

**(Effective until March 15, 2024)**

**WAC 51-54A-0510 Emergency responder radio coverage.**

**510.4.1.1 Minimum signal strength into building.** The minimum inbound signal strength shall be sufficient to provide usable voice communications throughout the coverage area as specified by the *fire code official*. The inbound signal level shall be a minimum of -95 dBm throughout the coverage area and sufficient to provide not less than a delivered audio quality (DAQ) of 3.0 or an equivalent signal-to-interference-plus-noise ratio (SINR) applicable to the technology for either analog or digital signals.

**510.4.2.4 Signal booster requirements.** If used, signal boosters shall meet the following requirements:

1. All signal booster components shall be a National Electrical Manufacturer's Association (NEMA) 4, IP65-type waterproof cabinet or equivalent.

2. Battery systems used for the emergency power source shall be contained in a NEMA 3R or higher-rated cabinet, IP65-type waterproof cabinet or equivalent.

3. Equipment shall have FCC or other radio licensing authority certification and be suitable for public safety use prior to installation.

4. Where a donor antenna exists, isolation shall be maintained between the donor antenna and all inside antennas to not less than 20 dB greater than the system gain under all operating conditions.

5. Bi-directional amplifiers (BDAs) active RF emitting devices used in emergency responder radio coverage systems shall have oscillation prevention built-in oscillation detection and control circuitry.

6. The installation of amplification systems or systems that operate on or provide the means to cause interference on any emergency responder radio coverage networks shall be coordinated and approved by the fire code official.

**510.5.3 Acceptance test procedure.** Where an emergency responder radio coverage system is required, and upon completion of installation, the building owner shall have the radio system tested to verify that two-way coverage on each floor of the building is not less than 95 percent. The test procedure shall be conducted as follows:

1. Each floor of the building shall be divided into a grid of 20 approximately equal test areas.

2. The test shall be conducted using a calibrated portable radio of the latest brand and model used by the agency talking through the agency's radio communications system or equipment approved by the fire code official.

3. Failure of more than one test area shall result in failure of the test.

4. In the event that two of the test areas fail the test, in order to be more statistically accurate, the floor shall be permitted to be divided into 40 equal test areas. Failure of not more than two non-adjacent test areas shall not result in failure of the test. If the system fails the 40 area test, the system shall be altered to meet the 95 percent coverage requirement.

5. A test location approximately in the center of each test area shall be selected for the test, with the radio enabled to verify two-way communications to and from the outside of the building through the public agency's radio communications system. Once the test location

has been selected, that location shall represent the entire test area. Failure in the selected test location shall be considered to be a failure of that test area. Additional test locations shall not be permitted.

6. The gain values of all amplifiers shall be measured and the test measurement results shall be kept on file with the building owner so that the measurements can be verified during annual tests. In the event that the measurement results become lost, the building owner shall be required to rerun the acceptance test to reestablish the gain values.

7. As part of the installation, a spectrum analyzer or other suitable test equipment shall be utilized to ensure spurious oscillations are not being generated by the subject signal booster. This test shall be conducted at the time of installation and at subsequent annual inspections.

8. Systems incorporating Class B signal-booster devices or Class B broadband fiber remote devices shall be tested using two portable radios simultaneously conducting subjective voice quality checks. One portable radio shall be positioned not greater than 10 feet (3048 mm) from the indoor antenna. The second portable radio shall be positioned at a distance that represents the farthest distance from any indoor antenna. With both portable radios simultaneously keyed up on different frequencies within the same band, subjective audio testing shall be conducted and comply with DAQ levels as specified in Sections 510.4.1.1 and 510.4.1.2.

**510.5 Installation requirements.** The installation of the public safety radio coverage system shall be in accordance with NFPA 1221 and Sections 510.5.1 through 510.5.5.

**510.5.5 Mounting of the donor antenna(s).** To maintain proper alignment with the system designed donor site, donor antennas shall be permanently affixed on the highest possible position on the building or where approved by the fire code official. A clearly visible sign stating "movement or repositioning of this antenna is prohibited without approval from the fire code official." The antenna installation shall be in accordance with the applicable requirements in the International Building Code for weather protection of the building envelope.

**510.6.1 Testing and proof of compliance.** The owner of the building or owner's authorized agent shall have the emergency responder radio coverage system inspected and tested annually or where structural changes occur including additions or remodels that could materially change the original field performance tests. Testing shall consist of the following:

1. In-building coverage test as described in Section 510.5.3 or as required by the fire code official.

2. Signal boosters shall be tested to verify that the gain is the same as it was upon initial installation and acceptance or set to optimize the performance of the system.

3. Backup batteries and power supplies shall be tested under load of a period of 1 hour to verify that they will properly operate during an actual power outage. If within the 1-hour test period the battery exhibits symptoms of failure, the test shall be extended for additional 1-hour periods until the integrity of the battery can be determined.

4. Other active components shall be checked to verify operation within the manufacturers specification.

5. At the conclusion of the testing, a report, which shall verify compliance with Section 510.5.3, shall be submitted to the fire code official.

[Statutory Authority: RCW 19.27.031 and 19.27.074. WSR 21-04-003, § 51-54A-0510, filed 1/20/21, effective 2/20/21; WSR 19-24-058, § 51-54A-0510, filed 11/27/19, effective 7/1/20.]

**(Effective March 15, 2024)**

**WAC 51-54A-0510 Emergency responder communication coverage.**

**510.1 Emergency responder communication coverage in new buildings.** Approved in-building, *emergency responder communications enhancement system (ERCES)* for emergency responders shall be provided in all new buildings. In-building ERCES within the building shall be based on the existing coverage levels of the public safety communication systems utilized by the jurisdiction, measured at the exterior of the building. The two-way emergency responder communications coverage system where required, shall be of a type determined by the fire code official and the frequency license holder(s). This section shall not require improvement of the existing public safety communication systems.

**EXCEPTIONS:**

1. Where approved by the building official and the fire code official, a wired communication system in accordance with Section 907.2.13.2 shall be permitted to be installed or maintained instead of an approved communication coverage system.
2. Where it is determined by the *fire code official* that the communication coverage system is not needed.
3. In facilities where emergency responder communication coverage is required and such systems, components or equipment required could have a negative impact on the normal operations of that facility, the *fire code official* shall have the authority to accept an automatically activated *emergency responder communication coverage system*.

**510.2 Emergency responder communication enhancement system in existing buildings.** Existing buildings shall be provided with approved in-building, emergency responder communications enhancement system for emergency responders as required in Chapter 11.

**510.3 Permit required.** A construction permit for the installation of or modification to in-building, emergency responder communication enhancement systems and related equipment is required as specified in Section 105.6.4. Maintenance performed in accordance with this code is not considered a modification and does not require a permit.

**510.4 Technical requirements.** Equipment required to provide in-building, emergency responder communication enhancement system shall be *listed* in accordance with UL 2524. Systems, components and equipment required to provide the in-building, emergency responder communication enhancement system shall comply with Sections 510.4.1 through 510.4.2.8.

**510.4.1 Emergency responder communication enhancement system signal strength.** The building shall be considered to have an acceptable in-building, emergency responder communication enhancement system where signal strength measurements in 95 percent of all areas and 99 percent of areas designated as critical areas by the fire code official on each floor of the building meet the signal strength requirements in Sections 510.4.1.1 through 510.4.1.3.

**510.4.1.1 Minimum signal strength into building.** The minimum inbound signal strength shall be sufficient to provide usable voice communications throughout the coverage area as specified by the *fire code official*. The inbound signal level shall be a minimum of -95 dBm in 95 percent of the coverage area and 99 percent in *critical areas* and suf-

ficient to provide not less than a delivered audio quality (DAQ) of 3.0 or an equivalent signal-to-interference-plus-noise ratio (SINR) applicable to the technology for either analog or digital signals.

**510.4.2 System design.** The in-building, *emergency responder communication enhancement system* shall be designed in accordance with Sections 510.4.2.1 through 510.4.2.8 and NFPA 1221.

**510.4.2.1 Amplification systems and components.** Buildings and structures that cannot support the required level of in-building, *emergency responder communication system* shall be equipped with systems and components to enhance the radio signals and achieve the required level of in-building, *emergency responder communication enhancement system* specified in Sections 510.4.1 through 510.4.1.3. In-building, *emergency responder communication enhancement systems* utilizing radio-frequency-emitting devices and cabling shall be approved by the *fire code official*. Prior to installation, all RF-emitting devices shall have the certification of the radio licensing authority and be suitable for public safety use.

**510.4.2.2 Technical criteria.** The fire code official shall maintain a document providing the specific technical information and requirements for the in-building, *emergency responder communication enhancement system*. This document shall contain, but not be limited to, the various frequencies required, the location of radio sites, the effective radiated power of radio sites, the maximum propagation delay in microseconds, the applications being used and other supporting technical information necessary for system design.

**510.4.2.3 Standby power.** In-building, *emergency responder communication enhancement systems coverage systems* shall be provided with dedicated standby batteries or provided with 2-hour standby batteries and connected to the facility generator power system in accordance with Section 1203. The standby power supply shall be capable of operating the in-building, *emergency responder communication enhancement system* at 100 percent system capacity for a duration of not less than 12 hours.

**510.4.2.4 Signal booster requirements.** If used, signal boosters shall meet the following requirements:

1. All signal booster components shall be a National Electrical Manufacturer's Association (NEMA) 4, IP66-type waterproof cabinet or equivalent.

EXCEPTION: Listed battery systems that are contained in integrated battery cabinets.

2. Battery systems used for the emergency power source shall be contained in a NEMA 3R or higher-rated cabinet, IP65-type waterproof cabinet or equivalent.

EXCEPTION: Listed battery systems that are contained in integrated battery cabinets.

3. Equipment shall have FCC or other radio licensing authority certification and be suitable for public safety use prior to installation.

4. Where a donor antenna exists, isolation shall be maintained between the donor antenna and all inside antennas to not less than 20 dB greater than the system gain under all operating conditions.

5. Bi-directional amplifiers (BDA) used for in-building, *emergency responder communication enhancement systems* shall be fitted with anti-oscillation detection and control circuitry and per-channel AGC.

6. The installation of amplification systems or enhancement systems that operate on or provide the means to cause interference on any in-building, *emergency responder communication enhancement system* network shall be coordinated and approved by the fire code official.

7. Only channelized signal boosters shall be permitted.

EXCEPTION: Broadband BDAs may be utilized when specifically authorized in writing by the *frequency license holder*.

**510.4.2.5 System monitoring.** The in-building, *emergency responder communication enhancement system* shall include automatic supervisory and trouble signals that are monitored by a supervisory service and are annunciated by the *fire alarm system* in accordance with NFPA 72. The following conditions shall be separately annunciated by the *fire alarm system*, or, if the status of each of the following conditions is individually displayed on a dedicated panel on the in-building, *emergency responder communication enhancement system*, a single automatic supervisory signal may be annunciated on the *fire alarm system* indicating deficiencies of the in-building, *emergency responder communication enhancement system*:

1. Loss of normal AC power supply.
2. System battery charger(s) failure.
3. Malfunction of the donor antenna(s).
4. Failure of active RF-emitting device(s).
5. Low-battery capacity at 70 percent reduction of operating capacity.
6. Active system component malfunction.
7. Malfunction of the communications link between the *fire alarm system* and the in-building, *emergency responder communication enhancement system*.
8. Oscillation of active RF-emitting device(s).

**510.4.2.6 Additional frequencies and change of frequencies.** The in-building, *emergency responder communication coverage enhancement system* shall be capable of modification or expansion in the event frequency changes are required by the FCC or other radio licensing authority, or additional frequencies are made available by the FCC or other radio licensing authority.

**510.4.2.7 Design documents.** The *fire code official* shall have the authority to require "as-built" design documents and specifications for in-building, *emergency responder communication enhancement systems*. The documents shall be in a format acceptable to the *fire code official*.

**510.4.2.8 Radio communication antenna density.** Systems shall be engineered to minimize the near-far effect. In-building, *emergency responder communication enhancement system* designs shall include sufficient antenna density to address reduced gain conditions.

EXCEPTION: Systems where all portable devices within the same band use active power control features.

**510.5 Installation requirements.** The installation of the in-building, *emergency responder communication enhancement system* shall be in accordance with NFPA 1221 and Sections 510.5.1 through 510.5.7.

**510.5.1 Mounting of the donor antenna(s).** To maintain proper alignment with the system designed donor site, donor antennas shall be permanently affixed on the highest possible position on the building or where *approved* by the *fire code official*. A clearly visible sign stating "MOVEMENT OR REPOSITIONING OF THIS ANTENNA IS PROHIBITED WITHOUT APPROVAL FROM THE FIRE CODE OFFICIAL." shall be posted. The antenna installation shall be in accordance

with the applicable requirements in the *International Building Code* for weather protection of the building envelope.

**510.5.3 Minimum qualifications of personnel.** The minimum qualifications of the system designer and lead acceptance test personnel shall include both of the following:

1. A valid FCC-issued general radio telephone operators license.
2. Certification of in-building system training issued by an *approved* organization or *approved* school, or a certificate issued by the manufacturer of the equipment being installed.

**510.5.4 Acceptance test procedure.** Where an in-building *emergency responder communication enhancement system* is required, and upon completion of installation, the building owner shall have the radio system tested to verify that two-way coverage on each floor of the building is in accordance with Section 510.4.1. The test procedure shall be conducted as follows:

1. Each floor of the building shall be divided into a grid of 20 approximately equal test areas, with a maximum test area size of 6,400 square feet. Where the floor area exceeds 128,000 square feet, the floor shall be divided into as many approximately equal test areas as needed, such that no test area exceeds the maximum square footage allowed for a test area.

2. The test shall be conducted using a calibrated portable radio of the latest brand and model used by the agency talking through the agency's radio communications system or equipment approved by the *fire code official*.

3. Coverage testing of signal strength shall be conducted using a calibrated spectrum analyzer for each of the test grids. A diagram of this testing shall be created for each floor where coverage is provided, indicating the testing grid used for the test in Section 510.5.4(1), and including signal strengths and frequencies for each test area. Indicate all critical areas.

4. Functional talk-back testing shall be conducted using two calibrated portable radios of the latest brand and model used by the agency's radio communications system or other equipment approved by the *fire code official*. Testing shall use digital audible quality (DAQ) metrics, where a passing result is a DAQ of 3 or higher. Communications between handsets shall be tested and recorded in the grid square diagram required by Section 510.5.3(2); each grid square on each floor; between each critical area and a radio outside the building; between each critical area and the fire command center or fire alarm control panel; between each landing in each stairwell and the fire command center or fire alarm panel.

5. Failure of more than 5 percent of the test areas on any floor shall result in failure of the test.

EXCEPTION: Critical areas shall be provided with 99 percent floor area coverage.

6. In the event that two of the test areas fail the test, in order to be more statistically accurate, the floor shall be permitted to be divided into 40 equal test areas. Failure of not more than two non-adjacent test areas shall not result in failure of the test. If the system fails the 40 area test, the system shall be altered to meet the 95 percent coverage requirement.

7. A test location approximately in the center of each test area shall be selected for the test, with the radio enabled to verify two-way communications to and from the outside of the building through the public agency's radio communications system. Once the test location

has been selected, that location shall represent the entire test area. Failure in the selected test location shall be considered to be a failure of that test area. Additional test locations shall not be permitted.

8. The gain values of all amplifiers shall be measured and the test measurement results shall be kept on file with the building owner so that the measurements can be verified during annual tests. In the event that the measurement results become lost, the building owner shall be required to rerun the acceptance test to reestablish the gain values.

9. As part of the installation, a spectrum analyzer or other suitable test equipment shall be utilized to ensure spurious oscillations are not being generated by the subject signal booster. This test shall be conducted at the time of installation and at subsequent annual inspections.

10. Systems shall be tested using two portable radios simultaneously conducting subjective voice quality checks. One portable radio shall be positioned not greater than 10 feet (3048 mm) from the indoor antenna. The second portable radio shall be positioned at a distance that represents the farthest distance from any indoor antenna. With both portable radios simultaneously keyed up on different frequencies within the same band, subjective audio testing shall be conducted and comply with DAQ levels as specified in Sections 510.4.1.1 and 510.4.1.2.

11. **Documentation maintained on premises.** At the conclusion of the testing, and prior to issuance of the building certificate of occupancy, the building owner or owner's representative shall place a copy of the following records in the Distributed Antenna System enclosure or the building engineer's office. The records shall be available to the fire code official and maintained by the building owner for the life of the system:

a. A certification letter stating that the *emergency responder enhancement coverage system* has been installed and tested in accordance with this code, and that the system is complete and fully functional.

b. The grid square diagram created as part of testing in Sections 510.5.3(2) and 510.5.3(3).

c. Data sheets and/or manufacturer specifications for the *emergency responder enhancement coverage system* equipment; back up battery; and charging system (if utilized).

d. A diagram showing device locations and wiring schematic.

e. A copy of the electrical permit.

**510.5 Installation requirements.** The installation of the public safety radio coverage system shall be in accordance with NFPA 1221 and Sections 510.5.1 through 510.5.7.

**510.5.5 FCC compliance.** The in-building, *emergency responder communication enhancement system* installation and components shall comply with all applicable federal regulations including, but not limited to, FCC 47 C.F.R. Part 90.219.

**510.5.6 Wiring.** The backbone, antenna distribution, radiating, or any fiber optic cables shall be rated as plenum cables. The backbone cables shall be connected to the antenna distribution, radiating, or copper cables using hybrid coupler devices of a value determined by the overall design. Backbone cables shall be routed through an enclosure that matches the building's required fire-resistance rating for

shafts or interior exit stairways. The connection between the backbone cable and the antenna cables shall be made within an enclosure that matches the building's fire-resistance rating for shafts or interior exit stairways, and passage of the antenna distribution cable in and out of the enclosure shall be protected as a penetration per the *International Building Code*.

**510.5.7 Identification signs.** *Emergency responder enhancement systems* shall be identified by an approved sign located on or near the fire alarm control panel or other approved location stating "This building is equipped with an *Emergency Responder Enhancement Coverage System*. Control Equipment located in ..... or as approved by the *Fire Code Official*." A sign stating "*Emergency Responder Enhancement Coverage System Equipment*" shall be placed on or adjacent to the door of the room containing the main system components.

**510.6 Maintenance.** The in-building, *emergency responder communication enhancement system* shall be maintained operational at all times in accordance with Sections 510.6.1 through 510.6.4.

**510.6.1 Testing and proof of compliance.** The owner of the building or owner's authorized agent shall have the in-building, two-way *emergency responder communication coverage system* inspected and tested annually or where structural changes occur including additions or remodels that could materially change the original field performance tests. Testing shall consist of the following items 1. through 7.:

1. In-building coverage test as required by the *fire code official* as described in Section 510.5.4 or 510.6.1.1.

EXCEPTION: Group R Occupancy annual testing is not required within dwelling units.

2. Signal boosters shall be tested to verify that the gain/output level is the same as it was upon initial installation and acceptance or set to optimize the performance of the system.

3. Backup batteries and power supplies shall be tested under load of a period of 1 hour to verify that they will properly operate during an actual power outage. If within the 1-hour test period the battery exhibits symptoms of failure, the test shall be extended for additional 1-hour periods until the integrity of the battery can be determined.

4. All other active components shall be checked to verify operation within the manufacturers specification.

5. If a fire alarm system is present in the building, a test shall be conducted to verify that the fire alarm system is properly supervising the emergency responder communication coverage system as required in 510.4.2.5. The test is performed by simulating alarms to the fire alarm control panel. The certifications in 510.5.2 are sufficient for the personnel performing this testing.

6. At the conclusion of testing, a record of the inspection and maintenance along with an updated grid diagram of each floor showing tested strengths in each grid square and each critical area shall be added to the documentation maintained on the premises in accordance with Section 510.5.3.

7. At the conclusion of the testing, a report, which shall verify compliance with Section 510.6.1, shall be submitted to the *fire code official*.

**510.6.1.1 Alternative in-building coverage test.** When the comprehensive test documentation required by Section 510.5.3 is available, or the most recent full five-year test results are available if the sys-



tem is older than six years, the in-building coverage test required by the fire code official in Section 510.6.1(1), may be conducted as follows:

1. Functional talk-back testing shall be conducted using two calibrated portable radios of the latest brand and model used by the agency's radio communications system or other equipment approved by the fire code official. Testing shall use digital audible quality (DAQ) metrics, where a passing result is a DAQ of 3 or higher. Communications between handsets in the following locations shall be tested: Between the fire command center or fire alarm control panel and a location outside the building; between the fire alarm control panel and each landing in each stairwell.

2. Coverage testing of signal strength shall be conducted using a calibrated spectrum analyzer for:

a. Three grid areas per floor. The three grid areas to be tested on each floor are the three grid areas with poorest performance in the acceptance test or the most recent annual test, whichever is more recent;

b. Each of the critical areas identified in acceptance test documentation required by Section 510.5.3, or as modified by the fire code official; and

c. One grid square per serving antenna.

3. The test area boundaries shall not deviate from the areas established at the time of the acceptance test, or as modified by the *fire code official*. The building shall be considered to have acceptable emergency responder communication coverage when the required signal strength requirements in Sections 510.4.1.1 and 510.4.1.2 are located in 95 percent of all areas on each floor of the building and 99 percent in critical areas, and any nonfunctional serving antenna are repaired to function within normal ranges. If the documentation of the acceptance test or most recent previous annual test results are not available or acceptable to the fire code official, the radio coverage verification testing described in Section 510.5.3 shall be conducted.

**510.6.2 Additional frequencies.** The building owner shall modify or expand the in-building, *emergency responder communication enhancement system* at their expense in the event frequency changes are required by the FCC or other radio licensing authority, or additional frequencies are made available by the FCC or other radio licensing authority. Prior approval of an in-building, *emergency responder communication enhancement system* on previous frequencies does not exempt this section.

**510.6.3 Nonpublic safety system.** Where other nonpublic safety amplification systems installed in buildings reduce the performance or cause interference with the in-building, *emergency responder communication enhancement system*, the nonpublic safety amplification system shall be corrected or removed.

**510.6.4 Field testing.** Agency personnel shall have the right to enter onto the property at any reasonable time to conduct field testing to verify the required level of radio coverage or to disable a system adversely impacting the *emergency responder communication enhancement system* in the region.

[Statutory Authority: RCW 19.27.031 and 19.27.074. WSR 22-13-093, 23-12-107, and 23-20-027, § 51-54A-0510, filed 6/14/22, 6/7/23, and 9/25/23, effective 3/15/24; WSR 21-04-003, § 51-54A-0510, filed

**(Effective March 16, 2024)**

**WAC 51-54A-0510 Emergency responder communication coverage.**

**510.1 Emergency responder communication coverage in new buildings.** Approved in-building, *emergency responder communications enhancement system (ERCES)* for emergency responders shall be provided in all new buildings. In-building ERCES within the building shall be based on the existing coverage levels of the public safety communication systems utilized by the jurisdiction, measured at the exterior of the building. The *emergency responder communications enhancement system*, where required, shall be of a type determined by the fire code official and the frequency license holder(s). This section shall not require improvement of the existing public safety communication systems.

**EXCEPTIONS:**

1. Where approved by the building official and the fire code official, a wired communication system in accordance with Section 907.2.13.2 shall be permitted to be installed or maintained instead of an approved communication coverage system.
2. Where it is determined by the *fire code official* that the communication coverage system is not needed.
3. In facilities where emergency responder communication coverage is required and such systems, components or equipment required could have a negative impact on the normal operations of that facility, the *fire code official* shall have the authority to accept an automatically activated *emergency responder communication coverage system*.

**510.2 Emergency responder communication enhancement system in existing buildings.** Existing buildings shall be provided with approved in-building, *emergency responder communications enhancement system* for emergency responders as required in Chapter 11.

**510.3 Permit required.** A construction permit for the installation of or modification to in-building, *emergency responder communication enhancement systems* and related equipment is required as specified in Section 105.6.4. Maintenance performed in accordance with this code is not considered a modification and does not require a permit.

**510.4 Technical requirements.** Equipment required to provide in-building, *emergency responder communication enhancement system* shall be listed in accordance with UL 2524. Systems, components and equipment required to provide the in-building, *emergency responder communication enhancement system* shall comply with Sections 510.4.1 through 510.4.2.8.

**510.4.1 Emergency responder communication enhancement system signal strength.** The building shall be considered to have an acceptable in-building, *emergency responder communication enhancement system* where signal strength measurements in 95 percent of all areas and 99 percent of areas designated as critical areas by the fire code official on each floor of the building meet the signal strength requirements in Sections 510.4.1.1 through 510.4.1.3.

**510.4.1.1 Minimum signal strength into the building.** The minimum inbound signal strength shall be sufficient to provide usable voice communications throughout the coverage area as specified by the *fire code official*. The inbound signal level shall be a minimum of -95 dBm in 95 percent of the coverage area and 99 percent in *critical areas* and sufficient to provide not less than a delivered audio quality (DAQ) of 3.0 or an equivalent signal-to-interference-plus-noise ratio (SINR) applicable to the technology for either analog or digital signals.

**510.4.2 System design.** The in-building, *emergency responder communication enhancement system* shall be designed in accordance with Sections 510.4.2.1 through 510.4.2.8 and NFPA 1221.

**510.4.2.1 Amplification systems and components.** Buildings and structures that cannot support the required level of in-building, *emergency responder communication enhancement system* shall be equipped with systems and components to enhance the radio signals and achieve the required level of in-building, *emergency responder communication enhancement system* specified in Sections 510.4.1 through 510.4.1.3. In-building, *emergency responder communication enhancement systems* utilizing radio-frequency-emitting devices and cabling shall be approved by the *fire code official*. Prior to installation, all RF-emitting devices shall have the certification of the radio licensing authority and be suitable for public safety use.

**510.4.2.2 Technical criteria.** The fire code official shall maintain a document providing the specific technical information and requirements for the in-building, *emergency responder communication enhancement system*. This document shall contain, but not be limited to, the various frequencies required, the location of radio sites, the effective radiated power of radio sites, the maximum propagation delay in microseconds, the applications being used and other supporting technical information necessary for system design.

**510.4.2.3 Standby power.** In-building, *emergency responder communication enhancement systems* coverage systems shall be provided with dedicated standby batteries or provided with 2-hour standby batteries and connected to the facility generator power system in accordance with Section 1203. The standby power supply shall be capable of operating the in-building, *emergency responder communication enhancement system* at 100 percent system capacity for a duration of not less than 12 hours.

**510.4.2.4 Signal booster requirements.** If used, signal boosters shall meet the following requirements:

1. All signal booster components shall be a National Electrical Manufacturer's Association (NEMA) 4, IP66-type waterproof cabinet or equivalent.

EXCEPTION: *Listed battery systems* that are contained in integrated battery cabinets.

2. Battery systems used for the emergency power source shall be contained in a NEMA 3R or higher-rated cabinet, IP65-type waterproof cabinet or equivalent.

EXCEPTION: *Listed battery systems* that are contained in integrated battery cabinets.

3. Equipment shall have FCC or other radio licensing authority certification and be suitable for public safety use prior to installation.

4. Where a donor antenna exists, isolation shall be maintained between the donor antenna and all inside antennas to not less than 20 dB greater than the system gain under all operating conditions.

5. Bi-directional amplifiers (BDA) used for in-building, *emergency responder communication enhancement systems* shall be fitted with anti-oscillation detection and control circuitry and per-channel AGC.

6. The installation of amplification systems or enhancement systems that operate on or provide the means to cause interference on any in-building, *emergency responder communication enhancement system* network shall be coordinated and approved by the fire code official.

7. Only channelized signal boosters shall be permitted.

EXCEPTION: Broadband BDAs may be utilized when specifically authorized in writing by the *frequency license holder*.

**510.4.2.5 System monitoring.** The in-building, *emergency responder communication enhancement system* shall include automatic supervisory and trouble signals that are monitored by a supervisory service and are annunciated by the *fire alarm system* in accordance with NFPA 72. The following conditions shall be separately annunciated by the *fire alarm system*, or, if the status of each of the following conditions is individually displayed on a dedicated panel on the in-building, *emergency responder communication enhancement system*, a single automatic supervisory signal may be annunciated on the *fire alarm system* indicating deficiencies of the in-building, *emergency responder communication enhancement system*:

1. Loss of normal AC power supply.
2. System battery charger(s) failure.
3. Malfunction of the donor antenna(s).
4. Failure of active RF-emitting device(s).
5. Low-battery capacity at 70 percent reduction of operating capacity.
6. Active system component malfunction.
7. Malfunction of the communications link between the *fire alarm system* and the in-building, *emergency responder communication enhancement system*.
8. Oscillation of active RF-emitting device(s).

**510.4.2.6 Additional frequencies and change of frequencies.** The in-building, *emergency responder communication enhancement system* shall be capable of modification or expansion in the event frequency changes are required by the FCC or other radio licensing authority, or additional frequencies are made available by the FCC or other radio licensing authority.

**510.4.2.7 Design documents.** The *fire code official* shall have the authority to require "as-built" design documents and specifications for in-building, *emergency responder communication enhancement systems*. The documents shall be in a format acceptable to the *fire code official*.

**510.4.2.8 Radio communication antenna density.** Systems shall be engineered to minimize the near-far effect. In-building, *emergency responder communication enhancement system* designs shall include sufficient antenna density to address reduced gain conditions.

EXCEPTION: Systems where all portable devices within the same band use active power control features.

**510.5 Installation requirements.** The installation of the in-building, *emergency responder communication enhancement system* shall be in accordance with NFPA 1221 and Sections 510.5.1 through 510.5.7.

**510.5.1 Mounting of the donor antenna(s).** To maintain proper alignment with the system designed donor site, donor antennas shall be permanently affixed on the highest possible position on the building or where *approved* by the *fire code official*. A clearly visible sign stating "MOVEMENT OR REPOSITIONING OF THIS ANTENNA IS PROHIBITED WITHOUT APPROVAL FROM THE FIRE CODE OFFICIAL." shall be posted. The antenna installation shall be in accordance with the applicable requirements in the *International Building Code* for weather protection of the building envelope.

**510.5.3 Minimum qualifications of personnel.** The minimum qualifications of the system designer and lead acceptance test personnel shall include both of the following:

1. A valid FCC-issued general radio telephone operators license.
2. Certification of in-building system training issued by an *approved* organization or *approved* school, or a certificate issued by the manufacturer of the equipment being installed.

**510.5.4 Acceptance test procedure.** Where an in-building *emergency responder communication enhancement system* is required, and upon completion of installation, the building owner shall have the radio system tested to verify that two-way coverage on each floor of the building is in accordance with Section 510.4.1. The test procedure shall be conducted as follows:

1. Each floor of the building shall be divided into a grid of 20 approximately equal test areas, with a maximum test area size of 6,400 square feet (595 m<sup>2</sup>). Where the floor area exceeds 128,000 square feet (11,904 m<sup>2</sup>), the floor shall be divided into as many approximately equal test areas as needed, such that no test area exceeds the maximum square footage allowed for a test area.

2. The test shall be conducted using a calibrated portable radio of the latest brand and model used by the agency talking through the agency's radio communications system or equipment approved by the *fire code official*.

3. Coverage testing of signal strength shall be conducted using a calibrated spectrum analyzer for each of the test grids. A diagram of this testing shall be created for each floor where coverage is provided, indicating the testing grid used for the test in Section 510.5.4(1), and including signal strengths and frequencies for each test area. Indicate all critical areas.

4. Functional talk-back testing shall be conducted using two calibrated portable radios of the latest brand and model used by the agency's radio communications system or other equipment approved by the *fire code official*. Testing shall use digital audible quality (DAQ) metrics, where a passing result is a DAQ of 3 or higher. Communications between handsets shall be tested and recorded in the grid square diagram required by Section 510.5.3(2); each grid square on each floor; between each critical area and a radio outside the building; between each critical area and the fire command center or fire alarm control panel; between each landing in each stairwell and the fire command center or fire alarm panel.

5. Failure of more than 5 percent of the test areas on any floor shall result in failure of the test.

EXCEPTION: Critical areas shall be provided with 99 percent floor area coverage.

6. In the event that two of the test areas fail the test, in order to be more statistically accurate, the floor shall be permitted to be divided into 40 equal test areas. Failure of not more than two non-adjacent test areas shall not result in failure of the test. If the system fails the 40 area test, the system shall be altered to meet the 95 percent coverage requirement.

7. A test location approximately in the center of each test area shall be selected for the test, with the radio enabled to verify two-way communications to and from the outside of the building through the public agency's radio communications system. Once the test location has been selected, that location shall represent the entire test area. Failure in the selected test location shall be considered to be a

failure of that test area. Additional test locations shall not be permitted.

8. The gain values of all amplifiers shall be measured and the test measurement results shall be kept on file with the building owner so that the measurements can be verified during annual tests. In the event that the measurement results become lost, the building owner shall be required to rerun the acceptance test to reestablish the gain values.

9. As part of the installation, a spectrum analyzer or other suitable test equipment shall be utilized to ensure spurious oscillations are not being generated by the subject signal booster. This test shall be conducted at the time of installation and at subsequent annual inspections.

10. Systems shall be tested using two portable radios simultaneously conducting subjective voice quality checks. One portable radio shall be positioned not greater than 10 feet (3048 mm) from the indoor antenna. The second portable radio shall be positioned at a distance that represents the farthest distance from any indoor antenna. With both portable radios simultaneously keyed up on different frequencies within the same band, subjective audio testing shall be conducted and comply with DAQ levels as specified in Sections 510.4.1.1 and 510.4.1.2.

11. **Documentation maintained on premises.** At the conclusion of the testing, and prior to issuance of the building certificate of occupancy, the building owner or owner's representative shall place a copy of the following records in the Distributed Antenna System enclosure or the building engineer's office. The records shall be available to the fire code official and maintained by the building owner for the life of the system:

a. A certification letter stating that the *emergency responder enhancement coverage system* has been installed and tested in accordance with this code, and that the system is complete and fully functional.

b. The grid square diagram created as part of testing in Sections 510.5.3(2) and 510.5.3(3).

c. Data sheets and/or manufacturer specifications for the *emergency responder enhancement coverage system* equipment; back up battery; and charging system (if utilized).

d. A diagram showing device locations and wiring schematic.

e. A copy of the electrical permit.

**510.5.5 FCC compliance.** The in-building, *emergency responder communication enhancement system* installation and components shall comply with all applicable federal regulations including, but not limited to, FCC 47 C.F.R. Part 90.219.

**510.5.6 Wiring.** The backbone, antenna distribution, radiating, or any fiber optic cables shall be rated as plenum cables. The backbone cables shall be connected to the antenna distribution, radiating, or copper cables using hybrid coupler devices of a value determined by the overall design. Backbone cables shall be routed through an enclosure that matches the building's required fire-resistance rating for shafts or interior exit stairways. The connection between the backbone cable and the antenna cables shall be made within an enclosure that matches the building's fire-resistance rating for shafts or interior exit stairways, and passage of the antenna distribution cable in and out of the enclosure shall be protected as a penetration per the *International Building Code*.

**510.5.7 Identification signs.** *Emergency responder enhancement systems* shall be identified by an approved sign located on or near the fire alarm control panel or other approved location stating "This building is equipped with an *Emergency Responder Enhancement Coverage System*. Control Equipment located in ..... or as approved by the *Fire Code Official*." A sign stating "*Emergency Responder Enhancement Coverage System Equipment*" shall be placed on or adjacent to the door of the room containing the main system components.

**510.6 Maintenance.** The in-building, *emergency responder communication enhancement system* shall be maintained operational at all times in accordance with Sections 510.6.1 through 510.6.4.

**510.6.1 Testing and proof of compliance.** The owner of the building or owner's authorized agent shall have the in-building, *emergency responder communication enhancement system* inspected and tested annually or where structural changes occur including additions or remodels that could materially change the original field performance tests. Testing shall consist of the following items 1 through 7:

1. In-building coverage test as required by the *fire code official* as described in Section 510.5.4 or 510.6.1.1.

EXCEPTION: Group R Occupancy annual testing is not required within *dwelling units*.

2. Signal boosters shall be tested to verify that the gain/output level is the same as it was upon initial installation and acceptance or set to optimize the performance of the system.

3. Backup batteries and power supplies shall be tested under load of a period of 1 hour to verify that they will properly operate during an actual power outage. If within the 1-hour test period the battery exhibits symptoms of failure, the test shall be extended for additional 1-hour periods until the integrity of the battery can be determined.

4. All other active components shall be checked to verify operation within the manufacturers specification.

5. If a fire alarm system is present in the building, a test shall be conducted to verify that the fire alarm system is properly supervising the *emergency responder communication enhancement system* as required in Section 510.4.2.5. The test is performed by simulating alarms to the fire alarm control panel. The certifications in Section 510.5.2 are sufficient for the personnel performing this testing.

6. At the conclusion of testing, a record of the inspection and maintenance along with an updated grid diagram of each floor showing tested strengths in each grid square and each critical area shall be added to the documentation maintained on the premises in accordance with Section 510.5.3.

7. At the conclusion of the testing, a report, which shall verify compliance with Section 510.6.1, shall be submitted to the *fire code official*.

**510.6.1.1 Alternative in-building coverage test.** When the comprehensive test documentation required by Section 510.5.3 is available, or the most recent full five-year test results are available if the system is older than six years, the in-building coverage test required by the fire code official in Section 510.6.1(1), may be conducted as follows:

1. Functional talk-back testing shall be conducted using two calibrated portable radios of the latest brand and model used by the agency's radio communications system or other equipment approved by

the fire code official. Testing shall use digital audible quality (DAQ) metrics, where a passing result is a DAQ of 3 or higher. Communications between handsets in the following locations shall be tested: Between the fire command center or fire alarm control panel and a location outside the building and between the fire alarm control panel and each landing in each stairwell.

2. Coverage testing of signal strength shall be conducted using a calibrated spectrum analyzer for:

a. Three grid areas per floor. The three grid areas to be tested on each floor are the three grid areas with poorest performance in the acceptance test or the most recent annual test, whichever is more recent;

b. Each of the critical areas identified in acceptance test documentation required by Section 510.5.3, or as modified by the fire code official; and

c. One grid square per serving antenna.

3. The test area boundaries shall not deviate from the areas established at the time of the acceptance test, or as modified by the *fire code official*. The building shall be considered to have acceptable emergency responder communication coverage when the required signal strength requirements in Sections 510.4.1.1 and 510.4.1.2 are located in 95 percent of all areas on each floor of the building and 99 percent in critical areas, and any nonfunctional serving antenna are repaired to function within normal ranges. If the documentation of the acceptance test or most recent previous annual test results are not available or acceptable to the fire code official, the radio coverage verification testing described in Section 510.5.3 shall be conducted.

**510.6.2 Additional frequencies.** The building owner shall modify or expand the in-building, *emergency responder communication enhancement system* at their expense in the event frequency changes are required by the FCC or other radio licensing authority, or additional frequencies are made available by the FCC or other radio licensing authority. Prior approval of an in-building, *emergency responder communication enhancement system* on previous frequencies does not exempt this section.

**510.6.3 Nonpublic safety system.** Where other nonpublic safety amplification systems installed in buildings reduce the performance or cause interference with the in-building, *emergency responder communication enhancement system*, the nonpublic safety amplification system shall be corrected or removed.

**510.6.4 Field testing.** Agency personnel shall have the right to enter onto the property at any reasonable time to conduct field testing to verify the required level of radio coverage or to disable a system adversely impacting the *emergency responder communication enhancement system* in the region.

[Statutory Authority: RCW 19.27.031 and 19.27.074. WSR 23-23-106, § 51-54A-0510, filed 11/15/23, effective 3/16/24; WSR 22-13-093, 23-12-107, and 23-20-027, § 51-54A-0510, filed 6/14/22, 6/7/23, and 9/25/23, effective 3/15/24; WSR 21-04-003, § 51-54A-0510, filed 1/20/21, effective 2/20/21; WSR 19-24-058, § 51-54A-0510, filed 11/27/19, effective 7/1/20.]