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* 1. **\* General.** Connections to supervising stations or commu- nications centers shall be in accordance with *NFPA 72*, *National Fire Alarm and Signaling Code*.
		1. **Signals.**
			1. **Priority of Signals.** A carbon monoxide alarm signal shall take precedence over supervisory or trouble signals.
			2. **Carbon Monoxide Alarm Signal Disposition.**
				1. The actuation of a carbon monoxide detector or system shall be distinctively indicated as a carbon monoxide alarm signal.
				2. **\*** Servicing of a system in alarm that cannot be reset shall be in accordance with Chapter 8 and shall occur within 4 hours of the carbon monoxide alarm signal.
			3. **Carbon Monoxide Trouble Signal Disposition.**
				1. Upon receipt of a carbon monoxide trouble signal, the responsible party(s) shall be notified.
				2. Servicing of a system in trouble shall be in accor- dance with Chapter 8 and shall occur within 4 hours of the trouble indication.

**7.2.2\* Supervising Station.** Upon receipt of a carbon monox- ide alarm signal, supervising station personnel shall perform the following actions in the order listed:

1. Where required by the emergency response agency, im- mediately retransmit indication of the carbon monoxide alarm signal to the communications center
2. Contact the responsible party(s) in accordance with the notification plan

**7.2.3\* Emergency Response Agency (ERA).** Where a carbon monoxide alarm signal is transmitted directly to a communi- cations center, communications center personnel shall per- form the following actions in the order listed:

1. Follow standard operating procedures
2. Contact the responsible party(s) in accordance with the notification plan
	1. **Prearranged Testing.** When the signal results from a pre- arranged test, the action required by 7.2.2 and 7.2.3 shall not be required.
	2. **Operation and Record Keeping.**
		1. The operation, staffing, and recordkeeping for a super- vising station shall be in accordance with *NFPA 72*, *National Fire Alarm and Signaling Code*.
		2. The operation, staffing, and recordkeeping for a com- munications center shall be in accordance with NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*.

**Chapter 8 Inspection, Testing, and Maintenance**

**8.1 Application.** This chapter covers the requirements for the inspection, testing, and maintenance of carbon monoxide alarms, detectors, systems, and their components.

**8.1.1** More stringent inspection, testing, or maintenance pro- cedures shall be permitted.

* + 1. Inspection testing and maintenance programs shall comply with the requirements of this chapter, conform to the equipment manufacturers’ published instructions, and verify proper operation of the carbon monoxide alarms, detectors, systems, and their components.
		2. Nothing in this chapter is intended to prevent the use of alternative test methods or testing devices, provided such methods or devices are equivalent in effectiveness and safety and meet the intent of the requirements of this chapter.
	1. **General.**
		1. **Responsibilities.**
			1. The property or building or system owner or the own- er’s designated representative shall be responsible for inspec- tion, testing, and maintenance of the system and for alter- ations or additions to this system. [**72:**14.2.3.1]
			2. Where the property owner is not the occupant, the property owner shall be permitted to delegate the authority and responsibility for inspecting, testing, and maintaining the [car- bon monoxide] systems to the occupant, management firm, or managing individual through specific provisions in the lease, written use agreement, or management contract. [**72:**14.2.3.2]
			3. Inspection, testing, or maintenance shall be permit- ted to be done by the building or system owner or a person or organization other than the building or system owner if con- ducted under a written contract. [**72:**14.2.3.3]
			4. Where the building or system owner has delegated any responsibilities for inspecting, testing, or maintenance, a copy of the written delegation required by 8.2.1.3 shall be provided to the authority having jurisdiction upon request. [**72:**14.2.3.4]
			5. **\* Service Personnel Qualifications and Experience.** Service personnel shall be qualified and experienced in accor- dance with the requirements of 4.4.3. [**72:**14.2.3.6]
		2. **\* Notification.**
			1. Before proceeding with any testing, all persons and facilities receiving alarm, supervisory, or trouble signals and all building occupants shall be notified of the testing to prevent unnecessary response. [**72:**14.2.3.1]
			2. At the conclusion of testing, those previously notified (and others, as necessary) shall be notified that testing has been concluded. [**72:**14.2.3.2]
			3. The owner or the owner’s designated representative and service personnel shall coordinate system testing to pre- vent interruption of critical building systems or equipment. [**72:**14.2.3.3]

**8.2.3 System Documentation.** Prior to system maintenance or testing, the system certificate of completion and the informa- tion regarding the system and system alterations, including specifications, wiring diagrams, and floor plans, shall be made available by the owner to a designated representative to the service personnel.

**8.3 Inspection.**

**8.3.1\*** Unless otherwise permitted by 8.3.2, visual inspections shall be performed in accordance with the schedules in Table 8.3.1 or more often if required by the authority having jurisdiction. [**72:**14.3.1]

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# Table 8.3.1 Visual Inspection Frequencies

**Initial Acceptance**

**Periodic Frequency**

**Method Reference**

1. All equipment X Annual Ensure there are no changes that affect equipment performance. Inspect for building modifications, occupancy changes, changes in environmental conditions, device location, physical obstructions, device orientation, physical damage, and degree of cleanliness.

8.3.4

2. Control equipment:

1. Fire alarm systems monitored for alarm, supervisory, and trouble signals
	1. Fuses X Annual
	2. Interfaced equipment X Annual
	3. Lamps and LEDs X Annual
	4. Primary (main) power supply X Annual
	5. Trouble signals X Semiannual
2. Fire alarm systems unmonitored for alarm, supervisory, and trouble signals
	1. Fuses X Weekly
	2. Interfaced equipment X Weekly
	3. Lamps and LEDs X Weekly
	4. Primary (main) power supply X Weekly
	5. Trouble signals X Weekly

3. Reserved

Verify a system normal condition.

Verify a system normal condition.

4. Emergency voice/alarm communications equipment

X Semiannual Verify location and condition.

1. Reserved
2. Reserved
3. Reserved

8. Batteries Inspect for corrosion or leakage. Verify

tightness of connections. Verify marking of the month/year of manufacture (all types).

1. Lead-acid X Monthly Visually inspect electrolyte level.
2. Nickel-cadmium X Semiannual
3. Primary (dry cell) X Monthly
4. Sealed lead-acid X Semiannual

9. Remote annunciators X Semiannual Verify location and condition.

4.5.9

10. Notification appliance circuit power extenders

X Annual Verify proper fuse ratings, if any. Verify that

lamps and LEDs indicate normal operating status of the equipment.

4.5

11. Remote power supplies X Annual Verify proper fuse ratings, if any. Verify that

lamps and LEDs indicate normal operating status of the equipment.

4.5

12. Transient suppressors X Semiannual Verify location and condition.

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**Table 8.3.1 *Continued***

# Initial Acceptance

**Periodic**

**Frequency Method Reference**

1. Reserved
2. Fiber-optic cable connections X Annual Verify location and condition.
3. Initiating devices Verify location and condition (all devices).
4. CO air sampling
	* General X Semiannual Verify that in-line filters, if any, are clean.

(2) Sampling system piping and sampling ports

(b) CO duct detectors

X Verify that sampling system piping and fittings are installed properly, appear airtight, and are permanently fixed. Confirm that sampling pipe is conspicuously identified. Verify that sample ports or points are not obstructed.

1. General X Semiannual Verify that detector is rigidly mounted. Confirm that no penetrations in a return air duct exist in the vicinity of the detector. Confirm the detector is installed so as to sample the airstream at the proper location in the duct.
2. Sampling tube X Verify proper orientation. Confirm the sampling tube protrudes into the duct in accordance with system design.

(c) Electromechanical releasing devices

X Semiannual

(d) Supervisory signal devices X Quarterly

16. Carbon monoxide alarm control interface and carbon monoxide emergency control function interface

X Semiannual Verify location and condition.

17. Notification appliances Verify location and condition (all appliances).

(a) Audible appliances X Semiannual

1. Audible textual notification appliances
2. Visible appliances

X Semiannual

(1) General X Semiannual 6.5.5

(2) Candela rating X Verify that the candela rating marking agrees with the approved drawings.

6.5.5

* + 1. Devices or equipment that is inaccessible for safety con- siderations (e.g., continuous process operations, energized electrical equipment, radiation, and excessive height) shall be permitted to be inspected during scheduled shutdowns if ap- proved by the authority having jurisdiction. [**72:**14.3.2]
		2. Extended intervals shall not exceed 18 months. [**72:**14.3.3]
		3. The visual inspection shall be made to ensure that there are no changes that affect equipment performance. [**72:**14.3.4]

# Testing.

* + 1. **Initial Acceptance Testing.**
			1. All new systems shall be inspected and tested in accor- dance with the requirements of Chapter 8. [**72:**14.4.1.1]
			2. The authority having jurisdiction shall be notified prior to the initial acceptance test. [**72:**14.4.1.2]

# \* Reacceptance Testing.

* + - 1. When an initiating device, notification, appliance, or control relay is added, it shall be functionally tested. [**72:**14.4.2.1]
			2. When an initiating device, notification appliance, or control relay is deleted, another device, appliance, or control relay on the circuit shall be operated. [**72:**14.4.2.2]
			3. When modifications or repairs to control equipment hardware are made, the control equipment shall be tested in accordance with Table 8.4.3, items 2(a) and 2(d). [**72:**14.4.2.3]
			4. When changes are made to site-specific software, the following shall apply:

(1) All functions known to be affected by the change, or iden- tified by a means that indicates changes, shall be 100 per- cent tested.

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1. In addition, 10 percent of initiating devices that are not directly affected by the change, up to a maximum of 50 devices, also shall be tested and correct system operation shall be verified.
2. A revised record of completion in accordance with

4.14.2.1 shall be prepared to reflect these changes. [**72:**14.4.2.4]

**8.4.2.5** Changes to the system executive software shall re- quire a 10 percent functional test of the system, 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. [**72:**14.4.2.5]

**8.4.3 Test Methods.** [Carbon monoxide detection] systems and associated equipment shall be tested according to Table 8.4.3. [**72:**14.4.3.2]

# Table 8.4.3 Testing

**Component Initial**

**Acceptance**

**Periodic Frequency**

**Method**

1. All equipment X See Table 8.3.1.
2. Control equipment and transponder
3. Functions X Annually Verify correct receipt of alarm, supervisory, and trouble signals (inputs); operation of evacuation signals and auxiliary functions (outputs); circuit supervision, including detection of open circuits and ground faults; and power supply supervision for detection of loss of ac power and disconnection of secondary batteries.
4. Fuses X Annually Verify rating and supervision.
5. Interfaced equipment X Annually Verify integrity of single or multiple circuits providing

interface between two or more control units. Test interfaced equipment connections by operating or simulating operation of the equipment being supervised. Verify signals required to be transmitted at the control unit.

1. Lamps and LEDs X Annually Illuminate lamps and LEDs.
2. Primary (main) power supply X Annually Disconnect and test all secondary (standby) power

under maximum load, including all alarm appliances requiring simultaneous operation. Reconnect all secondary (standby) power at end of test. Test redundant power supplies separately.

3. Carbon monoxide detection control unit trouble signals

1. Audible and visual X Annually Verify operation of control unit trouble signals. Verify ring-back feature for systems using a

trouble-silencing switch that requires resetting.

1. Disconnect switches X Annually If control unit has disconnect or isolating switches, verify performance of intended function of each switch. Verify receipt of trouble signal when a supervised function is disconnected.
2. Ground-fault monitoring circuit X Annually If the system has a ground detection feature, verify the

occurrence of ground-fault indication whenever any installation conductor is grounded.

(d) Transmission of signals to off-premises location

X Annually Actuate an initiating device and verify receipt of alarm

signal at the off-premises location.

Create a trouble condition and verify receipt of a trouble signal at the off-premises location.

Actuate a supervisory device and verify receipt of a supervisory signal at the off-premises location. If a transmission carrier is capable of operation under a single- or multiple-fault condition, activate an initiating device during such fault condition and verify receipt of an alarm signal and a trouble signal at the off-premises location.

4. Reserved

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**Table 8.4.3 *Continued***

# Component

**Initial Acceptance**

**Periodic**

**Frequency Method**

1. Engine-driven generator X Monthly If an engine-driven generator dedicated to the system

is used as a required power source, verify operation of the generator in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems,* by the building owner.

1. Secondary (standby) power supply X Annually Disconnect all primary (main) power supplies and

verify the occurrence of required trouble indication for loss of primary power. Measure or verify the system’s standby and alarm current demand and verify the ability of batteries to meet standby and alarm requirements using manufacturer’s data.

Operate general alarm systems a minimum of 5 minutes. Reconnect primary (main) power supply at end of test.

1. Uninterruptible power supply (UPS) X Annually If a UPS system dedicated to the system is used as a

required power source, verify by the building owner operation of the UPS system in accordance with NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*.

1. Battery tests Prior to conducting any battery testing, verify by the person conducting the test that all system software stored in volatile memory is protected from loss.
2. Lead-acid type
	* Battery replacement X Annually Replace batteries in accordance with the recommendations of the alarm equipment manufacturer or when the recharged battery voltage or current falls below the manufacturer’s recommendations.
	* Charger test X Annually With the batteries fully charged and connected to the charger, measure the voltage across the batteries with a voltmeter. Verify the voltage is 2.30 volts per cell ±0.02 volts at 77°F (25°C) or as specified by the equipment manufacturer.
	* Discharge test X Annually With the battery charger disconnected, load test the batteries following the manufacturer’s recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full carbon monoxide alarm load connected to the battery.
	* Load voltage test X Semiannually With the battery charger disconnected, load test the batteries following the manufacturer’s

recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery. Verify the battery does not fall below 2.05 volts per cell under load.

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**Table 8.4.3 *Continued***

# Component

**Initial Acceptance**

**Periodic**

**Frequency Method**

(5) Specific gravity X Semiannually Measure as required the specific gravity of the liquid in the pilot cell or all of the cells. Verify the specific gravity is within the range specified by the manufacturer. Although the specified specific gravity varies from manufacturer to manufacturer, a range of 1.205–1.220 is typical for regular lead-acid batteries, while 1.240–1.260 is typical for

high-performance batteries. Do not use a hydrometer that shows only a pass or fail condition of the battery and does not indicate the specific gravity, because such a reading does not give a true indication of the battery condition.

1. Nickel-cadmium type
	1. Battery replacement X Annually Replace batteries in accordance with the recommendations of the alarm equipment manufacturer or when the recharged battery voltage or current falls below the manufacturer’s recommendations.
	2. Charger testa X Annually With the batteries fully charged and connected to the charger, place an ampere meter in series with the battery under charge. Verify the charging current is in accordance with the manufacturer’s recommendations for the type of battery used. In the absence of specific information, use 1⁄30 to 1⁄25 of the battery rating.
	3. Discharge test X Annually With the battery charger disconnected, load test the batteries following the manufacturer’s recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery.
	4. Load voltage test X Semiannually With the battery charger disconnected, load test the batteries following the manufacturer’s recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery. Verify the float voltage for the entire battery is 1.42 volts per cell, nominal, under load. If possible, measure cells individually.
2. Sealed lead-acid type
	* Battery replacement X Annually Replace batteries in accordance with the recommendations of the alarm equipment manufacturer or when the recharged battery voltage or current falls below the manufacturer’s recommendations.
	* Charger test X Annually With the batteries fully charged and connected to the charger, measure the voltage across the batteries with a voltmeter. Verify the voltage is 2.30 volts per cell ±0.02 volts at 77°F (25°C) or as specified by the equipment manufacturer.
	* Discharge test X Annually With the battery charger disconnected, load test the batteries following the manufacturer’s recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery.
	* Load voltage test X Semiannually Verify the battery performs under load, in accordance with the battery manufacturer’s specifications.

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**Table 8.4.3 *Continued***

# Component

**Initial Acceptance**

**Periodic**

**Frequency Method**

1. Remote annunciators X Annually Verify the correct operation and identification of annunciators. If provided, verify the correct operation of annunciator under a fault condition.
2. Reserved
3. Reserved
4. Reserved
5. Conductors — metallic
6. Stray voltage X N/A Test all installation conductors with a volt/ohmmeter to verify that there are no stray (unwanted) voltages between installation conductors or between installation conductors and ground. Verify the maximum allowable stray voltage does not exceed

1 volt ac/dc, unless a different threshold is specified in the published manufacturer’s instructions for the installed equipment.

1. Ground faults X N/A Test all installation conductors, other than those intentionally and permanently grounded, for isolation from ground per the installed equipment manufacturer’s published instructions.
2. Short-circuit faults X N/A Test all installation conductors, other than those intentionally connected together, for

conductor-to-conductor isolation per the published manufacturer’s instructions for the installed equipment. Also test these same circuits

conductor-to-ground.

1. Loop resistance X N/A With each initiating and indicating circuit installation conductor pair short-circuited at the far end, measure and record the resistance of each circuit. Verify that the loop resistance does not exceed the limits specified in the published manufacturer’s instructions for the installed equipment.
2. Circuit integrity X N/A For initial and reacceptance testing, confirm the introduction of a fault in any circuit monitored for integrity results in a trouble indication at the fire alarm control unit. Open one connection at not less than 10 percent of the initiating devices, notification appliances and controlled devices on every initiating device circuit, notification appliance circuit, and signaling line circuit. Confirm all circuits perform as indicated in Sections 5.5, 5.6, and 5.7.

N/A Annually For periodic testing, test each initiating device circuit,

notification appliance circuit, and signaling line circuit for correct indication at the control unit. Confirm all circuits perform as indicated in Sections 5.5, 5.6, and 5.7.

14. Conductors — nonmetallic

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Missed pages out deliberately

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**Table 8.4.3 *Continued***

# Component

**Initial Acceptance**

**Periodic**

**Frequency Method**

1. Low-power radio (wireless systems) X N/A The following procedures describe additional

acceptance and reacceptance test methods to verify wireless protection system operation:

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

aExample: 4000 mAh × 1⁄25 = 160 mA charging current at 77°F (25°C).

bChapter 6 would require 15 dB over average ambient sound for public mode spaces. Sometimes the ambient sound levels are different from what the design was based upon. Private operating mode would require 10 dB over average ambient at the location of the device.

cWhere building, system, or occupancy changes have been observed, the owner should be notified of the changes. New devices might need to be installed and tested per the initial acceptance testing criteria.

* + - **\* Testing Frequency.** Unless otherwise permitted by other sections of this standard, testing shall be performed in accor- dance with the schedules in Table 8.4.3, or more often if re- quired by the authority having jurisdiction. [**72:**14.4.4]
			* Devices or equipment that are inaccessible for safety considerations (e.g., continuous process operations, ener- gized electrical equipment, radiation, and excessive height) shall be permitted to be tested during scheduled shutdowns if approved by the authority having jurisdiction. Extended inter- vals shall not exceed 18 months. [**72:**14.4.4.1]
			* If automatic testing is performed at least weekly by a remotely monitored [carbon monoxide detection] control unit specifically listed for the application, the manual testing frequency shall be permitted to be extended to annually. Table 8.4.3 shall apply. [**72:**14.4.4.2]

# Functional Test of Carbon Monoxide Detectors.

* + - * For all system detectors installed after January 1, 2012, carbon monoxide tests shall be performed at initial accep- tance and annually by the introduction of carbon monoxide into the sensing chamber or element. An electronic check (magnets, analog values, etc.) is not sufficient to comply with this requirement.
			* The functional test shall be performed in accordance with the manufacturer’s published instructions.
			* **\*** The result of each carbon monoxide detector test shall be confirmed through indication at the detector and the control unit.
			* All tests and results shall be recorded.

# Maintenance.

* + 1. [Carbon monoxide detection] system equipment shall be maintained in accordance with the manufacturer’s pub- lished instructions. [**72:**14.5.1]
		2. All apparatus that require resetting to maintain normal op- eration shall be restored to normal as promptly as possible after each test and alarm and kept in normal condition for operation. All test signal received shall be recorded to indicate date and time.

# Records.

* + 1. **Permanent Records.**
			- After successful completion of acceptance tests satisfac- tory to the authority having jurisdiction, a set of reproducible as-built installation drawings, operation and maintenance manu- als, and a written sequence of operation shall be provided to the building owner or the owner’s designated representative.
			- It shall be the responsibility of the owner to maintain these records for the life of the system and to keep them avail- able for examination by any authority having jurisdiction.
			- Paper or electronic media shall be permitted.

# Maintenance, Inspection, and Testing Records.

* + - 1. A record of all inspections, tests, and maintenance shall be documented and shall include all the applicable information included in Figure 8.6.2.1.
			2. Records shall be retained until the next test and for 1 year thereafter. [**72:**14.6.2.1]
			3. The system shall be clearly identified by a placard, sticker, or other means to indicate the next regularly sched- uled inspection period in accordance with Figure 8.6.2.1.

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