OWNER AND AHJ
(in writing within three business days)

Color: Black text on red background.

I.1.5.3

Immediately after attaching a red tag, the inspection, testing, or service personnel should notify the system owner or the owner's designated representative and the AHJ of all impairments in accordance with the following:

(1) If the system is inoperable, by immediate direct oral communication and in writing within one business day of the attachment of the red tag

(2) If the system has a fault condition or is impaired from normal operation, in writing within three business days of the attachment of the red tag

I.1.5.4

Red tags should remain in place until the conditions are corrected and a service tag is attached certifying that the corrections were made in accordance with I.1.2.1.

I.1.5.4.1

The red tag should be removed only by an inspection, testing, or service personnel qualified in accordance with 10.5.3 or the AHJ.

I.1.5.4.2

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The AHJ should be notified in writing within five business days of the removal of the red tag.

Second Revision No. 5091-NFPA 72-2020 [Detail]

Table 14.3.1:

Change Item 2 from “Control unit:” to "Control ~~unit~~ equipment:"

Submitter Information Verification

Committee: SIG-TMS

Submittal Date: Wed Jun 24 22:27:18 EDT 2020

Committee Statement

Committee Statement: The Technical Committee edits the text to be consistent with the definition of control equipment and the use of the term in Table 14.3.1 Item 30.

Response Message: SR-5091-NFPA 72-2020

Public Comment No. 227-NFPA 72-2020 [Section No. 14.3.1]

Second Revision No. 5092-NFPA 72-2020 [Detail]

Table 14.3.1:

16.	~~Fiber-optic~~ Optical fiber cable connections

Submitter Information Verification

Committee: SIG-TMS
Submittal Date: Wed Jun 24 22:35:40 EDT 2020

Committee Statement

Committee Statement: The Technical Committee edits the text in Table 14.3.1. for item 16. Change “Fiber-optic” to “Optical fiber” for consistency.

Response Message: SR-5092-NFPA 72-2020

Public Comment No. 87-NFPA 72-2020 [Section No. 14.3.1]

Second Revision No. 5093-NFPA 72-2020 [Detail]

Table 14.4.3.2, Item 22, 1st para:

For initial and reacceptance testing, measure sound pressure levels for alert tone signals and evacuation signal tones with a sound level meter meeting ANSI/ASA~~S1.4a~~S1.4/Part 1, *Electroacoustics — Sound Level Meters — Part 1: Specifications ~~for Sound Level Meters,~~* Type 2 requirements. Measure sound pressure levels to determine if they are in compliance with Chapter 18 and the required performance, as documented per 7.3.4. Set the sound level meter in accordance with ANSI/ASA S3.41, *Audible Emergency Evacuation (E2) and Evacuation Signals with Relocation Instructions (ESRI),* using the time-weighted characteristic F (FAST).

Supplemental Information

File Name	Description Approved
Table_14.4.3.2_Detail_Changes.docx	for prod use

Submitter Information Verification

Committee: SIG-TMS

Submittal Date: Wed Jun 24 22:42:26 EDT 2020

Committee Statement

Committee Statement: The Technical Committee adds evacuation signal tones to Table 14.4.3.2 Item 22 for correlation with the requirements of Chapter 18.

Response Message: SR-5093-NFPA 72-2020

Public Comment No. 120-NFPA 72-2020 [Section No. 14.4.3.2]

Second Revision No. 5094-NFPA 72-2020 [Detail]

Table 14.4.3.2:

17.	Initiating devices[i]
(8) ~~Single-criteria smoke~~ Smoke detectors — sensitivity testing	

Submitter Information Verification

Committee: SIG-TMS

Submittal Date: Wed Jun 24 22:45:58 EDT 2020

Committee Statement

Committee Statement: The Technical Committee revises the text as there is no reason to limit this to only a single criteria detector. There are Multi-Criteria smoke detectors that can meet one of the five tests for verifying sensitivity.

Response Message: SR-5094-NFPA 72-2020

Public Comment No. 201-NFPA 72-2020 [Section No. 14.4.3.2]

Second Revision No. 5097-NFPA 72-2020 [Detail]

Change Energy Storage Systems (ESS) in Table 14.4.3.2 Item 7 to EPSS/SEPSS as shown below:

7. ~~Energy storage systems (ESS)~~ Emergency power supply systems/stored-emergency power supply system (EPSS/SEPSS)

If an ~~ESS system~~EPSS/SEPSS dedicated to the system is used as a required power source, verify by the building owner operation of the ~~ESS system~~EPSS/SEPSS in accordance with NFPA 111.

Submitter Information Verification

Committee: SIG-TMS
Submittal Date: Fri Jun 26 07:39:02 EDT 2020

Committee Statement

Committee Statement: The Technical Committee edits the text as EPSS/SEPSS is the correct term.
Response Message: SR-5097-NFPA 72-2020

Public Comment No. 231-NFPA 72-2020 [Section No. 14.4.3.2]

Second Revision No. 5098-NFPA 72-2020 [Detail]

Table 14.4.3.2

29. Low-power radio (wireless systems)

(1) Use the manufacturer's published instructions and the as-built drawings provided by the system supplier to verify correct operation after the initial testing phase has been performed by the supplier or by the supplier's designated representative.

(2) Starting from the functional operating condition, initialize the system in accordance with the manufacturer's published instructions~~.~~ , including the following: ~~Confirm the alternative communications path exists between the wireless control unit and peripheral devices used to establish initiation, indication, control, and annunciation. Test the system for both alarm and trouble conditions.~~

(a) Confirm the alternative communications path exists between the wireless control unit and peripheral devices used to establish initiation, indication, control, and annunciation. Test the system for both alarm and trouble conditions.

(b) For initial and reacceptance testing, confirm the introduction of a fault in any Class A or B radio - frequency - specified pathway results in a trouble indication at fire alarm control unit. Disconnect the power (i.e., remove primary batteries) from a radio transceiver initiating device, notification appliance , or controlled device and confirm the pathway performs as indicted in 23.16.4.8 and 23.16.4.9.

Restore the system to normal and repeat the fault on not less tha n 10 percent of the radio frequency initiating devices , notification appliances, and controlled devices on every initiating device circuit radio pathway, notification appliance circuit radio pathway , and signaling line circuit radio pathway. Confirm all radio pathways perform as indicated in 23.16.4.8 and 23.16.4.9.

(c) For periodic testing, test each C lass A and B radio frequency initiating device circuit radio pathway, notification appliance circuit radio pathway , and signaling line circuit radio pathway for correct indication at the control unit. Confirm all radio pathways perform as indicated in 23.16.4.8 and 23.16.4.9.

(3) Check batteries for all components in the system monthly unless the control unit checks all batteries and all components daily.

Submitter Information Verification

Committee: SIG-TMS
Submittal Date: Fri Jun 26 08:36:41 EDT 2020

Committee Statement

Committee Statement: The Technical Committee accepts the submitter's text. FR 5072 added operation requirements for Class A and B radio pathways. The TC adds corresponding requirements to Chapter 14 - Inspection, Testing and Maintenance.

Response Message: SR-5098-NFPA 72-2020

Public Comment No. 295-NFPA 72-2020 [Section No. 14.4.3.2]

Second Revision No. 5099-NFPA 72-2020 [Detail]

Table 14.4.3.2, Item 16:

Change ~~Conductors nonmetallic~~ to Nonmetallic pathways

Change (1) ~~Fiber optics~~ to Optical fiber cables

Change Test the ~~fiber optic transmission line~~ transmission characteristics of optical fibers by the use of an optical power meter or by an …

Submitter Information Verification

Committee: SIG-TMS

Submittal Date: Fri Jun 26 08:41:11 EDT 2020

Committee Statement

Committee Statement: The Technical Committee edits the text relative to fiber optic for consistency throughout the Code and other NFPA documents. The TC changes Conductors nonmetallic to Nonmetallic pathways.

Response Message: SR-5099-NFPA 72-2020

Public Comment No. 88-NFPA 72-2020 [Section No. 14.4.3.2]

Second Revision No. 5114-NFPA 72-2020 [Detail]

Table 14.4.3.2, footnote d:

[d]The battery tests in Table 14.4.3.2, Item 9, are based on VRLA batteries and it is the intent that the tests specified in (1) through (4) be performed in order. FACU automated load testing of VRLA batteries ~~under load with record of enclosure~~ in accordance with Table 14.4.3.2, Item 9(5), with record of ambient temperature is an acceptable alternative to prescriptive manual methods using test equipment. For other secondary battery types, refer to the battery manufacturer's published instructions or IEEE 450, *Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications*, for vented lead-acid batteries, and IEEE 1106, *Recommended Practice for Installation, Maintenance, Testing, and Replacement of Vented Nickel-Cadmium Batteries for Stationary Applications*, for nickel-cadmium batteries.

Submitter Information Verification

Committee: SIG-TMS

Submittal Date: Wed Jul 01 22:06:08 EDT 2020

Committee Statement

Committee Statement: The Technical Committee edits the text to ensure automated testing meets the fundamental requirements of Table 14.4.3.2 Item 9.(5).

Response Message: SR-5114-NFPA 72-2020

Public Comment No. 157-NFPA 72-2020 [Section No. 14.4.3.2]

Second Revision No. 5070-NFPA 72-2020 [Section No. 14.2.2.2]

14.2.2.2 Impairments.

Where an automatic function of a fire alarm or signaling system is taken out of service for ~~performance~~ testing ~~in accordance with Table 14.4.3.2~~ and a manual means or other compensatory measures are unavailable, the system or portion thereof ~~shall be impaired in accordance~~ is impaired and shall comply with the requirements of Section 10.21 until the automatic function is restored.

Submitter Information Verification

Committee: SIG-TMS

Submittal Date: Tue Jun 23 12:03:59 EDT 2020

Committee Statement

Committee Statement: The Technical Committee revises the text as submitted. This comment removes unnecessary wording to make it easier to read and also clarifies that it is the corrective actions that are in accordance with 10.22 and not the impairment.

Response Message: SR-5070-NFPA 72-2020

Public Comment No. 197-NFPA 72-2020 [Section No. 14.2.2.2]

Public Comment No. 226-NFPA 72-2020 [Section No. 14.2.2.2]

Second Revision No. 5071-NFPA 72-2020 [Section No. A.14.2.1.1]

A.14.2.1.1

Initial and re-acceptance inspections are performed to ensure compliance with approved design documents whatever the quality or origin. This involves inspection to ensure that the correct equipment has been used and properly located and installed. Ensuring compliance helps to assure both operational reliability and mission reliability. This concept applies to any type of system, not just fire alarm ~~and~~ or signaling systems. At this stage of a system's life, the responsibilities for such inspections rest with the designers of the systems and with the various applicable authorities having jurisdiction.

Submitter Information Verification

Committee: SIG-TMS

Submittal Date: Tue Jun 23 12:09:01 EDT 2020

Committee Statement

Committee Statement: The Technical Committee revises this section by replacing "and" with "or" with respect to fire alarm/signaling systems as this is appropriate given the context and new definition of signaling systems.

Response Message: SR-5071-NFPA 72-2020

Public Comment No. 340-NFPA 72-2020 [Section No. A.14.2.1.1]

Second Revision No. 5115-NFPA 72-2020 [Section No. A.14.4.3.2]

A.14.4.3.2

Table 14.4.3.2 Item 9(4). Ohmic testing is a means to determine the state of health of a VRLA battery's cells by measuring some form of a cell's internal resistance. Typically, ohmic testing equipment uses one of three techniques — conductance, impedance, or resistance — to make these measurements.

In simplest technical terms, ohmic technology is based on Ohm's law, which expresses the relationship between volts, amperes, and ohms in an electrical circuit. Ohmic testing attempts to use voltage and current to determine the resistive characteristic of a battery's cells. As the cells in a battery age and start to lose capacity, the internal components of the battery are undergoing a degradation process. The degradation of these components (plates, grids, internal connection straps) within the battery's cells causes an increased resistance in the conduction paths of the cell, which in turn causes a change in the internal ohmic values. A measured increase in impedance or resistance, or a decrease in conductance, indicates the battery is losing its ability to produce the energy it was designed to deliver when called upon to support the connected loads.

The key to effective application of ohmic testing is the appropriate trending of test results over time compared to a baseline or reference value. Studies have demonstrated that an individual battery produces a unique ohmic "signature" and the use of ohmic testing equipment to trend changes in this signature from installation through the life of the battery is the most effective use of the technology. A program that involves ohmic testing on a regular interval to note changes in the battery is a good maintenance practice.

An ohmic baseline reference value is a benchmark value based on data collected from known good batteries. Reference values can be determined from site-specific measurement, or from testing a sample of new healthy batteries, or by using a generic baseline value to get started.

(1) The best baseline is one established on the installed battery within three to six months after installation and trend accordingly using good record keeping. Ideally the individual ohmic value should be measured at installation and again after the battery has been on float charge for at least 72 hours in order for it to reach a high state of stabilization. These initial "site-specific" values should be recorded and permanently affixed to the battery as a baseline for subsequent tests over the life of the battery. The ohmic value will typically increase for conductance and decrease for resistance and impedance between the initial installation and after being on float-charge for 90 to 180 days (10 percent to 15 percent depending on battery type and size). Six months after installation measure and compare the ohmic readings to the readings taken at installation. Use whichever value is greater for conductance or lower for resistance and impedance as the baseline for that particular battery at that site going forward.

(2) A sample of new healthy batteries in a fully charged state can be tested to obtain a baseline value representative of a new battery. A sample size of at least 30 batteries from one manufacturer with the same make, model, amp-hour rating, age (within 6 months), and manufacturing lot is recommended. Record the following information for the batteries:

   (a) Battery manufacturer

   (b) Model number

   (c) Date of manufacture

   (d) Manufacturing lot number (if available)

   (e) Battery temperature

   (f) Whether or not the battery has had a freshening charge

   (g) Battery voltage

   (h) Ohmic test value

   Calculate the average ohmic value of the batteries. Do not include batteries that deviate more than 30 percent from the average because they could be outside of an acceptable range. Use the average value as a baseline starting point for this model battery.

(3) A generic baseline value for a specific battery model can often be found by contacting the ohmic test equipment manufacturer or from the battery manufacturer. While it is important to note that the use of generic reference values might not be as accurate, it is still possible to identify grossly failed batteries and significant changes in battery condition by applying this method. Generic baseline values are typical averages to be used as general guidelines and should only be used when no other data is available. When testing older batteries for which no initial site-specific ohmic value is available, reference values can be obtained in the following ways:

   (a) Contact the equipment or battery manufacturer for assistance.

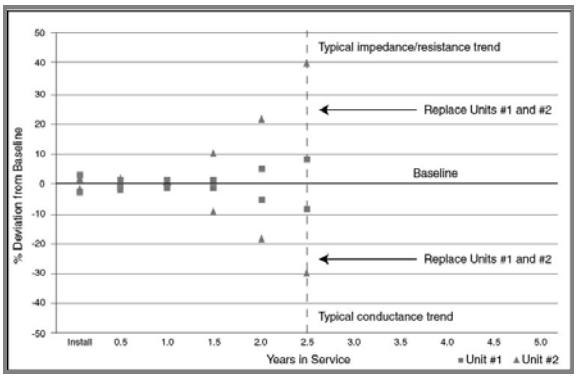
   (b) Consult your company documentation to see if reference values were created for the battery you are testing.

   (c) Using ohmic readings of recently installed batteries of the same manufacturer and model of the

battery, manufacturer and model of the alarm panel/system, charging circuit, and temperature at time of measurements, calculate the average ohmic value of the best 8 to 10 batteries and use this value as a baseline reference.

As a battery ages and loses capacity, the internal ohmic values change. Although the change might not be perfectly consistent over all battery models and sizes, experience and extensive test data shows that a deviation of ohmic values from the established baseline by 30 percent or more for conductance and 40 percent or more for resistance or impedance indicates that the actual battery capacity has dropped to 80 percent or lower. (For lead-acid batteries, capacity drops off rapidly once the 80 percent capacity point is reached in the lifetime curve, so this is known as the “knee” of the capacity vs. lifetime curve). This 80 percent capacity is the level at which battery manufacturers recommend battery replacement. Figure A.14.4.3.2 illustrates an ohmic trend of a 5-year design life battery with an actual expected service life of 3 years. Note that while battery Unit #1 still has good ohmic readings, semiannual measurements show Unit #2 failing prematurely. For this case, it is desirable to replace both units at the same time. If one unit fails at 2½ years, it is likely the second unit will fail in one of the next semiannual tests. Full replacement ensures that all units will “float” together. One exception might be when a unit fails in the first year.

Figure A.14.4.3.2 Example Ohmic Trend Analysis for a 24-Volt Battery Made Up of Two 12-Volt Units.



Ohmic testing can be a safe, simple, accurate, and reliable means of determining the state of health of VRLA batteries. It is important however to understand the following basic guidelines in order to maximize the benefits and avoid possible misleading test results:

(1) Follow safety regulations: wear eye protection and remove metal jewelry, and so forth prior to working with batteries.

(2) Conduct a visual inspection prior to testing. A cracked case, leaking terminal or post, or bulging battery should be replaced, not tested.

(3) Temperature changes affect measured ohmic values and battery capacity. Ohmic measurements should be taken at 77°F (25°C) ±13°F (7°C).

(4) For maximum accuracy and consistency, batteries should be tested when in a fully charged state.

(5) Check the battery charging current prior to test. The charging current should be stable and be within the normal float current recommendations of the battery manufacturer for the battery model. If it is not, it is likely that the batteries have recently been discharged and a test is not appropriate until this float current stabilizes.

(6) Whenever possible, ohmic readings should be taken each time with the same instrument, but as a minimum with the same model. Changing models will skew the data and require re-establishing the baseline.

(7) When test equipment is provided with an alert, set the ohmic baseline and/or thresholds prior to beginning the test to provide an indication of any deviations from baseline.

(8) It is essential to take ohmic measurements at the battery terminal or post. For consistency and accuracy, subsequent tests should always have probes or clamps placed at the same point while avoiding battery hardware such as bolt heads or washers. Connecting on the hardware will influence the readings and could cause replacement of a healthy battery.

(9) Maintain good contact at the test point for the duration of the test. If the probe or clamp slips off during the test, an incorrect reading will result.

(10) For batteries with fully insulated quick disconnect connectors, the battery should be taken offline by removing the quick disconnects from the battery terminals and then measuring and recording the internal ohmic value of the battery.

(11) Do not condemn a battery based upon results of a single test without any trending data or an established baseline for that specific battery.

(12) When one or more units in a battery falls outside the acceptable range from baseline, replace the entire string.

(13) While testing online is the preferred method, it should be noted that the capability of ohmic meters varies. As such, the test equipment manufacturer might provide instructions to disconnect the battery and test offline. A battery tested online can display a different value than when tested offline due to the charger circuit and load being across the battery. Always test the same way, either online or offline, to have consistent and meaningful results. When ohmic testing is performed online, a change in current occurs due to the ohmic test set signal that could impact battery voltage readings. Because battery float voltage is directly tied to float current, the sum of the voltages of each battery cell/unit have to equal the charger float voltage of the battery string. If a load is applied from the ohmic test set that depresses one cell/unit, then the others have to rise somewhat to offset it. As ohmic testing progresses through the battery string, each cell/unit gets pulled down by the ohmic test set somewhat, and the charger must boost the string current to maintain the voltage, raising the voltage of the cells/units that have not yet been tested. For this reason, voltage readings should be taken with a voltmeter prior to performing ohmic testing online.

Table 14.4.3.2 Item 9(5). Battery capacity is determined by the mass of active material contained in the battery and is a measure of the battery's stored energy. The rated capacity of small VRLA batteries used in fire alarm ~~and~~ or signaling system applications is typically measured in ampere-hours (Ah) where the ampere-hour rating is based on the battery's capability to provide a constant current at the nominal battery voltage for 20 hours. The rated capacity might vary from manufacturer to manufacturer.

The *actual* battery capacity during service life, often referred to as the state of charge (SOC), can vary significantly from *rated* capacity due to aging, charge and discharge cycles, temperature, and other factors. The unique failure modes of VRLA batteries due to aging and internal degradation are attributed for a high failure rate where the *actual* battery capacity has degraded to 80 percent of the manufacturer's *rated* capacity. As a result, battery manufacturers often recommend replacement much sooner than the rated design life for critical systems.

A test of battery capacity is designed to determine if the battery is capable of continuing to deliver the voltage level specified by the manufacturer. The results of a capacity test can also be used to estimate where the battery is in its service life. A test of capacity is performed by applying a constant current load to the battery based on the manufacturer's published discharge rates until voltage falls to specified levels. Although discharging the battery for capacity testing concerns some, VRLA batteries are designed to handle numerous discharges within the limits established by the battery manufacturer.

The discharge rate selected for testing should be representative of the battery duty cycle. At shorter test times, the test duration has a greater effect on the capacity calculation. For example, a 1-minute difference in actual test time for a 5-minute discharge rate compared to a 3-hour discharge rate will result in a greater deviation of the calculated capacity. The battery is also operating less efficiently at shorter discharge rates and the effects of aging and degradation might not be as prevalent during shorter discharges.

Fire alarm ~~and~~ or signaling system loading is typically insufficient for the practical application of a battery load test because the system load cannot be varied to maintain a constant current equal to the battery manufacturer's published discharge rates. The fixed load applied by the system will result in final voltage levels that are deceptively high. Battery sizing is also a factor. The calculated system loads for the battery duty cycle (e.g., 24 hours standby followed by 5 minutes in an alarm) will rarely align with published discharge rates necessary for load testing. In many applications where the battery size is large in comparison to the required system current, the system loading could be too small to accurately determine battery capacity. In these cases, a battery near failure could conceivably satisfy the low discharge rate applied by the fire alarm or signaling system.

In order to satisfy the load test requirements of Table 14.4.3.2, battery capacity testing can be performed in the following manner or in accordance with other methods such as those identified in IEEE 1188, *Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications*:

(1) Referring to the battery manufacturer's specifications, determine the load current for the 3-hour battery rating to the selected end voltage, typically 1.67 volts per cell (10.2 volts for a 12-volt system or 20.4 volts for a 24-volt system).

(2) Record the battery temperature at the negative terminal.

(3) Disconnect the charger and connect a load bank to the battery terminals.

(4) Apply the constant current specified for the 3-hour rate to the battery. Once the constant current is applied, continue the test until the battery terminal voltage decreases to the specified end voltage.

(5) Stop the test when the selected end voltage is reached.

(6) Record the actual test duration in minutes.

(7) Disconnect the load bank and reconnect the charger.

(8) Calculate percent battery capacity as follows:

$$\% \text{ Capacity} = [T_{actual}/(180 \times K_T)] \times 100$$

where:

T_{actual} = the test duration in minutes

K_T = the temperature correction factor for the actual battery temperature at the start of the test from ~~Table 14.4.3.2~~ Table A.14.4.3.2 . Additional temperature correction factors can be obtained from IEEE 1188.

(9) Replace the battery if the battery capacity is less than or equal to 80 percent. Replace the battery at the next scheduled test interval if the battery capacity is less than 85 percent.

Table A.14.4.3.2 Temperature Correction Factors

Temperature		-
°F	(°C)	K_T
65	18.3	0.92
66	18.9	0.927
67	19.4	0.935
68	20	0.942
69	20.6	0.948
70	21.1	0.955
71	21.7	0.96
72	22.2	0.97
73	22.8	0.975
74	23.4	0.98
75	23.9	0.985
76	24.5	0.99
77	25	1
78	25.6	1.002
79	26.1	1.007
80	26.7	1.011
81	27.2	1.017
82	27.8	1.023
83	28.3	1.03
84	28.9	1.035
85	29.4	1.04
86	30	1.045
87	30.6	1.05
88	31.1	1.055
89	31.6	1.06
90	32.2	1.065
95	35	1.09
100	37.8	1.112

As a good practice, a new battery should be fully charged and then load tested following the battery manufacturer's recommendations prior to installation. A new fully charged battery should have a capacity of at least 90 percent.

Table 14.4.3.2, Item 17. Where the manufacturer publishes limits of accuracy for the operation of an

initiating device, the test method should verify actuation is within the tolerances provided.

Table 14.4.3.2 Item 22(1) and 22(2). If, during the course of the periodic test of audible appliances, it is suspected that alarm sound levels could be lower than the required minimum, the system owner or the system owner's designated representative should be notified in writing. Such notification will allow the building owner or designated building representative to determine whether sound pressure level readings should be taken for the area(s) in question.

Table 14.4.3.2, Item 24. The extent of testing of a fire alarm or signaling system, including devices that were not tested, should be documented in accordance with the test plan in 14.2.10. *NFPA 72* does not require testing of an emergency control function, such as elevator recall, but does require testing of the emergency control function interface device, such as the relay powered by the fire alarm or signaling system. Where the emergency control function is not being tested concurrent with the fire alarm or signaling system testing, measurement of the emergency control function interface device output should be verified using the proper test devices. This might require reading or observing the condition of a relay, a voltage measurement, or the use of another type of test instrument. Once testing is complete, verification that any disabled or disconnected interface devices have been restored to normal is essential, and this verification should be documented in the testing results.

Testing of the emergency control functions themselves is outside of the scope of *NFPA 72*. A complete end-to-end test that demonstrates the performance of emergency control functions actuated by the fire alarm or signaling system might be required by some other governing laws, codes, or standards, or the authority having jurisdiction. In that situation, other applicable installation standards and design documents, not *NFPA 72*, would address testing and performance of the emergency control functions. NFPA 4 provides requirements for integrated (end-to-end) system testing.

It is important to note that the appropriate NFPA standard would provide the acceptance criteria for the overall emergency control function operation requirements, including performance and test methods, while *NFPA 72* covers the required performance and testing of the emergency function interface device.

For instance, if an end-to-end test for a building with an engineered smoke control system is required by some other governing laws, codes, standards, or the authority having jurisdiction, the test protocol would have unique criteria for the smoke control system design, and a special inspector would be responsible for the overall operation and performance of the smoke control system in accordance with the appropriate standard (NFPA 92 and NFPA *101*) during the testing, including measuring pressure differentials and ensuring proper fan and damper operation. Refer to the following extract from NFPA *101* on smoke control:

9.3.2 System Design. The engineer of record shall clearly identify the intent of the system, the design method, the appropriateness of that method used, and the required means of inspecting, testing, and maintaining the system. [***101*:** 9.3.2]

9.3.3 Acceptance Testing. Acceptance testing shall be performed by a special inspector in accordance with Section 9.13. [***101*:** 9.3.3]

Even though the fire alarm or signaling system initiating device might actuate the smoke control system, the actual testing of the dampers and fan operation would be as required by the smoke control design and not part of the fire alarm or signaling system.

Other emergency control operation requirements might be as follows: For fan shutdown and smoke damper operation, the fan and damper operations would be in accordance with NFPA 90A and NFPA 105 respectively, and those equipment operations would be verified by those responsible for HVAC systems in combination with the fire alarm system personnel. Guidance for elevator inspection and testing can be found in ASME A.17.2, *Guide for Inspection of Elevators, Escalators and Moving Walks*. For elevator systems, the recall function, elevator power shutdown, and hat illumination would be done with the elevator mechanics present during the test. This operational test is often accomplished during routine periodic fire alarm testing. For fire door holder and fire shutter release, it would be expected that the emergency control function operation of the doors/shutters would be verified in accordance with NFPA 80 and NFPA *101* during the test. In some cases, the door manufacturer representative might need to be present to reset the equipment.

Submitter Information Verification

Committee: SIG-TMS

Submittal Date: Wed Jul 01 22:10:19 EDT 2020

Committee Statement

Committee The Technical Committee edits the text to coincide with the current definition of signaling

Statement: system.

Response Message: SR-5115-NFPA 72-2020

Public Comment No. 343-NFPA 72-2020 [Section No. A.14.4.3.2]

Second Revision No. 5069-NFPA 72-2020 [Section No. F.1]

F.1 General.

Circuit class designations in this edition of the Code are Class A, B, C, D, E, N, and X. Definitions can be found in Chapter 12. Additionally, special circuits unique to supervising stations are designated as Types 4, 5, 6, and 7, and definitions can be found in Chapter 26.

The wiring diagrams depicted in Figure F.2.1.1 through Figure F.3.14(k) are representative of typical circuits encountered in the field and are not intended to be all-inclusive.

The noted symbols are as indicated in NFPA 170.

An individual point-identifying (i.e., addressable) fire alarm initiating device operates on a signaling line circuit and is designated as a Class A, Class B, or Class X initiating device circuit. All fire alarm circuits must test free of grounds because metallic conductors will cause failure of the circuit when a second ground condition occurs on the same power source.

Nonmetallic circuit paths, such as ~~wireless~~ low-power radio and optical fiber cable, ~~-optic,~~ might still be designated as Class A, B, or X if they meet the other performance requirements of those pathways.

The following initiating device circuits are illustrative of either alarm or supervisory signaling. Alarm-initiating devices and supervisory initiating devices are not permitted to have identical annunciation at the fire alarm control unit.

Directly connected system smoke detectors, commonly referred to as two-wire detectors, should be listed as being electrically and functionally compatible with the fire alarm control unit and the specific subunit or module to which they are connected. If the detectors and the units or modules are not compatible, it is possible that, during an alarm condition, the detector's visible indicator will illuminate, but no change of state to the alarm condition will occur at the fire alarm control unit. Incompatibility can also prevent proper system operation at extremes of operating voltage, temperature, and other environmental conditions.

Where two or more two-wire detectors with integral relays are connected to a single initiating device circuit, and their relay contacts are used to control essential building functions (e.g., fan shutdown, elevator recall), it should be clearly noted that the circuit might be capable of supplying only enough energy to support one detector/relay combination in an alarm mode. If control of more than one building function is required, each detector/relay combination used to control separate functions should be connected to separate initiating device circuits, or they should be connected to an initiating device circuit that provides adequate power to allow all the detectors connected to the circuit to be in the alarm mode simultaneously. During acceptance and reacceptance testing, this feature should always be tested and verified.

A loudspeaker is an alarm notification appliance, and, if used as shown in the diagrams in Section F.2, the principle of operation and supervision is the same as for other audible alarm notification appliances (e.g., bells and horns).

The testing of supervised remote relays is to be conducted in the same manner as for notification appliances.

Submitter Information Verification

Committee: SIG-TMS

Submittal Date: Tue Jun 23 11:49:58 EDT 2020

Committee Statement

Committee Statement: The Technical Committee revises this section as submitted. The term "wireless" is replaced with "low-power radio" to eliminate potential confusion as fiber optic transmission is also wireless. The term "fiber optic" is replaced with "optical fiber cable" for consistency.

Response Message: SR-5069-NFPA 72-2020

Public Comment No. 100-NFPA 72-2020 [Section No. F.1]