

International Building Code, 2009

Chapter 9: Fire Protection Systems

Section 915: Emergency Responder Radio Coverage

SECTION 915 EMERGENCY RESPONDER RADIO COVERAGE

[F] 915.1 General. Emergency responder radio coverage shall be provided in all new buildings in accordance with Section 510 of the *International Fire Code*.

International Fire Code, 2009

Chapter 5: Fire Service Features

Section 510: Emergency Responder Radio Coverage

SECTION 510 EMERGENCY RESPONDER RADIO COVERAGE

510.1 Emergency responder radio coverage in buildings. All newly constructed buildings above 10,000 square feet per floor with multiple below ground floors and greater than 3 floors in height, shall have *approved* radio coverage for emergency responders within the building based upon the existing coverage levels of the public safety communication systems of the jurisdiction at the exterior of the building. This section shall not require improvement of the existing public safety communication systems.

Exceptions:

1. Where it is determined by the *fire code official*, with documented proof, that the radio coverage system is not needed based upon the existing coverage levels of the public safety communication systems of the jurisdiction at the exterior of the building.

Exemptions:

1. All one and two family dwellings, townhomes, and newly constructed buildings with floors less than 10,000 sq. Ft.

510.2 Radio signal strength. The building shall be considered to have acceptable emergency responder radio coverage when signal strength measurements in 95 percent of all areas on each floor of the building including stairways and elevator machine rooms, meet the signal strength requirements of Sections [510.2.1](#) and [510.2.2](#).

510.2.1 Minimum signal strength into the building. A minimum signal strength necessary to achieve a DAQ of 3.4 shall be receivable within the building per TIA TSB-88

510.2.2 Minimum signal strength out of the building. A minimum signal strength necessary to achieve a DAQ of 3.4 when transmitted from within the building.

510.3 Emergency responder radio coverage in existing buildings. Existing buildings that do not have approved radio coverage for emergency responders within the building shall be equipped with such coverage according to one of the following:

1. Wherever existing wired communication system cannot be repaired or is being replaced, or where not *approved* in accordance with Section [510.1](#), Exception 1.
2. Within a time frame established by the adopting authority.

Add new Section 510.4 to the fire code to read as follows:

Section 510.4 Emergency Responder Radio Coverage Systems shall comply with Appendix J Emergency Radio Coverage Systems of the *Fire Prevention Code*.

Section 510.4 Provisions of Appendix J. Emergency Responder Radio Coverage

APPENDIX J: Emergency Responder Radio Coverage

Section J101: General

EMERGENCY RESPONDER RADIO COVERAGE

SECTION J101 GENERAL

J101.1 Scope. Systems, components and equipment required to provide emergency responder radio coverage shall be in accordance with this appendix.

J101.2 Permit. A construction permit is required for installation of or modification to emergency responder radio coverage systems and related equipment. Maintenance performed in accordance with this code is not considered a modification and does not require a permit.

APPENDIX J: Emergency Responder Radio Coverage

Section J102: Definitions

SECTION J102 DEFINITIONS

J102.1 Definitions. For the purpose of this appendix, certain terms are defined as follows:

AGENCY. Any emergency responder department within the jurisdiction that utilizes radio frequencies for communication. This could include, but not be limited to, various public safety agencies such as fire department, emergency medical services and law enforcement.

OUC. District of Columbia Office of Unified Communications.

Section J103: Technical Requirements

SECTION J103 TECHNICAL REQUIREMENTS

J103.1 System design. The emergency responder radio coverage system shall be designed in accordance with Sections [J103.1.1](#) through [J103.1.5](#) and in compliance the FCC Part 90 recommendation regarding public safety signal booster recommendations.

J103.1.1 Amplification systems allowed. Buildings and structures that cannot support the required level of radio coverage shall be equipped with a radiating cable system, a distributed antenna system (DAS) with Federal Communications Commission (FCC)-certified signal boosters such as bi-directional amplifiers (BDA) or other system approved by the *OUC* in order to achieve the required adequate radio coverage. The system shall operate on 800 MHz channels 806-824/851-869 MHz and 700 MHz channels 769-775/ 799-805 MHz. The system shall be compatible with operating on the 700 MHz National Public

Safety Broadband Network frequencies 758-768/ 788-798 MHz when the District government is required to implement this broadband data network.

J103.1.2 Technical criteria. The *OUC* shall maintain documentation providing the specific technical information and requirements for the emergency responder radio coverage 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 and other supporting technical information. The building owner is required to keep the latest document on site.

J103.1.3 Secondary power. The emergency responder radio coverage system shall be equipped with a secondary source of power. The secondary power supply shall supply power automatically when the primary power source is lost. The secondary source of power shall be capable of operating the emergency responder radio coverage system for a period of at least 12 hours.

J103.1.3.1 Standby and Emergency Power. Where the building is provided with a standby or emergency generator, the emergency responder radio system shall be connected to the emergency power circuit.

J103.1.3.2 Battery systems. The active components of the installed system or systems shall be capable of operating on an independent battery system for a period of at least 12 hours without external power input. The battery system shall automatically charge in the presence of external power input.

Exception: Where connected to a standby or emergency generator, the active components shall be capable of operating on the battery system for a period of at least 4 hours without external power input.

J103.1.4 Signal booster requirements. If used, signal boosters shall meet the following requirements:

1. All signal booster components shall be contained in a NEMA4-type waterproof cabinet.
2. The battery system shall be contained in a NEMA4- type waterproof cabinet.
3. The NEMA4-type cabinets shall be of fire engine red color, and bear the following in bright yellow lettering:

District of Columbia Public Safety Radio System Repeater

In case of system outages or downtime for maintenance please contact

District of Columbia Office of Unified Communications Radio Engineering

(202) 373-3737

4. The NEMA 4-type cabinets shall have a lock mechanism to keep the unit secure.
5. The system shall be monitored for integrity, including primary and secondary power sources and trouble or tamper signals supplied from the system in accordance with the requirements of NFPA 72. Required signals shall be annunciated locally as determined by the *fire code official*. Any resulting

trouble alarm shall be automatically transmitted to an approved supervising station as defined in NFPA 72 or, when approved by the *fire code official*, shall sound an audible signal at a constantly attended location. The system shall transmit alarms and system status to the District of Columbia's network operations center (NOC) using SNMP v3 format.

6. A visual indication shall be provided indicating that the radio equipment is on.

7. Equipment shall have FCC certification prior to installation.

8. The BDA shall be capable of repeating and transmitting both uplink and downlink frequencies for the trunked radio system.

9. Connection to primary power shall be by means of metallic conduit, supplied via a dedicated (20) amp circuit for each bi-directional amplifier.

10. A permanent sign shall be conspicuously installed in the fire command station or near the main entrance indicating the presence of the amplification system and the spectrum of frequencies served.

11. With the exception of mobile and portable radios, radio antenna systems shall include surge arrestors.

13. The system must be compatible and fully operational with both P25 Phase 1 and P25 phase 2 for all OUC channels. The system must be able to successfully operate to the voice quality standards in the presence of multiple simultaneous public safety portable radio transmissions (operating in "worst-case" locations).

14. The system must be able to withstand and maintain compliance with voice quality requirements with any other licensed system (other than the OUC system) signal at -35 dBm at the input of the signal booster.

J103.1.5 Additional frequencies and change of frequencies. The emergency responder radio coverage system shall be capable of modification or expansion in the event frequency changes are required by the District of Columbia, FCC, or other federal agency, or additional frequencies are made available by the FCC.

J103.2 Installation requirements. The installation of the public safety radio coverage system shall be in accordance with the Building Code and Sections [J103.2.1](#) through [J103.2.5](#).

J103.2.1 Approval prior to installation. No amplification system capable of operating on frequencies licensed to any public safety agency by the FCC shall be installed without prior coordination and approval of the OUC. The original BDA/DAS system design shall be submitted to the OUC Radio Engineering section for review and approval prior to installation. The BDA/DAS system talk-in contribution to the OUC system noise must be better than 10 dB below the equivalent receiver noise of the host OUC network site. Design documentation for the equipment must include talk-in and talk-out link budget calculations that demonstrate compliance with the OUC system noise requirement and compliance with the OUC system signal-to-noise ratio requirement. Any changes to the approved system design that occur shall be documented "as built" in the original design document and that

document shall be provided to both the OUC and the *fire code official*. Approval for system design changes must be received from the OUC prior to the implementation of the design changes.

J103.2.2 Permit required. A construction permit, as required by Sections [107.1 through 107.11](#), of the Fire Code shall be obtained prior to the installation of the emergency responder radio coverage system.

J103.2.3 Minimum qualifications of personnel. The minimum qualifications of the system designer and lead installation personnel shall include:

1. Certification of in-building system training issued by a nationally recognized organization or school or a certificate issued by the manufacturer of the equipment being installed.
2. Test personnel shall have five (5) years experience and be capable of operating the spectrum analyzer, sweep test equipment, and other required test equipment.

The OUC may waive these requirements upon successful demonstration of adequate skills and experience satisfactory to the OUC.

J103.2.4 Acceptance test procedure. When an emergency responder radio coverage system is required, and upon completion of installation, the building *owner* shall have the radio system tested to ensure that two-way coverage on each floor of the building is a minimum of 95 percent. The test procedure shall be conducted as follows:

1. The coverage tests shall be conducted to ensure compliance with **J103.1.4.13 and J103.1.4.14**.
2. For floors less than 32,000 sq ft, each floor of the building shall be divided into a grid of 20 approximately equal test areas. For floors 32,000 sq ft or more, each floor of the building shall be divided into grids of approximately 40 x 40 foot.
3. The test shall be conducted using a calibrated OUC portable radio of the latest brand and model used by the agency talking through the District's radio communications system.
4. A maximum of 10% non-adjacent areas shall be allowed to fail the test for a given floor.
5. In the event that more than 10% of the grid areas fail the test on a floor, in order to be more statistically accurate, the total number of grids shall be doubled. A maximum of 10% non-adjacent smaller grid areas shall be allowed to fail the test. If the system fails the smaller grid area test on a floor or if the overall system fails to meet the 95 percent coverage requirement, the system shall be redesigned to meet the requirements.
6. A test location approximately in the center of each grid area shall be selected for the test, then the radio shall be 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 area. If the test fails in the selected test location, that grid area shall fail, and prospecting for a better spot within the grid area shall not be allowed.

7. 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.

8. As part of the installation a spectrum analyzer or other suitable test equipment shall be utilized to insure spurious oscillations are not being generated by the subject signal booster. This test shall be conducted at time of installation and subsequent annual inspections. The spectrum analyzer shall be calibrated within 12 months of use and certification provided during testing.

9. The following radio calls shall be made during the course of the tests in each test location:

1. A voice call from a portable inside the building on a trunked talk group to a portable or mobile outside the building.
2. An audio quality voice test shall be conducted and shall meet the District's minimum design criteria of 3.4 Delivered Audio Quality (DAQ). DAQ of 3.4 is defined as "speech understandable without repetition, with some noise/distortion present."
3. Audio quality voice shall be conducted for talk-out and talk-in calls.
4. Voice calls shall be made from a portable radio at hip level with a speaker microphone. At a given test location, rekeying will be allowed if an initial PTT is not successful. Separate talk in tests shall be conducted simultaneously for both near and far radios using:
 - a. 800 MHz frequencies
 - b. 700 MHz frequencies (using separate 700 MHz frequencies)
 - c. 700 MHz frequencies (using TDMA on the same frequency but on different timeslots)
5. The tests shall determine if there is any interference with any collocated commercial services that might include a BDA/DAS system for commercial cellular carriers sharing or not part or all of equipment. Resolution of interference issues in such cases will be prioritized such that the DC-public safety emergency communications are satisfactory.
6. The tests shall also measure the BDA signals and voice audio quality beyond the building into the street to determine if there is any interference to the District's 10-site Simulcast radio system. Those tests shall be both ways.

10. Voice test from inside the building to another radio outside the building or the dispatcher shall be from a 3 watt 700/800 MHz portable radio. The talk out and talkback tests shall be conducted from the approximate center of the grids as defined in Section **J103.2.4.2**. Once the test location has been selected, prospecting for a better spot within the grid will not be permitted.

11. The Delivered Audio Quality (DAQ) test shall apply principles outlined in the National Telecommunications and Information Administration (NTIA) report 99-358. Specifically, the tests shall utilize sentences that are phonetically balanced, with both male and female voices reading four of the sixteen sentences created for this test. NTIA has recorded these sentences and they are available either via download or by request on a CD. The contractor shall use these recorded messages as a guideline in developing their audio test plan.

12. The tests may be conducted by the contractor that the building owner has hired to install the BDA/DAS system. However, prior to final acceptance, DAQ tests shall be conducted by fire department and OUC personnel as outlined above.

13. A copy of the test results shall be provided to the Fire Code Official and the OUC.

14. The fire code official and the OUC or their designees shall oversee the field tests.

J103.2.5 FCC compliance. The emergency responder radio coverage system installation and components shall also comply with all applicable federal regulations, including but not limited to, FCC 47 CFR 90.219.

J103.3 Maintenance. The emergency responder radio coverage system shall be maintained in accordance with Sections [J103.3.1](#) through [J103.3.5](#).

J103.3.1 Maintenance. The public radio coverage system shall be maintained operational at all times. Any failures of 4 hours or longer require notification to the OUC and the fire code official. In case of downtime due to maintenance, the OUC shall be notified in advance.

J103.3.2 Permit required. A construction permit, as required by Sections 107.1 through 107.11 of the *Fire Code*, shall be obtained prior to the modification or alteration of the emergency responder radio coverage system.

J103.3.3 Testing and proof of compliance. The emergency responder radio coverage system shall be inspected and tested annually or whenever 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 [J103.2.4](#).

2. Signal boosters shall be tested to ensure that the gain is the same as it was upon initial installation and acceptance.

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

4. All other active components shall be checked to verify operation within the manufacturer's specifications.

5. At the conclusion of the testing a report which shall verify compliance with Section [J103.3.4](#) shall be submitted to the *fire code official* and the OUC.

6. If an annual test fails to meet the minimum requirements, the fire code official and OUC shall consider this a fire protection system impairment, and will agree upon remediation timeline with the building owner.

J103.3.4 Additional frequencies. The building *owner* shall modify or expand the emergency responder radio coverage system at his or her expense in the event frequency changes are required by the District of Columbia, FCC, or other federal agency, or additional frequencies are made available by the FCC. Prior approval of a public safety radio coverage system on previous frequencies does not exempt this section.

J103.3.5 Field testing. Agency personnel and OUC representatives 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 in accordance with Section 108.3 of the Fire Code.

J103.3.6 Field Strength Test Equipment. All field strength measurements shall be conducted by test equipment that has been calibrated within the past year. Field strength shall be measured in dBm for each in-building client antenna and recorded as a baseline measurement. The test equipment shall use a flexible antenna similar to the one used on portable radios and shall be positioned directly below in-building client antennas with the top of the antenna 5 ft off the floor.

With the BDA connection to the donor antenna coax disconnected at the BDA, test equipment shall be connected to the BDA to measure the BDA uplink noise, absent any uplink signals, in dBm. Test equipment shall then be connected to the donor antenna coax to measure the host system control channel field strength in dBm. Both of these measurements shall be recorded as a baseline of the BDA's noise contribution to the host system.

With the BDA connection to the donor antenna coax disconnected at the BDA, an OUC portable radio configured with BDA compatible frequencies and operating on an FDMA talkgroup will be connected to the donor antenna coax to be keyed up for testing. Test equipment shall then be connected to the BDA to measure the field strength of the portable radio as received and amplified by the in-building client antennas and BDA in dBm. The transmit power of the portable radio and the received field strength measurements shall be recorded in dBm as a baseline of the total system isolation.

The BDA and antenna system shall be swept with test equipment to show frequency response, return loss, amplifier gain values and recorded as a baseline measurement.

Any anomalies will be corrected, and the tests repeated. Upon successful completion of the tests, the baseline test files shall be provided to the OUC on a CD or other media as specified by the OUC.

Failure of this section will prevent the issuance of a certificate of occupancy by the DC Dept. of Consumer and Regulatory Affairs.

J104.1 Documentation of Owner Responsibilities. The owner shall furnish a letter to the fire code official and the OUC accepting responsibility for the following requirements:

1. The upgrading of the system as required by the OUC and Fire Code Official.
2. To engage and maintain a service contract with a qualified vendor for required testing and maintenance of the system. The contract shall include an emergency service provision that requires emergency response within 4 hours of notification on a 24 hour, 7 day a week basis. Emergency contact information shall be maintained within the fire control room.
3. The letter shall be on company letterhead, signed by the property owner or his/her representative

OUC Radio Network Specifications Relevant to DAS Design

Site Name	Site Address (Washington, DC)	Latitude	Longitude
Reeves Center	2000 14th St NW	38°55'2.40"N	77° 1'57.10"W
4D	6001 Georgia Ave NW	38°57'46.89"N	77° 1'36.10"W
GW Hospital	2150 Pennsylvania Ave NW	38°54'3.54"N	77° 2'49.02"W
UDC	4200 Connecticut Ave NW	38°56'36.64"N	77° 3'54.41"W
1700 Rhode Island Ave.	1700 Rhode Island Ave NE	38°55'38.36"N	76°58'49.51"W
Georgetown Hospital	3800 Reservoir Rd NW	38°54'41.93"N	77° 4'31.46"W
One Judiciary Square	441 4th St NW	38°54'13.20"N	77° 1'1.39"W
Fletcher Johnson School	4650 Benning Rd SE	38°52'57.45"N	76°56'3.48"W
Sibley Hospital	5255 Loughboro Rd NW	38°56'11.97"N	77° 6'40.61"W
St. Elizabeth's Tower	2901 Robinson Pl SE	38°50'53.67"N	76°59'16.41"W

OUC 800 MHz Frequencies			OUC 700 MHz Frequencies		
P25 Phase 1 (FDMA) Channel	TX Freq (Talk Out)	RX Freq (Talk In)	P25 Phase 2 (TDMA) Channel	TX Freq (Talk Out)	RX Freq (Talk In)
1	854.8625	809.8625	5	769.90625	799.90625
2	856.1875	811.1875	6	769.96875	799.96875
3	856.5875	811.5875	7	770.40625	800.40625
4	857.1875	812.1875	8	770.46875	800.46875
5	857.5875	812.5875	9	770.71875	800.71875
6	858.5875	813.5875	10	770.96875	800.96875
7	859.0375	814.0375	11	773.34375	803.34375
8	859.0875	814.0875	12	774.03125	804.03125
9	855.2125	810.2125	13	774.28125	804.28125
10	855.2375	810.2375	14	774.34375	804.34375
11	855.4625	810.4625	Note: 700 MHz radios use 800 MHz control channel:		
12	856.9875	811.9875			
13	857.9875	812.9875			
14	858.9875	813.9875			
15	859.9875	814.9875			
16	860.9875	815.9875			