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FIRE DETECTION AND ALARM SYSTEM

Ref.: IFC 509, 907, NFPA 72

8.01 Standards Established

- 8.01-1. **Scope.** The purpose of this standard is to clarify existing Code and City of Bellevue Fire Department requirements for the design, installation, performance and maintenance of fire alarm systems. This information is to supplement existing code requirements and does not cover all aspects. Section 907.1 of the IFC, as amended by the City of Bellevue provides the charging language and requirement that the installation be in accordance with NFPA 72.

The City of Bellevue has adopted the 2007 edition of NFPA 72.

- 8.01-2. The City of Bellevue has amended the 2006 International Fire Code by Ord. 5749. Section 903.4.2 of the IFC is amended to read as follows:

903.4.2 Alarms. Approved audible and visible alarm notification appliances shall be provided for every new or substantially altered automatic sprinkler system in accordance with Section 907 and throughout areas designated by the Fire Code Official. Sprinkler water-flow alarm devices shall be activated by water flow equivalent to the flow of a single sprinkler of the smallest orifice size installed in the system. Alarm devices shall be provided on the exterior of the building in an approved location. Where a fire alarm system is installed, actuation of the automatic sprinkler system shall actuate the building fire alarm system. Exception: With approval of the Fire Code Official, audible and visible alarm notification appliances may be omitted for approved residential sprinkler systems in 1 or 2 dwelling units if not otherwise specifically required.

- 8.01-3. Additional Fire Alarm controls and features are required when the fire alarm system is integral to Smoke Control Systems. Reference Section 909 of the IBC and Chapter 11 of the Fire Department Development Standards.

8.02 *Submission of Plans and Permits*

Ref.: IFC 907.1.1

- 8.02-1. Shop drawings for fire alarm systems are intended to provide basic information consistent with the objective of installing a fully operational, code-compliant fire alarm system and to provide the basis for the record drawings required elsewhere in the Codes.

Approval of shop drawings is not intended to imply waiver or modification of any requirements of the Codes or any other applicable criteria.

Shop drawings should include, to an extent commensurate with the extent of the work being performed, floor plan drawings, riser diagrams (except for systems in single-story buildings), control unit wiring diagrams, point-to-point wiring diagrams, and typical wiring diagrams as described herein.

All shop drawings should be drawn on sheets of uniform size and must include the minimum details required in IFC 907.1.1. In addition, the following information shall be provided:

- (1) Installing contractors fire alarm or low voltage permit number.
- (2) Device legend.
- (3) Point of compass.
- (4) Graphic scale.
- (5) System Operation Matrix indicating the actual fire alarm control panels response for each initiating device or zones input and its building controls output function. The matrix should include all If/Then - And/Or markers of the systems sequence of operation and events capabilities.

Floor plan drawings should be drawn to an indicated scale and should include the following information:

- (1) Floor identification.
- (2) Full height cross section, room description and ceiling construction details.
- (3) All walls and doors including partitions extending to within 15 percent of the ceiling height.
- (4) Fire alarm device/component locations.
- (5) Locations of fire alarm primary power connection(s).
- (6) Locations of monitor/control interfaces to other systems.
- (7) Riser locations.
- (8) Methods for compliance for survivability (emergency voice systems and shaft pressurization control wiring), where applicable.

System Information:

- (1) Manufacturer's cut sheets for all equipment including, but not limited to:
 - fire alarm control/annunciator panels.
 - automatic detection devices.
 - manual fire detection or signaling devices.
 - audible alarm devices.
 - visual signaling devices.
 - storage batteries.
 - door closers, smoke dampers, HVAC shut down devices, elevator recall devices, fire protection system monitoring devices, or similar devices that affect buildings or fire protection equipment services.
- (2) The source of primary power and its wiring riser diagram .
- (3) The source of secondary power, including battery discharge calculations. Battery calculations will be determined using 1.2 as a multiplier for amp. hr. requirements.
- (4) Voltage Drop Calculations.

Fire alarm system riser diagrams should include the following information:

- (1) General arrangement of the system, in building cross-section.
- (2) Number of risers.
- (3) Type and number of circuits in each riser.
- (4) Type and number of fire alarm system components/devices on each circuit, on each floor or level.

Control unit wiring diagrams should be provided for all control equipment (i.e., equipment listed as either a control unit or control unit accessory), power supplies, battery chargers, and annunciators and should include the following information:

- (1) Identification and location of the control equipment depicted
- (2) The signal initiating circuits and wiring diagram including size and number of conductors.
- (3) The audible and/or visual alarm indicating circuits and wiring diagram.
- (4) Rating and location of end-of-line resistors, relays and capacitors.
- (5) The means of protecting alarm detection or signaling circuits from physical damage and/or over current.
- (6) Identification of individual detectors, monitor modules and control relay modules is required by assigning each a unique number on the plans, as follows: Zone # -- Addressable Loop # (if applicable)--Device #. For a conventional system this may be shown as 14-07, representing zone fourteen with smoke detector

number seven. For addressable systems the example would be 14-05-07, representing zone fourteen, addressable loop number five, detector or device number seven.

- 8.02-2. Typical wiring diagrams should be provided for all initiating devices, notification appliances, remote alarm light emitting diodes (LEDs), remote test stations, and end-of-line and power supervisory devices.
- 8.02-3. Plans for all fire detection and alarm systems shall be submitted for review in accordance with this Chapter and Section 907 of the IFC.

8.03 *Wiring Methods*

Ref.: IFC 907.6

- 8.03-1. All wiring methods shall comply with the National Electrical Code, NFPA 72 and the Laws, Rules & Regulations for Installing Electric Wires & Equipment as adopted by the City of Bellevue and Washington Department of Labor and Industries.
- 8.03-2. The requirements for the primary power supply shall apply to all auxiliary panels and equipment. These shall include: A dedicated circuit, marked at the electric panels location and the fire alarm panel or auxiliary panels locations. All primary power conductors shall be physically protected in accordance with the IFC 907, 2005 NEC .
- 8-03.3. Wiring controlling smoke control or pressurization systems must comply with IBC 909 and Bellevue Development Standards Chapter 11. In particular pressurization control wiring must be protected to 2hr in accordance with amended IBC 909.20.6.

8.04 *General Requirements*

Ref.: IFC 907, NFPA 72, Chapter 4

- 8.04-1. Fire alarm systems shall be designed and installed only by persons who are experienced in the proper design, application, installation, and testing of fire alarm systems. Installers must hold a valid low voltage installation license pursuant to RCW 19.28. Ref '07 NFAP 72 – 4.3.2 and 4.3.3
- 8.04-2. All equipment, devices, and wiring shall be listed or approved by Underwriters Laboratories, and/or Factory Mutual and shall be approved for the purpose and environment for which they are being used. No one shall perform any type of modification to any device that would void its listing.
- 8.04-3. The fire alarm control panel, trouble signal indicators or remote annunciator shall be installed in areas which are normally staffed during the hours the building is occupied.
- 8.04-4. When the fire alarm control panel is located in an area that is not normally occupied a remote annunciator (R.A. / RZA) shall be provided at a normally occupied location with the minimum ability to display visually

and/or audibly alarm zone(s), trouble and supervisory signals. This provision also applies to control panels used solely for the purpose of elevator recall and other associated supervisory functions. (Normally occupied locations would include: reception areas, main elevator lobbies, information kiosk, etc.)

- 8.04-5. When the fire alarm control panel is located in an area that is not continuously occupied a smoke detector shall be provided within 15 feet of the panel. (Measured horizontally) This applies to all auxiliary panels and equipment that may be located remote from the fire alarm panel. (EX. Digital dialers, STUs, remote located power supplies, and fire alarm terminal cabinets)

EXCEPTION: When ambient conditions will not allow the use of smoke detectors a heat detector may be used. (IFC 907.2)

- 8.04-6. Where the Fire Alarm Control Panel (FACP) has controlling circuits for building controls the signal silence switch shall not reverse their operation. Only resetting the FACP. or a separate control reset device shall reverse their operation from an alarm condition.

- 8.04-7. Acceptance testing of fire protection systems (signaling, suppression, etc) shall be in accordance with the International Fire Code and NFPA 72. Prior to calling for an acceptance test the Fire Prevention Division shall be furnished with a written statement from the installing contractor to the effect that all parts, functions and components of the system have been installed in accordance with approved plans and 100% functionally tested in accordance with nationally recognized standards. (IFC 907.17, 907.18)

- 8.04-8. Fire Alarm Control Panel access must be via keyed locks, not keypads.

- 8.04-9. Where multiple panels are utilized in the same building, they shall be of same manufacturer unless otherwise approved by the Fire Code Official.

8.05 System Monitoring

Ref: IFC 907

- 8.05-1. All required fire alarm systems shall be supervised by an approved central, proprietary or remote station service or a local alarm which will give an audible signal at a constantly attended location.
- 8.05-2. Only central stations which are Underwriters Laboratories listed and/or Factory Mutual approved shall be used for monitoring fire alarm systems.
- 8.05-3. Communications methods for off premise monitoring shall be dual line digital dialer, radio with DACT primary, cellular with DACT primary, direct line, or multiplex. Where a DACT or STU are installed in any R-1 occupancy the telephone circuits shall be dedicated to the fire alarm control panel. In other occupancies DACT and STU circuits may be common to voice and data paths providing circuits are installed prior to

any telephone equipment. Minimum signals to be transmitted where applicable shall be:

- 1) Automatic fire sprinkler water flow alarm
- 2) Automatic fire sprinkler supervisory
- 3) Automatic fire sprinkler trouble
- 4) Automatic fire alarm (automatic and manual)
- 5) Fire alarm trouble.

8.05-4. International Fire Code Section 511 has been added by amendment, requiring Building radio coverage systems under specific instances. Section 511.1.5 of the IFC has been added to read as follows:

511.1.5 Supervision/continuing operation. The occurrence of any fault in this radio system where the system function is decreased will result in the transmission of a supervisory signal to the central station. If the system cannot be fully restored within one hour, the fire chief will be notified.

8.06 *Sprinkler System Supervision and Zoning*

Ref.: IFC 903

8.06-1. Only those transmitters that are UL listed and/or FM approved for this purpose may be used. When an audible alarm is required, only the transmitters approved for this purpose may be used. If a bell silence switch or a bell test switch is required, it must be used in conjunction with a UL/FM listed local control panel.

8.06-2. Any time a water-flow detection device is used in conjunction with a fire alarm panel, the following criteria shall be met:

1. The water flow indication shall be isolated to the first zone or zones or the fire alarm panel.
2. The installation shall be in conformance with Underwriters Laboratories Standard #864, which states that no alarm bell silencing switch shall be included unless installation wiring terminals are provided in the fire alarm control panel for the connection of a second alarm bell circuit to which the alarm signal will be transferred when the silence switch is operated.
3. In all occupancy types the notification appliances shall be arranged so that the interior notification devices will be silenced by the fire alarm control panels alarm silence switch. The exterior notification device shall be arranged so that it will not silence when water is flowing. The requirements for the exterior device may be accomplished by mechanical means, an alarm arranged in accordance with this document, or as configured by the fire alarm panel.

4. Approved tamper switches that sound a separate and distinct signal for both the off- normal and restoration to normal conditions shall be installed on sprinkler control valves. The trouble indication function of the water flow circuit may not be used to accomplish this requirement.

EXCEPTION: Valves in roadway boxes or in underground vaults that are subject to flooding may be locked in the open position as specified in Chapter 7 of these Standards.

5. Supervisory zone annunciation for automatic sprinkler systems shall be in accordance with the following:
 1. All compressor high/low air monitor devices shall be zoned independently.
 2. All exterior water control valves (P.I.V., OS&Y, etc.) shall be zoned independently.
 3. All temperature monitoring devices shall be zoned independently.
 4. All other supervisory initiating circuits shall be limited to 20 devices per zone.

8.06-3. Local 120-volt alarms shall have their circuit breaker clearly labeled and equipped with a lock-out to prevent inadvertent shut-off.

8.06-4. Minimum audible and visual signaling requirements for automatic sprinkler systems shall be an alarm bell located on the exterior of the building, and, audible and visual notification devices located on the interior of the building or occupancy in accordance with sections 6-8.07-5, 6-8.07-6, 6-8.07-7 and 6-8.07-10 of these standards. All notification circuits and appliances shall be in conformance with the Washington Amended Codes, Chapter 11, to the Uniform Building Code, 1997 Ed. and the Uniform Fire Code Standards 10-2, 1997 Ed. Notification appliances and circuits designed in accordance with the most recent edition of N.F.P.A. 72 shall be recognized as approved standards for occupant notification.

8.07 Placement and Type of Equipment

Ref.: IFC, 907 IBC 909

8.07-1. Smoke detectors used for activation of ventilating equipment in accordance with IBC Section 909.20.6 shall be located outside the smoke proof enclosure served. Where the conditions outside the smoke proof enclosure preclude the installation of a smoke detector, a smoke detector shall be located inside the smoke proof enclosure within 5 feet of each affected entrance.

- 8.07-2. Where complete automatic fire detection is required, fire alarm devices shall be installed in all accessible areas.
1. Rate-of-rise heat detectors shall be placed in storage lockers, janitorial closets, electrical rooms, machine equipment rooms and elevator equipment rooms. They shall not be installed outside or in bathrooms, laundry rooms or other areas where there is steam or moisture.
 2. Fixed temperature heat detectors shall be used in places where there is moisture or excessive heat, such as laundry rooms, bathrooms, attics, kitchens and boiler rooms.
 3. Smoke detectors shall be installed as specified by the Fire Chief or his/her designate.
- 8.07-3. Buildings divided by one or more area or occupancy separation walls shall be zoned to indicate the separate areas.
- Multiple floor buildings shall be zoned to indicate each floor level and, if necessary, separate zones on each floor level.
- Automatic detection devices shall be installed on a separate zone from manual signaling devices when required by the Fire Chief or his/her designate.
- Additional zoning shall be required as directed by the Fire Chief or his/her designate.
- 8.07-4. In a building three or more stories in height, or a multiple building arrangement (campus), Signaling Line Circuits shall be arranged so that a short, ground or open within a zone will not cause the loss of initiating devices, notification devices or building control in any other zone or building of the protected premises. A zone shall indicate a building, a floor, or area of a floor divided by fire walls.
- Notification circuits shall be arranged so that an open or short on one notification zone will not affect other notification circuits or zones.
- 8.07-5. All initiating devices in non accessible areas, hidden from view, or located so it is not apparent as to which device has initiated an alarm shall be installed with a remote alarm indicating light (R.A.I.L.) (L.E.D) located in close proximity to the device.
- EXCEPTION:** Individual devices on their own zone with alpha-numeric displays or zone placards capable of describing the exact location of the device.
- 8.07-6. In all buildings where duct detectors are required by any other code, duct detectors shall be supervised by the fire alarm control panel.
(International Mechanical Code Sec. 606)

8.07-7. Elevator recall function (Phase 1) shall be performed with smoke detectors on two separate vertical zones. One for primary, and one for alternate floor recall. All elevator capture signals shall be generated by the Fire Alarm Control Panel for elevator lobby, hoist way or machine room smoke detectors. Smoke detectors with relay bases shall not use the relay to initiate Phase 1 recall. The relay shall be used to trip zone(s)-(wire supervised) in the adjacent corridor for floor location annunciation at the F.A.C.P. Manual pull stations, water flow switches, process monitoring and other input functions shall not be used to initiate elevator recall.

EXCEPTION: General alarm relay outputs originating at, and supervised by, the F.A.C.P. may be used to initiate primary and alternate floor recall from appropriately zoned floor coverage providing only automatic initiating devices are utilized.

8.07-8. Where audible appliances are installed to signal sleeping areas, the maximum of 15 dBA above the average ambient sound or a minimum of 70 dBA shall be provided. Audible devices shall be placed in apartments, hotels, and motels or similar occupancies so that with all intervening doors closed, sound level measurements shall be the maximum of 15dbA above the average ambient sound or a minimum of 70 dbA at any point within the room.

Where handicapped accessible dwelling units are provided, individual audible and visual alarm indication device shall be installed in those units.

8.07-9. Audible signals intended for the operation in public mode shall have a sound level of not less than 75dBA at 10ft. (3m) or more than 110 dBA at the minimum hearing distance from the audible appliance.

To ensure that audible public mode signals are clearly heard, it shall be required that their sound level be at least 15dBA above the average ambient sound level or 5 dBA above the maximum sound level having a duration of at least 60 seconds (whichever is greater), measured 5 feet (1.5m) above the floor in the occupiable area. For the purposes of this section, the Table 6-8.07 shall be used as a guide for the average ambient noise level of various occupancies.

**Table 8.07
Ambient Noise Table**

Occupancy Type	Ambient Noise Level
Business Occupancies.....	45 dbA
Educational Occupancies.....	45 dbA
Industrial Occupancies*.....	80 dbA
Institutional Occupancies.....	50 dbA
Mercantile Occupancies.....	40 dbA
Piers and Water Surrounded Structures.....	40 dbA
Places of Assembly.....	40 dbA
Residential Occupancies.....	35 dbA
Storage Occupancies.....	30 dbA

NOTE: Where audible appliances are installed in mechanical equipment rooms for any of the above occupancies, the average ambient sound level that may be used for design guidance is at least 85 dbA.

NOTE: To keep the audible alarm and voice message from transmitting to areas not in alarm or required to relocate or evacuate, elevator lobby, freight elevator lobby or device within 5 feet of a stairwell door shall be of visual (strobe) type only.

8.07-10. Whenever a fire alarm exists in a building, the fire alarm system shall be upgraded to include visible and audible alarms whenever the alarm system or associated components such as speakers or horns are modified or moved. Whenever an entire space or area is being remodeled, the space or area shall be upgraded to include visible and audible alarms. The system or device upgrade is not required to extend beyond the scope of the improvement work. Fire alarm systems shall be in accordance with this section and the International Fire Code . (State Building Code Interpretation No. 92-107).

8.07-11. When an automatic fire alarm system is installed in facilities that have commercial cooking equipment, the fire extinguishing system protecting the cooking equipment shall be interconnected with the fire alarm system so that activation of the fire extinguishing system will cause an alarm to sound throughout the protected premises.

8.07-12. Voice / paging speakers in stairwells shall be installed at intervals not exceeding one in every five floors. Alert tone, voice Messaging and alarm signal audibility levels shall be in accordance with nationally recognized standardsVoice / paging speakers installed in stairwells shall not activate on a general alarm condition where the life-safety plan of the building allows for relocation of occupants. Voice / paging speakers in stairwells shall be on a separate paging circuit where the life-safety plan of the building allows for relocation of occupants.

- 8.07-13. In buildings which relocate occupants (phased evacuation) or in building which are 5 or more story in height shall have ALL of these stairwell doors, elevator lobby doors (secured elevator lobbies) and any doors leading to the exit stairwell un- lock on activation of the building fire alarm system and activation of the manual door unlocking switch. The manual unlocking switch shall be located on the FFSCP.
- 8.07-14. All system components including relays, transient suppressors, terminal strips, modules, etc. must be securely mounted by mechanical means. (Adhesives shall not be permitted)

8.08 *Operating Instructions*

Ref.: IFC 907

- 8.08-1. A set of instructions on methods to reset the fire alarm system after an alarm or trouble condition shall be permanently posted adjacent to the fire alarm panel. The instructions shall be protected from moisture or other damage.

The location of the power disconnect switch for the fire alarm system shall be clearly posted inside the door of the fire alarm control panel.

The power disconnect switch for the fire alarm system shall be clearly labeled within the circuit breaker panel or fuse box where it is found.

8.09 *Fire Alarm Signage*

Ref.: IFC 907

- 8.09-1. A clearly marked pictograph of the building layout indicating the fire alarm zone configurations shall be provided adjacent to the fire alarm control panel, at the main entrance, or in a location as specified by the Fire Chief or his/her designate, when it is required by the Fire Chief or his/her designate.
- 8.09-2. When required by the Fire Chief or his/her designate, the pictograph shall be a lighted annunciator panel.
- 8.09-3. Where applicable, the pictograph shall also describe the location of the fire sprinkler riser, and shall indicate that it is on a separate fire alarm zone.
- 8.09-4. A detailed sketch of the pictograph shall be submitted to the Fire Department for review and approval prior to installation.
- 8.09-5. When the control panel is located inside a room, the outside of the door shall have a sign that reads: "**Fire Alarm Control Panel**"

Letters shall be one (1) inch high and shall contrast to their background.

A key to provide emergency access to the fire alarm control panel shall be provided on the premises.

- 8.09-6. All fire alarm control panels shall be outfitted with permanent signs on or adjacent to the front panel door as follows:

**NOTICE TO TECHNICIANS
NOTIFY YOUR CENTRAL STATION**

False alarms resulting from a Technician's failure to notify the fire department prior to system service shall be billed at the rate of \$150 per occurrence.
DO NOT REMOVE BY ORDER OF THE FIRE MARSHAL
Bellevue City Ordinance 4653

The sign shall measure at least four (4) inches wide by two (2) inches tall and shall have letters on a contrasting background.

- 8.09-7. All Signage and placards shall be in accordance with the following: The use of marking pens, tapes or other non-permanent marking devices is prohibited. Engraved phenolic resin plates or their equivalent will be an accepted method of placarding for zoning, RAILS, fire alarm control rooms, etc.

8.10 Elevator Shaft and Machine Rooms

- 8.10-1. When automatic sprinkler protection is provided in elevator machine rooms and at the top of elevator shafts, the sprinkler system shall be arranged to disconnect electrical service to the elevator main line prior to the application of water by the following method:
- a. A fixed temperature 135 degree Fahrenheit thermal detector shall be provided at the top of the elevator hoist way and within the elevator equipment room to disconnect the main line power.
 - b. Thermal detectors shall be ceiling mounted and located within eighteen (18) inches of each sprinkler.
 - c. Thermal detectors shall be an auxiliary function of the elevator equipment only, and shall be identified with signs reading: "**Elevator Control Only-- DO NOT TEST**". The signs shall have letters at least one-half (1/2) inch high on a contrasting background.
 - d. Power for the automatic disconnect control circuit shall be derived from the load side of the elevator power main disconnecting means. The disconnect control device shall be located in the elevator equipment room, and shall be provided with a sign

reading “**ELEVATOR AUTOMATIC DISCONNECT**”. The sign shall have letters at least one-half (1/2) inch high on a contrasting background.

- 8.10-2. Alternative power disconnect means are acceptable provided they are approved by the Washington State Department of Labor and Industries Elevator Section. (Their telephone number is 1-206-277-7281).
- 8.10-3. See Chapter 7.12 of these Standards for sprinkler requirements in elevator shafts and machine rooms.
- 8.10-4. See Appendix VIII of these standards for elevator recall information.

APPENDIX 8

FIRE DETECTION AND ALARM SYSTEMS - RESERVED

The following is reserved for a Fire Detection and Alarm Plan Review Checklist, which must be completed and submitted with the working plans and calculations: