

28 31 46 – Smoke Detection Sensors

1. General

- A. Smoke detectors are the one of the most critical components of life safety systems. Unfortunately, the tests used for approval or listing of these devices in the United States have shortcomings. These tests do not grade performance, nor do they evaluate the reliability of real-world systems operating in a variety of environments. Detectors must prove themselves in the field.
- B. OESO approval is required for each model number of smoke detector to be used. Approval will require conformance to all the criteria below, **plus** satisfactory proof of reliable performance in the field. OESO approval may be withdrawn at any time based on evidence to the contrary.

2. Smoke Detection Sensors

- A. Smoke detectors shall operate on the ionization and/or photoelectric principle (as describe in Subsection 3 of this document).
- B. Consultants will coordinate selection of smoke detector types on a space-by-space basis with FMD.
- C. Locations not suited to the installation of conventional spot-type smoke may be protected by other means, including thermal detectors, IR/UV flame sensors, linear beam detectors or air sampling smoke detectors.
- D. Smoke detector selection should prioritize the following criteria:
 - 1. Adequate sensor coverage to ensure activation in case of fire and
 - 2. Minimization of false alarms through accidental activation and tampering.
- E. Smoke detectors shall be capable of having their sensitivity electrically calibrated in the field (while installed in the systems) without the use of "smoke". Spot type smoke detectors which have a field sensitivity adjustment must provide a total adjustment range of at least 0.6% per foot obscuration.
 - 1. **Note:** The field calibration must provide valid data that can be directly correlated with smoke measurements made for ANSI/UL 268 listing tests.
- F. The "nominal" sensitivity of spot-type smoke detectors shall be factory set between 1.3% per foot and 3.5% per foot obscuration (calibrated using the UL's standard smoke test).
 - 1. **Note:** This does not mean that each smoke detector has to be adjusted in a smoke test chamber. Equivalent methods such as firing voltage offset may be used.

- G. Detectors must have necessary RF/EMI shielding to prevent any interference from nearby operation of equipment such as radio transmitters, diathermy machines, lamp ballasts and cellular telephones.
- H. Smoke detectors must not false alarm for air stream velocities up to 650 feet/minute (200 meters/minute), from any direction.
- I. All detectors must be sufficiently rigged to withstand required handling and cleaning while using ordinary care, without damage to FET's or other components.
 - 1. **Note:** In addition to instructions on the use of air/vacuum to remove loose dust and insects, the manufacturer shall provide either a detailed cleaning procedure for removing greasy and grimy deposits **or** shall have a factory exchange program for recycling detectors for periodic cleaning and recalibration.
- J. Ionization chambers shall be stainless steel (or approved equal) to assure long term stability and resistance to corrosion in coastal areas.
- K. Detectors for open area use shall have a concealed locking device securing them to their base in order to prevent unauthorized removal.
- L. Housings must be relatively strong and resistant to physical abuse.
- M. Jumper clips used on bases for circuit checkout prior to installation of detector head must be designed so that the detector cannot be plugged in with the clips in place.
- N. The following requirements apply only to linear beam smoke detectors:
 - 1. Linear beam detectors shall have a minimum of three calibrated sensitivity settings capable of maintaining sensitivity between 1.0% and 2.0% per meter obscuration, at any operating distance between 10 and 60 meters.
 - 2. The manufacturer shall provide a calibration chart giving the Smoke Sensitivity versus Operating Distance for each sensitivity setting. This chart shall also show the UL-permitted sensitivity limits for the entire range of rated operating distances.
 - 3. Linear beam detectors must be rated for continuous operation up to 50°C (122°F) and 95% RH.
 - 4. Compensating circuits must be provided in the detector to maintain normal sensitivity as environmental condition change and as dust builds up on the lenses. When the limits of this compensation are reached, a "trouble" signal must be initiated.
 - 5. Horizontal and vertical adjustments must be provided on both the transmitter and the receiver for alignment of the IR beam. They must permit a minimum angular change of 7.5° from the center axis (in any direction).

6. The IR beam must be modulated to assure reliable operation in the presence of very high ambient light and/or background IR.
 7. Abrupt, maintained blockage of the IR beam shall result in a "trouble" signal (not alarm), to be initiated within a time span of 10 seconds minimum to 60 seconds maximum. Obscuration equal to the alarm threshold shall cause alarm within 10 seconds maximum.
 8. Removal of the receiving unit's cover shall cause a "trouble" signal in order to prevent tampering.
 9. Each linear beam detector must be supplied with a kit of obscuration filters for sensitivity testing.
 10. Provide test switch 5' AFF (above finished floor) for each detector (if remote test option available).
- O. The following smoke detector systems meet the criteria set forth in this document and are acceptable for Campus Facilities. We encourage designers of life safety systems to contact FMD and OESO if they wish to seek approval of other detectors.
1. **Note:** Several of these smoke detectors are sold by various OEMs under their own brand names and model numbers. These are too numerous to list here. They are acceptable for Duke University use, contingent upon the Engineer being provided with corporate documentation verifying that they are UL Listed and identical to below, except for marking and/or communications protocol.

Manufacturer	Model	Type
Fenwalnet	70-401001-000	Ion
	71-401001-000	Photo
	70-404001-000	Ion w/RV
	71-404001-000	Photo w/RV
System Sensor	6424	LB
Detection Systems	DS240	LB
Gamewell/Pyrotronics	A2400	LB
Edwards	SIGA	

3. Applications for Smoke Sensors

The chart below provides 'rule of thumb' recommendations for smoke detector system selection based on generic room types (e.g. "gymnasiums," "office areas," etc.). However, room type alone is not sufficient information for the selection of a smoke detector system. For example, a low-ceilinged room used for fencing practice might be considered a "gymnasium" in terms of its type — but the recommended Linear Beam type detector would be subject to frequent false alarms due to the room geometry and use.

This chart is not intended to form the sole basis of smoke detector system selection, nor is it intended to absolve the Design Consultant of responsibility for selection of the optimal system. It is the Design Consultant's responsibility to recommend and specify (with Owner approval) the most appropriate smoke detector system for each room, based on anticipated use, occupancy and room geometry, to achieve the smoke detector system performance goals outlined in Division 28 31 46, Section 2A3.

Locations	Recommended Detector Type
Atriums/Auditoriums	Linear Beam
Attics	Thermal
Corridors-Residential	Photo
Corridors-Institutional	Photo
Corridors - Other Occupancies	Ion/Photo
Office Areas	Ion/Photo
Cable Rooms (PVC)	Photo
Elevator Equip. Rooms	Ion/Photo
Furnace/Boiler Rooms	Thermal
Gymnasiums	LB
Kitchens	Thermal
Laboratories (Chemical)	Thermal
Linen Rooms	Thermal
Loading Docks	Thermal
Mech/Elect. Equip. Rooms	Thermal
Motor-Generator Rooms	Thermal
Storage (Ambient)	Thermal
Storage (Conditioned)	Thermal
Duct Smoke Detectors	Photo

- A. **Note:** LB indicates Linear Beam smoke detector with separate transmitter and receiver. Typical operating range 30 to 300 feet.
- B. **Caution:** Vehicle exhaust, nearby cooking, ambient temperatures, or very high humidity may preclude the use of smoke detectors in some locations. Thermal detectors should include rate-of-rise feature, unless installed where temperature increase may exceed 15°F/minute. **Always consider device ratings vs. environment of planned installations!**
- C. **Caution:** See "Standards for Fire Detection and Alarm Systems" regarding detector-control panel compatibility and "HVAC shutdown" and other functions.
- D. **Note:** Most spot type "ceiling" smoke detectors are also listed for wall mounting, which is preferred for some applications (generally those with very low ceilings). Contact OESO-Fire Safety Division for more information.
- E. **Note:** Duct smoke detectors capable of operating on either 120 VAC or 24 VDC (selectable option in the detector) must be powered from the FACP. The use of 120 VAC for duct detector power is limited to cases where there is no system FACP present.
- F. **Note:** Return air duct detectors can be **omitted** if a complete smoke detection system or other alternative complying with NFPA 72 is provided. This may reduce total system cost, especially in rather small buildings.
- G. **Note:** Detector usage must conform to the Applications for Smoke Detectors in Subsection 3 of this document. Deviations may be permitted by OESO if warranted by specific project considerations. Please contact FMD or OESO.