

Essential Fire Alarm



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Glossary

Active device - An electronic device requiring power to function.

Addressable Loop - A 2-wire non shielded (low capacitance) communications and power bus for addressable fire alarm devices.

Addressable Device - Input monitors and manual pull stations, heat, smoke, combination detectors, output relays and specialized modules.

AHU - Air Handling Unit

Ancillary - Having a life safety function that is not a primary part of the FAS.

Annunciator - Common Controls and LED zone indicators.

Audible Device - Signalling devices designed to emit sound.

CACF - See *Central Alarm and Control Facility*

Central Alarm and Control Facility - Annunciator and common controls for firefighters.

Contact-type device - A passive device that provides a NO contact-closure when active.

Data Isolator - A passive electronic module used to isolate addressable loop short circuits.

Data Loop - See Addressable Loop

Device - A Fire Alarm Initiating, Signaling or Ancillary Appliance.

End of Line - End of Line Device, typically a current limiting resistor for conventional zone supervision.

End of Line Relay - 24VDC relay. Paired with an input module to supervise an unsupervised power bus.

EOL - See *End of Line*.

EOLR - See *End of Line Relay*

FAS - Fire Alarm System

FACP - Fire Alarm Control Panel.

Initiating Zone - (INI) A supervised input to a FACP

Indicating Zone - (IND) A polarity-reversing supervised output from the FACP.

Input Module - An addressable input module used to supervise a dry contact.

Relay Module - An addressable dual Form C relay contact closure.

Signaling - An audible or visual FACP output.

Strobe - A visual indicating appliance (strobe light) operating at 1~3Hz

Supervised Output - A module used to supervise a load and energize it when active.

Synchronization Module - Provides synchronous operation between visual appliances. Located at FACP inline between field wiring and signal zone wiring. 4 11/16 box.

Conventional Fire Alarm Systems

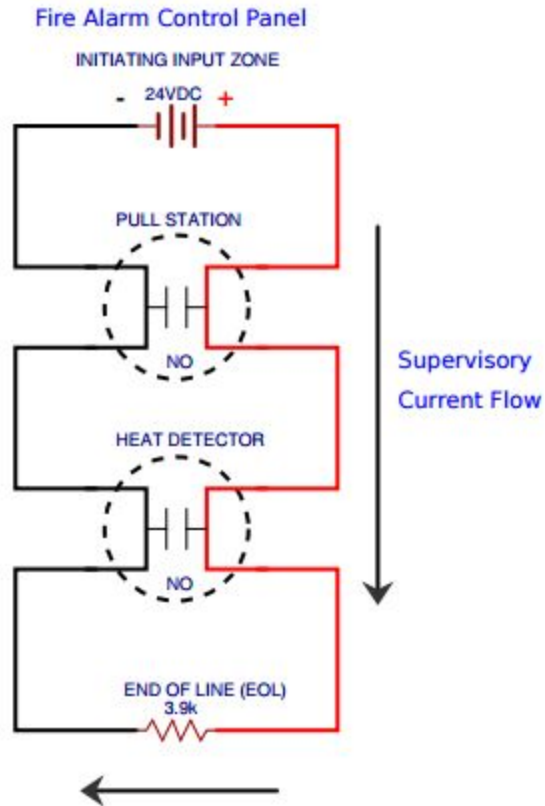
Applications

Conventional fire alarm systems are suitable for applications with a limited number of zones and trivial requirements for electrical interlocks to ancillary life-safety devices such as AHU shutdown relays. Initiating and signalling wiring must be home-run and dedicated to each specific zone.

Conventional Zone 4-Wire Supervision

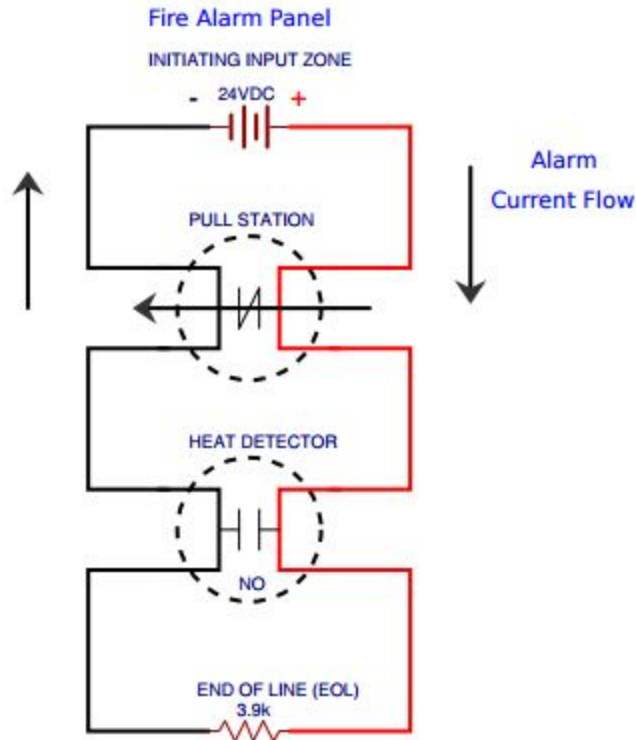
Input, or “initiating” zones in a normal, non-alarm condition, are said to be in a “supervisory state”. Each device on the zone is electrically supervised via a 4-conductor electrical supervision scheme in which the system monitors supervisory current through an End of Line (EOL) device; typically a passive, current-limiting resistor. If any conductor should break away from a device, supervisory current is interrupted and a trouble condition is raised on the system.

Notice each device has 4 terminating leads --This ensures current flows through the factory sealed internal terminations, thereby electrically supervising the device:



Conventional Initiating Zone Activation

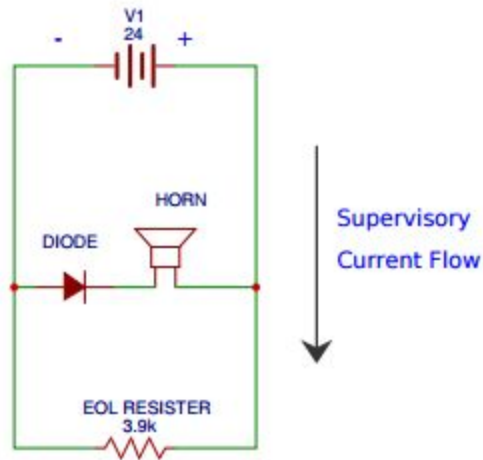
Passive contact-type devices such as manual pull stations and heat detectors signal an alarm condition via dry contact closure; a momentary short activates the zone, initiating an alarm condition. In the figure below, a manual station has been activated, thereby shorting the input zone:



Tip! Conventional smoke detectors are an active-type electronic initiating device and require a compatible initiating input zone. Unlike contact-type fire detectors that short the line to indicate an alarm, smoke detectors signal an alarm condition by loading the circuit; this allows a nominal voltage level to remain on the line to keep the active electronic components of the smoke detector powered while in alarm. Performing a system reset temporarily removes the zone power, allowing activated conventional smoke detectors on the zone to clear from an alarm.

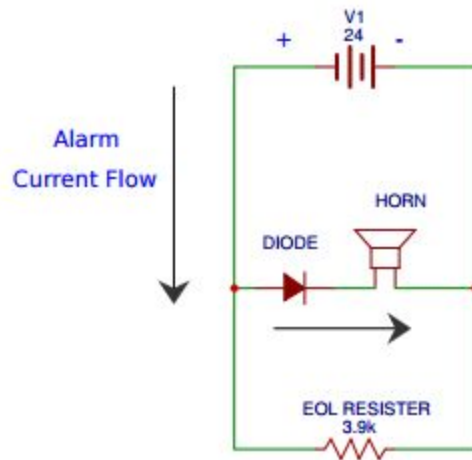
Conventional Signal Circuit Supervision

Signaling devices such as fire alarm gongs, suite buzzers and horns have a built-in diode that blocks current flow through the device's electronics when the zone is in a supervisory state. As such, the system only detects current flow through the EOL device for zone supervision:



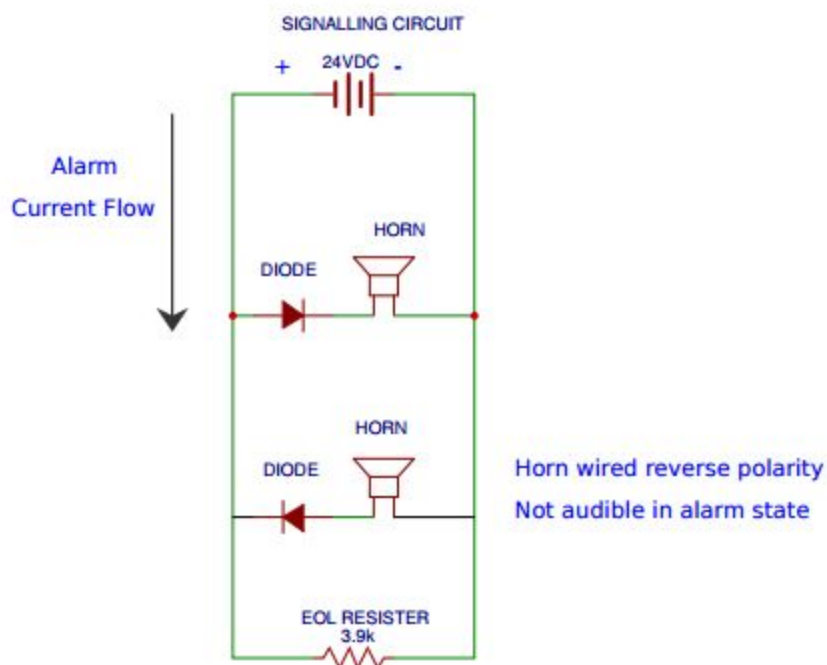
Signal Circuit Polarity Reversal

To signal an alarm, the circuit's polarity is reversed by the panel thereby allowing current to flow through each signaling device:



Signal Circuit Troubleshooting

When one or more devices are wired in reverse polarity, the current greatly exceeds the nominal supervisory current anticipated through the EOL as current flows through the EOL and the load devices that are wired reverse. As such, systems typically isolate current limited signalling zones and report a short circuit trouble. To troubleshoot polarity reversals, initiate a fire drill *before* terminating the zone in the panel. This allows the zone to activate normally as signal zones in alarm are not supervised --The load current while in alarm is too large to detect the EOL supervisory current.



Conventional System Electrical Interlocks

Conventional initiating devices can be interconnected with conventional signalling devices in one of two ways, by device or by zone:

- **By Device:** hardwired in-field relay base provides Form C dry contacts signalling discrete *device* activation.
- **By Zone:** programmable relay at the FACP - provides Form C dry contacts signalling *zone* activation.

Conventional System Annunciation

Conventional systems offer hardwired local and remote annunciation via sequential (mirror image) LED display panels. An output LED is activated upon activation of any initiating (input) zone.

Tip! In Canada, an individual LED must be provided at the fire department response point for each NBC of Canada required alarm zone. In short, an LED display must be located at the primary building entrance, typically in the main lobby. The main FACP need not include zone annunciation LEDs when a remote annunciator is provided for the purpose.

Considerations of Conventional Systems

Conventional systems offer a cost-effective solution for small applications of minimal complexity, require dedicated home-run zone wiring and hard-wired electrical interlocks

Every conventional field device must be connected 4-wire on dedicated home-run zone wiring – NO Tee-Taps or Pig Tails as this circumvents the wiring methods necessary for proper conventional zone wiring supervision.

Tip! Conventional zone wiring must not have more than 2 conductors in a splice, junction or termination --Use this as a quick visual check to rule out wiring supervision issues.

Addressable Fire Alarm Systems

Addressable fire alarm systems allow a network of devices to communicate over a common addressable data bus. Each device reports detected levels and diagnostic information to the central FACP. The FACP is then responsible for determining what action to take. For example, if subsequent sensor values reported by a smoke detector are indicative of a dirty environment, the system follows a compensation algorithm and allows the detector's alarm threshold to drift over time, thereby avoiding false alarms.

This communication over a common bus is made possible by assigning a unique electronic address number to each device. A major advantage to this scheme is that addressable devices are supervised electronically; not electrically through zone wiring. This means that 4-wire conventional wiring methods are no longer necessary --supervision is assured as the FACP communicates with each addressable device.

Tip! With a unique address assigned to every detector, addressable fire alarm systems have the capability of activating an output upon activation of one or more input devices. This facilitates advanced interlock capabilities without the necessity of dedicated home run wiring. Elevator recall signals, for example, can be achieved entirely through programming by correlating elevator lobby smoke detectors to activate homing relays located in the elevator machine room.

Addressable Loop Wiring Methods

Early addressable systems were not protected from short circuit conditions on field wiring. As such, a single short would cause the entire addressable loop to fail. Data isolation modules are now mandated to segment the shared data loop wiring. This offers electrically isolated data loop zones similar to the isolation that would have been provided with conventional zone wiring.

Required Isolation Zones

Data isolators must be provided for any NBC required fire alarm zone. At minimum, isolate into zones vertically for each floor level, horizontally for each NFPA 13 system protection area limit (typical 3,700m²) or 2,000m² for non-sprinkled buildings, hoistways, stairwells and required fire compartments per BCBC. Special requirements exist for Group B occupancies where horizontal separation is required per floor into a minimum of two zones of <1,000m² in floor area.

Fire Alarm Zones vs Data Isolation Zones

A fire alarm zone required by Building Code must provide a dedicated zone LED for alarm annunciation. Data isolators must also be provided for each of these required fire alarm zones. However, there are specific exceptions to this rule: Sprinkler mechanical devices, HVAC equipment and suppression system monitor modules are permitted to be wired within the physical isolation zone in which they are physically installed. E.g., sprinkler flow and tamper modules located in a stairwell are served by the stairwell isolator; not the isolator on the floor area zone that the mechanical devices serve.

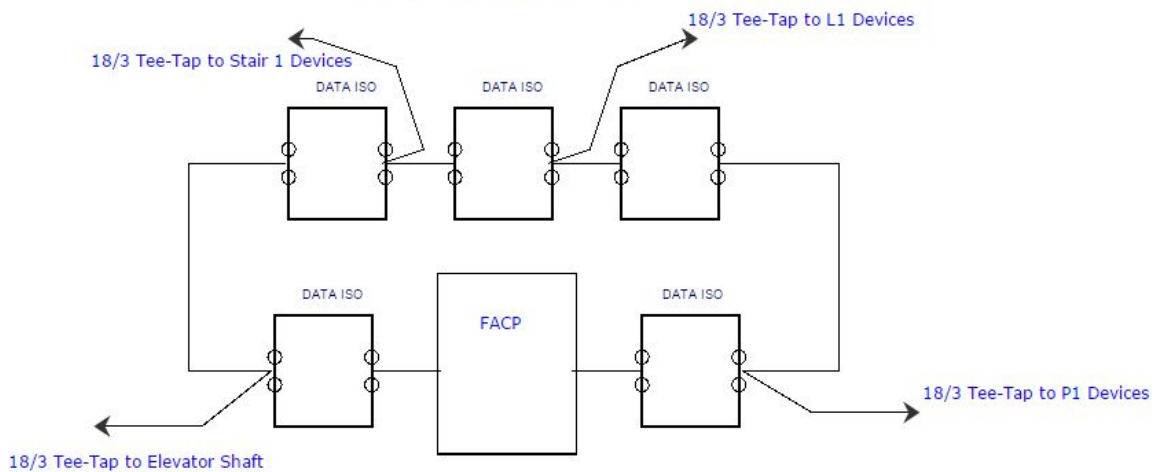
Class A Loop with Class B Zone Taps

The figure below specifies recommended isolation zones for typical applications.

			MUA		
Stair 1			Elevator Shaft		Stair 2
L4					
L3					
L2					
L1					
P1		Mechanical Rm	Elevator Machine Room	Elect Rm	

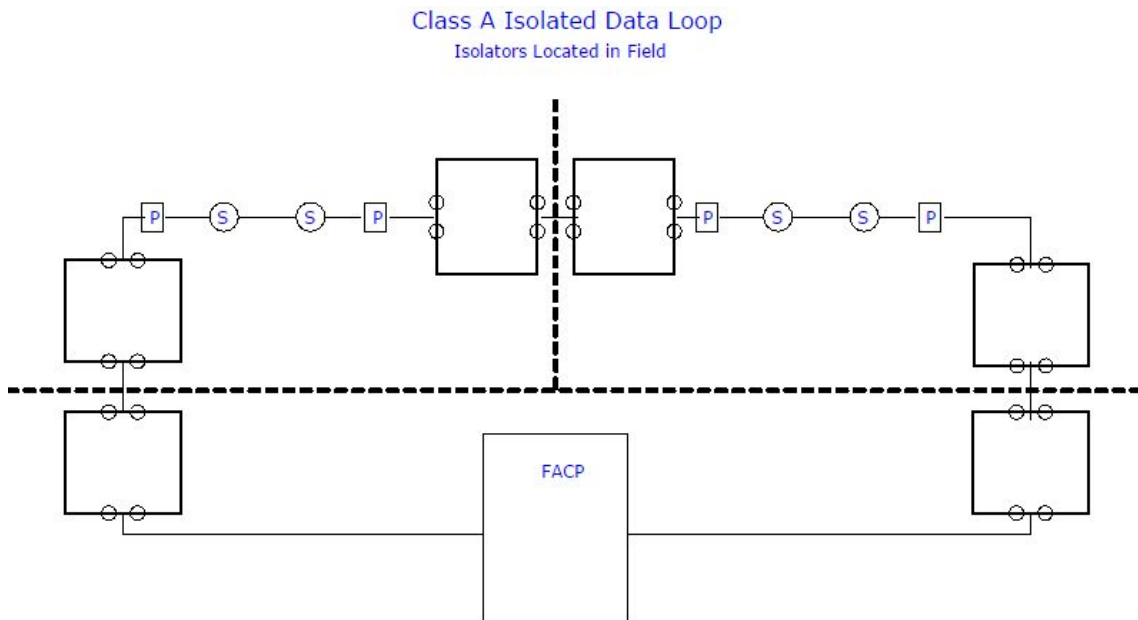
Class A Isolated Data Loop

Isolators Located in Electrical Room



Tip! It is acceptable to locate data loop isolators at the FACP -this is a practical approach when using existing conventional zone wiring in a retrofit to an addressable system and requires minimal isolators per zone.

Overall Class A Loop



Tip! When entering or leaving a fire separation, data isolators must be provided on both sides. This is a typical approach when crossing multiple fire separation in long corridors.

Installation Notes and Circuit Loading

Addressable Data Loop Specifications

- 18/3C non-shielded twisted pair, typical red FA cable.
- Isolators wired Class A
- Each loop is capable of 99 detector addresses and 99 module addresses - recommended ~70% device load.
- 16VDC nominal. Max loop current: 100mA.

Grounding, Bonding & Shields

Fire alarm device boxes are to be bonded per electrical code. Sound earth bonds form an important part of overall FAS supervision via ground-fault detection.

Mircom End of Line Resistor Values:

- Addressable input modules: 47K Ω (supplied with device)
- Speaker zones, 15W amplifier: 22K Ω , 30W/60W Amplifiers 10K Ω
- Fire phone zones (MIX-M500FPA) - 10K Ω
- Signal zones, strobes, bells, and horns: 3.9K Ω
- Conventional initiating zones (DM-1008): 3.9K Ω

Electrical Supply

Each fire alarm panel, audio cabinet and signal booster to be provided dedicated 15A circuit utilizing provided knockouts -do not enter the bottom as this space is reserved for batteries.

Remote Annunciator Wiring

RS-485/24VDC Aux Power - 18/5 Shielded, typical - RS-485 bus wiring daisy chain to multiple annunciators.

Outdoor applications: add 14/2C 24VAC heater circuit to direct wire Class 2 transformer on fixed load lighting branch circuit. Do not install in FACP.

CACF Wiring

CACF to FACP:

14/2 24VDC Aux Power to FACP

18/3C Shielded RS-485 to FACP

CACF to audio cabinet:

18/3C Shielded RS-485

18/3C - 24VDC audio power

18/3C shielded - mic

18/3C - PTT

FACP Auxiliary Relay Loads

Do not enter the FACP with any unlisted non-fire alarm power source. To interlock with external sources and loads, use 24VDC aux power provided by FACP to drive intervening external 24VDC relays via programmable relays in FACP.

Elevator Recall

A smoke detector must be within 6m of the elevator cab (per CSA B44 - Elevator Safety) in the lobby on every floor and noted on your programming info.

A 5 pair interconnect is required from the fire alarm addressable relay cabinet to the elevator controller.

Fan Control

For specifications requiring fan control, one addressable fire alarm relay is provided for each HOA (Hand/Off/Auto) switch located at the CACF. Electrical interlock to multiple loads to be provided via interposing cube relays.

One common alarm addressable relay is provide to override fan automation, e.g., CO exhaust controllers, during a fire condition. Electrical interlock to multiple controllers to be provided via interposing cube relays.

Monitoring Requirements - Typical

3-pair (4-pair City of Vancouver): 18 gauge mechanically protected interconnect from FACP to monitoring dialer.

Account must be commissioned by alarm monitoring company prior to verification.

Colour Code Conventions

Red/Brown/White (+) Black/Blue (-)

Conductor Size

Audible signaling circuits: #18/3 – Max 75 devices/circuit. #18 AWG gauge conductor is the smallest size approved for use with fire alarm system installations.

Visual signaling circuits: #14/2C – Maximum 20 devices/circuit at 15cd.

Addressable Data Loop Wiring

Mircom specifies #18/3C AWG non-shielded or low capacitance-type twisted cabling. Use the same wiring throughout the data loop - do not mix wire type or gauge as this introduces electrical signal reflections (noise) due to the impedance mismatch between dissimilar conductor types.

Signal Zone Capacity

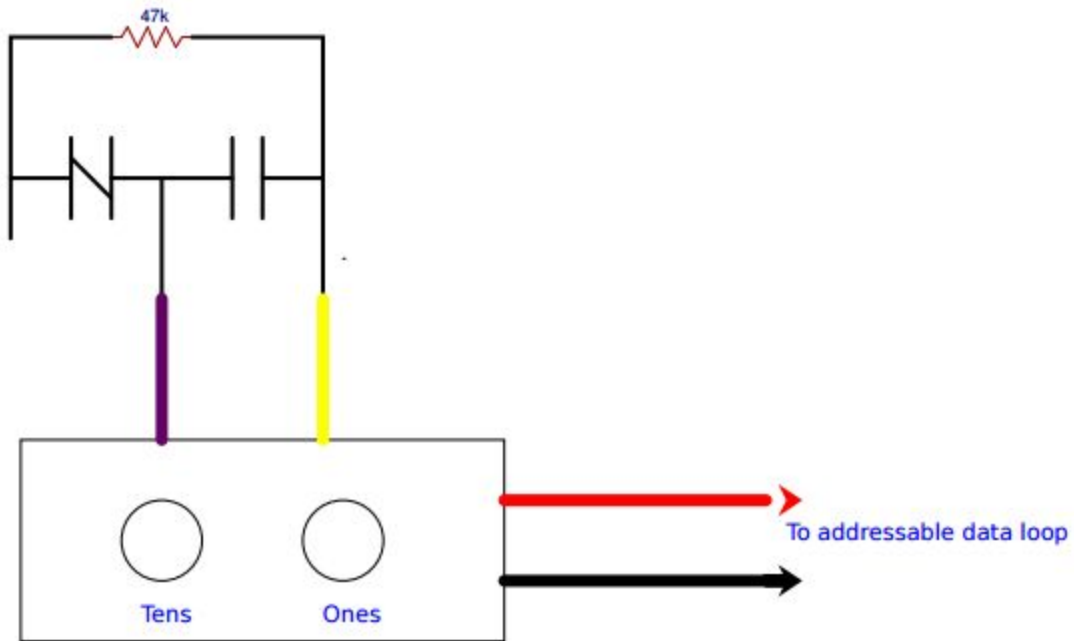
FACP Signal Zones (All): 1.7A

Conventional Signal Zone Booster (BPS-1100): 1.7A

Addressable Signal Zone Booster (INX-10A): 2.5A

Wiring Diagrams

Dry contacting monitoring



Contact device monitored by single input (mini) monitor module. Use for monitoring outdoor conventional pull stations, heat trace, high level CO, etc.

Code References

Control Panel Heights

5.1.4	<2.4M top to floor

Control Heights - FACP/CACF/Annunciator

5.2.5	Visual displays and operating controls >600mm <1,800mm from floor

Manual Stations

8.1.1	<u>1,050 ~ 1,150mm finished floor to centre.</u>
8.1.2	<u>Latch side of required exit within 1.5M of door.</u>
8.1.5	<u>Series of doors >12M wide, install on both sides.</u>

Visual Devices

9.4.3	2~ 2.4M entire lens to floor.
9.4.14	<4.6M from end of corridor, <30M apart.
9.4.2	More than 2 strobes visible must be synchronized

Audible Device

	>2.3M floor to top > 150mm from ceiling.
CAN/ULC-S524 9.3.1	Where silencing means are separately installed or incorporated in the audible signal device, the silencing means shall be clearly identified and installed 1,050mm to 1,150mm above the finished floor level measured from the centre of the silencing means.

End of Line

		>1.8M floor to centre, beyond last device.
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Fire Phone

		Near exit stairs 1,350~1,150 to centre

Fire Detectors

	8.2.1.4	Protect from contamination during construction.
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Smoke Detectors

General Requirements

	8.3.11.1	Required a Top of Stair
	8.2.1.3	Concealed space location requires remote LED
	8.3.11.2	Required every 3rd landing stairs >18m

Obstructions

	8.2.3.7	450mm obstruction-free hemisphere.
	8.2.3.7	<100mm surface obstructions.

Airflow Sources

	8.2.3.9	1,000mm from fan blades
	8.2.3.10	Not in direct airflow
	8.2.3.10	450mm from sources of supply air

Required Locations

	8.3.11.1	Top of Stair
	8.3.11.2	Every 3rd landing stairs >18m

Coverage Area

	8.2.3.5	<9.1M spacing, 83m square
	8.6.3.1	6.4M radius (.7 * 9.1M) max rectangle

Elevator Recall

	CSA B44 Elevator Safety	6m from elevator cab in each lobby
	8.2.2.5	Smoke at top shaft

	CSA B44 Elevator Safety	Elevator machine room smoke
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Heat Detectors

Ceiling Clearance	8.2.3.3	100~300mm top from ceiling