

BROOKLINE FIRE DEPARTMENT

System Requirements for a Public Safety Communication System

Effective April 24, 2020

1) **Emergency Responder Radio Coverage in Buildings**

- a) Emergency responder coverage shall be provided in all new buildings in accordance with 780 CMR (MA Building Code)
- b) Buildings shall have approved radio coverage for Brookline Fire Fighters and Police based upon the existing coverage levels of the Brookline Fire and Police Radio Systems. This shall be based on the available coverage at the exterior of the building. This shall not require improvement of the existing town radio systems.
- c) Existing buildings undergoing substantial renovations as determined by 780 CMR Chapter 34, a change of occupancy, or the installation of a new fire alarm system are required to provide radio coverage for the Brookline Fire and Police departments.
- d) Buildings and structures that cannot support the required level of radio coverage shall be equipped with a system that includes a bi-directional amplifier(s) (BDA) to achieve the required level of radio coverage.
- e) RF emitting devices and cabling used in the installation of the BDA shall be approved by the Brookline Fire Department. All RF emitting devices shall have the certification of the FCC and be suitable for public safety use prior to installation.

2) **Waiver of Radio Coverage System**

- a) Buildings that have sufficient levels of radio coverage to satisfy the requirements may request a waiver by submitting an affidavit to the Brookline Fire Department.
 - i) An accurate and complete RF survey indicating sufficient levels of Radio Coverage
 - ii) Coverage will be verified by contractors experienced and licensed to conduct the survey
- b) Waivers are valid for five (5) years and must be renewed
- c) At any time, if it is determined by the Brookline Fire Department, that radio coverage is not adequate, the waiver will be withdrawn. The owner will then be required to provide radio coverage as needed.

3) **Approval and Permit**

- a) Prior to the installation of a radio booster system, the following must be submitted to Brookline Fire Prevention:
 - i) Detailed drawings showing
 - (1) Location of the amplification equipment
 - (2) Location of the antenna systems
 - (3) View showing access to the equipment
 - ii) Schematic drawings
 - (1) Of the electrical system to the BDA
 - (2) Backup power
 - (3) Other necessary associated equipment

- iii) Manufacturer's data sheets on all equipment to be installed.
- b) Upon approval, a permit must be secured or amended through the Brookline Building Department from the Electrical Inspector. Any field changes that occur during construction shall be updated in the As-Built plans. This shall include any manufacturer's data sheets for any equipment changes not submitted in the original submittal. As Built plans shall be submitted and reviewed prior to acceptance.
- c) Property owners who maintain compliance with this document are granted permission to operate a signal booster on frequencies licensed to the Brookline Fire and Police Departments by the FCC. The failure to maintain compliance with this specification will result in the automatic withdrawal of said permissions. Citations may be levied by town departments for not maintain compliance.
- d) The Brookline Fire and Police Departments maintain responsibility for registering approved signal boosters with the FCC.

4) **Radio Coverage**

- a) General building areas shall be provided with 90% floor area radio coverage.
- b) Critical areas, including fire command centers, fire pump rooms, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical, shall be provided with 99% floor area coverage.

5) **System Design**

- a) The distributed antenna system may a radiating cable, fixed antennas or a combination of both.
- b) The system must comply with all applicable sections of FCC Rules (Appendix A).
- c) Permanent external filters or attachments shall not be permitted.
- d) Assembly/installation of all components shall comply with the present National Electrical Code.
- e) Survivability from attack by fire shall meet NFPA 72.
- f) All system components shall be installed, tested, inspected, and maintained in accordance with the manufacturer's published instructions.
- g) The system design and installation shall not exceed the FCC OET 65 Standards.
- h) The system shall be normally powered on and continuously provide passing of required frequencies.
- i) Shall be compatible with both analog and digital communications, simultaneously at the time of installation.
- j) BDA systems shall have lightning protection that complies with NFPA 780.
- k) Maximum propagation delay is 15 μ s
- l) The BDA shall be UL2524 Listed, UL Certificate of Compliance required in product submittal package.

6) **Signal Strength**

- a) A minimum inbound (downlink) signal strength of -95 dBm shall be provided throughout the coverage area. The inbound signal level shall be sufficient to provide a minimum of DAQ 3.0 for either analog or digital signals.
- b) A minimum outbound (uplink) strength of -95 dBm shall be provided at the Brookline public safety receivers. The outbound signal level shall be sufficient to provide a minimum of DAQ 3.0 for either analog or digital signals.

7) **Isolation**

- a) Antenna isolation shall be maintained between the donor antenna and all inside antennas
- b) This shall be kept to a minimum of 20dB under all operating conditions

8) **Pathway Survivability**

- a) Levels shall be as described in 780 CMR Section 5.10.
- b) Shall have a pathway survivability of Level 1, Level 2, or Level 3.
- c) Radiating cable shall not be required to be installed in metal raceway.
- d) Feeder and riser coaxial cables shall be rated as plenum cables.
 - i) Feeder coaxial cables shall be connected to the riser coaxial cable using hybrid coupler devices of a value determined by the overall design.
 - ii) Riser coaxial cables shall be rated as riser cables shall be rated as riser cables and routed through a 2 hour rated enclosure.
- e) The connection between the riser and feeder coaxial cables shall be made within the 2-hour rated enclosure, and passage of the feeder cable in and out of the 2-hour enclosure shall receive fire stopping rated to 2 hours.

9) **Non-Interference and Non-Public Safety System Degradation**

- a) No amplification system capable of operating on frequencies or causing interference on frequencies assigned to the Brookline Public Safety Departments by the FCC shall be installed without prior coordination and approval of said departments
- b) The property owner shall suspend and correct equipment installations that degrade the performance of the Brookline Public Safety radio frequencies or the BDA.
- c) BDA systems that share infrastructure with non-public safety service shall ensure that the coverage and performance of the public safety communication channels are not degraded below the required level of performance, regardless of the traffic carried by the non-public safety services.

- d) Secondary users must furnish a complete list of transmit and receive frequencies along with an intermodulation (IM) study that will accompany the permit application. The IM study will consist of the following calculations: $IM = Q * F$, $IM = F1 + F2 - F3$, $IM = Q1 * F1 + Q2 * F2$ for all follow-up frequencies up-link and down-link. These calculations will be done to the 5th order.

10) **System Radio Frequencies**

- a) The BDA shall be capable of transmitting all radio frequencies assigned to the Brookline Public Safety Departments and be capable of using any modulation technology in current use by them.
- b) Assigned Fire Department frequencies:
 - i) Downlink – 483.4375
 - ii) Uplink – 486.4375
- c) Assigned Police Department frequencies
 - i) Downlink – 471.0125 / 471.0125
 - ii) Uplink – 474.0125 / 474.0625
- d) Class B Amplifier Pass Band
 - i) The down link (from Brookline Fire) shall have a frequency center of 483 +/- 75 Hz.
 - ii) The up-link (to Brookline Fire) band shall have a frequency center of 486 +/- 75 Hz
- e) The BDA system is required to have up-link noise squelch.

11) **Frequency Changes**

- a) The BDA system shall be upgradeable to allow for changes or additions to system frequencies maintain radio system coverage as it was originally designed.

12) **Radio Survey**

- a) The building owner shall have the in-building radio system tested to ensure that 2-way radio coverage on each floor of the building meets or exceeds the required signal strength.
- b) Each floor of the building shall be divided into a grid of approximately twenty (20) equal areas.
 - i) A maximum of two (2) areas will be allowed to fail the test per floor.
 - ii) A spot located approximately in the center of a grid areas will be selected for the test.
 - iii) Once the spot has been selected, looking for a better spot is not permitted
 - iv) Field strength testing instrument
 - (1) Shall be calibrated annually
 - (2) Shall be of the frequency selective type incorporating a flexible antenna

- c) RF plots indicating the initial assessment of radio coverage and the enhanced coverage shall be submitted at the time of acceptance testing.
- d) All compliance testing is to be done with 50 ohm loads in place of the donor antenna to avoid interference. Brookline Dispatch shall be notified prior to any testing (617-730-2260).
- e) Unattended operation of the BDA is not permitted until the completion of acceptance testing.

13) **Power Supplies**

- a) At least two independent and reliable power supplies shall be provided for all RF emitting devices and any other components of the system.
- b) The Primary Power Source shall be supplied from a dedicated branch circuit and comply with NFPA 72.
- c) The Secondary Power Source shall consist of a storage battery dedicated to the system with 24 hours of 100% system operation capacity.

14) **Component Enclosures**

- a) All BDA components, RF filters, and battery system components shall be contained in a NEMA 4 or NEMA 4x type enclosure
- b) The cabinet shall be large enough to dissipate internal heat without venting the inside of the cabinet to the outside atmosphere. External or exposed RF filters are unacceptable
- c) The cabinet shall be painted red and equipped with a locking mechanism.
- d) The cabinet shall be labeled (in bright yellow)

15) **System monitoring**

- a) A sign located at the dedicated monitoring panel with the name and telephone number of the radio service provider indicating that they shall be notified of any alarm.
- b) Trouble signals must be immediately reported to the radio service provider.
- c) The Brookline Fire Department must be notified of any failures that extend beyond the two (2) hour time limit.
- d) The building's Fire alarm system shall include automatic supervisory signals for malfunctions of the BDA system that are annunciated by the fire alarm system in accordance with NFPA 72, and shall comply with the following.
 - i) Ownership must be made aware of the supervisory signal
 - ii) Monitoring for integrity of the system shall comply with NFPA 72
 - iii) System supervisory signals shall include the following:
 - (1) Donor antenna malfunction
 - (2) Active RF emitting device failure
 - (3) Low battery when 70% of the 24 hour battery is depleted

- (4) System component failure
- iv) Power supply supervisory shall include:
 - (1) Loss of normal power
 - (2) Loss of normal AC power
- v) The communications link between the fire alarm system and the BDA must be monitored for integrity
- e) A dedicated monitoring panel shall be provided at the main entrance alongside the FACP or with the remote annunciator for the FACP. It shall indicate:
 - i) Normal AC power
 - ii) Loss of normal AC power
 - iii) Battery charger failure
 - iv) Low Battery capacity (to 70% depletion)
 - v) Active RF emitting device malfunction
- f) The communications link between the dedicated monitoring panel and the two-way radio communications enhancement system must be monitored for integrity.

16) **Acceptance Testing**

- a) Delivered audio quality (DAQ) testing will be conducted by BrFD personnel to ensure that two-way radio coverage on each floor of the building, meets the minimum coverage requirements. At least five (5) business days' notice is required prior to the test being conducted.
- b) The building owner must ensure that acceptance testing occurs prior to the Fire Alarm System testing for the building.
- c) At the time of the test, the following are required:
 - i) The approved radio technician shall certify that the in-building radio system was installed and tested in accordance with the requirements of the current BrFD in-building radio specification.
 - ii) As part of the acceptance of the system, ownership must provide to the Brookline Fire Department proof of a maintenance contract with the BDA provider. The owner shall also be notified that they are required to have the requisite maintenance on the booster in accordance with the Building Code.
 - (1) 24/7 day response within 2 hours of notification of the problem
 - (2) The contract must be in place for a minimum of one (1) year
 - (3) RF survey results, gain values of all amplifiers
- d) Small scale drawings (11" x 17" maximum) of the structure shall be provided by the owner/contractor.
 - i) The plan shall show each floor divided into the grids
 - ii) Each grid shall be labeled to indicate the DAQ result from the RF survey.
- e) As-built plans
- f) BDA Manufacturer, Model #, Serial #, FCC Cert #
- g) Link Budget

17) **Testing procedures**

- a) For testing system signal strength and quality
 - i) The testing shall be based on the DAQ system
 - ii) A DAQ below 3.0 is a failure
- b) Delivered Audio Quality Definitions
 - i) *DAQ 1: Unusable, speech present but unreadable.*
 - ii) *DAQ 2: Understandable with considerable effort. Frequent repetition due to noise / distortion.*
 - iii) *DAQ 3: Understandable with slight effort. Occasional repetition required due to noise/distortion*
- c) A number of cells per floor shall be selected at random. Signal strength measurements shall be taken at the center of each cell.
- d) A maximum of two grid cells per floor will allowed to fail the test. If three (3) fail, the testing grid resolution may be double. If the number of grid cells is adjusted, the number of failed cells permitted shall be adjusted accordingly to meet the 90% coverage requirement.
- e) Failures will not be permitted in critical areas, including:
 - i) The Fire command center
 - ii) Emergency generator room
 - iii) Stairwells with a standpipe
 - iv) Elevator lobbies serving the Emergency Elevator
 - v) And other areas deemed critical by the fire department
- f) Both inbound and outbound signals shall be measured on each and every floor above and below ground including
 - i) Stairwells
 - ii) Basements
 - iii) Penthouse facilities
 - iv) Parking areas
- g) Measurements shall be made with the antenna held in a vertical position 3 to 4 feet above the floor (ie portable radio on a belt or in a turnout coat pocket).

18) **Annual Test**

- a) All active components of the in-building radio system, including but not limited to amplifier, power supplies, and back-up batteries, shall be inspected a minimum of once every twelve (12) months.
- b) Annual tests will be conducted by an authorized licensed company
- c) Amplifiers shall be tested to ensure that the gain is the same as it was upon initial installation and acceptance. The original gain shall be noted and any change in gain shall be documented.

- d) Back-up batteries and power supplies shall be tested under load for a period of one (1) hour to verify that they will operate during an actual power outage
- e) Active components shall be tested to verify they are operating as designed by the manufacturer. If communications appear to have degraded or if the tests fail to demonstrate adequate system performance, the owner of the building or structure is required to remedy the problem and restore the system in a manner consistent with the original approval criteria.
- f) The re-testing will be done at no expense to the Town as required in the original testing procedures.

19) **Five Year RF Survey**

- a) An RF Survey be conducted a minimum of once every five (5) years to insure that the radio system continues to provide the required level of radio coverage.
- b) The procedure set forth in Section L shall apply to such tests.

20) **Maintenance and Servicing**

- a) At final acceptance the building owner shall supply a letter to the Fire Department accepting the property owner's responsibilities. These responsibilities are as follows:
 - i) Upgrades to system as directed by the Brookline Fire Department;
 - ii) Maintenance contract in place with name of authorized company, who will provide a 24 hour by 7 day emergency response within two (2) hours after notification. The system shall be maintained in accordance with FCC requirements
 - iii) Annual Inspections
 - iv) 5- year surveys
- b) This letter is to be on company letterhead signed by the property owner or a legal representative.

21) **Modifications**

- a) Modification of an existing BDA System requires prior approval from the Brookline Fire Department.
- b) A permit application shall be submitted which includes a description of the work to be performed and drawings showing intended modification
- c) Modification work must not degrade radio coverage at any time
- d) An RF Survey must be completed and submitted after any modification to an existing antenna system.

22) **Radio Service Provider**

- a) An approved Radio Service Provider is a company that employs individual(s) that are qualified by the equipment manufacturer (in writing) to work on the bi-directional amplifier system and holds a valid FCC license
- b) Design, Installation and Testing shall be conducted, documented, and signed by a technician qualified by the equipment manufacturer (in writing) to work on the bi-directional amplifier system and who is also in possession of one of the following:
 - i) FCC General Radiotelephone Operator License
 - ii) APCO Radio Technician Certification
 - iii) Certification from an industry organization acceptable to the BFD
 - iv) Radio service providers will be issued call signs for use when transmitting on the Brookline Fire Radio System
 - v) Reports of annual inspections and 5-year RF Surveys must be submitted to the Brookline Fire Department.
 - vi) The Brookline Fire Department shall be notified in writing at least thirty (30) days prior to cancellation of a maintenance contract. Such notice shall contain the date and time such cancellation is to take effect, BDA location, and BDA Permit #.
 - vii) The BrFD Fire Prevention office shall be notified in writing upon the procurement of contractual agreements relating to in-building radios covered by this specification.

23) **Fire Department Inspections**

- a) BrFD Fire Personnel shall have the right to enter the property to conduct inspection IAW 527 CMR 1.00 (MA Fire Code) and MGL 148 (Fire Prevention Statute)
 - b) BrFD will endeavor to notify ownership should a BDA inspection be necessary
- The Brookline Fire Department does not endorse, recommend or specify any specific product, service provider or configuration as the means to comply with this specification.

Appendix A FCC Regulations

Title 47: Telecommunication PART 90-PRIVATE LAND MOBILE RADIO SERVICES Subpart I-General Technical Standards

§90.219 Use of signal boosters.

This section contains technical and operational rules allowing the use of signal boosters in the Private Land Mobile Radio Services (PLMRS). Rules for signal booster operation in the Commercial Mobile Radio Services under part 90 are found in §20.21 of this chapter.

(a) *Definitions.* The definitions in this paragraph apply only to the rules in this section.

Class A signal booster. A signal booster designed to retransmit signals on one or more specific channels. A signal booster is deemed to be a Class A signal booster if none of its passbands exceed 75 kHz.

Class B signal booster. A signal booster designed to retransmit any signals within a wide frequency band. A signal booster is deemed to be a Class B signal booster if it has a passband that exceeds 75 kHz.

Coverage area of a PLMRS station. All locations within the normal reliable operating range (service contour) of a PLMRS station.

Deploy a signal booster. Install and/or initially adjust a signal booster.

Distributed Antenna System (DAS). A network of spatially separated antenna nodes connected to a common source via a transport medium that provides wireless service within a geographic area or structure.

Operate a signal booster. Maintain operational control over, and responsibility for the proper functioning of, a signal booster.

Signal booster. A device or system that automatically receives, amplifies, and retransmits signals from wireless stations into and out of building interiors, tunnels, shielded outdoor areas and other locations where these signals would otherwise be too weak for reliable communications. Signal booster systems may contain both Class A and Class B signal boosters as components.

(b) *Authority to operate.* PLMRS licensees for stations operating on assigned channels higher than 150 MHz may operate signal boosters, limited to the service band for which they are authorized, as needed anywhere within the PLMRS stations' service contour, but may not extend the stations' service contour.

(1) PLMRS licensees may also consent to operation of signal boosters by non-licensees (such as a building owner or a signal booster installation contractor) within their service contour and across their applicable frequencies, but must maintain a reasonable level of control over these operations in order to resolve interference problems.

(i) Non-licensees seeking to operate signal boosters must obtain the express consent of the licensee(s) of the frequencies for which the device or system is intended to amplify. The consent must be maintained in a recordable format that can be presented to an FCC representative or other relevant licensee investigating interference.

(ii) Consent is not required from third party (unintended) licensees whose signals are incidentally retransmitted. However, signal booster operation is on a non-interference basis and operations may be required to cease or alter the operating parameters due to a request from an FCC representative or a licensee's request to resolve interference.

(2) [Reserved]

(c) *Licensee responsibility; interference.* PLMRS licensees that operate signal boosters are responsible for their proper operation, and are responsible for correcting any harmful interference that signal booster operation may cause to other licensed communications services. Normal co-channel transmissions are not considered to be harmful interference. Licensees are required to resolve interference problems pursuant to §90.173(b). Licensees shall act in good faith regarding the operation of signal boosters and in the resolution of interference due to signal booster operation. Licensees who are unable to determine the location or cause of signal booster interference may seek assistance from the FCC to resolve such problems.

(d) *Deployment rules.* Deployment of signal boosters must be carried out in accordance with the rules in this paragraph.

(1) Signal boosters may be used to improve coverage in weak signal areas only.

(2) Signal boosters must not be used to extend PLMRS stations' normal operating range.

(3) Signal boosters must be deployed such that the radiated power of the each retransmitted channel, on the forward link and on the reverse link, does not exceed 5 Watts effective radiated power (ERP).

(4) Class B signal boosters may be deployed only at fixed locations; mobile operation of Class B signal boosters is prohibited after November 1, 2014.

(5) Class B signal booster installations must be registered in the FCC signal booster database that can be accessed at the following URL: www.fcc.gov/signal-boostersiregistration.

(6) Good engineering practice must be used in regard to the radiation of intermodulation products and noise, such that interference to licensed communications systems is avoided. In the event of harmful interference caused by any given deployment, the FCC may require additional attenuation or filtering of the emissions and/or noise from signal boosters or signal booster systems, as necessary to eliminate the interference.

(i) In general, the ERP of intermodulation products should not exceed -30 dBm in 10kHz measurement bandwidth.

(ii) In general, the ERP of noise within the passband should not exceed -43 dBm in 10kHz measurement bandwidth.

(iii) In general, the ERP of noise on spectrum more than 1 MHz outside of the passband should not exceed -70 dBm in a 10kHz measurement bandwidth.

(7) Signal booster pass bands are limited to the service band or bands for which the operator is authorized. In general, signal boosters should utilize the minimum passband that is sufficient to accomplish the purpose. Except for distributed antenna systems (DAS) installed in buildings, the passband of a Class B booster should not encompass both commercial services (such as ESMR and Cellular Radiotelephone) and part 90 Land Mobile and Public Safety Services.

(e) *Device Specifications.* In addition to the general rules for equipment certification in §90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.

(1) The output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel.

(2) The noise figure of a signal booster must not exceed 9 dB in either direction.

(3) Spurious emissions from a signal booster must not exceed -13 dBm within any 100 kHz measurement bandwidth.

(4) A signal booster must be designed such that all signals that it retransmits meet the following requirements:

(i) The signals are retransmitted on the same channels as received. Minor departures from the exact provider or reference frequencies of the input signals are allowed, *provided that* the retransmitted signals meet the requirements of §90.213.

(ii) There is no change in the occupied bandwidth of the retransmitted signals.

(iii) The retransmitted signals continue to meet the unwanted emissions limits of §90.210 applicable to the corresponding received signals (assuming that these received signals meet the applicable unwanted emissions limits).

by a reasonable margin).

(5) On or after March 1, 2014, a signal booster must be labeled to indicate whether it is a Class A or Class B device, and the label must include the following advisory

- (1) In on-line point-of-sale marketing materials,
- (2) In any print or on-line owner's manual and installation instructions,
- (3) On the outside packaging of the device, and
- (4) On a label affixed to the device:

"WARNING. This is NOT a CONSUMER device. It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLERS. You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device. You MUST register Class B signal boosters (as defined in 47 CFR 90.219) online at www.fcc.gov/signal-boostersiregistration. *Unauthorized* use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation."

[78 FR 21564, Apr. 12, 2013]