



8745 E. Orchard Rd #518
Greenwood Village, CO 80111
1-800-875-4292
Sales@Frontier-Radio.com

Denver, CO:

907.2.12.3.3 Radio systems. New high-rise buildings shall be equipped throughout with an approved Department of Safety Radio Enhancement System (RES) for radio communications in accordance with this section. The RES shall use bi-directional amplifiers with radiating (“leaky coax”) cable, or a discrete distributed antenna system or an equivalent technology. Radio communications systems shall operate on the frequencies range of 800 MHz to 870 MHz.

Amplifiers shall be powered by a dedicated uninterruptible power source (UPS) with a minimum backup time of eight (8) hours with all amplifiers at rated output. The UPS input circuit shall be a dedicated circuit and connected to the emergency generator, where provided. The circuit shall be provided with a “lock-on” device. The RES shall be maintained in an operative condition at all times and shall be replaced or repaired where defective. Maintenance of the RES shall be the responsibility of the owner. Records of all system inspections, tests, and maintenance shall be maintained on the premises for a minimum of three years and shall be copied to the Fire Department inspection official upon request.

907.2.12.3.3.1 Definitions.

Coverage Requirement. The radio system control channel signal level shall exceed -100dBm at 90% or more of the locations measured within each grid area. Equivalently, the service area reliability shall be 90% or greater on each floor of the structure and parking areas. In grid quadrants that exhibit marginal RF signal levels, DFD personnel will perform a radio test to determine if intelligible transmissions can be made through the enhanced radio system to and from the quadrant without the need for retransmission. If this test fails, communications will be considered inadequate and the quadrant will be considered to be outside the standard.

Radio Frequency Maintenance Plan. The Radio Frequency Maintenance Plan is a document developed by the Fire Department and distributed by the building owner for the purpose of maintaining the Department of Safety radio system from harmful interference generated on the property or otherwise under the control of the owner. At a minimum, it shall:

- Prohibit the use of any electronic systems known to degrade the effectiveness of Department of Safety radio communications.
- Permit Department site access during reasonable business hours when necessary to assess the source of interference to Department of Safety radio communications.

Department of Safety Radio Enhancement System (RES). The RES is a network of amplifiers, fiber optic cable, coaxial cable, and radiating cable and/or discrete antennas or an equivalent technology installed on or inside the property to enhance indoor radio communications.

907.2.12.3.3.2 Requirements. The system shall effectively operate throughout the structure. In addition to the areas identified in IFCA Section 907.2.12.3.1, radio communication is required throughout the parking garage and all areas below grade. Those areas which shield radio communication will be remedied through the use of currently acceptable technology, i.e. bi-directional amplifiers or (leaky coax) amplifier systems. Acceptance of the completed communication system will be based upon Fire Department approval of the acceptance test as described below. All RES equipment shall be FCC compliant.

Continued...



1. **Acceptance Test.** Measurement locations shall be uniformly distributed to the extent practical. There shall be at least 10 sampling measurements per 2,250 sq ft. (209.025 sq m) of gross building square footage. Adequate radio coverage shall be determined for the structure and parking areas separately. Elevators, stairways, and enclosed areas within each grid must be included in the testing. Execute the following steps:

- a) Create a uniform grid over each floor with 15 ft. (4.57 m) centers.
- b) At each accessible grid location, using a test receiver with sensitivity and thermal noise floor equal to or better than the Department of Safety radio, take at least one sample measurement of the radio system control channel.
- c) Repeat Step b for each grid point.
- d) Calculate the service area reliability:

$$\text{Service Area Reliability (\%)} = \frac{T_p}{T_t} 100\%$$

Where T_p is the total number of grid points passed (i.e., control channel $>-100\text{dBm}$) T_t is the total number of grid points measured.

If the building fails to achieve the coverage requirement, the building owner shall install additional RES and conduct a new acceptance test.

Measurements shall be taken with calibrated radio receivers by Denver Fire Department radio technicians or technicians with appropriate knowledge and training who are licensed by the Denver Fire Department to install RES systems, at the City's option. Test results shall be certified by a professional engineer licensed by the state of Colorado or by Denver Fire Department radio technicians. Random spot testing by Denver Fire and/or Police officials may take place at any time.

- 2) **Radio Frequency Maintenance Plan.** A radio frequency maintenance plan shall be developed which prohibits use of electrical/electronic equipment which cause degradation to the RES. The radio frequency maintenance plan shall be incorporated into the lease of every tenant.

- a) **Description:** High-rise building owners are required to maintain a Department of Safety Radio Enhancement System (RES) to permit Emergency Response personnel to communicate over their department radios in the event of an emergency. These communications are within the frequency range 800-870Megahertz (Mhz). The radio system control channel level signal shall be at least -100dBm at 90% or more of locations measured in accordance with the adopted Fire Code Section 907. Service area reliability shall be 90% or greater on each floor of the structure.
- b) This Plan specifically prohibits use of electronic and or communication devices and systems which are shown to degrade the effectiveness of the RES.
- c) This Plan requires Denver Fire Department personnel access to all areas of the structure including but not limited to; dwelling units, storage areas, parking areas, tenant offices and public areas, mechanical, electrical and communication equipment areas upon reasonable notice to building management and during reasonable business hours in order to assess and locate a source or sources of interference with the RES. Building management is responsible for coordination with building occupants. During such inspection, Department personnel shall be accompanied by a member of building management at all times.
- d) Future building alterations shall not degrade the effectiveness of the RES.

Continued...



8745 E. Orchard Rd #518
Greenwood Village, CO 80111
1-800-875-4292
Sales@Frontier-Radio.com



e) Failure of any RES component shall result in a distinct audible notification at a constantly attended location. Repair of RES shall be accomplished within 72 hours. Upon repair, the Denver Fire Department shall be notified to schedule an acceptance test. The extent of the test shall be at the Department's discretion as necessary to confirm proper operation and system coverage.

f) All work on the RES shall be accomplished by certified installers of companies possessing a valid Denver Fire Department license and after obtaining the appropriate Department permit.

g) Building; owners, occupants, employees, guests, contractors or subcontractors are prohibited from removing, modifying, altering or otherwise disturbing any RES component or system.

3. Periodic Testing of RES. Periodic testing of the RES shall be conducted as follows:

If the radio enhancement system appears to have degraded or if the tests fail to demonstrate adequate system performance in compliance with this standard, the owner of the building or structure is required to restore the system to a condition consistent with the original approval criteria. If the degradation to the system is due to building additions or renovation, the owner of the building shall restore/extend the system to all areas of the building in a condition consistent with the original approval criteria. Random spot testing by Denver Fire and/or Police officials may take place at any time.

a) Annual testing. All active components of the system, such as amplifiers, power supplies and backup batteries, shall be tested annually. More frequent testing shall be required if the operability of the system is in question. Alternatively, the RES may be continuously monitored electronically with remote fault alarms. Amplifiers shall be tested or monitored to ensure that the gain has not degraded from the installed value. Backup batteries and power supplies shall be tested under load for a period of at least one hour to verify that they will properly operate during an actual power outage. Annual tests shall be performed in accordance with the acceptance test procedures described above and shall be conducted in all common areas, garages, stairwells, elevators and corridors. Measurements shall be taken with calibrated radio receivers by Denver Fire Department radio technicians or technicians with appropriate knowledge and training and licensed by the Denver Fire Department. Test results shall be certified by a professional engineer licensed by the state of Colorado or by Denver Fire Department radio technicians.

b) Five-year testing. Every five (5) years, a radio coverage test in accordance with the Acceptance Test procedure described above shall be performed to ensure the system provides adequate radio coverage. Documentation of test results shall be submitted to the Fire Department. Measurements shall be taken with calibrated radio receivers by Denver Fire Department radio technicians or technicians with appropriate knowledge and training and licensed by the Denver Fire Department. Test results shall be certified by a professional engineer licensed by the state of Colorado or by Denver Fire Department radio technicians.

4. Failure detection. RES equipment shall have failure detection circuitry which provides detection of mechanical, electrical and power failure of the RES, as well as oscillation detection capability which will reduce the amplifier output to zero in the event of system oscillation. Detection of any failure shall result in a distinct audible notification at a constantly attended location approved by the Fire Department.

Continued...



8745 E. Orchard Rd #518
Greenwood Village, CO 80111
1-800-875-4292
Sales@Frontier-Radio.com



5. Permits. A #3A permit is required prior to installation. Repair, alteration or replacement of any RES system or component shall require issuance of a #3A permit. Submittal and approval of shop drawings are required to obtain a permit for RES system installations. Permits shall only be issued to companies possessing a valid Fire Department issued certificate. An annual Denver Fire Department permit for the RES shall be secured and maintained current.

6. Information signs. A legible sign stating "THIS BUILDING IS EQUIPPED WITH A RADIO REPEATER SYSTEM" shall be conspicuously posted in the fire command center.

7. Shop drawings. Shop drawings shall be submitted and approved prior to installation of any RES. Drawings shall be a deferred submittal in accordance with IBCA Section 154. Two sets of scaled, engineered installation shop drawings shall be provided. Documents shall be of sufficient clarity and detail to fully describe the proposed installation and equipment. Handwritten notes or comments on drawings is not acceptable. Documents shall include, but are not limited to:

- a) Facility address and name where applicable
- b) Name and address of system design and installation contractor with installation contractor DFD certificate number.
- c) Stamp and dated signature of Colorado registered professional engineer
- d) Manufacturer cut sheets for all cables, connectors, terminations, amplifiers, UPS, batteries, and antenna
- e) Manufacturer's installation instructions.
- f) Design calculations, (Link Budget) for signal levels at each terminal point and initial input signal strength
- g) Wiring riser and distribution diagrams
- h) Grounding details
- i) Battery calculations
- j) Location of all RES equipment
- k) "North" reference arrow
- l) Copies of FCC authorizations

907.2.12.3.3.3 Wiring methods. Installation wiring for radio communications shall follow the manufacturer's recommendations and NFPA 70 (NEC) Articles 810 and 820. All cable installations shall be UL listed.. Radiating cables shall be FCC type approved and installed using manufacturer specified clips to secure cables to the support structure. Coax cable installed as risers and in plenums shall be listed for the application. All risers shall be installed in metallic conduit. All terminations shall be made with manufacturer approved devices. Cable cuts shall be made with manufacturer approved tools and methods. Limited-use cable is not permitted. All penetrations through fire-rated construction shall be properly fire-stopped.

907.2.12.3.3.4 Installer certification. No contractor shall install, modify, repair, alter or replace an RES without a valid Denver Fire Department license. All field installers shall be individually certified by the manufacturer for the equipment being installed. Each certified installer shall be permitted to supervise one apprentice/helper.



8745 E. Orchard Rd #518
Greenwood Village, CO 80111
1-800-875-4292
Sales@Frontier-Radio.com