Fire Alarm Systems

Design Drawings — Sample Set

An educational reference set of fire alarm design, detection, notification, panel architecture, survivability and ITM drawings · NFPA 72

EngineersUniverse

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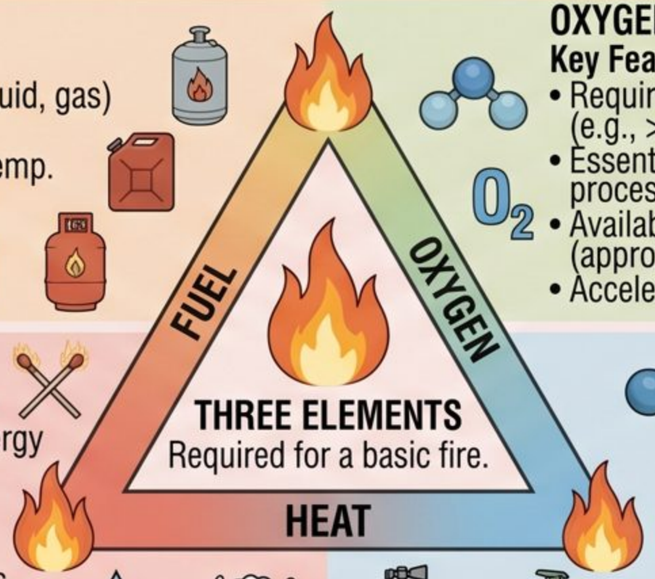
Fire Triangle & Tetrahedron

THE FIRE TRIANGLE

FUEL
Key Features:
- State (solid, liquid, gas)
- Flash point
- Auto-ignition temp.
- Combustibility.

OXYGEN
Key Features:
- Required concentration (e.g., >16%)
- Essential for combustion process
- Available in ambient air (approx. 21%)
- Accelerates reaction



Key Features:
- Ignition source
- Maintained energy for reaction
- Spontaneous
- Required for vaporizing fuels.

WATER (Heat Removal) | FOAM (Fuel Smothering) | CO_2 (Oxygen Displacment) | CLEAN AGENT (Chain Reaction Inhibition)

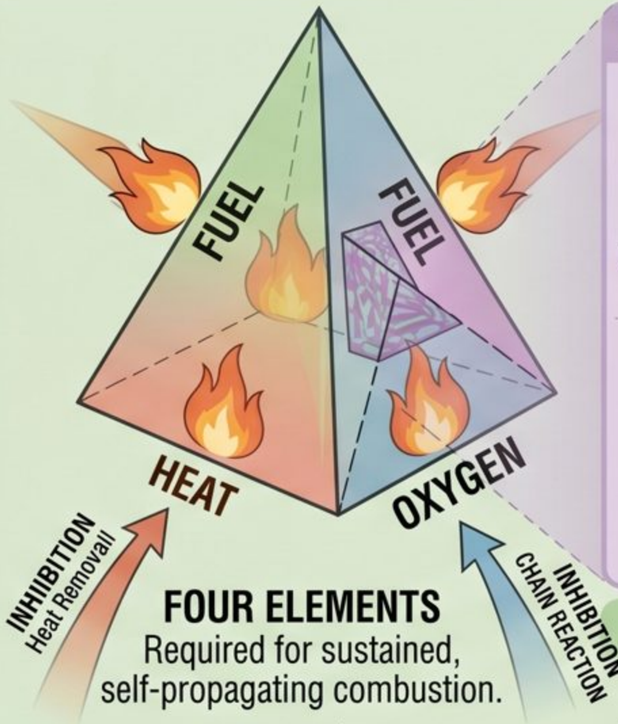
Disruption Methods

Fire Extinguishment and Supression Backhaul
(Extinguishment Methods - Block/Disrupt Elements)

Disrupts Methods

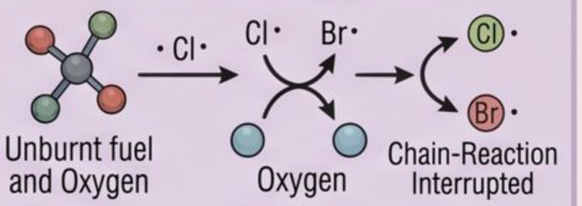
Fire Extinguishment and Infibited
(Extinguishment Methods - Block/Disrupt Elements)

THE FIRE TETRAHEDRON

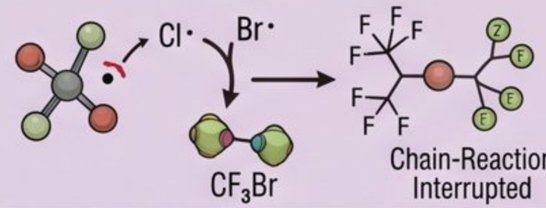


Inhibition Chain Reaction Close-Up

Chain-Reaction Process



Inhibited Chain Reaction



THE FIRE TETRAHEDRON

Key Features:
- Sustains combustion once initiated
- Uninhibited reaction process
- Free radical propagation
- Blocked by fire suppressants (e.g., clean agents, dry chemical powders).

Ridgewood, NJ
location marked on Earth cross-section map

Fire Element | Suppression Method | Inhibitor Molecule | Free Radical | Molecular Structure | Uninhibited Reaction | Inhibited Reaction | Chain Reaction Interrupted

Reaction Sustenance Scale
Inhibited Reaction to Self-Propagating Combustion

Stages of Fire Development

TIME-TEMPERATURE CURVE

TEMPERATURE (°C)

INCIPIENT

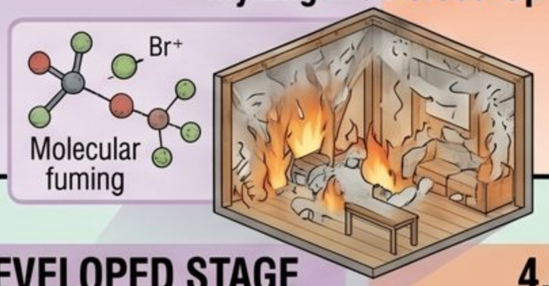
GROWTH

FULLY DEVELOPED STAGE

DECAY

TIME (minutes/hours)

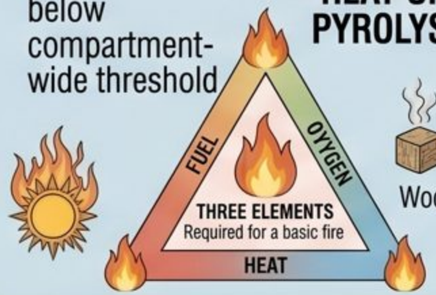
Fully Engulfed Close-Up

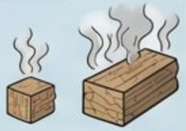


1. INCIPIENT STAGE

Key Features:
- Local ignition
- Low heat release
- Fuming wood
- Plume limited by compartment
- Temperature below compartment-wide threshold

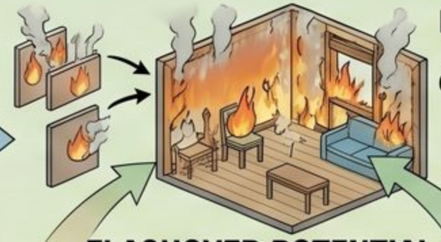
HEAT-UP / PYROLYSIS





Wood block fuming

2. GROWTH STAGE



Pyrolysis of many elements

Rapid invenising

FLASHOVER POTENTIAL
- Compartment involvement
- Rapid flame spread
- Rising heat release
- Fuel-controlled to ventilation-controlled transition
- Thermal layering

Pyrolysis of many rising

3. FULLY DEVELOPED STAGE

Minimal unburnt fuel

All fuels simultaneously fuming and burning

All fuels simultaneously

Fullb burning

FULLY ENGULFED COMBUSTION

Key Features:
- Maximum heat release
- Constant high temperature
- Ventilation-controlled (all fuel burns)
- Pyrolysis of all unburnt fuel
- Entire room is a fuming mass

Uninhibited

High visual

Fuming fuming

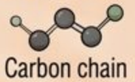
4. DECAY STAGE

Unburnt fuel mostly consumed

Mostly heat, mostly from fuming

FUEL-CONSUMED COMBUSTION

Key Features:
- Heat release decreases
- Gradual temperature drop
- Fuel-limited (insufficient unburnt fuel)
- Uninhibited to inhibited reaction (no chain reaction to maintain)
- Residual heat



Carbon chain reaction fuming

Fire Extinguishment and Supression Backhaul
(Extinguishment Methods - Block/Disrupt Elements)

Ridgewood, NJ
location marked on Earth cross-section map

Fire Element

Water (Heat fuming)

Foam (Fuel Smothering fuming)

Clean Agent (Chain Reaction Inhibition)

Free radicals capture fuming)

Reaction Sustenance Scale

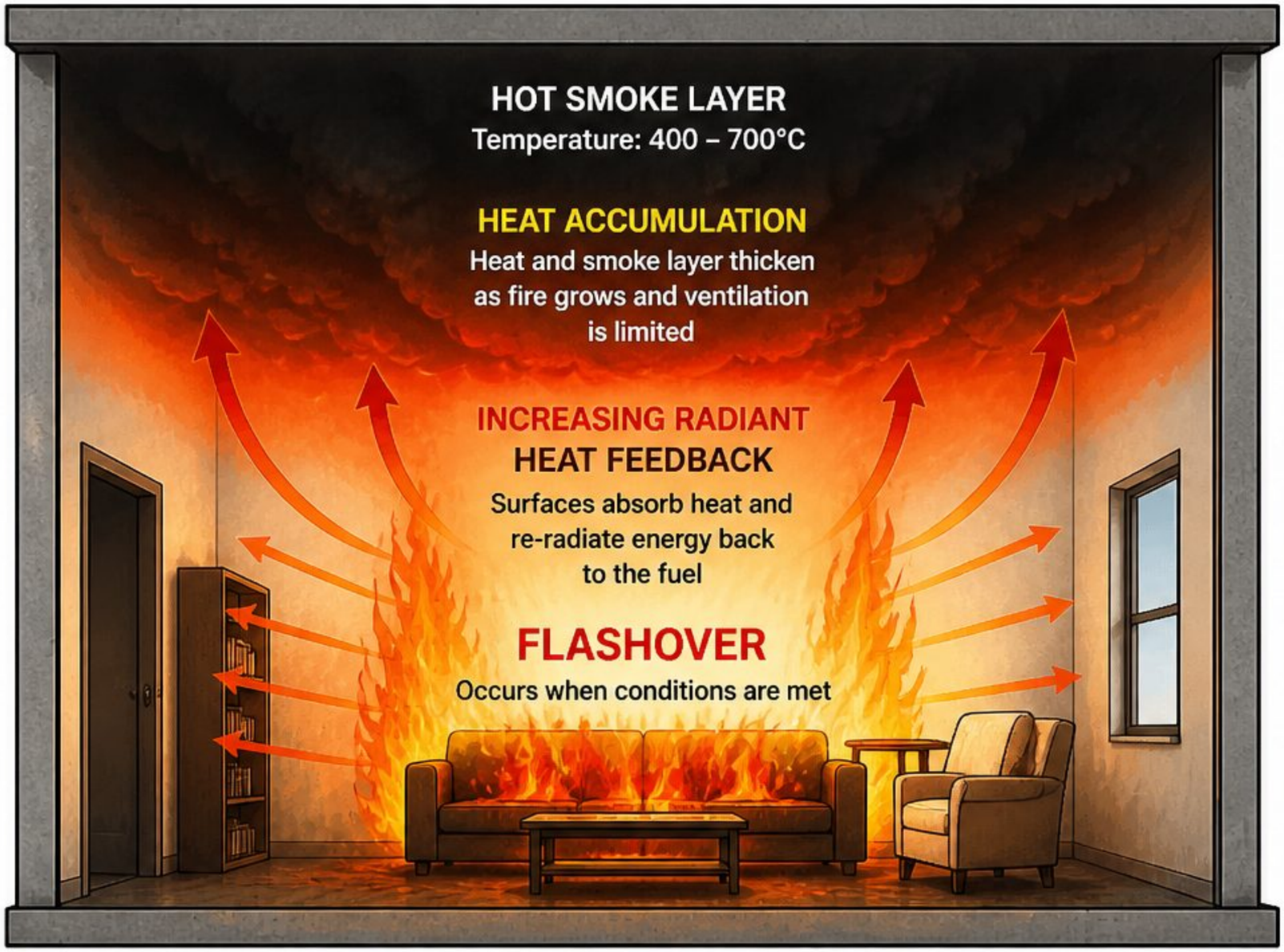
Inhibited Reaction to Self-Propagating Combustion

Flashover Conditions

Flashover is a rapid transition from a fire growing in a room to a fully developed fire throughout the entire compartment.

CONDITIONS LEADING TO FLASHOVER

1. **Sufficient Heat Release Rate**
   Fire grows large enough to heat the compartment
2. **Heat Accumulation**
   Hot smoke layer thickens and temperature rises
3. **Radiant Heat Feedback**
   Surfaces reach high temperatures and re-radiate heat to fuels
4. **Ventilation Controlled**
   Limited openings prevent heat from escaping



FLASHOVER INDICATORS

- Upper layer temperatures > 500 – 600°C
- Thick, dark, turbulent smoke
- Increasing gas layer temperature
- Surfaces becoming hot to the touch
- Cracking / popping sounds from heated materials

CRITICAL RADIANT FLUX

Flashover typically occurs when floor level radiant heat flux reaches:

~ 20 – 30 kW/m²

Corresponding surface temperatures:

~ 500 – 600°C

FLASHOVER: When the majority of exposed surfaces in the compartment reach ~ 500 – 600°C due to radiant heat feedback, ignition occurs nearly simultaneously throughout the room, transtiioning to fully developed fire.

- Hot Smoke Layer
- Hot Gas Layer
- Cooler Air Layer

KEY PARAMETERS

- Heat Release Rate (HRR)
- Ventilation (opening size)
- Compartment geometry
- Fuel load and distribution
- Surface properties

Heat Transfer Modes

1. CONDUCTION STAGE

Key Features:
- Requires Direct Physical Contact
- Solid materials (wood, metal, masonry)
- Molecular fuming/ vibration fuming
- Temp. gradient fuming

Fuming
SOLID-TO-SOLID
convectent
fuming

Conduction Close-Up
Molecular fuming

SOLID-TO-SOLID CONTACT

THREE ELEMENTS
Required for a busle fire
FUEL
OXYGEN
HEAT

Wood block fuming

2. CONVECTION STAGE

Fan

Key Features:
- Requires fluid motion (gas or liquid)
- Natural & Forced convection fuming

Earth
Mantle
Core

Pyrolysis of many rising

FLUID MOTION & THERMAL LAYERING

Key Features:
- Requires fluid motion (gas or liquid)
- Natural & Forced convection fuming
- Thermal layering fuming
- Compartment fuming involvement

3. RADIATION STAGE

Fuming

Key Features:
- Does not require a medium
- fuming through space/vacuum
- Depends on temp. ($T^{\wedge 4}$ fuming)
- fuming of all surfaces simultaneously.

Radiation Close-Up
Free radicals capture fuming

ELECTROMAGNETIC WAVE

Key Features:
- Does not require a medium
- fuming through space/vacuum
- Depends on temp. (T^4 fuming)
- fuming of all surfaces simultaneously

Fuming fuming

Fire Extinguishment and Supression Backhaul
(Extinguishment Methods - Block/Disrupt Elements)

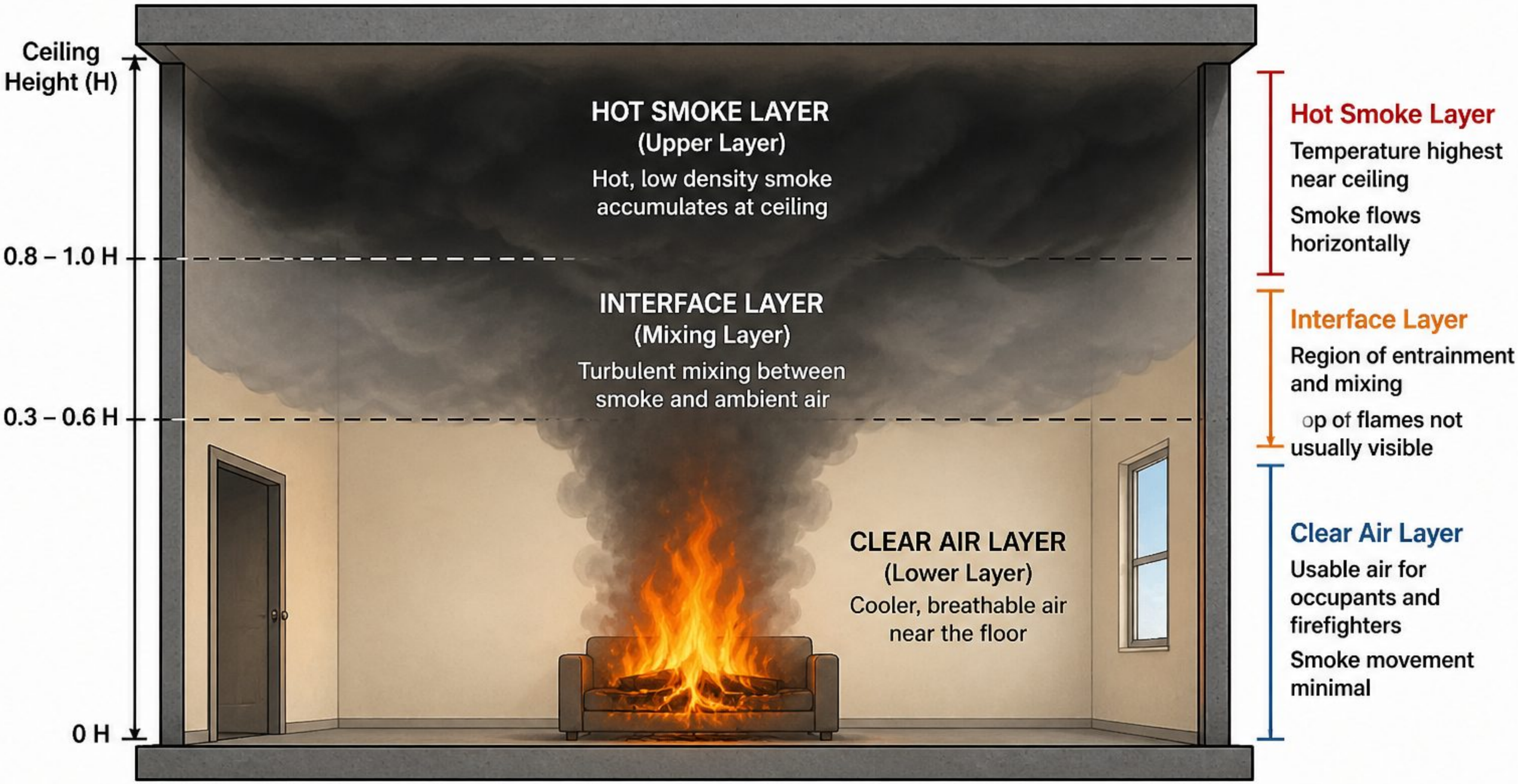
Ridgewood, NJ
location marked on Earth cross-section map

Fire Element
Water (Heat fuming)
Foam (Fuel Smothering fuming)
Clean Agent (Chain Reaction Inhibition)
Free radicals capture fuming)

Reaction Sustenance Scale
Inhibited Reaction to Self-Propagating Combustion

Smoke Stratification

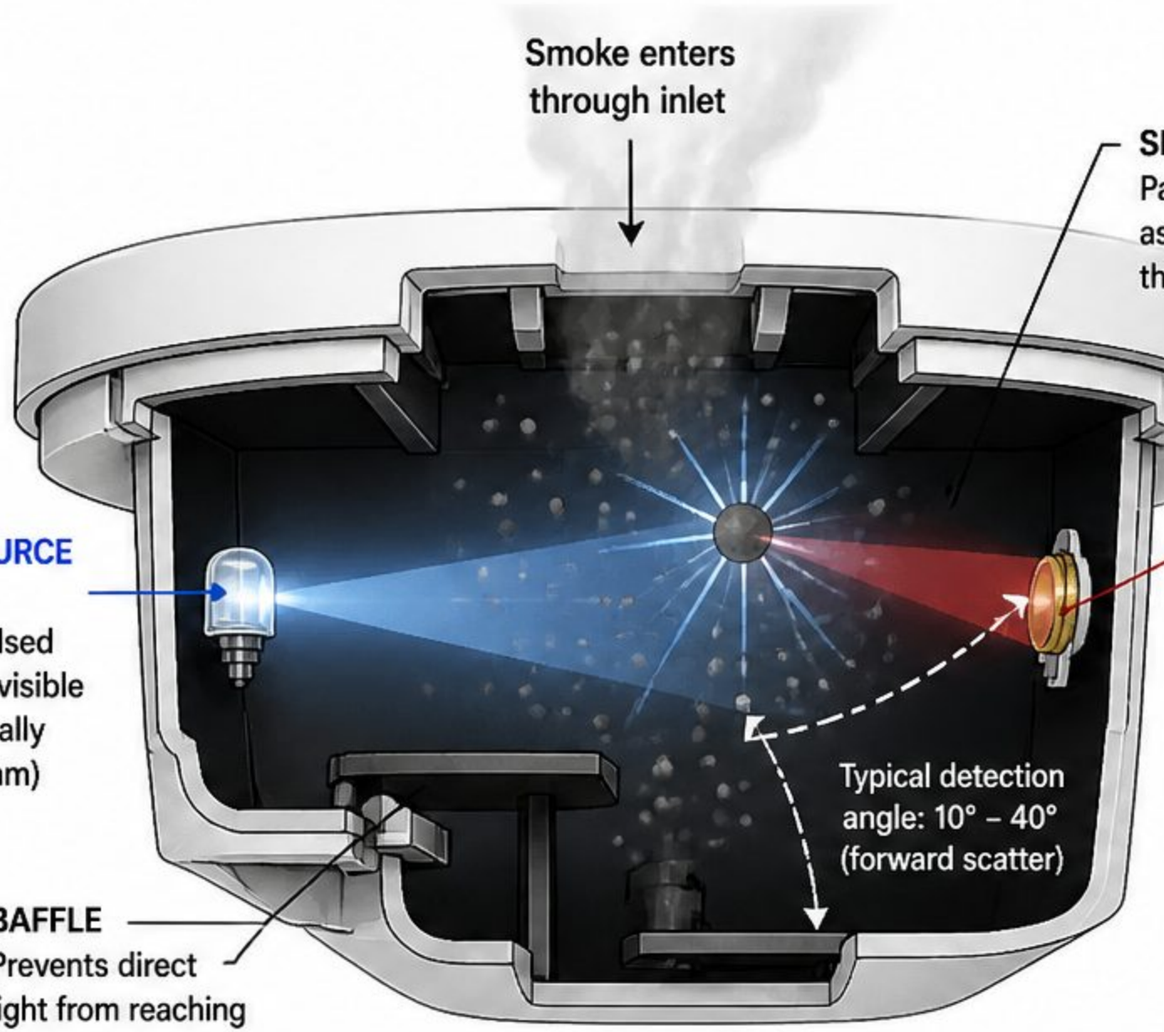
Hot smoke rises and stratifies beneath the ceiling



Typical neutral plane (interface) occurs at 0.3 – 0.6 of ceiling height, depending on fire size, heat release rate, and ventilation.

Photoelectric Detector — Light Scatter

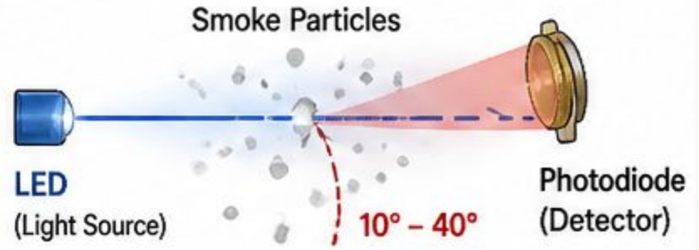
Detects smoke by sensing light scattered by particles in the optical chamber using the forward scatter (Tyndall) principle.



HOW IT WORKS

1. LED emits pulses of light across the optical chamber.
2. Smoke particles entering the chamber scatter a portion of the light.
3. The photodiode, positioned at an angle, senses the scattered light.
4. When the detected signal exceeds a threshold, the alarm is triggered.

FORWARD LIGHT SCATTER (TYNDALL EFFECT)



Particles scatter light in many directions. The detector, placed at a forward angle to the beam, captures the scattered light while being shielded from the direct light by the baffle.

KEY POINT

Photoelectric (light scatter) detectors are generally more responsive to slow, smoldering fires that produce larger smoke particles.

LED (Light Source) | Smoke Particle | Photodiode (Detector) | Baffle

Ionization Smoke Detector

1. CHAMBER STAGE

Key Features:
- Alpha Source Ionization, Dual Chamber Design
- Reference Chamber fuming
- Molecular fuming visual
- Fuming alpha

ALPHA SOURCE

AMERICIUM-241 (Am-241)

Positive Electrode

Negative Electrode

Dual-Electrode System

Open Sensing Chamber

Chamber Close-Up

Fuming fuming

IONIZED AIR

SOLID-TO-SOLID CONTACT

THREE ELEMENTS Resyired for a basie fire

FUEL

OST*ION

HEAT

Wood block fuming

2. SMOKE STAGE

Fan

Key Features:
- Smoke Particles Block Ion Flow
- Current Drop Detected
- Reference current vs.

Sensing Electronics (Control Circuit)

SMOKE PARTICLE DISRUPTION

Earth

Mantie

Core

Pyrolysis of many rising

Key Features:
- Smoke Particles Block Ion Flow
- Current Drop Detected
- Reference current vs. Sensing current fuming
- Fuming smoke visual
- Thermal layering involvement fuming

3. ALARM STAGE

Fuming

Key Features:
- Threshold Detector
- Horn Activated
- Free radical propagation fuming

UNINHIBITED COMBUSTION

Uninhibited Close-Up

Free radicals capture fuming

Sensing Electronics Close-Up

Key Features:
- Threshold Detector
- Horn Activated
- Free radical propagation fuming
- Uninhibited reaction process fuming

Fuming fuming

Fire Extinguishment and Supression Backhaul
(Extinguishment Methods - Block/Disrupt Elements)

Ridgewood, NJ
location marked on Earth cross-section map

Fire Element

Water (Heat fuming)

Foam (Fuel Smothering fuming)

Clean Agent (Chain Reaction Inhibition)

Free radicals capture fuming)

Reaction Sustenance Scale

Inhibited Reaction to Self-Propagating Combustion

Aspirating Smoke Detector (ASD)

1. CHAMBER STAGE

Key Features:
- Continuous fuming air sampling
- Laser-based fuming sensing
- Pre-filter, Dual sensor
- Self-monitoring

LASER SENSING CHAMBER

LASER SENSING HEAT DETECTOR MECHANISM

Laser Source

Electrical Contacts

Chamber Close-Up

Fuming fuming

IONIZED AIR

SOLID-TO-SOLID CONTACT

THREE ELEMENTS Required for a bourn fiber

HEAT

Wood block fuming

2. SMOKE STAGE

Fan

Bimetal Disk (e gold or plated)

Electrical Contacts

Key Features: Active sampling
- Multi-point sampling funing
- High-speed air expansion
- Calibrated vent

PIPE SAMPLING NETWORK

Active Sensor

Fuming Rising

SMOKE PARTICLE DISRUPTION

Earth

Mantie

Core

Pyrolysis of many rising

Key Features:
- Requires fluid motion (gas or liquid)
- Multi-Use (Restorable)
- Bimetal disk bends/snaps at set point
- Compartment fuming involvement

3. ALARM STAGE

Fuming

Key Features:
- Does not require a medium
- Uninhibited reaction process
- Free radical propagation
- Entire room fuming is a mass.

UNINHIBITED COMBUSTION

CHAIN-REACTIso-Up INTERRUPTED

Free radicals capture fuming

Sensing Electronics Close-Up

Key Features:
- Does not require a medium
- Uninhibited reaction process fuming
- Free radical propagation fuming
- Entire room fuming is a mass.

Fuming fuming

Fire Extinguishment and Supression Backhaul
(Extinguishment Methods - Block/Disrupt Elements)

Ridgewood, NJ
location marked on Earth cross-section map

Molecular fuming

Fuming wood

Atomic vibration fuming fuming

Free radicals capture fuming

• Diaphragm snap

Free radicals capture fuming)

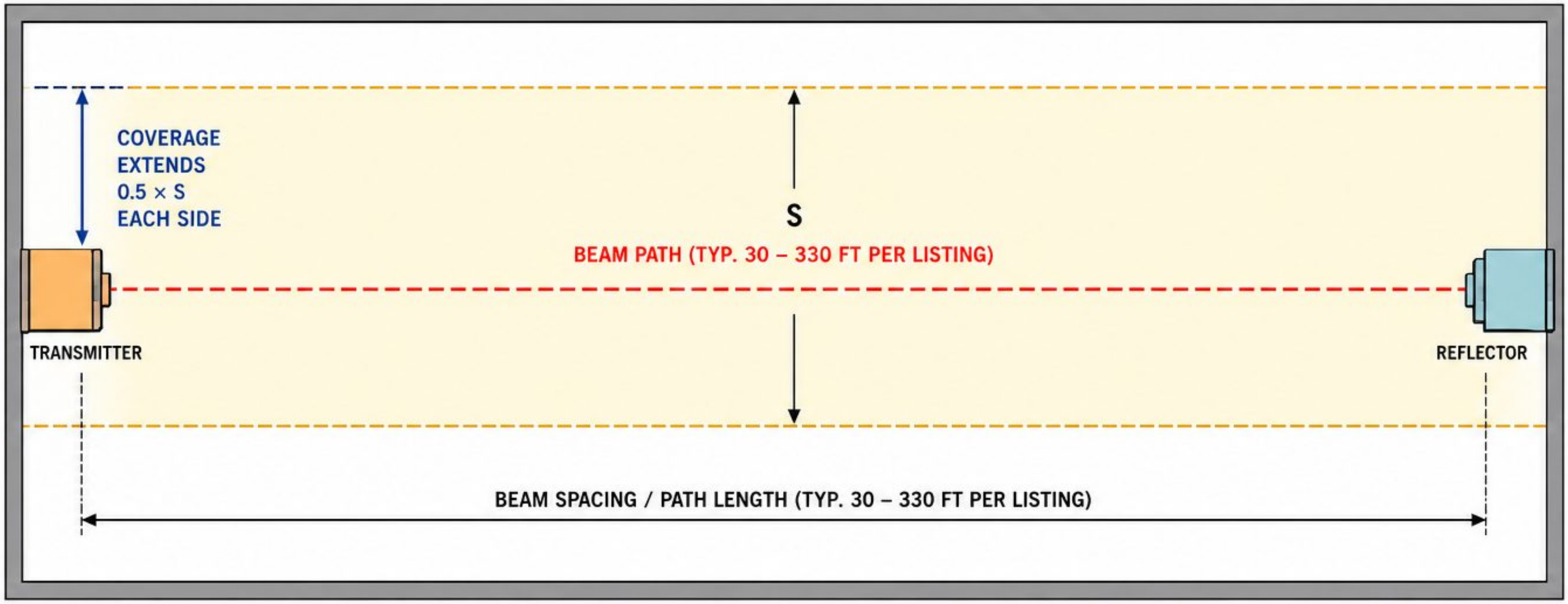
Reaction Sustenance Scale

Inhibited Reaction to Seif-Propagating Combustion

PROJECTED BEAM SMOKE DETECTOR — COVERAGE GEOMETRY

NFPA 72 17.7.3.7

Beam smoke detectors are intended for protection of open areas where air sampling smoke detectors are inappropriate.



COVERAGE GEOMETRY

S	=	Ceiling height (ft)
0.5 × S	=	Coverage extends above and below the beam centerline
S	=	Vertical spacing of beam sample area
L	=	Beam path length (ft)
L (typ.)	=	30 – 330 ft (per manufacturer listing)

DESIGN GUIDANCE

- Effective for ceiling heights > 30 ft (9.1 m).
- Verify manufacturer listing for maximum path length and spacing.
- Ensure clear line-of-sight between transmitter and reflector.
- Avoid obstructions within the beam path.
- Follow NFPA 72, manufacturer instructions, and AHJ requirements.

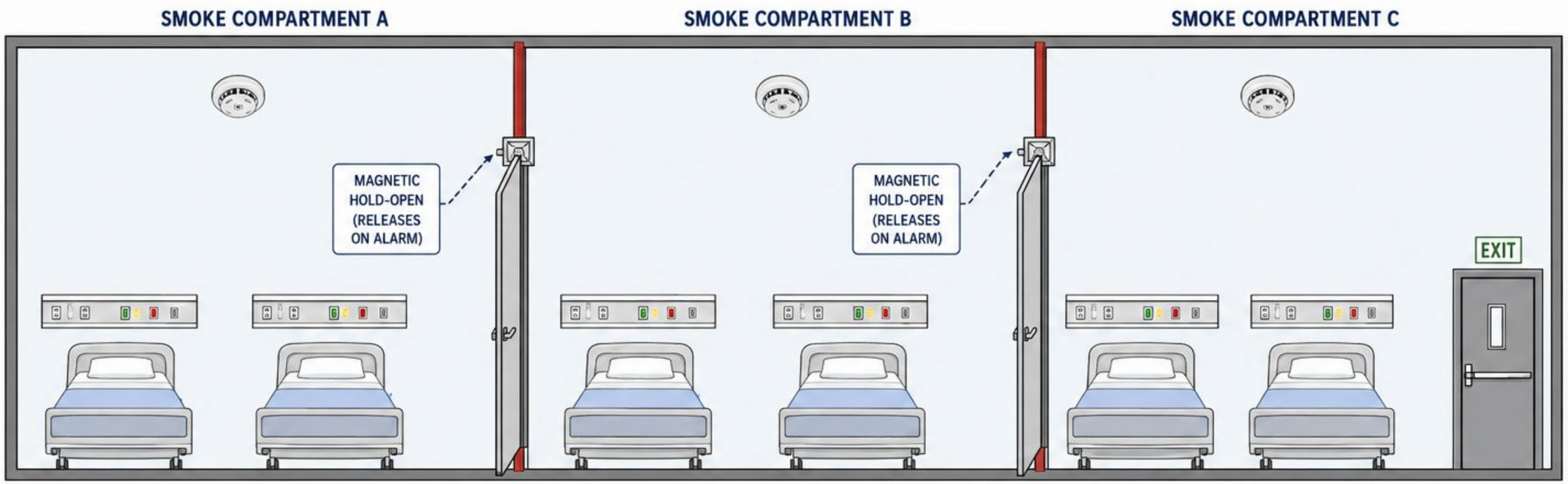
EXAMPLE

Ceiling height (S)	=	40 ft
Coverage extends above centerline	=	0.5 × S = 20 ft
Coverage extends below centerline	=	0.5 × S = 20 ft
Total vertical sample area (S)	=	40 ft
Beam path length (L)	=	100 ft (within listing)

NOTE: This drawing is a typical example. Design and installation shall be in accordance with NFPA 72 (2025), manufacturer's listing, and AHJ (Authority Having Jurisdiction) requirements.

DEFEND-IN-PLACE STRATEGY — HEALTHCARE (I-2) SMOKE COMPARTMENTS

Patients shelter in adjacent compartment behind 1-hour smoke barrier;
magnetic door holders release on alarm (NFPA 101 19.2.2.2.7, 19.3.7).



KEY NOTES

- Healthcare (I-2) occupancies are typically protected using defend-in-place strategy.
- Each smoke compartment is separated by 1-hour smoke barriers.
- Patients remain in an adjacent compartment while the affected area is managed.
- Magnetic door holders release upon alarm activation to allow door closure.
- Doors are 1-hour rated, self-closing, self-latching.

SYMBOL LEGEND

- Smoke Detector
- 1-Hour Smoke Barrier
- 1-Hour Rated Door (Self-Closing, Self-Latching)
- Magnetic Hold-Open (Releases on Alarm)
- EXIT — Exit

APPLICABLE REQUIREMENTS

NFPA 101 19.2.2.2.7	Smoke barriers shall be constructed to limit the transfer of smoke.
NFPA 101 19.3.7	Smoke doors in smoke barriers shall be self-closing, self-latching, and released by the fire alarm system where permitted.
NFPA 72 23.5.14	Magnetic door holders shall be released upon a signal from the fire alarm system.
NFPA 72 24.3.4	Smoke detection in ducts and open areas as required to support compartmentation.

SYSTEM RESPONSE

1. Smoke Detected in Compartment
2. Fire Alarm System Activates
3. Magnetic Door Holders Release
4. Smoke Doors Close Automatically
5. Patients Shelter in Adjacent Compartment

NOTE: This is a typical example. Design and installation shall be in accordance with NFPA 101 (2021), NFPA 72 (2025), and AHJ requirements.

Rate-of-Rise Heat Detector

1. CHAMBER STAGE

Key Features:
- Requires Direct Physical Contact
- Detects dynamic temp. change
- Air expands
- Diaphragm deflects

RATE-OF-RISE MECHANISM

Diaphragm (e.g., metal-plated)

Bimetal Disk (e.g., gold or plated)

Electrical Contacts

Electrical Contacts

Chamber Close-Up

Fuming fuming

IONIZED AIR

SOLID-TO-SOLID CONTACT

THREE ELEMENTS Required for a basic fire

HEAT

Wood block fuming

2. SMOKE STAGE

Fan

Key Features:
- Requires fluid motion (gas or liquid)
- High-speed air expansion
- Calibrated vent

RAPID TEMPERATURE INCREASE (>15°F/min)

SMOKE PARTICLE DISRUPTION

Earth

Mantie

Core

Pyrolysis of many rising

Key Features:
- Requires fluid motion (gas or liquid)
- Multi-Use (Restorable)
- Bimetal disk bends/snaps at set point
- Compartment fuming involvement

3. ALARM STAGE

Key Features:
- Does not require a medium
- Uninhibited reaction process
- Free radical propagation
- Entire room fuming is a mass.

Fuming

UNINHIBITED COMBUSTION

CHAIN-REACTIso-Up INTERRUPTED

Free radicals capture fuming

Sensing Electronics Close-Up

Key Features:
- Does not require a medium
- Uninhibited reaction process fuming
- Free radical propagation fuming
- Entire room fuming is a mass.

Fuming fuming

Fire Extinguishment and Supression Backhaul
(Extinguishment Methods - Block/Disrupt Elements)

Ridgewood, NJ location marked on Earth cross-section map

Fire Element

Water (Heat fuming)

Foam (Fuel Smothering fuming)

Clean Agent (Chain Reaction Inhibition)

Free radicals capture fuming)

Reaction Sustenance Scale

Inhibited Reaction te Self-Propagating Combustion

Fixed Temperature Heat Detector

1. CHAMBER STAGE

Key Features:
- Requires Direct Physical Contact
- Single-Use (Non-Restorable)
- Eutectic alloy melts at set point
- Thermal lag

FUSIBLE ALLOY HEAT DETECTOR MECHANISM

Fusible Link (e.g., Eutectic Alloy)

Bimetal Disk (e.g., steel/brass,

Electrical Contacts

Electrical Contacts

Chamber Close-Up

Fuming fuming

IONIZED AIR

SOLID-TO-SOLID CONTACT

THREE ELEMENTS Required for a basic fire

FUEL

OXYGEN

HEAT

Wood block fuming

2. SMOKE STAGE

Fan

Key Features:
- Requires fluid motion (gas or liquid)
- Multi-Use (Restorable)
- Actuating Pin

Sensing Electronics (Control Circuit)

SMOKE PARTICLE DISRUPTION

Earth

Mantie

Core

Pyrolysis of many rising

Key Features:
- Requires fluid motion (gas or liquid)
- Multi-Use (Restorable)
- Bimetal disk bends/snaps at set point
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3. ALARM STAGE

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UNINHIBITED COMBUSTION

CHAIN-REACTIse-Up INTERRUPTED

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Sensing Electronics Close-Up

Key Features:
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Fuming fuming

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Free radicals capture fuming)

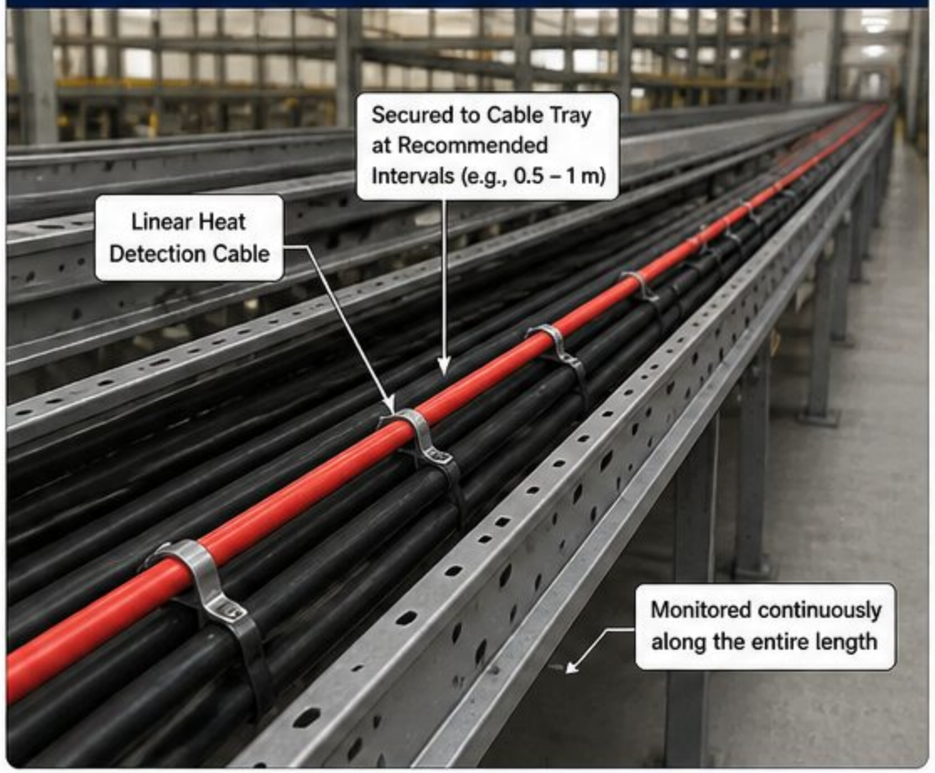
Reaction Sustenance Scale

Inhibited Reaction te Self-Propagating Combustion

Linear Heat Detection Cable

Analog linear heat detector cable senses temperature along its entire length and provides continuous measurement for early fire detection.

INSTALLATION EXAMPLE 1: CABLE TRAYS



INSTALLATION EXAMPLE 2: CONVEYOR SYSTEMS

KEY FEATURES

CONTINUOUS TEMPERATURE SENSING
Measures temperature at any point along the entire length.

EARLY FIRE DETECTION
Detects overheating conditions before flames or smoke are present.

ROBUST & RELIABLE
Designed for harsh industrial environments.

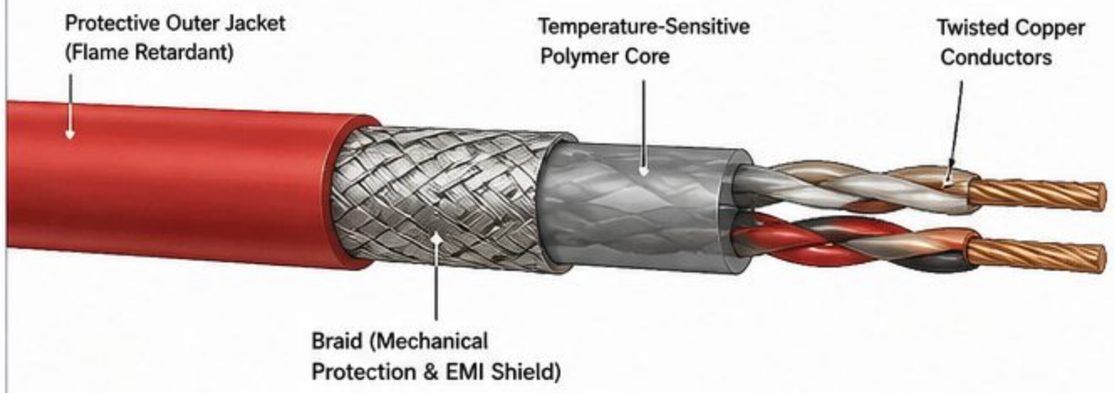
EASY INSTALLATION
Flexible cable for easy routing along trays, conveyors, and equipment.

ANALOG OUTPUT
Provides temperature value and alarm information to the control panel.

HOW IT WORKS

1. The sensing cable contains two twisted conductors with a temperature-sensitive polymer between them.
2. Temperature changes alter the electrical characteristics of the polymer.
3. The control unit sends a low current pulse and measures the response.
4. The control unit calculates the temperature at any point along the cable and alarms when thresholds are exceeded.

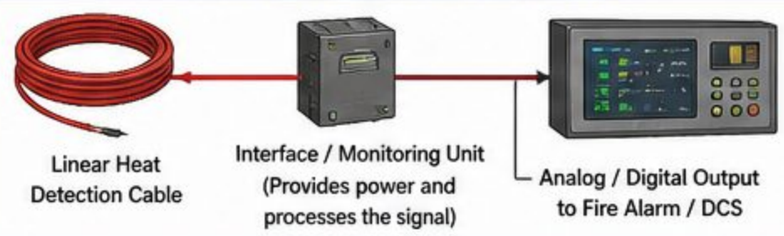
CABLE CONSTRUCTION



IDEAL FOR

- Cable trays and cable tunnels
- Conveyor belts and transfer points
- Bucket elevators
- Chutes and hoppers
- Motor control centers
- Transformer and generator areas
- Critical process equipment

TYPICAL SYSTEM CONFIGURATION



Linear Heat Detection Cable provides distributed temperature sensing for fast, accurate, and reliable fire detection in industrial and commercial applications.

Install and maintain per manufacturer's instructions and applicable standards (e.g., NFPA 72, EN 54-22).

Flame Detector Types

Flame detectors respond to the unique spectral signature and flicker characteristics of flames.

UV FLAME DETECTOR

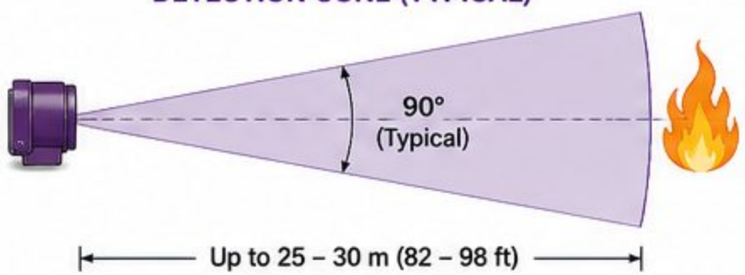
Detects ultraviolet (UV) radiation emitted by flames.

- Most responsive to hydrocarbon fires
- Fast response time
- Best for clear line-of-sight applications
- Sunlight and welding may cause unwanted alarms (false alarms)

SPECTRAL RESPONSE

185 – 260 nm (UV)

DETECTION CONE (TYPICAL)



IR FLAME DETECTOR

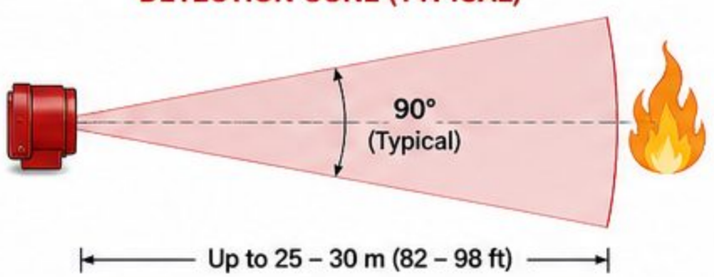
Detects infrared (IR) radiation emitted by flames.

- Strong performance in smoky or hazy environments
- Less sensitive to sunlight
- May be slower on small hydrocarbon fires compared to UV

SPECTRAL RESPONSE

4.0 – 4.6 µm (IR)

DETECTION CONE (TYPICAL)



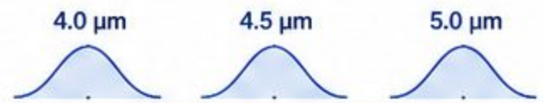
MULTI-SPECTRUM INFRARED (MSIR) FLAME DETECTOR

Detects multiple infrared wavelengths at the same time.

- Highest immunity to false alarms
- Detects a wide range of fuels
- Excellent performance in hot, smoky, or adverse environments
- Ideal for high reliability applications

SPECTRAL RESPONSE

4.0 µm + 4.5 µm + 5.0 µm (IR Bands)



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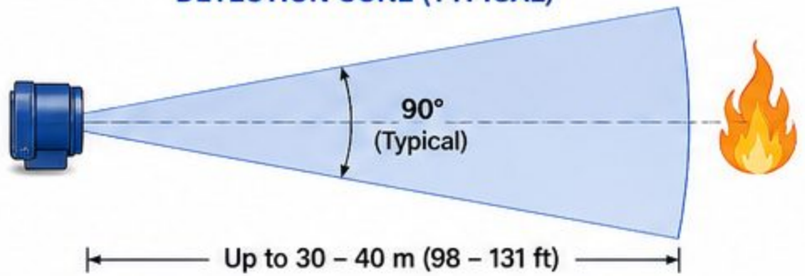


COMPARISON SUMMARY

Feature	UV	IR	MSIR
Speed of Response	Very Fast	Fast	Fast
False Alarm Immunity	Low	Medium	High
Smoke / Haze Performance	Fair	Good	Excellent
Sunlight Immunity	Low	Good	Excellent
Best For	Hydrocarbon Fires (Clean Line-of-Sight)	Smoky / Hazy Environments	All Fuel Types, Harsh & High Reliability Areas

TYPICAL APPLICATIONS

UV

- Indoor Areas
- Clean Environments
- Ouick-Response Hydrocarbon Fires

IR

- Outdoor Areas
- Smoky / Hazy Conditions
- Longer Range Detection

MSIR

- Harsh / Adverse Environments
- Wide Range of Fuels
- High Integrity Safety Systems

KEY

- Centerline (Optical Axis)
- Detection Cone (Field of View)
- Flame Source
- Spectral Response Curve

Detection range varies with flame size, fuel type, environment, and detector model. Always follow manufacturer's recommendations for installation and application.

120 VAC

120 VAC

REMOTE ANNUNCIATOR

MANUAL PULL

ELEC.

MECH.

SMOKE DETECTOR

HEAT DETECTOR

SPEAKER STROBE

WATERFLOW

VISUAL STROBE

TAMPER SWITCHS

MANUAL DETECTOR

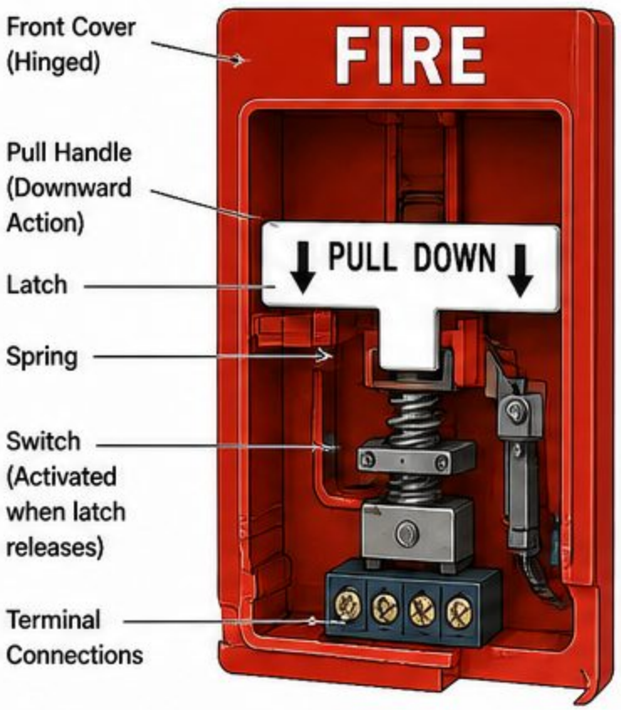
DOOR HOLDER

FIRE ALARM RISER DIAGRAM — SCHOOL (K-12)

Manual Pull Station — Single & Double Action

Manual pull stations allow occupants to initiate a fire alarm by actuating the station, sending a signal to the fire alarm control panel.

SINGLE-ACTION PULL STATION



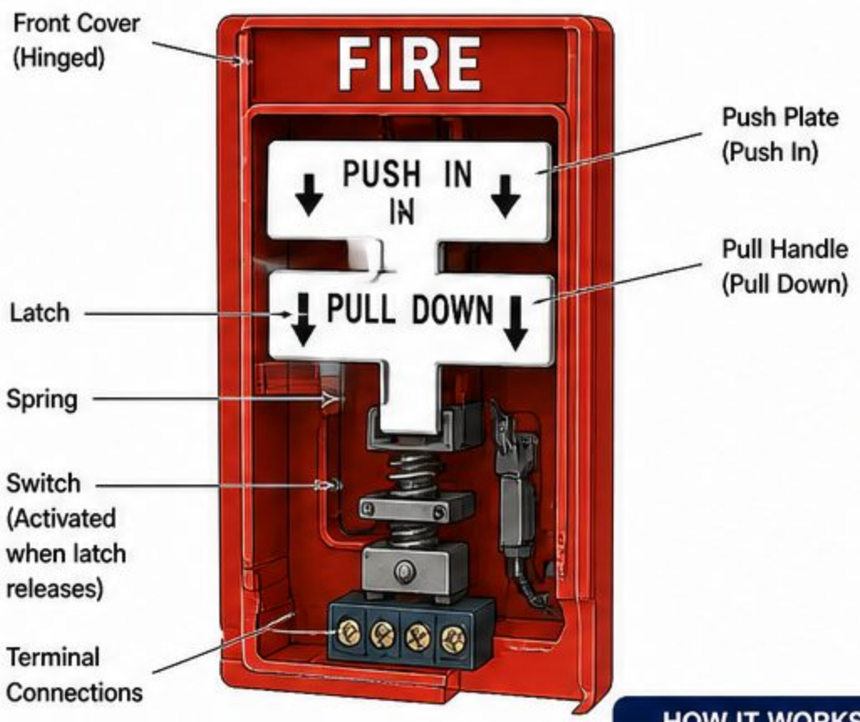
Normal (Reset)

Activated

HOW IT WORKS (SINGLE-ACTION)

1. Pull the handle down.
2. The latch releases.
3. The switch is activated.
4. A signal is sent to the fire alarm control panel.

DOUBLE-ACTION PULL STATION



Normal (Reset)

Activated

HOW IT WORKS (DOUBLE-ACTION)

1. Push the plate in.
2. Pull the handle down.
3. The latch releases.
4. The switch is activated.
5. A signal is sent to the fire alarm control panel.

KEY FEATURES

MANUAL ALARM INITIATION
Provides a simple way for people to report a fire.

DURABLE CONSTRUCTION
Built to withstand impacts and tampering.

VISIBLE INSTRUCTIONS
Clearly marked for easy identification and operation.

RESETTABLE
Easily reset with a compatible reset key.

APPLICATIONS

- Corridors and exit routes
- Stairwells
- Near exits and elevators
- Throughout all building occupancies as required by code

COMPONENT IDENTIFICATION

1. Actuation (Push / Pull)
2. Latch Mechanism
3. Return Spring
4. Micro Switch
5. Terminal Connections

Follow NFPA 72 and local codes for installation location and accessibility.

Mount at 42 – 48 in. (107 – 122 cm) above finished floor.

After activation, reset the station using the appropriate key and inspect for damage.

Notification Appliance Candela Requirements

NFPA 72® National Fire Alarm and Signaling Code® – Table 18.4.5.1 (2022 Edition)

The minimum candela rating of notification appliances shall be in accordance with Table 18.4.5.1.

TABLE 18.4.5.1 REQUIRED MINIMUM CANDELA FOR VISIBLE NOTIFICATION APPLIANCES

NON-SLEEPING AREAS (Visible appliances only)		SLEEPING AREAS (Visible appliances only)	
AREA OF ROOM (square feet)	MINIMUM CANDELA RATING	AREA OF ROOM (square feet)	MINIMUM CANDELA RATING
0 – 50	15 cd	0 – 50	75 cd
51 – 100	30 cd	51 – 100	110 cd
101 – 150	75 cd	101 – 150	150 cd
151 – 200	110 cd	151 – 200	185 cd
201 – 400	135 cd	201 – 400	220 cd
401 – 800	185 cd	401 – 800	300 cd
801 – 1,200	260 cd	801 – 1,200	375 cd
1,201 – 1,600	300 cd	1,201 – 1,600	520 cd
1,601 – 2,000	375 cd	1,601 – 2,000	600 cd
2,001 – 3,000	450 cd	2,001 – 3,000	675 cd
3,001 – 4,000	535 cd	3,001 – 4,000	750 cd
4,001 – 5,000	615 cd	4,001 – 5,000	820 cd
Over 5,000	110 cd per 1,000 sq ft or fraction thereof	Over 5,000	185 cd per 1,000 sq ft or fraction thereof

Note: For rooms used for both sleeping and non-sleeping purposes, use the sleeping area values.

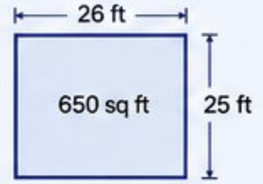
KEY REQUIREMENTS

- The required candela is based on the total area of the room.
- Visible appliances shall have a candela rating not less than the values shown.
- Audible appliances are required in all areas.
- Sleeping areas have higher candela requirements to ensure visibility during sleep.

EXAMPLES

NON-SLEEPING AREA EXAMPLE

Room area: 650 sq ft
From Table (401 – 800 sq ft):
Minimum candela required = 185 cd



SLEEPING AREA EXAMPLE

Room area: 650 sq ft
From Table (401 – 800 sq ft):
Minimum candela required = 300 cd

ADDITIONAL NOTES (NFPA 72 – 18.4.5.1.1)

- Candela ratings are the minimum effective intensity at 75°F (24°C).
- Appliances shall be listed for the required candela setting.
- Where multiple appliances are used, their light output shall be synchronized.
- Public mode notification appliances shall have a minimum candela rating of 15 cd regardless of room size.

TYPICAL APPLIANCE CANDELA SETTINGS (EXAMPLES)

15 cd	Wall-mounted appliance (small rooms)
75 cd	Standard wall unit
110 cd	High output wall unit
185 cd	High output / large area
300 cd	Very high output
520 cd+	Ultra high output (large spaces)

PLACEMENT CONSIDERATIONS

Appliances must be visible from all points in the room.

Mounting height:

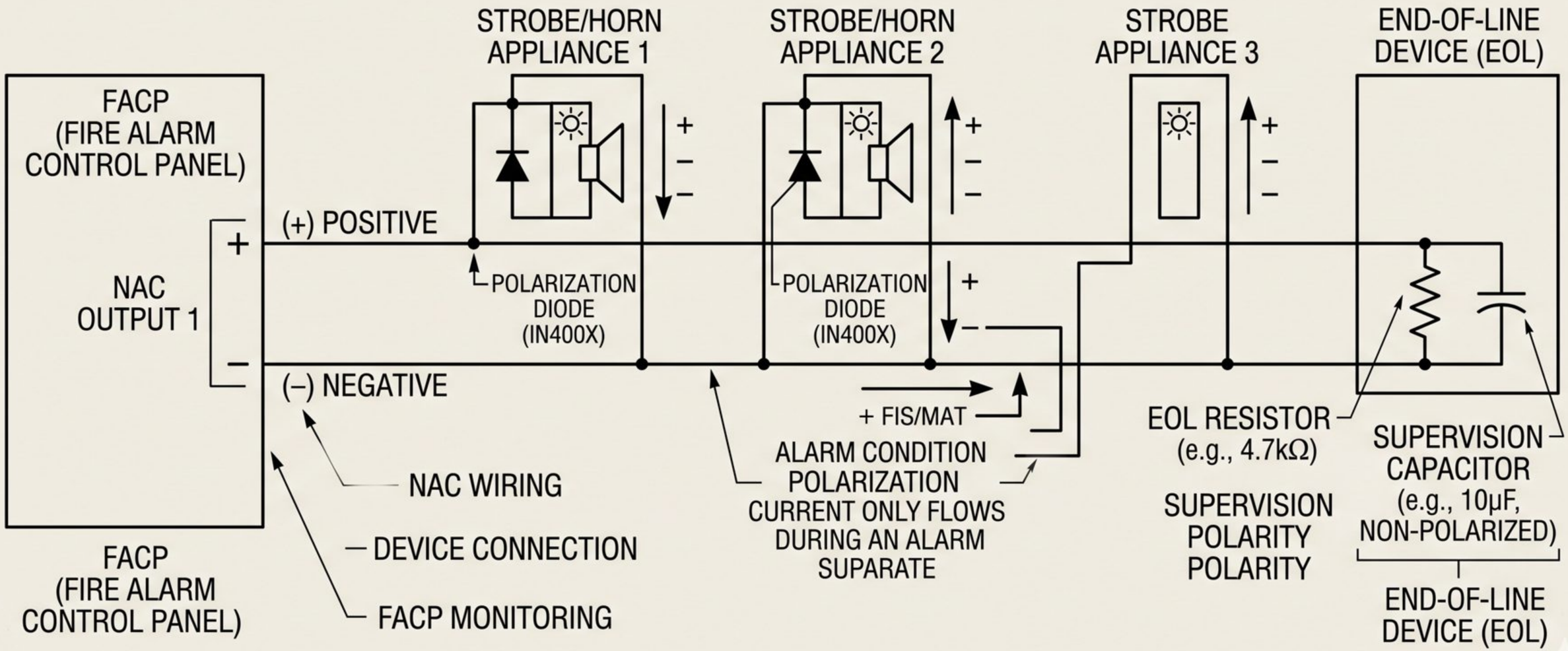
- Wall: 80 in. (203 cm) max. to top of appliance
- Ceiling: As listed

Always follow the latest edition of NFPA 72 and manufacturer's installation instructions.

Reference: NFPA 72® 2022 Edition – Table 18.4.5.1

cd = Candela (unit of luminous intensity)

NAC — Notification Appliance Circuit

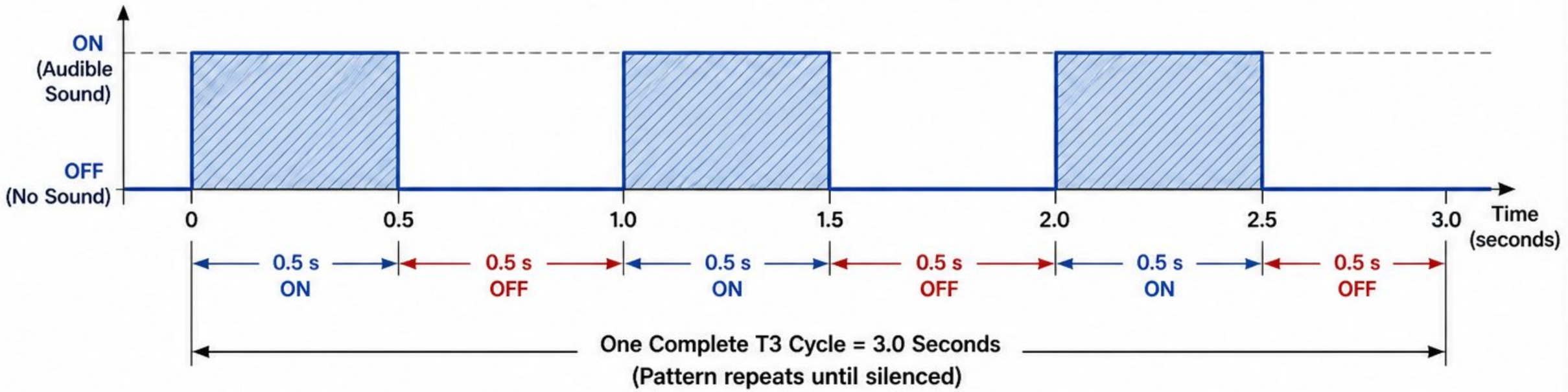


T3 Temporal Pattern Waveform

NFPA 72 Evacuation Signal — Temporal 3 Pattern

The Temporal 3 (T3) evacuation signal consists of three (3) ON pulses of 0.5 seconds each, separated by OFF intervals of 0.5 seconds. The pattern repeats until the signal is silenced.

T3 TEMPORAL PATTERN WAVEFORM



PATTERN SUMMARY

- 3 audible pulses
- Each pulse: 0.5 seconds ON
- Each interval: 0.5 seconds OFF
- 1 cycle duration: 3.0 seconds
- Repeats continuously until acknowledged

COMMON USE

Evacuation Signal

Used to instruct building occupants to evacuate the premises.

TECHNICAL SPECIFICATIONS

- Signal Type: Temporal (Time-based)
- Pattern: T3 (Three-pulse)
- ON Time: 0.5 seconds ± 10%
- OFF Time: 0.5 seconds ± 10%
- Fundamental Frequency: 400 Hz – 4,000 Hz (Per NFPA 72 requirements)
- Sound Pressure Level: Per NFPA 72, Table 18.4.5.3

The T3 temporal pattern is intended for general evacuation of the building. Follow NFPA 72 and local codes for installation and design requirements.

Reference: NFPA 72® 2022 Edition – Section 18.4.5.2 (Temporal Patterns)

Voice Evacuation System – Public Address

1. CONTROL STAGE

Key Features:
- Voice alarm contel
- Stored Voice Messages
- System Monitoring
- Priority Control
- Evacuation message sequence

MESSAGE CONTROLLER

Chamber Close-Up

Fuming fuming

IONIZED AIR

2. AMPLIFICATION STAGE

Key Features:
- Audio Signal Boost
- Speaker Line Monitoring
- Redundancy
- Class A/B wiring options

Fan

AMPLIFIERS

AMPLIFIERS

3. ZONING STAGE

Key Features:
- Selective Message Broadcast
- Staged Evacuation
- Fault Isolation

Zone 1: Ground Floor

Zone 2: Floor Floor

Zone 3: Stairwell

SPEAKER CIRCUITS & ZONING

Key Features:
- Selective Message Broadcast
- Staged Evacuation
- Fault Isolation
- Independent Zone Control

4. DISPATCH STAGE

- Clear Voice Instructions
- Improved Safety Response to voice messages

Fuming

Building users

Message broadcast

Sensing Electronics Close-Up

Key Features:
- Clear Voice Instructions
- Improved Safety Response
- Chain Reaction Interrupted

Fuming fuming

SOLID-TO-SOLID CONTACT

THREE ELEMENTS Required for a burn

HEAT

Wood block fuming

Earth

Mantie

Core

Pyrolyeis of many rising

Fire Extinguishment and Supression Backhaul
(Extinguishment Methods - Block/Disrupt Elements)

Ridgewood, NJ location marked on Earth cross-section map

Molecular fuming

Fuming wood

Atomic vibration fuming fuming

Clean Agent (Chain Reaction Inhibition)

Free radicals capture fuming)

Reaction Sustenance Scale

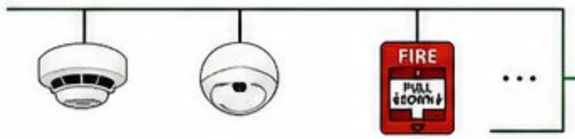
Inhibited Reaction te Self-Propagating Combustion

FACP BLOCK DIAGRAM (Conventional System)

Typical Architecture of a Conventional Fire Alarm Control Panel

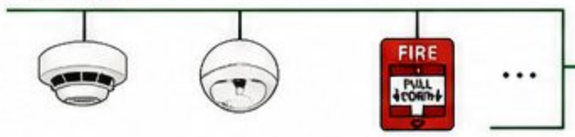
INITIATING DEVICE CIRCUITS (IDC) – INPUTS

IDC LOOP 1



Smoke Detectors Heat Detectors Pull Station

IDC LOOP 2



Smoke Detectors Heat Detectors Pull Station

ADDITIONAL IDC LOOPS

IDC LOOP 3 … IDC LOOP N
(As Configured)

POWER SUPPLY

AC POWER INPUT
(120/240 VAC, 50/60 Hz)

POWER SUPPLY / CHARGER
- Regulated DC Power
- Battery Charger

BATTERIES
(Standby Power)

FIRE ALARM CONTROL PANEL (FACP)

MEMORY
- Program (Firmware)
- Configuration
- Event History

IDC INTERFACE CIRCUITS
(Supervised)

Open / Short / Ground Fault Detection

CENTRAL PROCESSING UNIT (CPU)
- Signal Processing
- System Control
- Diagnostics
- Event Logging
- Decision Logic

SYSTEM TIMING & CONTROL
- Alarm Silence
- NAC Timing
- Walk Test

USER INTERFACE
Display | Indicators | Keypad | Controls

NAC (Notification Appliance Circuit) DRIVERS
(Supervised)

Open / Short / Ground Fault Detection

AUXILIARY RELAYS
(Supervised)
- Alarm
- Trouble
- Supervisory

STATUS INDICATORS

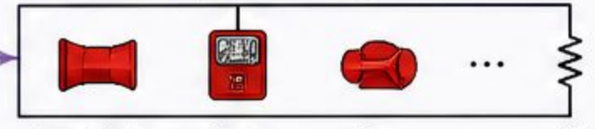
ALARM SUPERVISORY TROUBLE POWER SILENCED DISABLED

NOTIFICATION APPLIANCE CIRCUITS (NAC) – OUTPUTS

NAC CIRCUIT 1 (CLASS B STYLE)

Horn / Strobe Strobe Horn EOL

NAC CIRCUIT 2 (CLASS B STYLE)



Horn / Strobe Strobe Horn EOL

AUXILIARY RELAY OUTPUTS

ALARM RELAY (Form C) TROUBLE RELAY (Form C) SUPERVISORY RELAY (Form C)

COMMUNICATION

IP COMMUNICATOR
(Ethernet)

IP Network / Internet

CELLULAR COMMUNICATOR
(Primary or Backup)

Cellular Network

LEGEND

- Control / Data
- Power
- IDC Inputs
- IDC Inputs
- NAC Outputs
- Network / Comm.

NOTES

- All circuits are supervised for Open, Short, and Ground faults.
- Power-limited (IDC & NAC) and non-power-limited circuits as required.
- Battery provides standby power in the event of AC failure.

This block diagram represents a typical conventional FACP. Features and configuration may vary by manufacturer and model.

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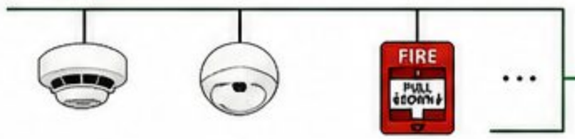
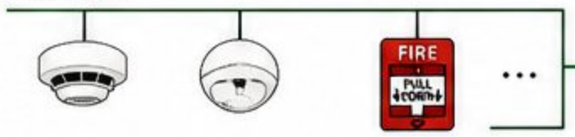


Smoke Detectors Heat Detectors Pull Station

IDC LOOP 2



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- Alarm Silence
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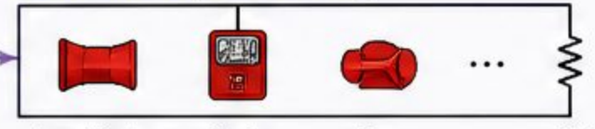

Horn / Strobe Strobe Horn EOL

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(Ethernet)

IP Network / Internet

CELLULAR COMMUNICATOR
(Primary or Backup)

Cellular Network

LEGEND

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- Power
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- IDC Inputs
- NAC Outputs
- Network / Comm.

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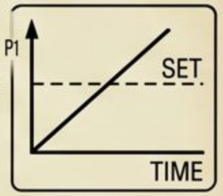
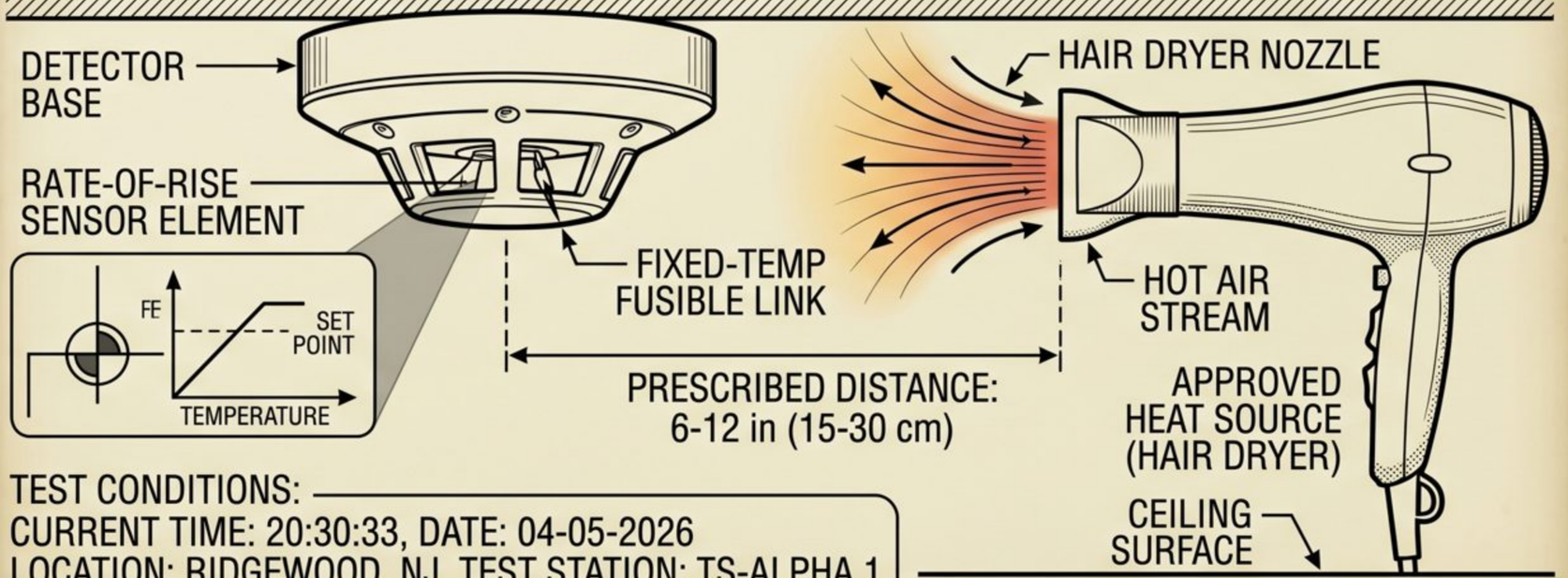
- Battery provides standby power in the event of AC failure.

This block diagram represents a typical conventional FACP. Features and configuration may vary by manufacturer and model.

HEAT DETECTOR FUNCTIONAL TEST

FUNCTIONAL TEST PROCEDURE:
HEAT SOURCE: APPROVED (HAIR DRYER, LOW SETTING)
TEST OBJECTIVE: CONFIRM RATE-OF-RISE ACTIVATION
PRESSCRIBED DISTANCE: 6-12 INCHES (15-30 CM) FROM SENSOR





TEST CONDITIONS:
CURRENT TIME: 20:30:33, DATE: 04-05-2026
LOCATION: RIDGEWOOD, NJ, TEST STATION: TS-ALPHA 1
ROOM TEMP: 21°C (70°F), RELATIVE HUMIDITY: 45%

SYSTEM IFTECTOR → TEST CONFIRMED

SYSTEM MONITORS ACTIVATION →

11. System Design, Documentation & Submittals

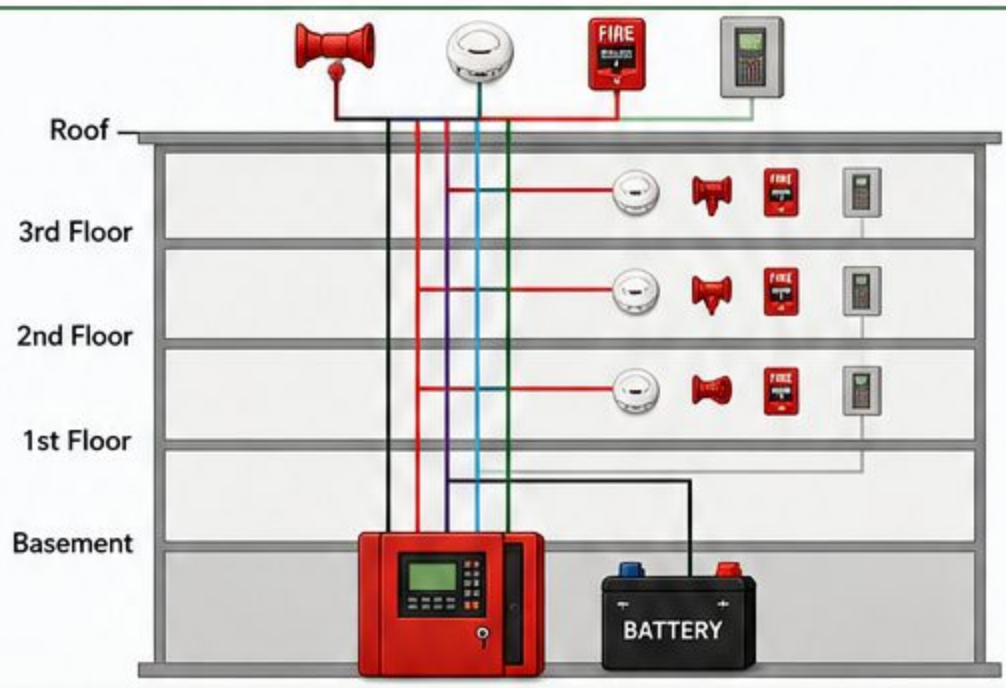
Required Design Documentation

- Floor plans showing device layout, zones, and system components.
- Riser diagram of all system wiring.
- Sequence of operations matrix.
- Battery calculations and backup power requirements.
- Voltage drop calculations.
- Equipment specifications and data sheets.
- Manufacturer's installation instructions.
- Permits and code compliance documents.
- Testing, inspection, and maintenance plan.

Riser Diagram

Legend

- Notification Appliance Circuit (NAC)
- SLC / Initiating Circuit
- Communications Circuit
- Power Circuit
- Other Wiring / Conduit



Notes

- Shows vertical (riser) wiring between floors.
- Indicates all major system circuits.
- Refer to floor plans for horizontal routing.

Sequence of Operations Matrix

Initiating Device / Condition	System Response / Actions						
	Notification Appliances	Control Equipment	HVAC Controls	Elevator Controls	Door Releases	Fire Dept. Connection	Annunciator / Display
Smoke Detector Activation	●	●	●	●	●	●	●
Heat Detector Activation	●	●	●	●	●	●	●
Manual Pull Station	●	●	●	●	●	●	●
Sprinkler Flow Switch (WF)	●	●	●	●	●	●	●
Tamper Switch (VS)	–	–	–	–	–	–	●
System Trouble	–	–	–	–	–	–	●
AC Power Failure	–	●	–	–	–	–	●
Low Battery Condition	–	●	–	–	–	–	●

12. Operations – Manual, Automatic & Supervisory

Manual Operation

Manual Pull Stations
Activate the system when pulled.

Control Panel
Allows authorized personnel to operate system controls.

System Annunciation
Provides audible & visual indications of system status.

Acknowledgment
Alarms and troubles are acknowledged at the control panel.

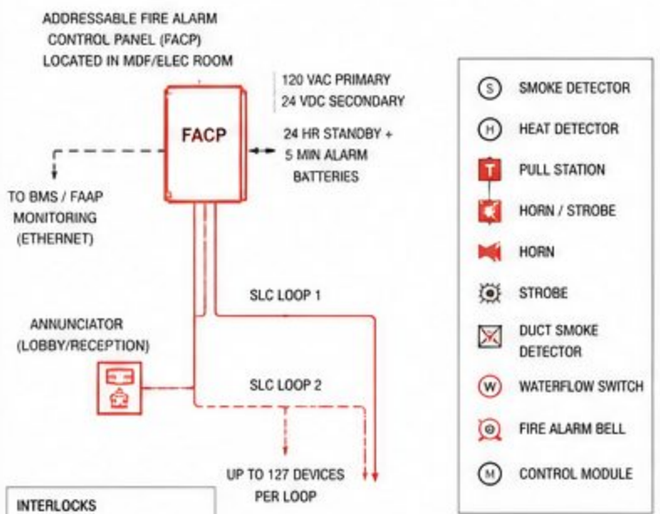
Operation Types

Manual Operation
Initiated by a person (e.g., pull station).

Automatic Operation
Initiated by detectors or system conditions.

Supervisory Operation
Monitors system status and reports conditions.

1. FIRE ALARM RISER DIAGRAM



INTERLOCKS

- HVAC SHUTDOWN
- ACCESS CONTROL FAIL-SAFE
- DOOR HOLD-OPENS RELEASE
- ELEVATOR RECALL (IVA - 1 STORY)

2. FIRE ALARM DEVICE LAYOUT PLAN

SCALE: 1/16" = 1'-0"

3. SPRINKLER ZONING PLAN

LEGEND

- WET PIPE
- SPRINKLER HEAD (K5.6, 165°F)
- RISER / ZONE CONTROL VALVE
- WATERFLOW SWITCH
- DESIGN AREA (1,500 FT²)

SPRINKLER ZONE SUMMARY

ZONE	AREA (FT²)	DENSITY	REQUIRED FLOW (GPM)
1 (OPEN OFFICE)	17,000	0.10	170
2 (CONF. SUITE / OFFICES)	2,000	0.10	20
3 (LOBBY / PANTRY)	1,800	0.10	18
4 (SUPPORT / STORAGE)	4,200	0.10	42
TOTAL (MAX SIMULTANEOUS)			170 GPM @ 44 PSI

4. HYDRAULIC CALCULATION SUMMARY (NFPA 13)

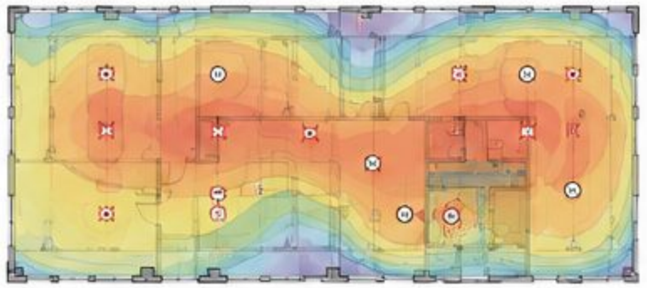
DESIGN CRITERIA	
OCCUPANCY	Business
HAZARD CLASSIFICATION	Light Hazard
DENSITY	0.10 gpm/ft²
DESIGN AREA	1,500 ft²
SPRINKLER TYPE	K5.6, 165°F
SYSTEM TYPE	Wet Pipe
STATIC PRESSURE (AT FDC)	68 psi (City)
RESIDUAL PRESSURE (AT FDC)	61 psi (City)
AVAILABLE FLOW (AT 20 PSI)	> 1,000 gpm
REQUIRED FLOW (MAX AREA)	170 gpm
REQUIRED PRESSURE @ BASE	44 psi
SAFETY FACTOR	> 4.0
FIRE PUMP	NOT REQUIRED

WATER SUPPLY CALC	
Flow Test Data (gpm)	
At 20 psi Residual	1,250
At 0 psi Residual	1,900
Static Pressure (psi)	68
RESULT	
Available @ 20 psi	1,250 gpm
Required	170 gpm
	OK

NOTES

1. ALL CALCULATIONS PER NFPA 13.
2. MOST REMOTE HEAD SET GOVERNING.
3. FRICTION LOSS CALCULATED USING HAZEN-WILLIAMS C=150.

5. AUDIO/VISUAL (AV) COVERAGE – CANDELA MAP

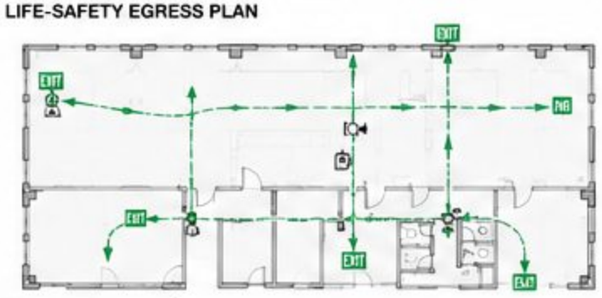


MEETS NFPA 72 REQUIREMENTS

NOTES

1. MINIMUM 15 cd IN OPEN OFFICE AND CORRIDORS.
2. MINIMUM 75 cd IN RESTROOMS PER NFPA 72.
3. AUDIBLE LEVEL: MIN 15 dBA ABOVE AMBIENT OR 5 dBA ABOVE MAXIMUM.

6. LIFE-SAFETY EGRESS PLAN



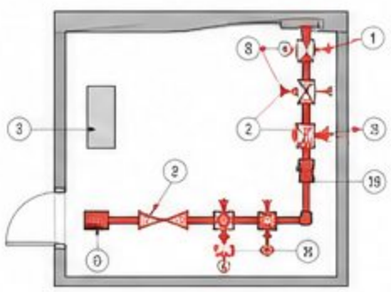
LEGEND

- EXIT SIGN (277V)
- EXIT ROUTE
- EMERGENCY LIGHT
- AREA OF REFUGE (IF REQUIRED)

LIFE-SAFETY NOTES

1. MAX TRAVEL DISTANCE: 200 FT.
2. DEAD-END CORRIDOR: 20 FT MAX.
3. EXIT SIGNS ILLUMINATED AT ALL TIMES.
4. EMERGENCY LIGHTING PER NFPA 101.
5. LP-EM PANEL ON GENERATOR/UPS PATH.

7. RISER ROOM / FIRE PROTECTION ROOM PLAN



NO.	DESCRIPTION
1	6" FIRE SERVICE INLET
2	OS&Y GATE VALVE
3	CHECK VALVE
4	BACKFLOW PREVENTER
5	WATER METER (IF REQUIRED)
6	FIRE DEPT CONNECTION (FDC)
7	MAIN DRAIN
8	INSPECTOR'S TEST CONNECTION
9	SPRINKLER RISER
10	RACK FOR SPARE HEADS

ROOM SIZE: 12'-0" x 16'-0" MIN.
FLOOR DRAIN: YES
ACCESS: 36" CLEAR DOOR
SIGN: "FIRE PROTECTION ROOM"

8. GENERAL NOTES

FIRE PROTECTION

- SYSTEM DESIGNED PER NFPA 13.
- ALL PIPING SCHEDULE 40 STEEL.
- SPRINKLERS K5.6, 165°F, UPRIGHT.
- FDC 4 1/2" WITH LOCKING CAP.
- EXTERIOR BELL/STROBE AT FDC.

FIRE ALARM

- SYSTEM DESIGNED PER NFPA 72.
- ADDRESSABLE SYSTEM.
- BATTERY CAPACITY: 24 HR STANDBY + 5 MIN ALARM.
- ALL DEVICES LISTED, U.L. LISTED.
- COORDINATE DEVICE LOCATIONS WITH ARCH/CEILING PLANS.

GENERAL

- PROVIDE SIGNAGE AND FIRE EXT. PER NFPA 10.
- MAINTAIN 36" CLEARANCE IN FRONT OF ELECTRICAL EQUIPMENT.
- FIELD VERIFY ALL CONDITIONS.

INTEGRATED BUILDING DESIGN (ALL SYSTEMS)

FIRE PROTECTION & LIFE SAFETY DESIGN

HAZARD CLASSIFICATION

LIGHT HAZARD (NFPA 13)

WITH LOCAL ORDINARY HAZARD GROUP 1 ALLOWANCE FOR STORAGE ZONES

SHEET CONTENTS

- FIRE ALARM RISER
- DEVICE LAYOUT PLAN
- SPRINKLER ZONING PLAN
- HYDRAULIC CALC SUMMARY
- AV CANDELA MAP

PROJECT NO.
IBD-2405

DATE
05/20/2024

DRAWN BY
EED

CHECKED BY
FPD

SHEET
FP1.0

9. Device Layout – Residential & Commercial

Typical Residential Layout

Smoke Detectors
In bedrooms, outside sleeping areas & on each level

Heat Detectors
In kitchens, garages & near furnaces

Manual Pull Stations
Near exits

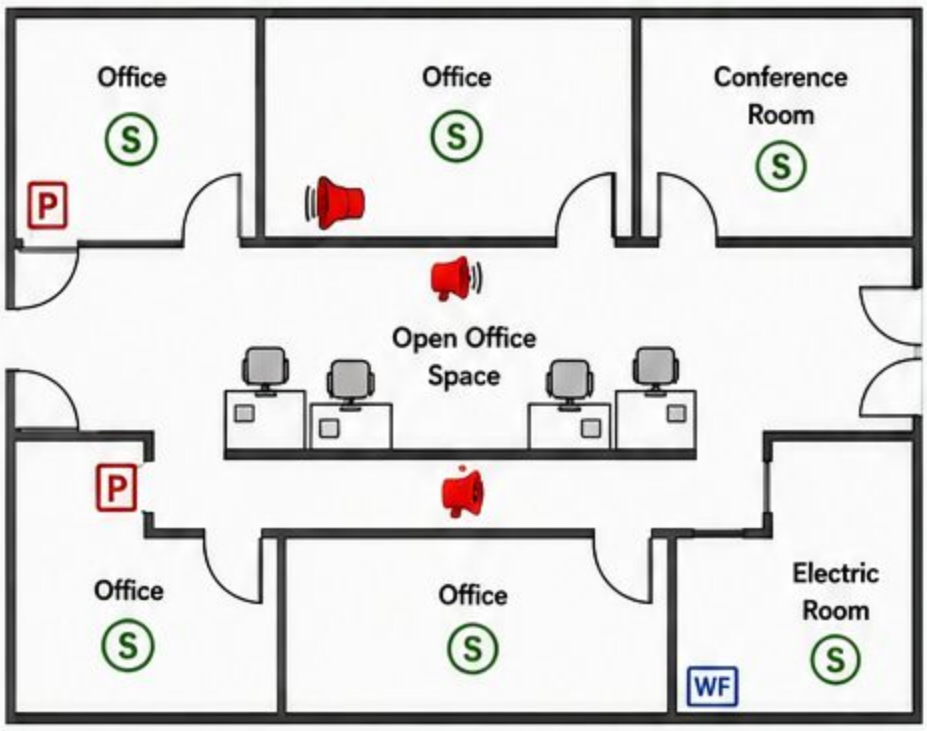
Notification Appliances
Audible/visual alarms in all required areas

Fire Extinguisher
Kitchen, garage & accessible locations

Placement Guidelines

- Smoke detectors on ceilings or high on walls.
- Heat detectors away from cooking appliances & vents.
- Pull stations near exit doors.
- Alarms visible & audible throughout the home.
- Follow local codes & NFPA 72 requirements.

Sample Commercial Office Layout



Smoke Detectors
In all offices, conference room, open areas & common spaces

Manual Pull Stations
At all exits & near stairwells

Notification Appliances
Audible/visual throughout the building

Sprinkler Flow Switch (WF)
Monitors sprinkler system water flow

Tamper Switches (VS)
On critical equipment & access doors

General Guidelines

- Provide complete coverage in all occupied areas.
- Ensure alarms are both audible and visible.
- Keep paths to exits clear at all times.
- Comply with NFPA 72, NFPA 101, & local building codes.

10. Emergency Control Features

Door Unlocking
Automatically unlock doors to allow safe evacuation.

Elevator Recall
Returns elevators to the designated floor and prevents use.

Smoke Control
Activates fans, dampers, and pressurization systems.

Power Control
Shuts down or controls non-essential systems (e.g., HVAC, gas).

Alarm Activation
Triggers audible and visual notification appliances.

Door Releasing Service
Releases fire doors and magnetic holders.

Fire Department Connection (FDC)
Provides connection for fire department hoses.

Emergency Communications Systems (NFPA 72 Chapter 26)

Emergency Communications Systems (ECS) provide reliable communication during emergencies.

Components include:

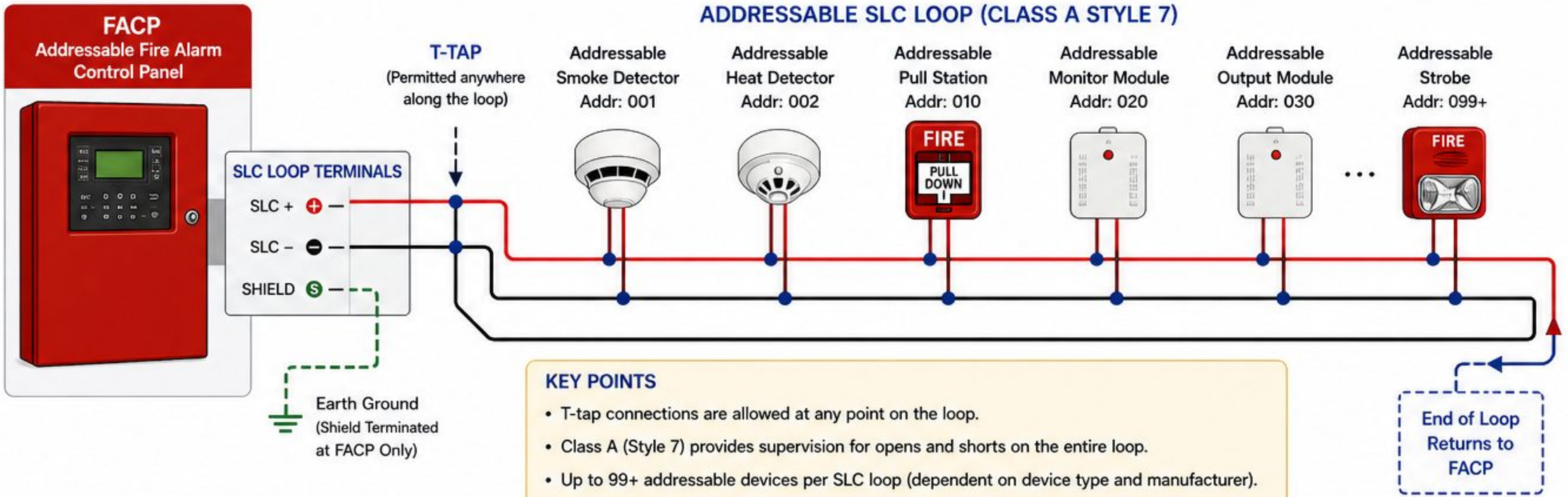
- Fire Alarm Communicators
- Voice Alarm Systems
- Two-Way Radio Enhancers
- Mass Notification Systems
- Emergency Telephones
- Public Address Systems

Key Purposes

- Enable communication for occupants, first responders, and building staff.
- Operate during power failures.
- Integrate with fire alarm system.
- Comply with NFPA 72 requirements.

Addressable SLC Loop Architecture

Addressable Signaling Line Circuit (SLC) — Supports 99+ Addressable Devices per Loop



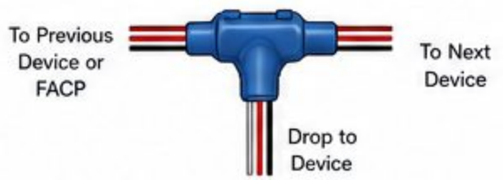
99+ Addressable Devices per Loop*

*Refer to manufacturer documentation for exact device count limitations.

KEY POINTS

- T-tap connections are allowed at any point on the loop.
- Class A (Style 7) provides supervision for opens and shorts on the entire loop.
- Up to 99+ addressable devices per SLC loop (dependent on device type and manufacturer).
- Shielded cable recommended; shield is terminated at the FACP only.

T-TAP CONNECTION (EXAMPLE)



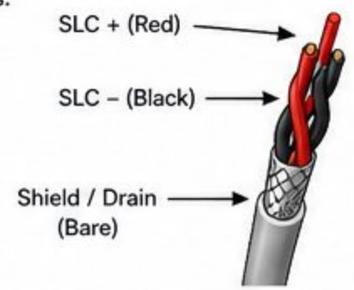
Use listed T-tap devices or terminals listed for the application.

LEGEND

- \+ SLC Positive (SLC +)
- — SLC Negative (SLC –)
- ● T-Tap Connection
- - - Shield (Terminate at FACP Only)

SLC LOOP WIRING GUIDELINES

- Install in accordance with NFPA 72, NEC, and manufacturer's instructions.
- Maintain polarity on all devices.
- Use twisted, shielded pair cable listed for fire alarm systems.
- Do not mix power-limited wiring with non-power-limited wiring in the same cable.
- Maximum loop resistance (typical): – 40 ohms (refer to manufacturer for exact limit)
- Wire gauge and length depend on cable type and loop load.
- Proper T-tap connections ensure reliable supervision and communication.



Twisted, Shielded Pair Cable (Typical)

SLC LOOP SUPERVISION

CONDITION	FACP RESPONSE
Normal	No Trouble
Open on Loop	Trouble (Open Circuit)
Short on Loop	Trouble (Short Circuit)
Device Removed	Trouble / Missing Device
Device Added	New Device Detected
Device Communication Failure	Trouble / Device Offline

NOTE: Loop wiring methods and device counts vary by manufacturer. Always follow the manufacturer's documentation and applicable codes.

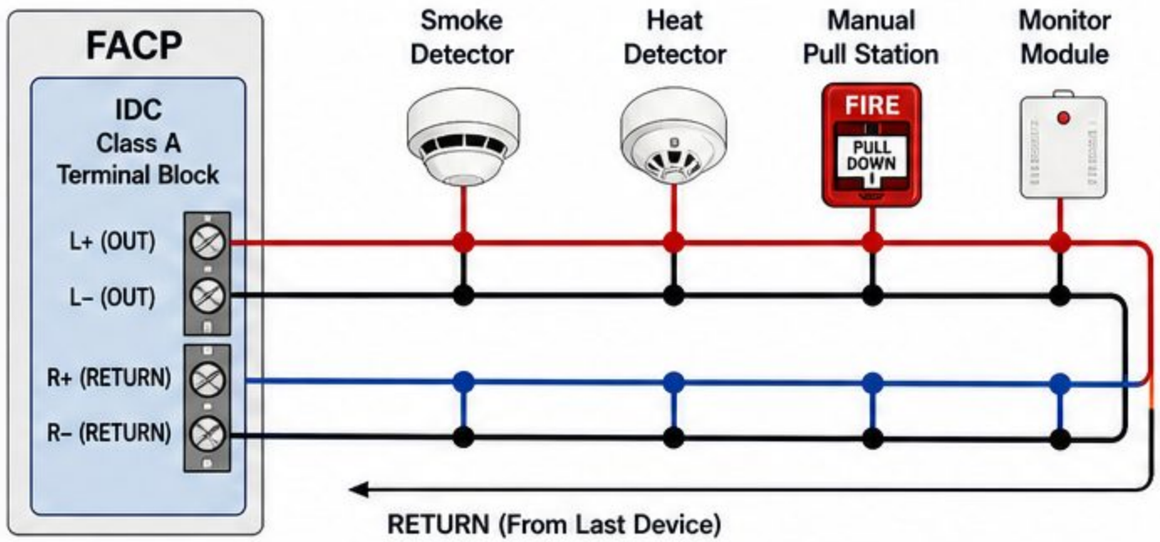
Reference: NFPA 72® 2022 – 23.7, 23.8, 23.9

Class A vs Class B Wiring

Initiating Device Circuit (IDC) Wiring Methods

CLASS A (STYLE Z – 4-WIRE RETURN)

Supervised for opens and shorts on both the line and return.



CLASS A FEATURES

- 4 wires: 2 for the outgoing (L+ / L–) and 2 for the return (R+ / R–).
- Supervised for opens and shorts on both outgoing and return paths.
- Maintains communication if a single wire opens.
- Required in high-rise buildings (per IBC) and where continuity of operation is critical.

TROUBLE CONDITIONS

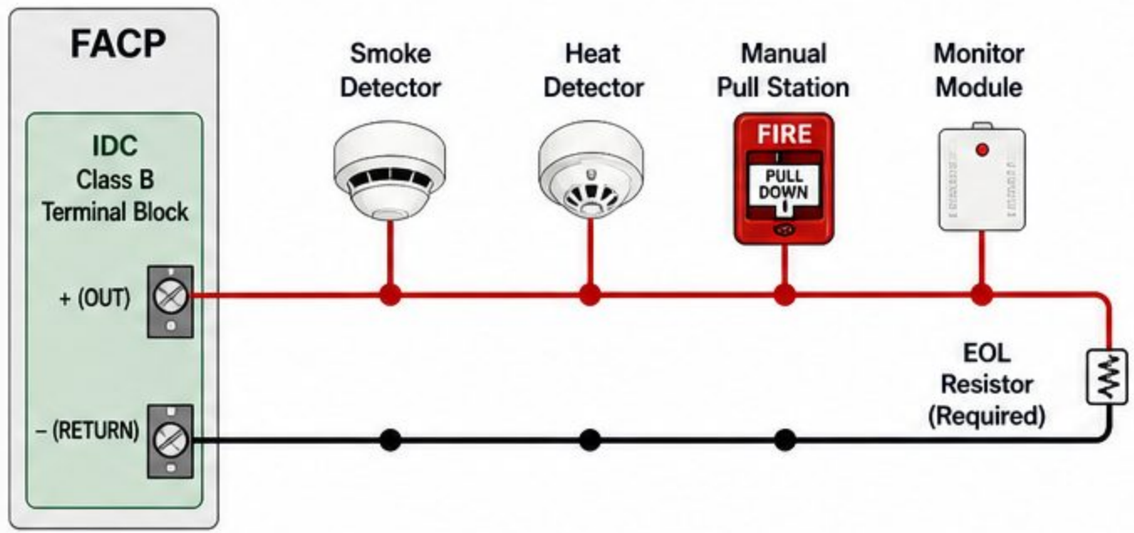
CONDITION	CLASS A RESPONSE
Open on OUT (L+ or L–)	Trouble (open)
Open on RETURN (R+ or R–)	Trouble (open)
Short on any wire	Trouble (short)
Device removed	Trouble

LEGEND

- L+ (OUT)
- L– (OUT)
- R+ (RETURN)
- R– (RETURN)
- Connection Point

CLASS B (STYLE B – 2-WIRE)

Supervised for opens and shorts on the circuit.



CLASS B FEATURES

- 2 wires: one outgoing (+) and one return (–).
- Supervised for opens and shorts on the circuit.
- A single open will cause loss of communication to all devices beyond the open.
- End-of-line (EOL) resistor required at the last device.

TROUBLE CONDITIONS

CONDITION	CLASS B RESPONSE
Open on circuit	Trouble (open)
Short on circuit	Trouble (short)
Device removed	Trouble

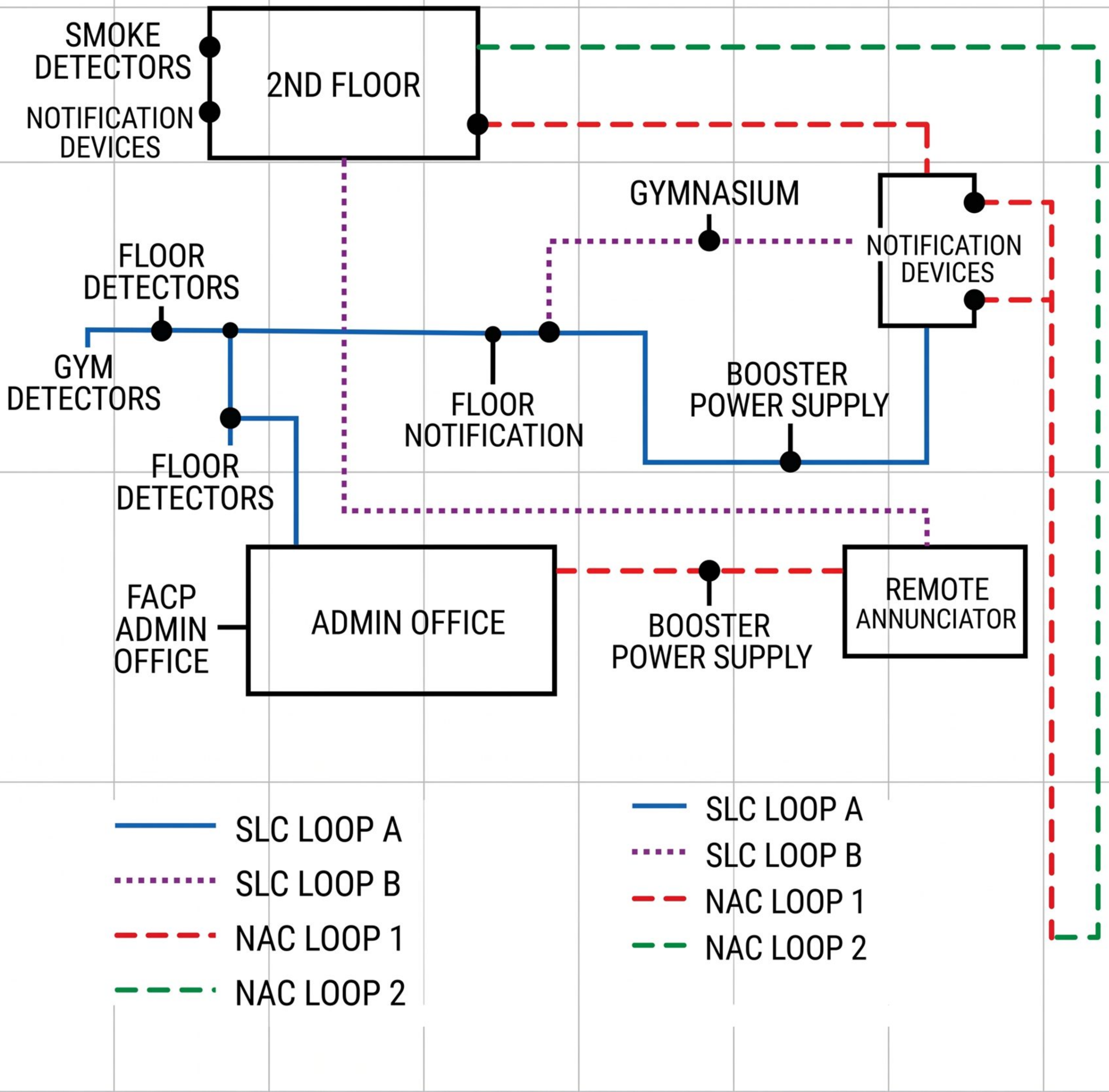
LEGEND

- + (OUT)
- – (RETURN)
- EOL Resistor
- Connection Point

NOTE: All wiring shall be installed in accordance with NFPA 72, NEC, and applicable local codes.

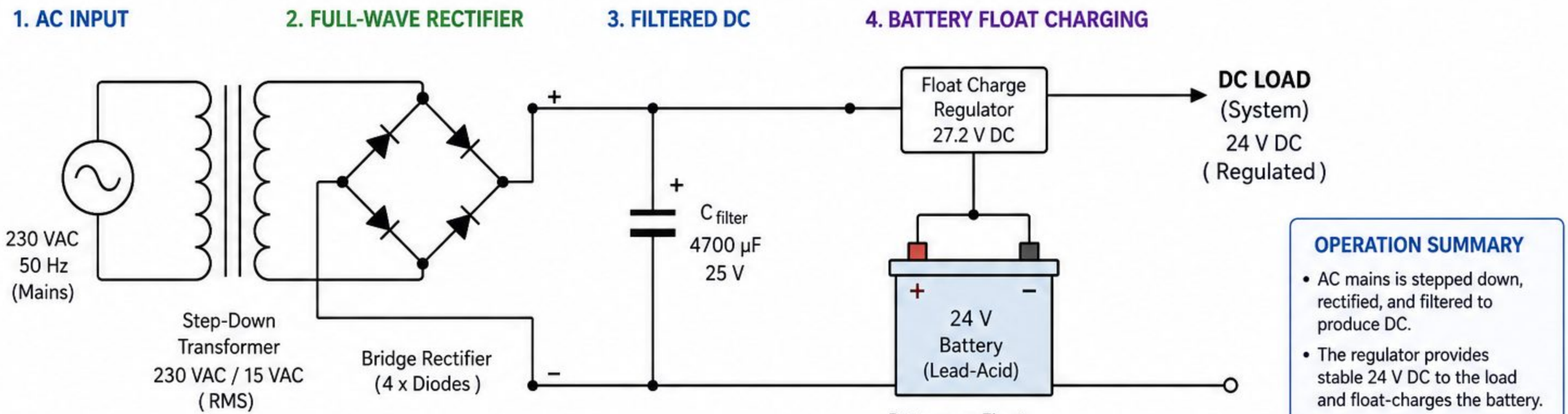
Class A provides the highest level of survivability.
Class B is permitted in most occupancy types.

WIRING TOPOLOGY DIAGRAM



Power Supply & Battery Backup

Diagram showing AC input, full-wave rectifier, filtered DC, battery float charging, and 24-hr standby calculation.



OPERATION SUMMARY

- AC mains is stepped down, rectified, and filtered to produce DC.
- The regulator provides stable 24 V DC to the load and float-charges the battery.
- On AC failure, the battery supplies the load automatically for backup.

DC VOLTAGE (APPROX.)

Secondary AC (RMS)	=	15 VAC
Peak DC (no-load)	=	$15 \times \sqrt{2} - 2V_d$
	≈	19.8 V ($V_d \approx 0.7$ V per diode)
Filtered DC (under load)	≈	24 – 26 VDC
Regulated Output	=	24 VDC

BATTERY FLOAT CHARGING

- Float Voltage (Lead-Acid, 24 V) : 27.2 V DC (≈ 2.27 V/cell)
- Maintains battery at 100% charge
- Automatically makes up for self-discharge and load variations

24-HR STANDBY CALCULATION

Assume:

- Load Current (I_{load}) = 2.0 A
- System Voltage (V_{sys}) = 24 V
- Backup Time = 24 hours

Required Battery Capacity (C_{Ah}) = I_{load} × Time

= 2.0 A × 24 h

= 48 Ah (Minimum)

For reliability and battery life, select next higher standard size: 24 V, 50 Ah or above.

IP/Network Transmission Path

NFPA 72 – 26.6.3 Requires two independent communication paths to the supervising station.

PREMISES EQUIPMENT

FACP
Fire Alarm
Control Panel

BUILDING DEVICES

Detectors, Pull Stations,
Notification Appliances, etc.

IP COMMUNICATOR

IP COMMUNICATOR
Converts FACP signals to IP and provides secure transmission.

CUSTOMER NETWORK (LOCAL)

ROUTER / SWITCH
(Customer Provided)

PRIMARY PATH
(Path 1)

SECONDARY PATH
(Path 2)

INTERNET

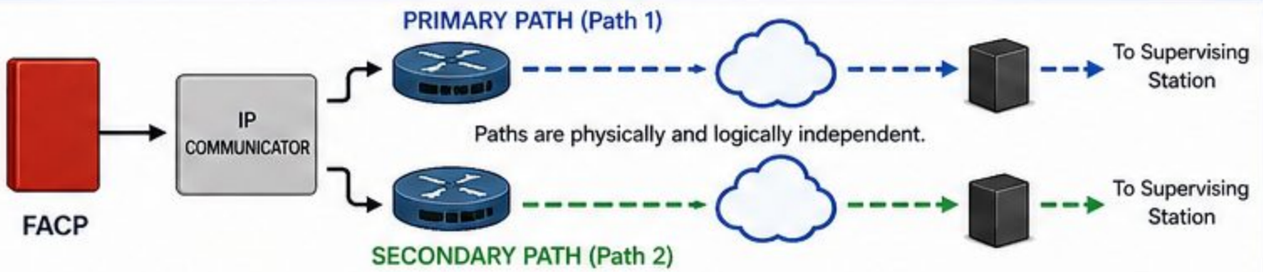
INTERNET
Public IP Network

SUPERVISING STATION

SUPERVISING STATION
Receives and processes alarm, supervisory, trouble, and other signals.

REDUNDANT PATH REQUIREMENT

- Two independent communication paths are required to the supervising station.
- Failure of one path shall not impair the transmission of signals over the other path.



INDEPENDENCE REQUIREMENTS

- Use different physical paths (separate conduits, cable routes, or wireless carriers).
- Use different service providers or technologies (e.g., broadband + cellular).
- A single failure shall not affect both paths.
- Path supervision shall be provided.

COMMON TECHNOLOGIES

Wired Broadband
(Ethernet / DSL / Fiber)

Cellular LTE / 4G / 5G
(Wireless Primary or Backup)

Satellite
(Primary or Backup)

Microwave / Radio
(Licensed / Unlicensed)

TYPICAL SIGNALS TRANSMITTED

- Alarms
- Supervisory
- Troubles
- Restore
- System Test
- Other Events

LEGEND

- Wired Connection (Premises)
- Primary Communication Path (Path 1)
- Secondary Communication Path (Path 2)

Maintain documentation of both communication paths. Test and verify operation of all paths in accordance with NFPA 72.

Reference: NFPA 72® 2022 Edition – Section 26.6.3

DACT Signal Path

1. DETECTOR STAGE

- Detector fuming (e.g., Ionization, Rate-of-Rise)

Local fuming

Local Alarm Panels

Chain Reaction fuming **Interrupted**

Chamber Close-Up

Fuming fuming

IONIZED AIR

SOLID-TO-SOLID CONTACT

THREE ELEMENTS Required for a bodie low

HEAT

Wood block fuming

2. TRANSMITTER (DACT) STAGE

- Monitors Alarm Panels
- Communicates via PSTN (Primary & Secondary)
- Encodes Alarm Data
- Manages Handshakes

Fan

DACT UNIT

Earth

Mantie

Core

Pyrolyeis of many rising

3. NETWORK (PSTN) STAGE

PSTN (PUBLIC SWITCHED TELEPHONE NETWORK)

NETWORK (PSTN) TELEPHONE NETWORK)

Key Features:

- Requires fluid motion (gas or liquid)
- Multi-Use (Restorable)
- Bimetal disk bends/snaps at set point
- Compartment fuming involvement

4. CENTRAL STATION STAGE

Fuming

- Central Station Receiver
- Decodes Alarm Data
- Acknowledges Handshakes
- FACP (Fire Alarm Control Panel) Connection fuming

UNINHIBITED COMBUSTION

CHAIN-REACTIso-Up INTERRUPTED

Free radicals capture fuming

Sensing Electronics Close-Up

Key Features:

- Does not require a medium
- Uninhibited reaction process fuming
- Free radical propagation fuming
- Entire room fuming is a mass.

Fuming fuming

Fire Extinguishment and Supression Backhaul
(Extinguishment Methods - Block/Disrupt Elements)

Ridgewood, NJ location marked on Earth cross-section map

Molecular fuming

Fuming wood

Foam (Fuel Smothering fuming)

Clean Agent (Chain Reaction Inhibition)

Free radicals capture fuming)

Reaction Sustenance Scale

Inhibited Reaction te Self-Propagating Combustion

FACP

Riser

SMOKE DETECTOR

SMOKE DETECTOR

SMOKE DETECTOR

Riser

SMOKE DETECTOR

MANUAL PULL

SPEAKER/ STROBE

DUCT DETECTOR

CORRIDOR

SNECKR. UTILITY

UTILITY

SPEAKER/ STROBE

UTILITY

DUCT FAN

SMOKE DETECTOR

HEAT DETECTOR

ELECT. ROOM

SMOKE DETECTOR

KITCHEN

STROBE

KITCHEN

SOUNDER BASE

GAS SHUTOFF

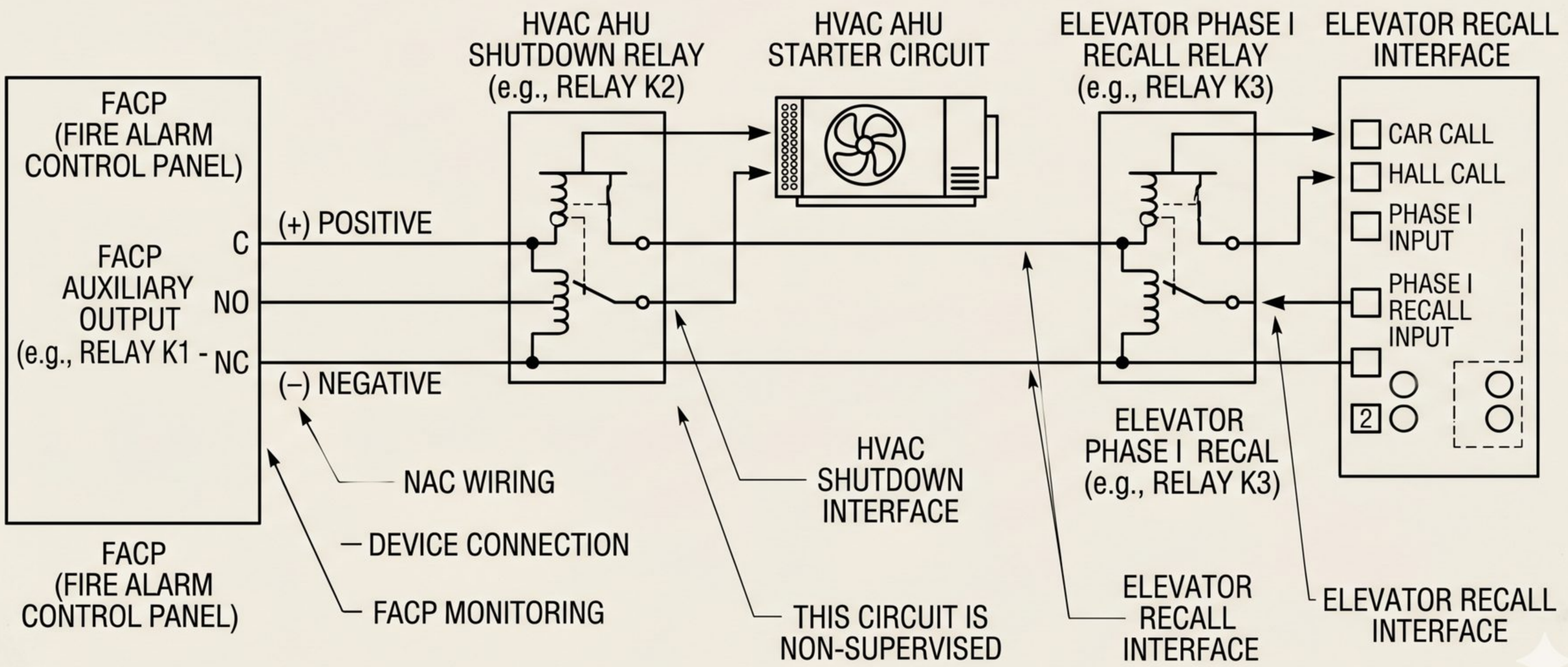
FAN

NURSE CALL

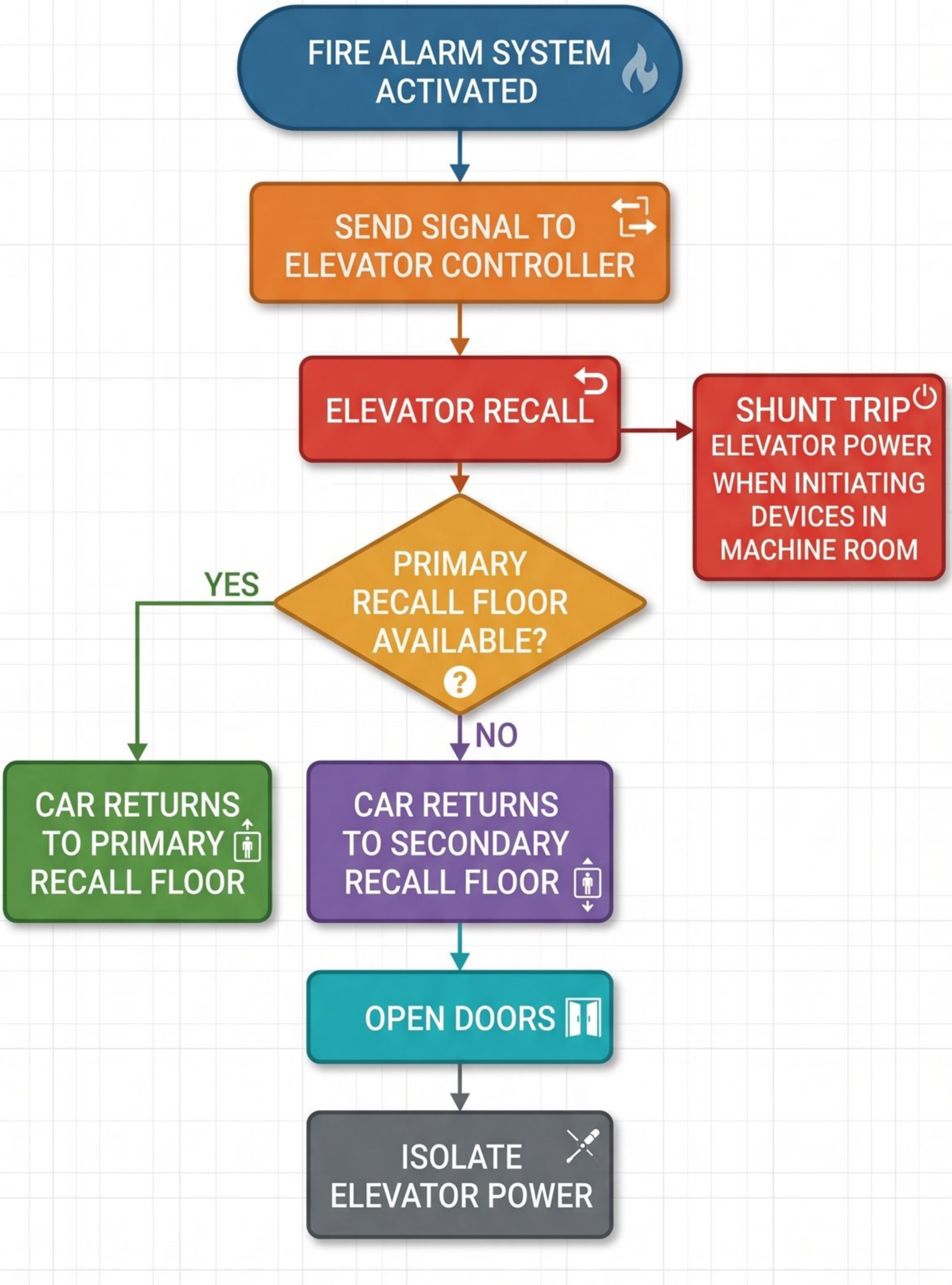
ELEVATOR

EQUIPMENT RISER DIAGRAM

HVAC Shutdown & Elevator Recall Wiring

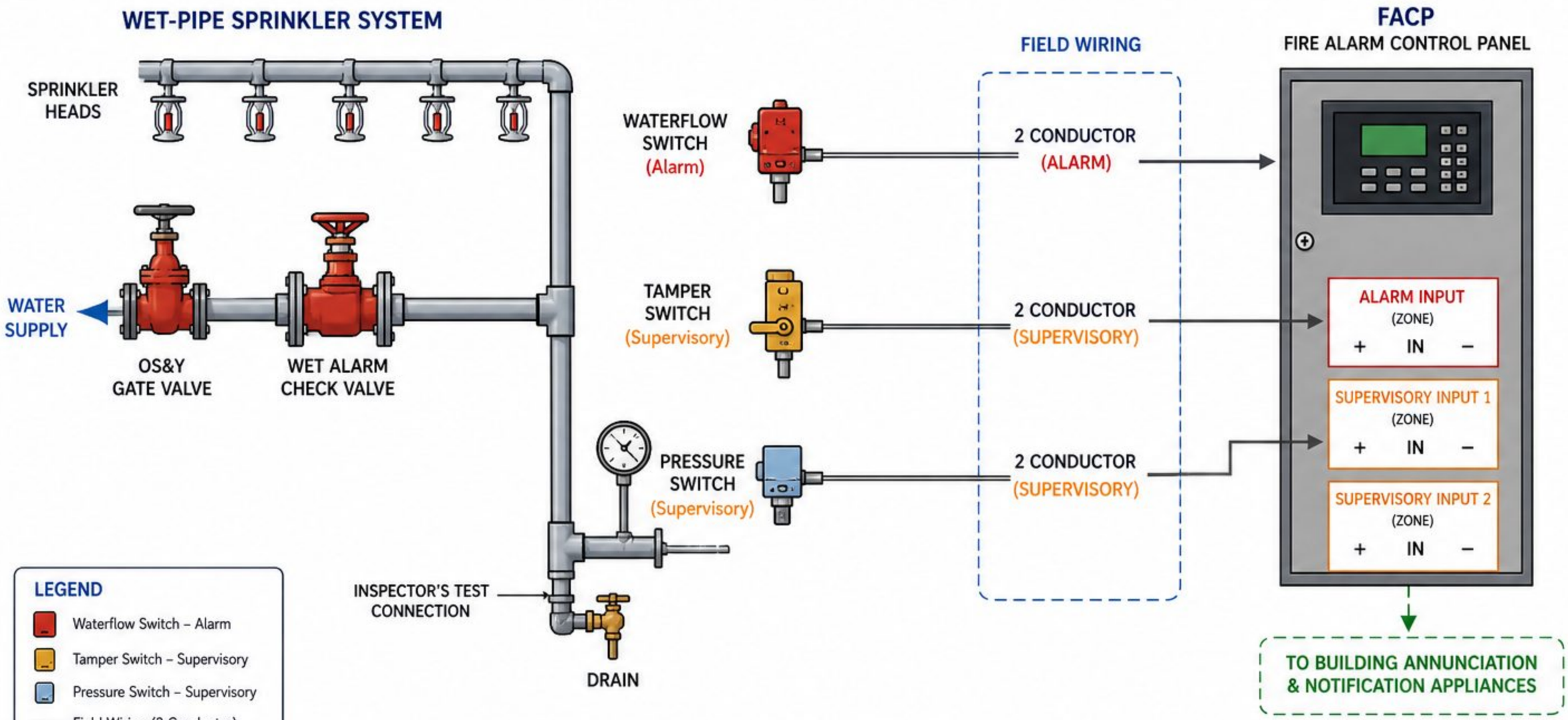


ELEVATOR INTERFACE LOGIC



Wet-Pipe Sprinkler Integration

System diagram connecting wet-pipe sprinkler waterflow switch, tamper switch, and pressure switch to FACP.



LEGEND

- Waterflow Switch – Alarm
- Tamper Switch – Supervisory
- Pressure Switch – Supervisory
- Field Wiring (2 Conductor)
- Wiring Boundary (Field to FACP)

DEVICE FUNCTIONS

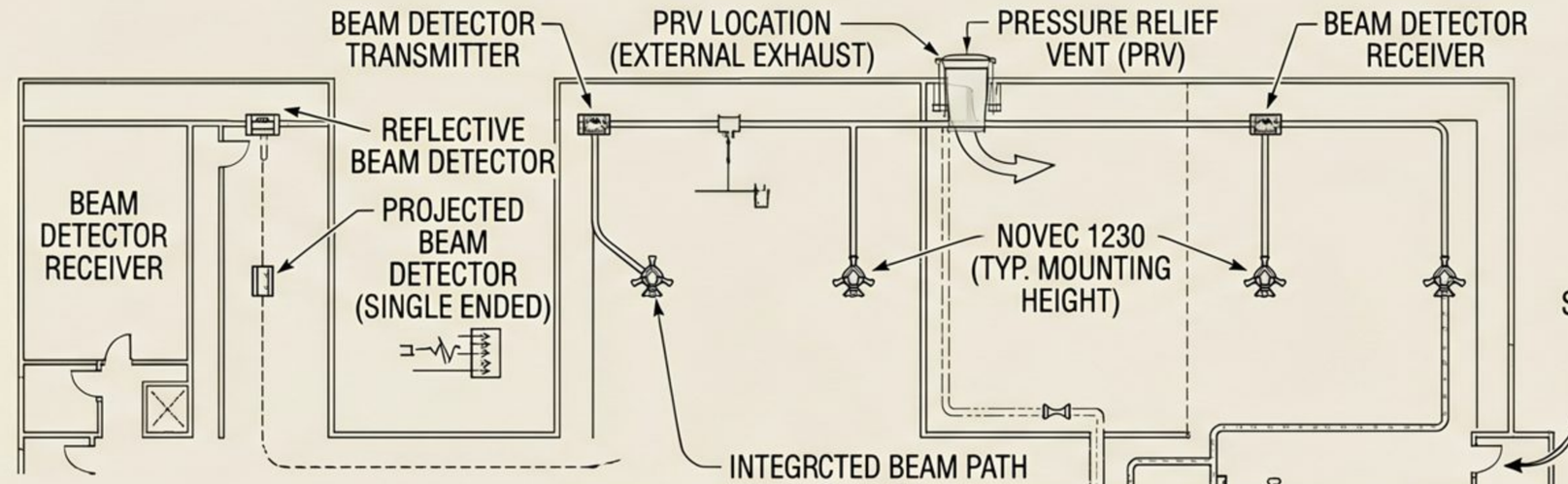
- **Waterflow Switch:** Activates on water flow to indicate sprinkler operation (Alarm).
- **Tamper Switch:** Monitors control valve tamper condition (Supervisory).
- **Pressure Switch:** Monitors system water pressure (Supervisory).

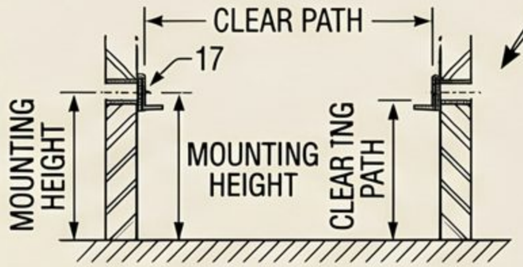
NOTES

- All field devices shown are normally open and supervised.
- Wiring shown is Class B (Style Y or FPL/FPLR as required by code).
- Installation shall comply with NFPA 13, NFPA 72, and local codes.

Clean Agent Suppression — Room Integrity

Diagram of protected enclosure showing Novec 1230 nozzles, door seals, pressure relief vent, and abort station.

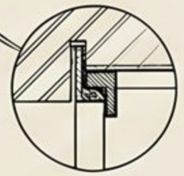




TYPICAL PRV INSTALLATION DETAIL (CROSS-SECTION)

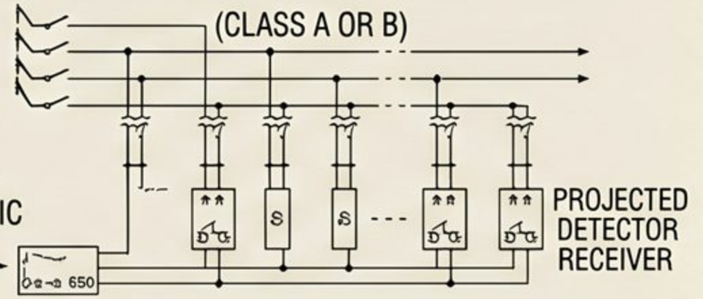
FACP MONITORING (ALL FUNCTIONS)

PROTECTED ENCLOSURE FLOOR PLAN



DOOR SEAL INTEGRITY DETAIL (GASKET CROSS-SECTION)

SUPPRESSION SYSTEM SCHEMATIC AND INTEGRITY LOGIC



AGENT CALCULATION PARAMETERS

- DETECTION - RET
- SUPPRESSION RELEASE
- PRV ACTUATION + MF

ROOM INTEGRITY TESTING SCHEDULE (RET)

- ROOM INTEGRITY
- PRV LEBATION
- ABORT STATION - RET

SYSTEM LEGEND

- NOVEC 1230 NOZZLE
- PRV
- ABORT STATION
- DOOR SEAL
- AGENT PIPE
- REFLECTIVE BEAM DETECTOR
- PROJECTOR REICEIVER
- NOTIFICATION ACTIVMITTER
- FACP INTERFACE
- TIMED ACTIMED

SYSTEM SCHEMATIC AND SPECIFICATIONS

CIRCUIT PATHWAY SURVIVABILITY — NFPA 72 12.4

Provides increasing levels of integrity for Life Safety circuits to ensure operation during a fire.

LEVEL	DESCRIPTION	TYPICAL APPLICATIONS & EXAMPLES	KEY REQUIREMENTS (NFPA 72)
LEVEL 0 **BASIC** *No Additional Protection*	No additional protection. NEC Article 760 only.	 Most small, low-rise systems.	• Circuits installed per NEC Article 760. • No circuit integrity requirements.
LEVEL 1 **PERFORMANCE** *Performance-Based Pathway Protection*	Performance-based pathway protection in fully sprinklered buildings. High-rise voice systems with sprinklers.	 High-rise voice systems in fully sprinklered buildings.	• Pathways protected based on performance criteria (heat, water, mechanical damage). • Typically through building construction and sprinkler protection.
LEVEL 2 **ENHANCED** *2-Hour Rated Pathways (Typical)*	2-hour rated cable system (Class I or MIC) or 2-hour rated enclosure.	 High-rise voice-evac risers, standpipes, critical areas.	• Circuits provided in 2-hour rated cable system (Class I or MIC) OR • Circuits enclosed in 2-hour rated construction. • Maintains circuit function for 2 hours.
LEVEL 3 **MAXIMUM** *2-Hour Enclosure + 2-Hour Rated Cables*	Level 2 cable system inside a separate 2-hour rated enclosure. Highest integrity for critical life safety systems.	 Critical EVACS paths, where AHJ requires maximum survivability.	• 2-hour rated enclosure providing physical protection. • Cables inside enclosure are 2-hour rated (Class I or MIC). • Ensures circuit integrity for 2 hours (minimum).

HIGHER LEVEL = GREATER INTEGRITY DURING THE FIRE.

Selection per code, the Authority Having Jurisdiction (AHJ), and risk analysis.

LEGEND

NEC: National Electrical Code
EVACS: Emergency Voice/Alarm Communication System
AHJ: Authority Having Jurisdiction
CI: Class I Circuit Integrity (2-hour rated)
MI: Multiple Integrity (2-hour rated)
MIC: Mineral-Insulated Cable (2-hour rated)

REFERENCES

NFPA 72®: 2025 – 12.4 Circuit integrity. | NEC®: 2023 – Article 760

High-Rise Stairwell Pressurization Diagram

Building section showing stairwell pressurization fans, barometric dampers, and differential pressure sensors.

LEGEND

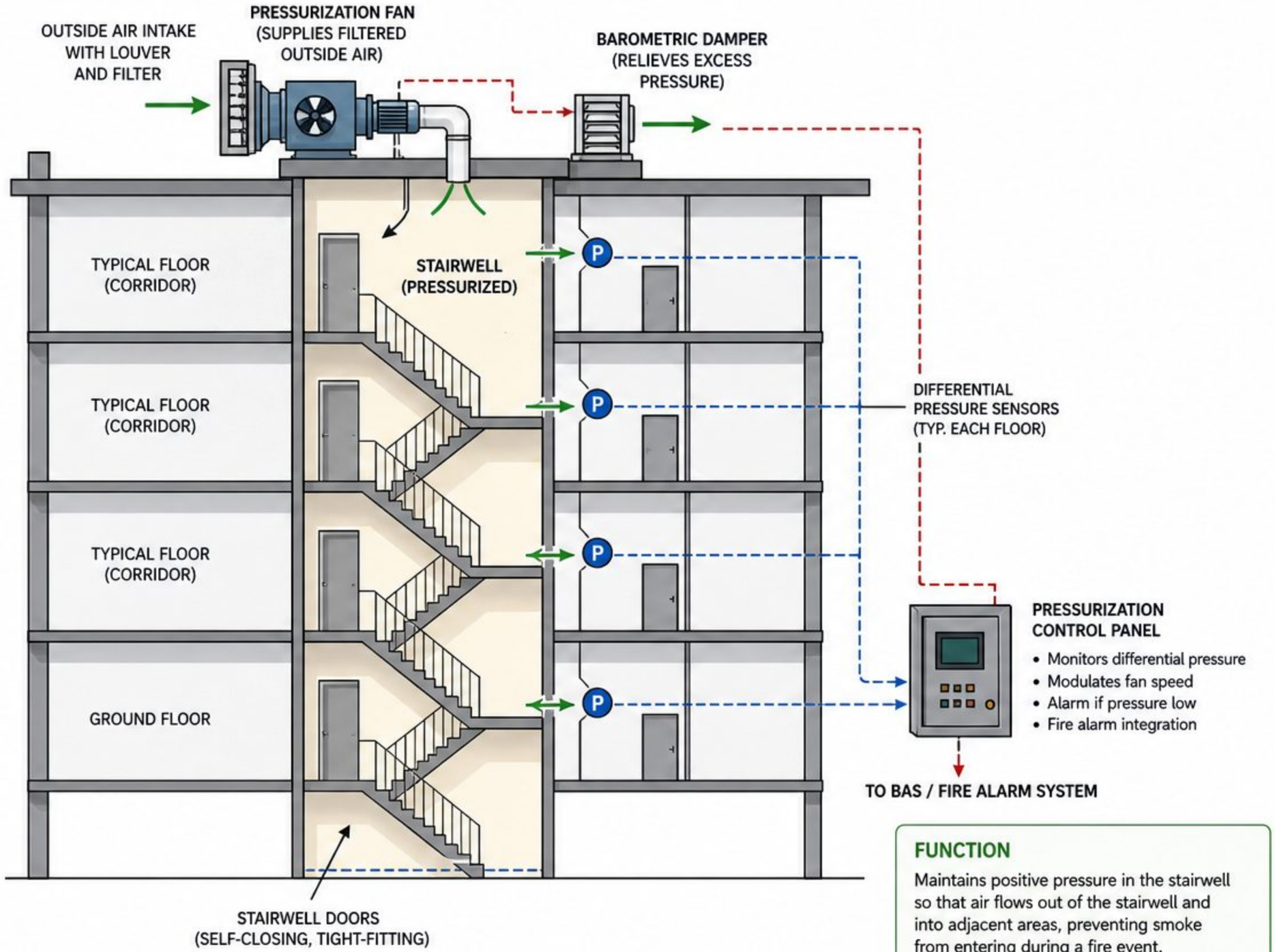
- Pressurization Fan
- Barometric Damper
- Differential Pressure Sensor
- Airflow
- Pressure Sensing Tube
- Electrical/Control Wiring

SYSTEM OVERVIEW

- Pressurization fans supply filtered outside air into the stairwell.
- Barometric dampers relieve excess pressure to maintain target differential.
- Differential pressure sensors monitor pressure between stairwell and adjacent areas.
- System maintains positive pressure to prevent smoke infiltration during a fire.

TYPICAL DESIGN CRITERIA

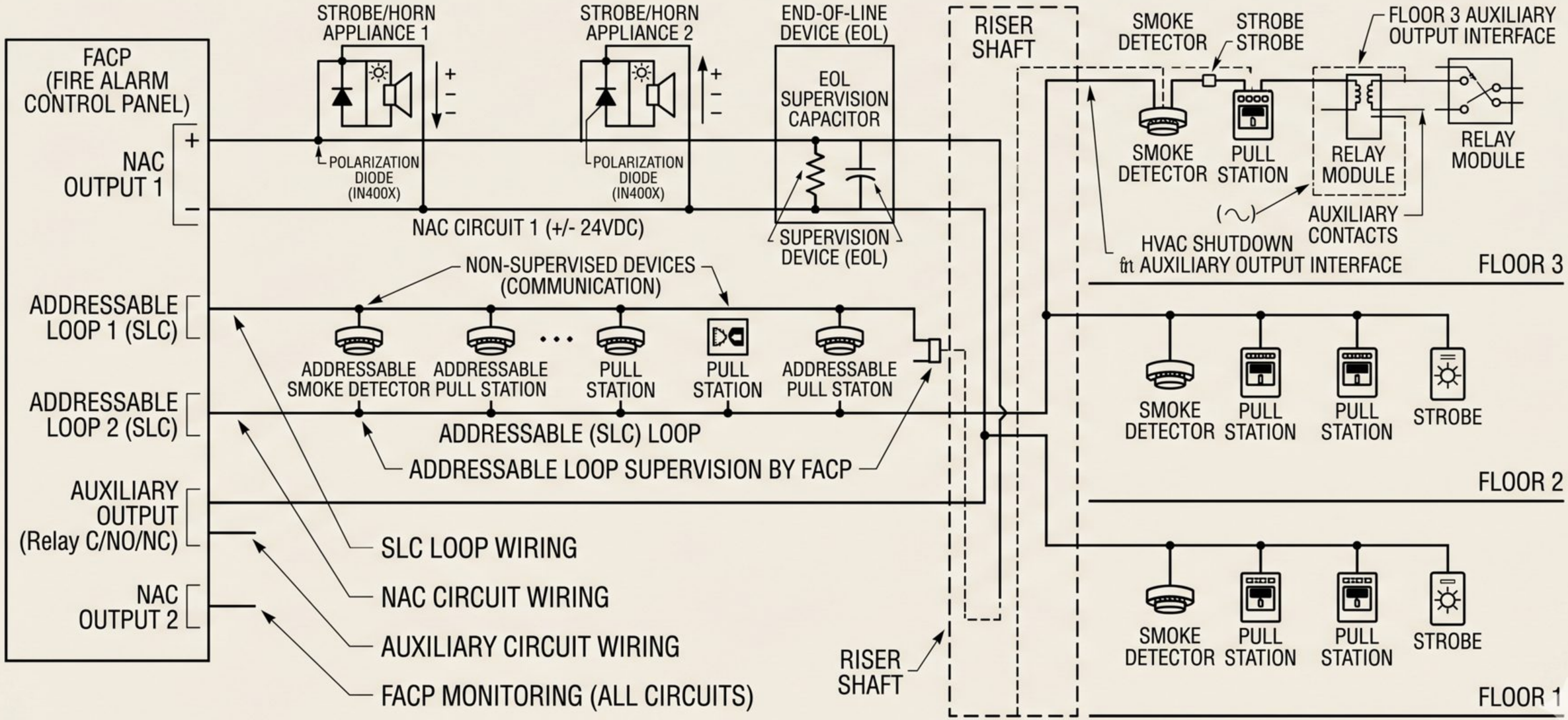
- Stairwell Differential Pressure: 0.05 to 0.10 in. w.g. (12 to 25 Pa)
- Pressurization Air Change Rate: 0.5 to 1.0 ACH
- System runs continuously (fire/alarm integration as required)



FUNCTION

Maintains positive pressure in the stairwell so that air flows out of the stairwell and into adjacent areas, preventing smoke from entering during a fire event.

Commercial Office — System Riser



High-Rise Evacuation System

Building section showing floor-of-alarm, floors above/below, and stairwell intercom placement per NFPA 72 Ch. 24.

LEGEND

- Stairwell Intercom
- Fire Alarm Annunciator
- Smoke Detector
- Alarm / Strobe

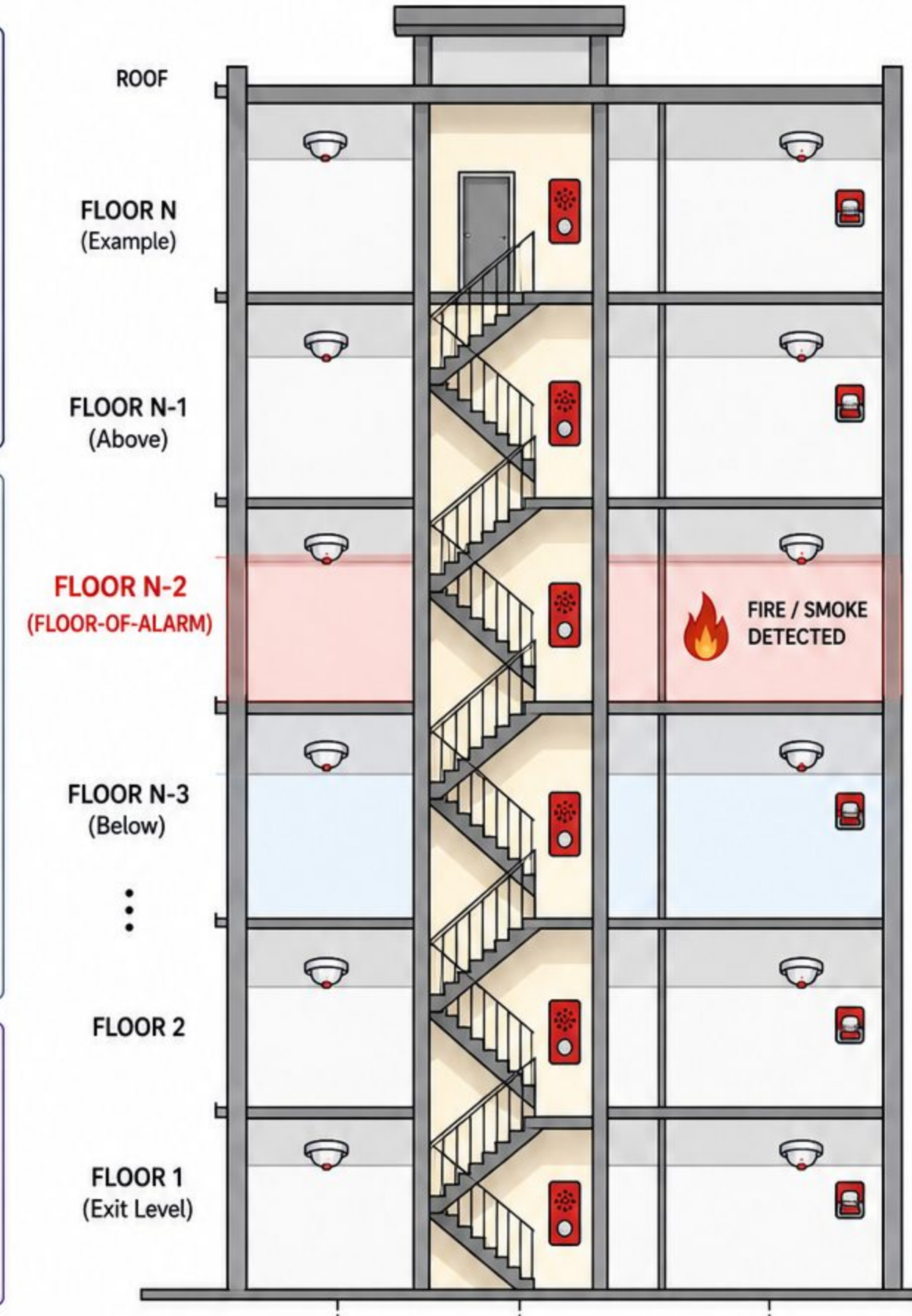
STAIRWELL INTERCOM PLACEMENT

- One intercom station on each floor level.
- Located in the stairwell landing area.
- Two-way communication with constant supervision.
- Powered by emergency power (24 hours standby).

NFPA 72 REFERENCE

Chapter 24 – Emergency Communications Systems

24.9 Stairway Communications



FLOORS ABOVE

Occupants are notified to evacuate down to a safe exit.

FLOOR-OF-ALARM

- Fire / smoke detected on this floor.
- Occupants evacuate via the nearest exit stairs.

FLOORS BELOW

Occupants are notified of the alarm and instructed to prepare to evacuate.

FIRE ALARM ANNUNCIATOR
Located at the Fire Command Center

STAIRWELL INTERCOM SYSTEM WIRING
(Class A or Class B)
Supervised

EMERGENCY COMMUNICATIONS EQUIPMENT
Provides power, supervision, and two-way voice communication

SYSTEM OVERVIEW

TWO-WAY COMMUNICATION
Occupants in the stairwell can speak with Fire Command Center personnel.

CONSTANT SUPERVISION
Intercom stations, wiring, and equipment are supervised for opens, shorts, and ground faults.

EMERGENCY POWER
System operates for a minimum of 24 hours standby and 15 minutes alarm.

CODE COMPLIANCE
Designed in accordance with NFPA 72, Chapter 24 – Emergency Communications Systems.

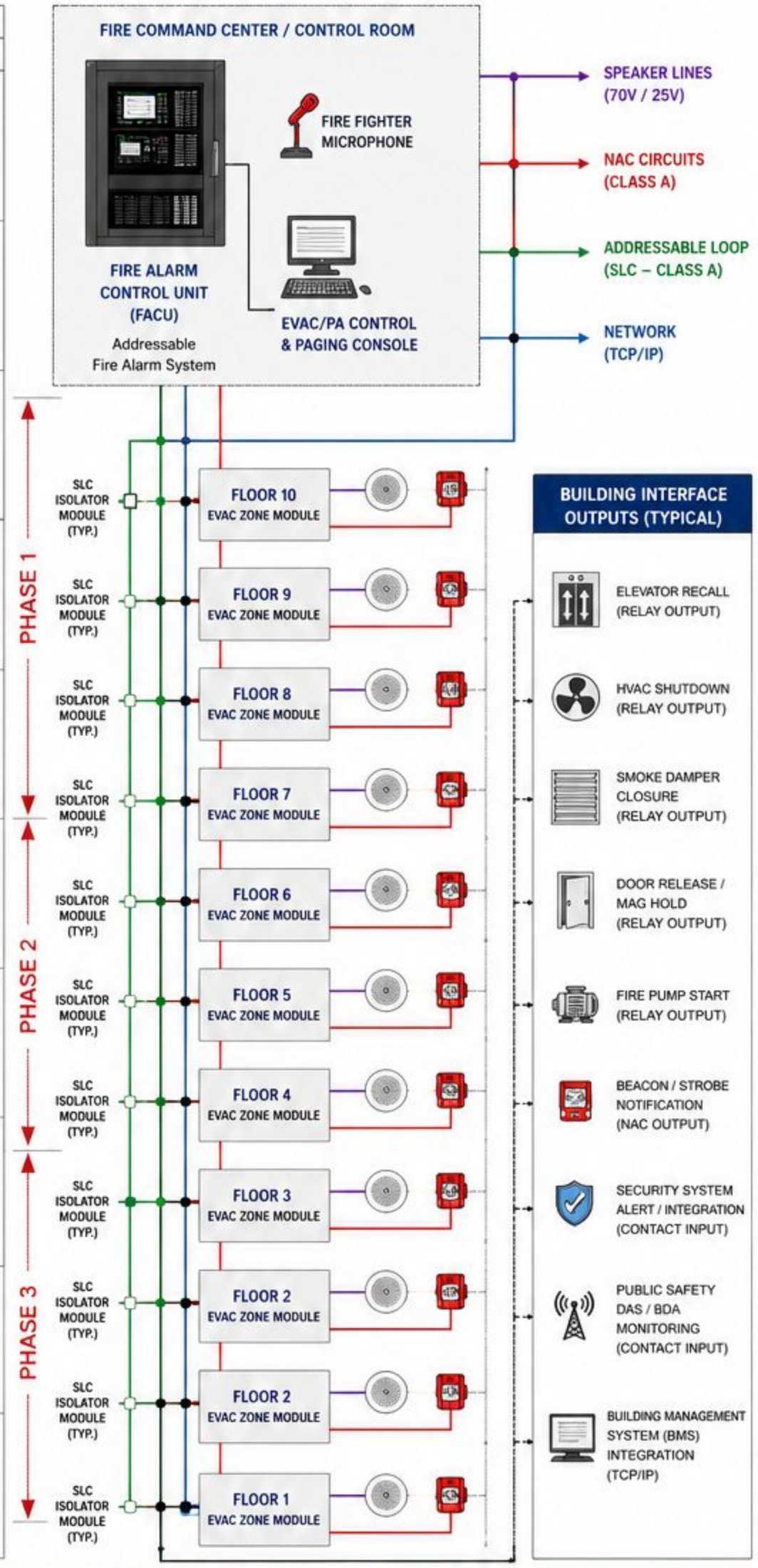
Note: This diagram is a typical example. Final design shall comply with NFPA 72, local codes, and the Authority Having Jurisdiction (AHJ) requirements.

SELECTIVE EVACS ZONING — HIGH-RISE PHASED EVACUATION

NFPA 72 (2025) COMPLIANT DESIGN

Pre-recorded messages + live paging from the fire command center; phased evacuation reduces stair congestion.

FLOOR LEVEL	EVACUATION ZONE / MESSAGE	TYPICAL DEVICES PER FLOOR		
		VISUAL	AUDIBLE	SPEAKER
10	AWARENESS MESSAGE ONLY (No action required)			
9	AWARENESS MESSAGE ONLY (No action required)			
8	AWARENESS MESSAGE ONLY (No action required)			
7	STAND-BY TONE (Prepare to evacuate) Per AHJ requirements			
6	ADJACENT FLOORS ALERT + VOICE (Be aware of emergency)			
5	FIRE FLOOR FULL ALARM TONE + VOICE (Evacuate now)			
4	ADJACENT FLOORS ALERT + VOICE (Be aware of emergency)			
3	STAND-BY TONE (Prepare to evacuate) Per AHJ requirements			
2	AWARENESS MESSAGE ONLY (No action required)			
1	AWARENESS MESSAGE ONLY (No action required)			



DESIGN NOTES

- System designed in accordance with NFPA 72 (2025).
- Addressable SLC is a Class A loop.
- NAC circuits are Class A unless otherwise noted.
- Evacuation messages are prioritized by zone per phased plan.
- All speaker circuits supervised for open and short.
- Power supplies and batteries per NFPA 72 Chapter 10.
- Coordinate zone strategy and messages with AHJ.

LEGEND

- SLC (Addressable Loop)
- NAC (Notification Appliance Circuit)
- Speaker Line (70V / 25V)
- Network (TCP/IP)
- 24 VDC Power
- Dry Contact / Relay
- Optional / Field Installed

DEVICE LEGEND (TYPICAL)

- Visual Notification Appliance
- Horn / Strobe Notification Appliance
- Ceiling Speaker
- SLC Isolator Module
- Evac Zone Module

COLOR KEY (ZONES)

- Awareness Only (No Action)
- Stand-by Tone (Prepare)
- Adjacent Floors (Alert + Voice)
- Fire Floor (Evacuate Now)

REFERENCES (NFPA 72)

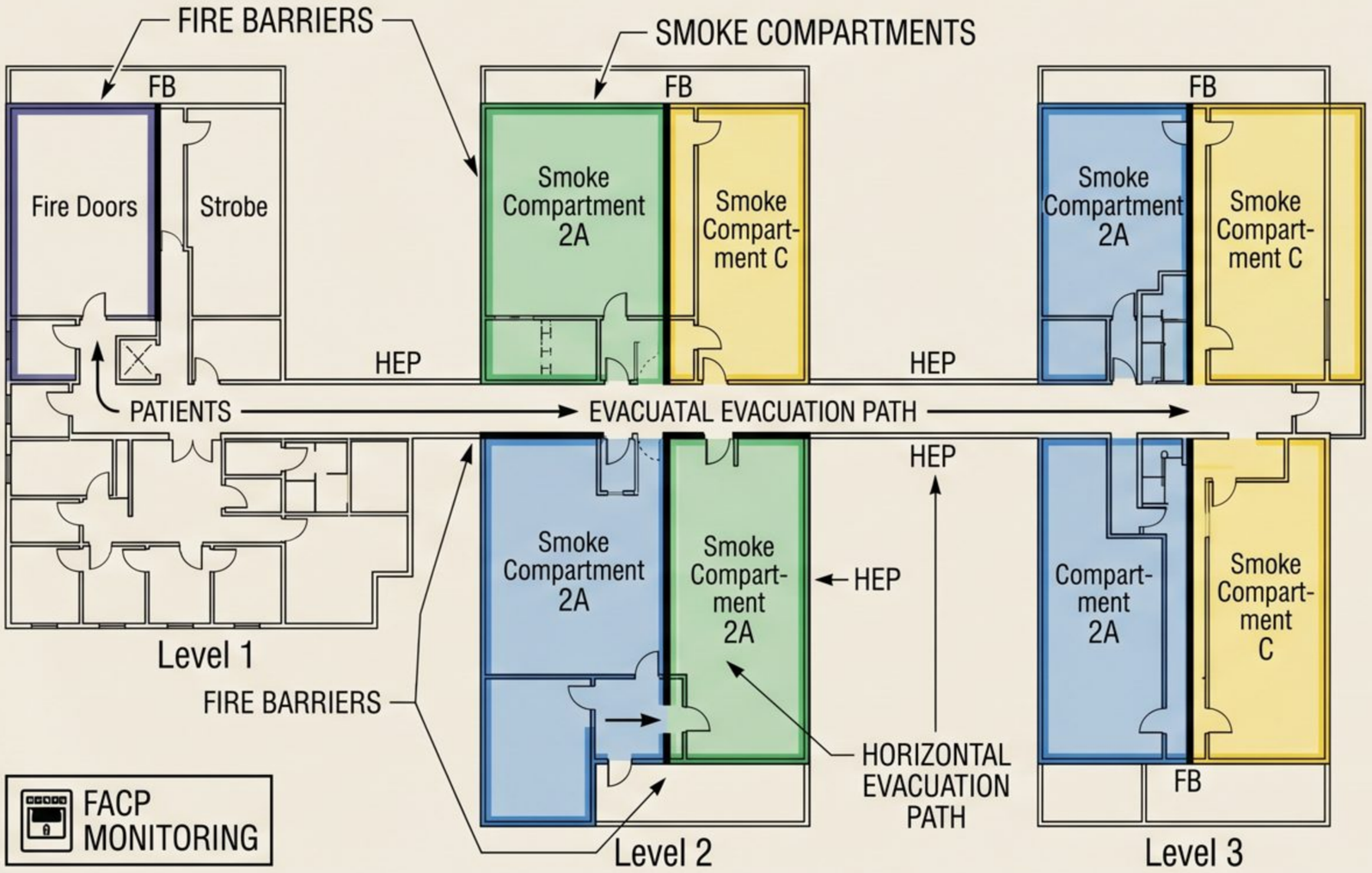
- Chapter 7 – Initiating Devices
- Chapter 10 – Power Supplies
- Chapter 18 – Notification Appliances
- Chapter 21 – Smoke Control
- Chapter 24 – Emergency Communications Systems (ECS)
- Chapter 23 – Protected Premises Fire Alarm Systems

NOTES

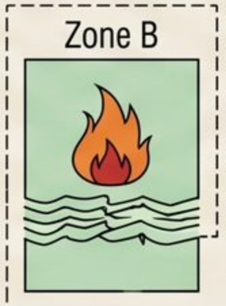
This diagram is a typical example.
Quantities and exact configurations shall be per project requirements and AHJ review.

Hospital Defend-in-Place Zoning

Floor plan showing smoke compartments, fire barriers, horizontal evacuation path, and zone alarm sequencing



ZONE ALARM SEQUENCING



ZONE B ALARM - ACTIVATE ALL DEVICES (GENERAL ALARM)

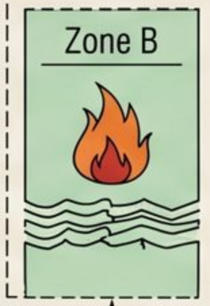
- 18s → SMOKE DAMPERS
- 10s → FIRE DOOR
- 20s → NOTIFICATION APPLIANCES

ZONE A/C - (SELECTIVE ACTIVATION)

- 10s → MOKE DAMP
- 20s → FIRE DOORS

ZONE A/C - (SELECTIVE ACTIVATE ALL TIMMEST DEVICES (GENERAL ALARM)

- 10s → SMOKE DAMPERS
- 10s → FIRE DOORS



- 1 in → SMOKE DAMPER
- 10s → FIRE DOORS
- 20s → NOTIFICATION APPLIANCES (NOTIFICATION APPLIANCES)

ZONE A/C - (SELECTIVE ACTIVATION)

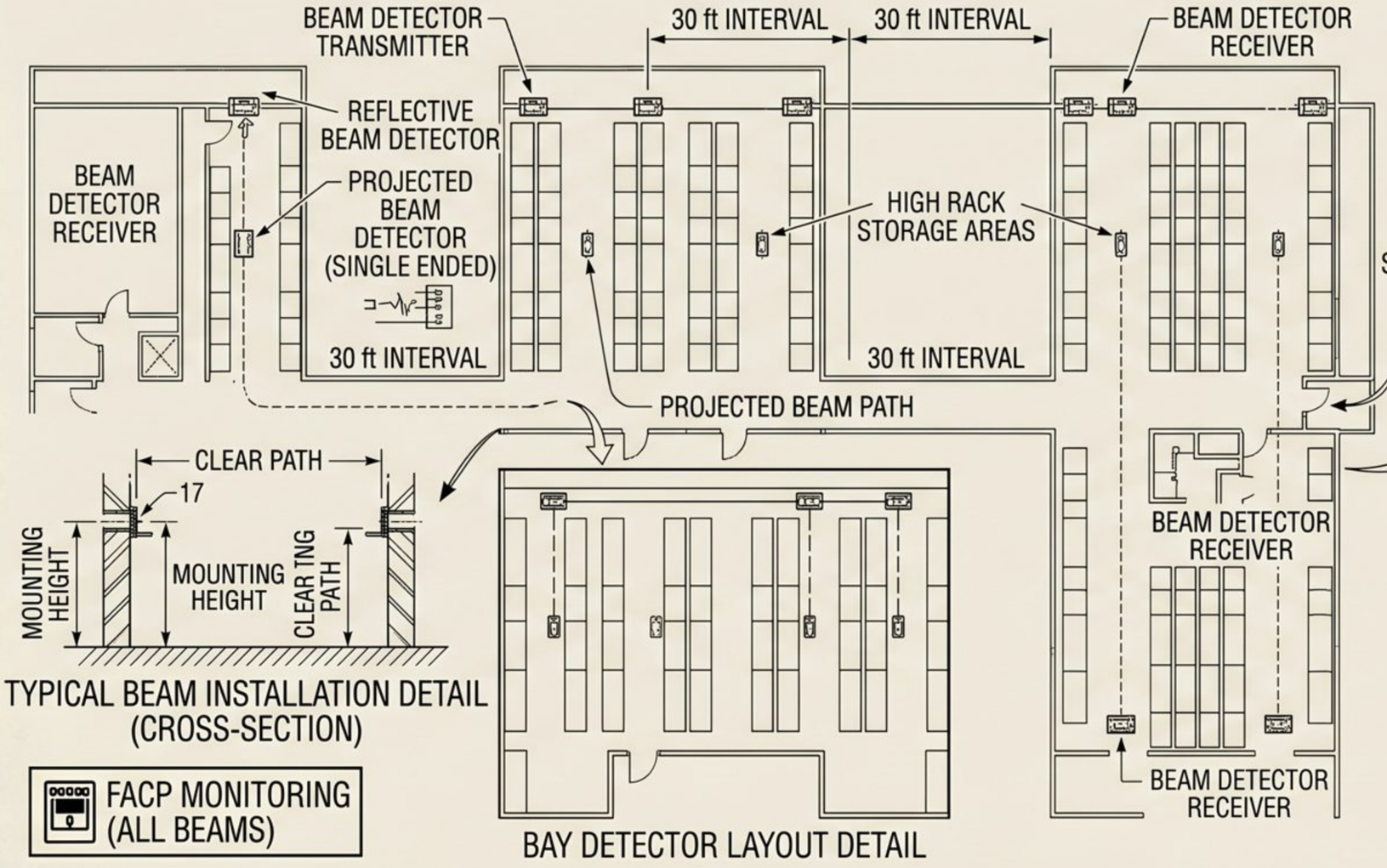
- 3os → SMOKE DAMPER
- 20s → FIRE DOORS
- 20s → 1h
- 3:3m → TIMED ACTIMED

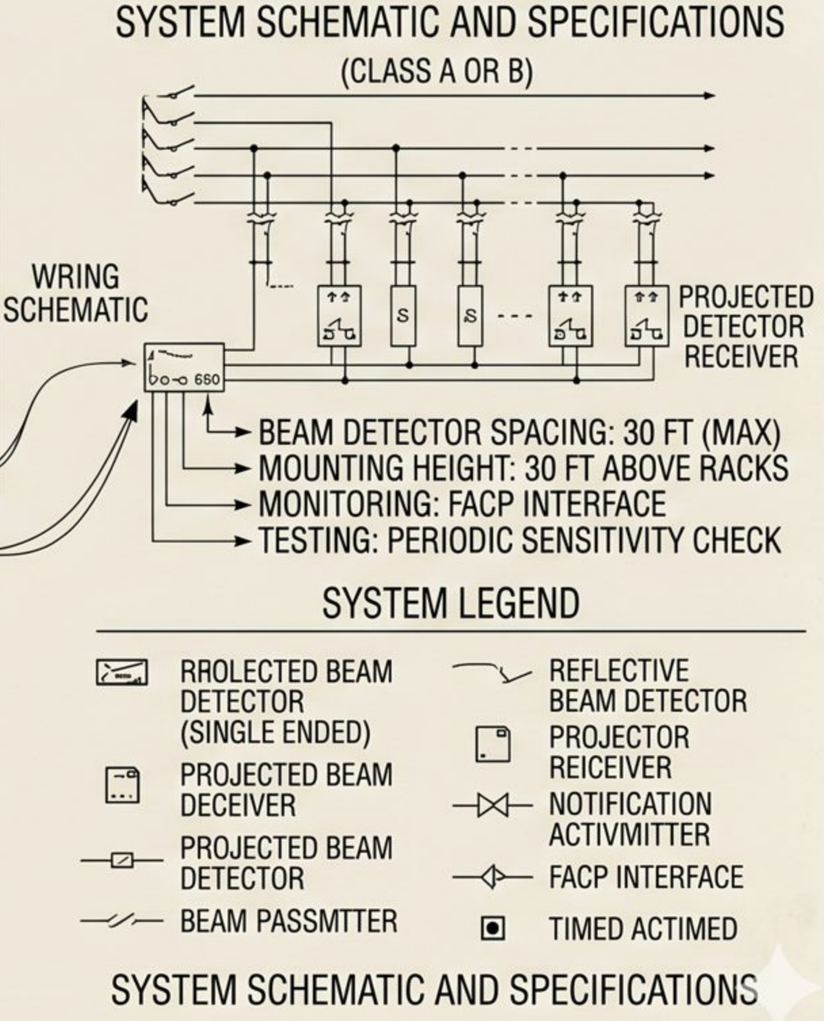
FACP MONITORING

ZONE ALARM SEQUENCING

Industrial Warehouse — Beam Detector Layout

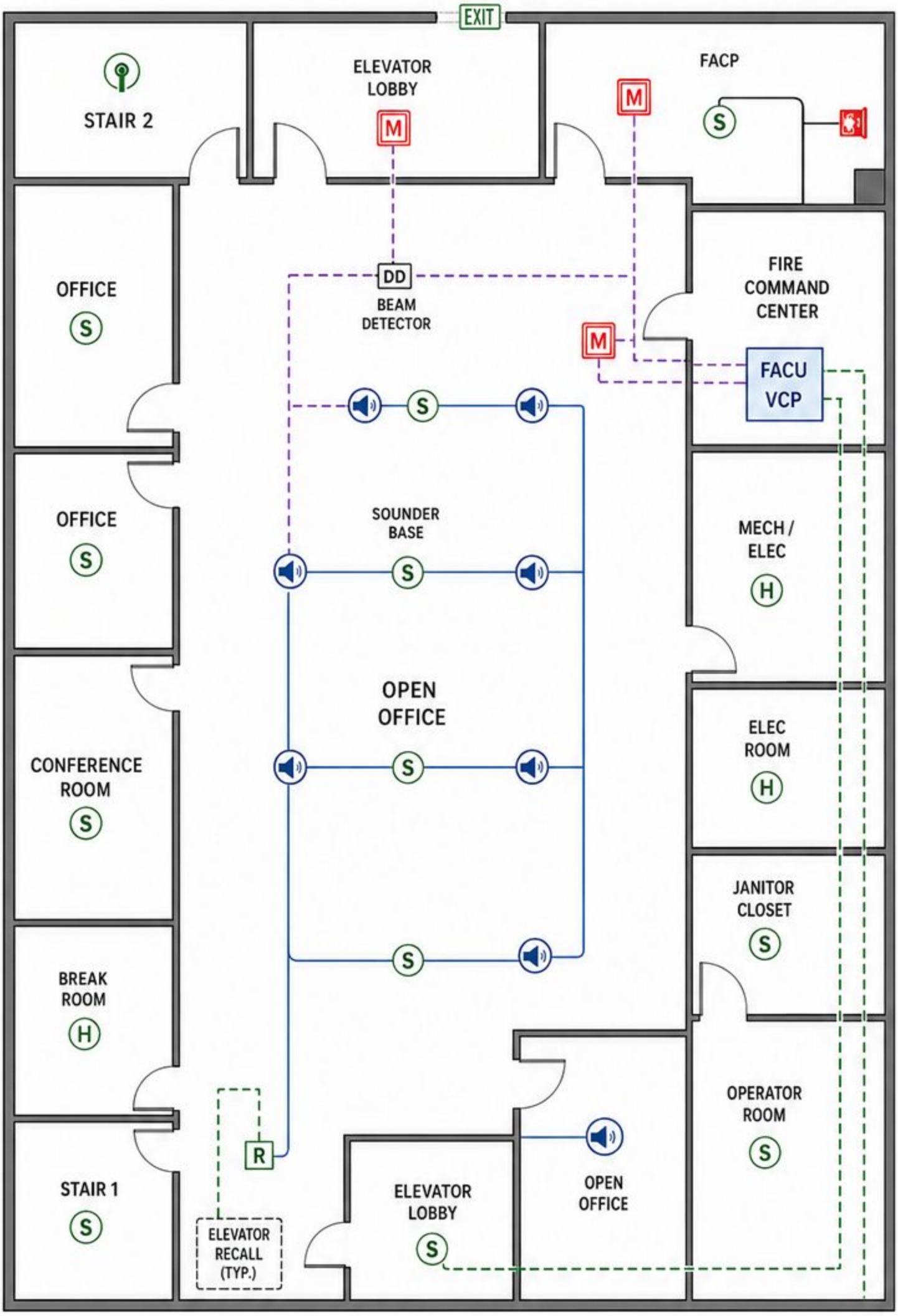
Reflected ceiling plan with projected beam detectors at 30 ft intervals over high rack storage areas.





FIRE ALARM & LIFE SAFETY SYSTEMS — FLOOR PLAN

NFPA 72 (2025) COMPLIANT DESIGN



LEGEND — DEVICES

- M — MANUAL PULL STATION
- S — SMOKE DETECTOR
- H — HEAT DETECTOR
- DD — DUCT SMOKE DETECTOR
- SPEAKER / STROBE
- SOUNDER BASE
- STROBE (VISUAL APPLIANCE)
- R — RELAY MODULE
- FACU — FIRE ALARM CONTROL UNIT
- VCP — VOICE CONTROL PANEL

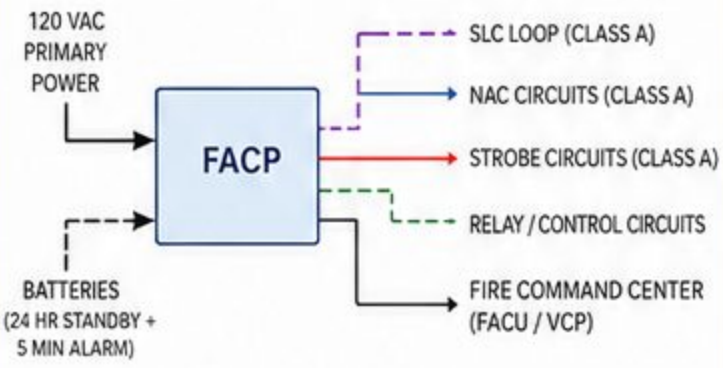
WIRING / CIRCUITS

- ADDRESSABLE LOOP (SLC CLASS A)
- NAC CIRCUIT (CLASS A)
- NAC CIRCUIT (STROBE) (CLASS A)
- CONTROL / RELAY CIRCUIT
- AUX 24 VDC POWER
- OPTIONAL / FUTURE

SYSTEM INTERFACES (TYPICAL)

- R — ELEVATOR RECALL (RELAY OUTPUT)
- HVAC SHUTDOWN (RELAY OUTPUT)
- DOOR RELEASE / MAG HOLD (RELAY OUTPUT)
- FIRE PUMP START (RELAY OUTPUT)
- BEACON / STROBE (NAC OUTPUT)
- SECURITY SYSTEM ALERT / INTEGRATION (CONTACT INPUT)
- FIREFIGHTER PHONE (COMMUNICATIONS)
- PUBLIC SAFETY DAS / BDA MONITORING (CONTACT INPUT)

TYPICAL RISER / ONE-LINE DIAGRAM



NFPA 72 (2025) KEY REQUIREMENTS

- System designed in accordance with NFPA 72 (2025), and applicable codes.
- Addressable system with Class A SLC and NAC circuits.
- Notification appliances installed per NFPA 72 Table 18.5.5.3.
- Visible notifications installed in all occupiable spaces.
- All circuits supervised for opens, shorts, and grounds.
- Power supplies sized per NFPA 72 Chapter 10.
- System interfaces supervised.
- Record of Completion and Acceptance Testing required.

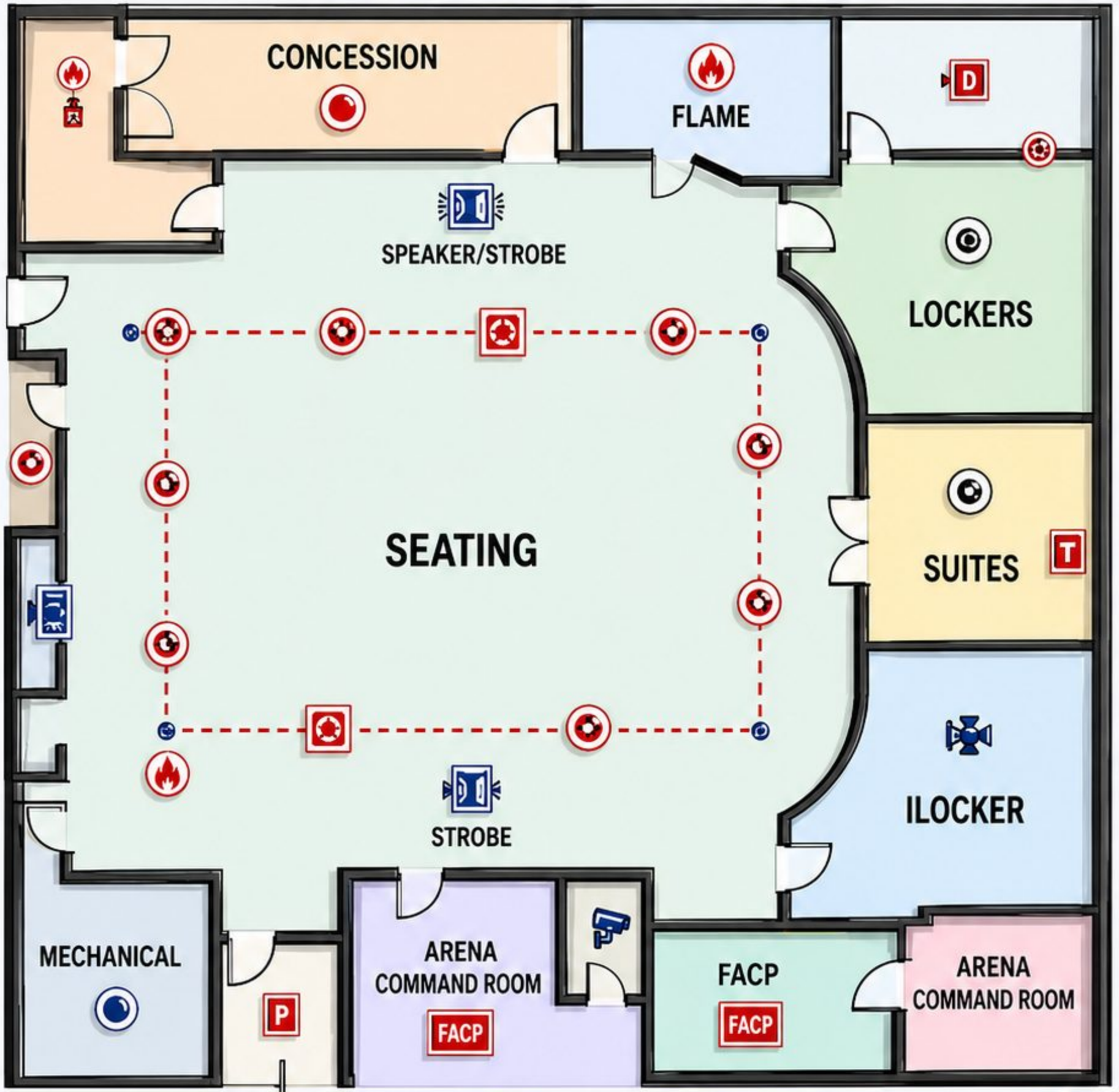
ABBREVIATIONS

FACP	Fire Alarm Control Panel
FACU	Fire Alarm Control Unit
VCP	Voice Control Panel
SLC	Signaling Line Circuit
NAC	Notification Appliance Circuit
DD	Duct Detector
DAS	Distributed Antenna System
BDA	Bi-Directional Amplifier
HVAC	Heating, Ventilation, and Air Conditioning

⚠ **NOTE:** This is a typical floor plan example. Device quantities and exact locations shall be per project requirements and AHJ (Authority Having Jurisdiction) review and approval.

FIRE ALARM & LIFE SAFETY PLAN — [redacted]

NFPA 72 (2025) COMPLIANT – TYPICAL ARENA / PUBLIC ASSEMBLY LEVEL



DETECTION DEVICES

- Aspiration Smoke Detector
- Beam Smoke Detector
- Smoke Detector
- Flame Detector
- Duct Smoke Detector
- Heat Detector (Fixed Temp.)

NOTIFICATION APPLIANCES

- Pull Station
- Speaker/Strobe
- Strobe
- Horn
- Horn/Strobe

SYSTEM INTERFACES

- Waterflow Switch (Sprinkler)
- HVAC Shutdown
- Access Control / Door Release

SYMBOL LEGEND

- Smoke Detector
- Beam Smoke Detector
- Flame Detector
- Duct Smoke Detector
- Heat Detector
- Pull Station
- Speaker/Strobe
- Strobe
- Horn
- Horn/Strobe

GENERAL NOTES

- All devices and mounting per NFPA 72 (2025).
- Coverage, spacing and sensitivity per manufacturer.
- Notification appliance circuits are supervised.
- System interfaces provide shutdowns and notifications for life safety functions.
- Refer to Part 5, Chapter 16 for egress, visibility and accessibility requirements.

ABBREVIATIONS

FACP – Fire Alarm Control Panel

HVAC – Heating, Ventilation and Air Conditioning

FSD – Fire Safety Director

NFPA 72 – National Fire Alarm & Signaling Code

FIRE ALARM RISER DIAGRAM

NFPA 72 (2025) COMPLIANT

RISER NOTES

- All wiring and equipment shall comply with NFPA 72, NFPA 70 (NEC), and applicable local codes.
- Addressable system shown. SLC is Class A.
- NAC circuits are Class A unless noted otherwise.
- Power supplies and batteries sized per NFPA 72 Chapter 10 and Annex M.
- All floor devices are shown schematically. See floor plans for quantities and exact locations.

FIRE ALARM CONTROL UNIT (FACU) WITH VOICE COMMUNICATION

POWER SUPPLIES

24 VDC POWER SUPPLY (MAIN)

NAC POWER SUPPLY (IF REQUIRED)

BATTERIES
(24 HOUR STANDBY + 5 MIN ALARM)
PER NFPA 72 ANNEX M

FLOOR LEVEL	DEVICES (TYPICAL PER FLOOR) SYMBOLS SHOWN ARE TYPICAL, QUANTITIES VARY	RISER
ROOF	SMOKE DETECTOR; HEAT DETECTOR; HORN/ STROBE; OUTDOOR HORN/STROBE	
PENTHOUSE / MECHANICAL	DUCT SMOKE DETECTOR; WATERFLOW SWITCH; CONTROL MODULE	
LEVEL 5 (TYPICAL)	SMOKE DETECTOR; HEAT DETECTOR; HORN/ STROBE; MANUAL PULL STATION	
LEVEL 4 (TYPICAL)	SMOKE DETECTOR; HEAT DETECTOR; HORN/ STROBE; MANUAL PULL STATION	
LEVEL 3 (TYPICAL)	SMOKE DETECTOR; HEAT DETECTOR; HORN/ STROBE; MANUAL PULL STATION	
LEVEL 2 (TYPICAL)	SMOKE DETECTOR; HEAT DETECTOR; HORN/ STROBE; MANUAL PULL STATION	
LEVEL 1 (ENTRY / RETAIL)	SMOKE DETECTOR; HORN/ STROBE; MANUAL PULL STATION; ANNUNCIATOR (FACP REMOTE)	
BASEMENT	SMOKE DETECTOR; HORN/ STROBE; MANUAL PULL STATION; WATERFLOW SWITCH	

SLC LOOP (CLASS A)

ISOLATOR MODULE (AS REQUIRED) • • • • END OF LINE RESISTOR (EOLR)

NAC CIRCUITS (CLASS A)

HORN/STROBE APPLIANCES • • • • EOLR

LEGEND

- Smoke Detector
- Heat Detector
- Duct Smoke Detector
- Waterflow Switch
- Manual Pull Station
- Horn/Strobe (Indoor)
- Horn/Strobe (Outdoor)
- Control Module
- Isolator Module
- Annunciator
- Fire Alarm Control Unit (FACU)
- SLC (Class A)
- NAC (Class A)
- Notification Appliance Circuit
- Data / IP Network
- 24 VDC Power
- Dedicated Control / Relay
- Optional / Field Installed

BUILDING INTERFACES (TYPICAL)

- ELEVATOR RECALL (RELAY OUTPUT)
- HVAC SHUTDOWN (RELAY OUTPUT)
- FIRE PUMP START (RELAY OUTPUT)
- DOOR RELEASE / MAG HOLD (RELAY OUTPUT)
- SECURITY SYSTEM MONITORING (CONTACT INPUT)
- PUBLIC SAFETY DAS / BDA MONITORING
- NETWORK / BMS (TCP/IP)

WIRING LEGEND

- SLC (Class A)
- NAC (Class A)
- Notification Appliance Circuit
- Data / IP Network
- 24 VDC Power
- Dedicated Control / Relay
- Optional / Field Installed

ABBREVIATIONS

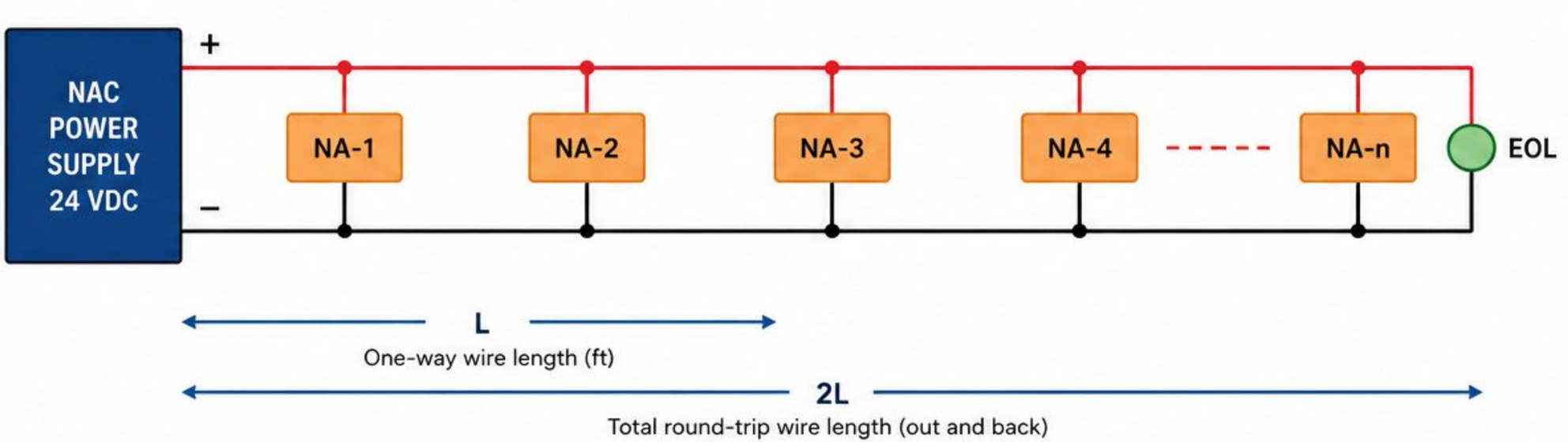
FACU	Fire Alarm Control Unit
SLC	Signaling Line Circuit
NAC	Notification Appliance Circuit
EOLR	End of Line Resistor
DAS	Distributed Antenna System
BDA	Bi-Directional Amplifier
BMS	Building Management System

GENERAL NOTES (NFPA 72 REFERENCES)

- Signaling Line Circuits (SLC) – NFPA 72 § 18.6, § 18.7
- Notification Appliances – NFPA 72 § 18.4
- Power Supplies – NFPA 72 Chapter 10, Annex M
- Emergency Voice/Alarm Communication Systems – NFPA 72 § 24
- Building Interface – NFPA 72 § 21.8, § 23.8
- Testing, Inspection & Maintenance – NFPA 72 Chapter 14

DRAWING NOT TO SCALE

NAC VOLTAGE-DROP CALCULATION CONCEPT



VOLTAGE-DROP FORMULA

$$V_{drop} = 2 \times I_L \times R_{per\_ft} \times L \quad \text{or} \quad V_{at\_end} = V_{source} - V_{drop}$$

$$V_{at\_end} \geq 0.85 \times V_{source}$$
(Per NFPA 72)

WHERE:

- V_{drop} = Voltage drop on the circuit (V)
- I_L = Total alarm current load (A)
- V_{source} = NAC output voltage (VDC) – typically 24 VDC
- R_{per} = Total alarm current load (A)
- L L = DC resistance of conductors (Ω per ft) – use manufacturer's published value
- V_{at_end} = Voltage at the farthest device (VDC)

ACCEPTABLE VOLTAGE AT THE END OF LINE

$$V_{at\_end} \geq 0.85 \times V_{source}$$

Per NFPA 72 (24.6.3.1.1)

This ensures notification appliances operate at or above 85% of their listed voltage under alarm conditions.

EXAMPLE CALCULATION

NAC output voltage, V_{source}	= 24 VDC
Total alarm current, I_L	= 2.0 A
One-way length, L	= 250 ft
Conductor resistance, R_{per_ft} (14 AWG)	= 0.002525 Ω/ft

V_{drop} = 2 × 2.0 × 0.002525 × 250
= 2.525 V

V_{at_end} = 24 – 2.525
= **21.475 V** ✔ **OK**

Minimum required: 0.85 × 24 = 20.4 V

IMPORTANT NOTES

- Use DC resistance from cable manufacturer data (Ω per ft).
- Current (I_L) must be the total alarm current of all NAC loads.
- All wiring must comply with NFPA 72 (2025), 12.6, 12.8, and 24.6.
- Larger conductors reduce voltage drop and improve system performance.

TYPICAL COPPER RESISTANCE (OHMS PER FOOT)

AWG	18	16	14	12
Ω / ft	0.006385	0.004016	0.002525	0.001588

Design all NAC circuits to ensure voltage at the farthest notification appliance is ≥ 85% of the source voltage per NFPA 72.

Walk Test Mode Indicator

Control panel display showing walk-test mode activation, device address, and LED blink confirmation sequence.

WALK TEST MODE ACTIVATION

1. Press MENU.
2. Select “Walk Test”.
3. Press ENTER.
4. Select “Enable”.
5. Press ENTER to activate.

All initiating devices will operate in walk-test. Alarms are acknowledged automatically.

DISPLAY INDICATIONS

WALK TEST MODE ACTIVE
Walk test is enabled.

Device Address
Address of the last activated device.

Walk Test Timer
Time remaining in walk-test mode.

Walk Test Mode will automatically time out or can be exited manually.

LED BLINK CONFIRMATION SEQUENCE

When a device is activated, the device LED will blink to confirm communication.

Blink sequence repeats while the device is in Walk Test Mode and communicates with the panel.

EXAMPLE: DEVICE 045 ACTIVATED

1. Technician activates device (e.g., smoke detector).
2. Panel displays Device Address: 045 and device details.
3. Device LED performs confirmation blink sequence.
4. Panel acknowledges automatically in walk-test mode.
5. Repeat for all devices.

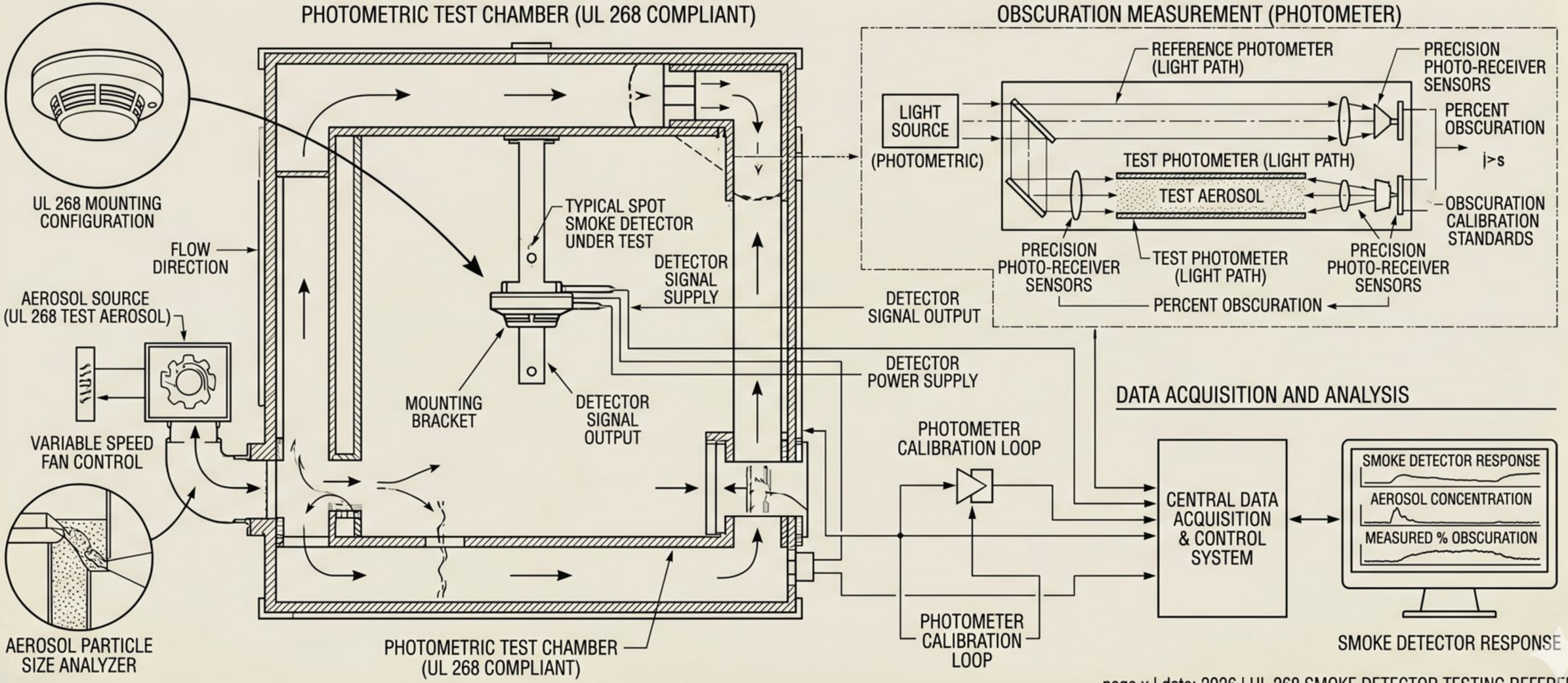
EXIT WALK TEST MODE

1. Press MENU.
2. Select “Walk Test”.
3. Select “Disable / Exit”.
4. Press ENTER.
5. Panel returns to normal operation.

Walk Test Mode is exited.
All device LEDs return to normal.

Smoke Detector Sensitivity Test Setup

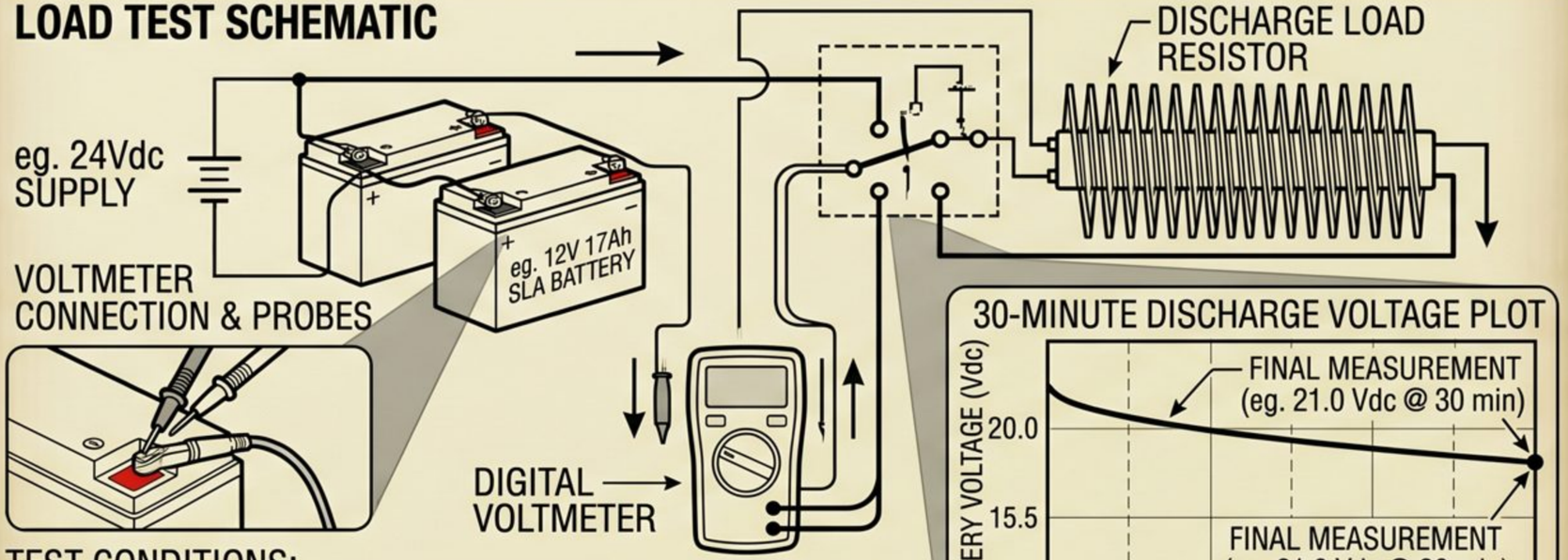
Diagram of listing test equipment measuring obscuration percentage using photometric test chamber per UL 268.



BATTERY LOAD TEST PROCEDURE

TEST DESCRIPTION: Electrical test diagram showing discharge load resistor, voltmeter connection, and 30-minute discharge measurement.

LOAD TEST SCHEMATIC



TEST CONDITIONS:
TIME-STAMP: 20:30:33, DATE: 04-05-2026
LOCATION: RIDGEWOOD, NJ, TEST STATION: TS-ALPHA 1
BATTERY TYPE: SEALED LEAD-ACID (eg. 12V 17Ah x2)
LOAD SETTING: 8.5 AMPS (30-min discharge rate)

BATTERY VOLTAGE > 20.8 Vdc → TEST CONFIRMED

SYSTEM MONITORS ACTIVATION →

NFPA 72 Testing Frequency Chart

Table from NFPA 72 Chapter 14 showing annual, semi-annual, and 5-year test requirements for all device types.

	COMPONENT OR SYSTEM	TEST TYPE	TEST FREQUENCY		
			SEMI-ANNUAL (6 MO)	ANNUAL (1 YR)	5-YEAR
FIRE ALARM SYSTEMS	Fire Alarm Control Panel (FACP)	Functional	X	X	 TYPICAL FACP BATTERY CHECK
		Batteries	X	R	
		Visual Check	R	R	
		Functional Test	Functional Test	X	
INITIATING DEVICES	Smoke Detectors (Spot, (Projected Beam Seot) (Aspiration)	Functional	X	X	
		Functional Test	X	X	
		Sensitivity	X	X	
	Heat Detectors	Calibration	X	X	
	Pull Stations	Functional Test		X	X
	Waterflow Switches	Functional Test		X	X
	Tamper Switches	Functional Test		X	X
NOTIFICATION APPLIANCES	Horns	Functional	X	X	
	Strobes	Sensitivity	X	X	
	Speakers	Calibration	X	X	
SUPPRESSION SYSTEMS	Agent Storage Containers	Functional	X	X	–
	Releasing Circuits (Emergency Holded)	Functional Test	X	X	
	Abort Stations	Functional	X	X	X
	Pressure Switches	Functional Test		X	
	Cnessure Switches	Calibration		X	
SPECIALTY DETECTORS	Beam Detector (Spot (Projected Beam) (Single-ended, Reflective)	Functional	X	X	X
		Sensitivity	X	X	X
		Calibration	X	X	–
	Beam Detector Receivers/Transmitters	Calibration	X	X	X

* Fequency test frequency output testting annual, semi-annualst, and 5-year.
** Functional test doaatior, and comiponcıu-stor rnte dotators.
** Firee detection doctime after seeted beasrires and pressured tarritery ends od test directors.

** Referencal sorea of oosurs temi-annual; an 1230 nozzles.
** Boat mnit test are virrequirements for all device stats.

Fault Analysis Flowchart

Decision tree for troubleshooting common trouble conditions: ground fault, open circuit, loss of AC, and low battery.

START
TROUBLE INDICATION ON FACP
(Check display for specific trouble type and affected point.)

WHAT IS THE TROUBLE?

GROUND FAULT
Indication: GROUND FAULT

Is the ground fault isolated to a specific circuit?

- NO → Multiple circuits affected?
  - YES → Check system wiring for short to ground on common path or shared cable.
  - NO → Proceed to isolate the affected circuit.
- YES → Disconnect circuit at panel. Check insulation resistance (megger) to ground.
  - Insulation resistance > 20 MΩ?
    - NO → Locate point of contact to ground. Repair or replace damaged wiring or device.
    - YES → Clear trouble and retest.

OPEN CIRCUIT
Indication: OPEN CIRCUIT

Is the open circuit at a device?

- YES → Check device connections. Are terminals secure?
  - Terminals secure?
    - NO → Tighten terminals and retest.
    - YES → Replace device. Retest.
  - Clear trouble and retest.
- NO → Check for open wiring between devices and panel. Look for:
  - Loose connections
  - Broken conductors
  - Damaged cable
  - Clear trouble and retest.

LOSS OF AC
Indication: AC LOSS

Is AC power present at outlet?

- YES → Check AC connection at panel. Is it secure?
  - Connection secure?
    - NO → Secure connection. Retest.
    - YES → Check circuit breaker / fuse. Is it tripped or blown?
      - Breaker / Fuse OK?
        - NO → Reset breaker or replace fuse. Retest.
        - YES → AC supply is present. Check panel power supply. Replace if necessary.
  - Clear trouble and retest.
- NO → Check building power. Verify voltage at outlet.
  - Restore AC power. Investigate building electrical supply.
  - Clear trouble and retest.

LOW BATTERY
Indication: LOW BATTERY

Is battery installed correctly?

- NO → Check battery connections (polarity & tightness). Correct and retset.
- YES → Check battery voltage. Is voltage within normal range?
  - Voltage Normal?
    - NO → Charge battery for 24 hours. Retest.
      - Still Low?
        - YES → Replace battery. Retest.
        - NO → Battery recovered. Monitor.
      - Clear trouble and retest.
    - YES → Check for excessive load or faulty charger. Correct issue. Retest.
      - Clear trouble and retest.

GENERAL CHECKS (APPLY TO ALL TROUBLES)

- Verify correct device addressing.
- Check for loose wiring or poor connections.
- Inspect for physical damage or environmental issues.
- After corrective action, clear the trouble and monitor the system.

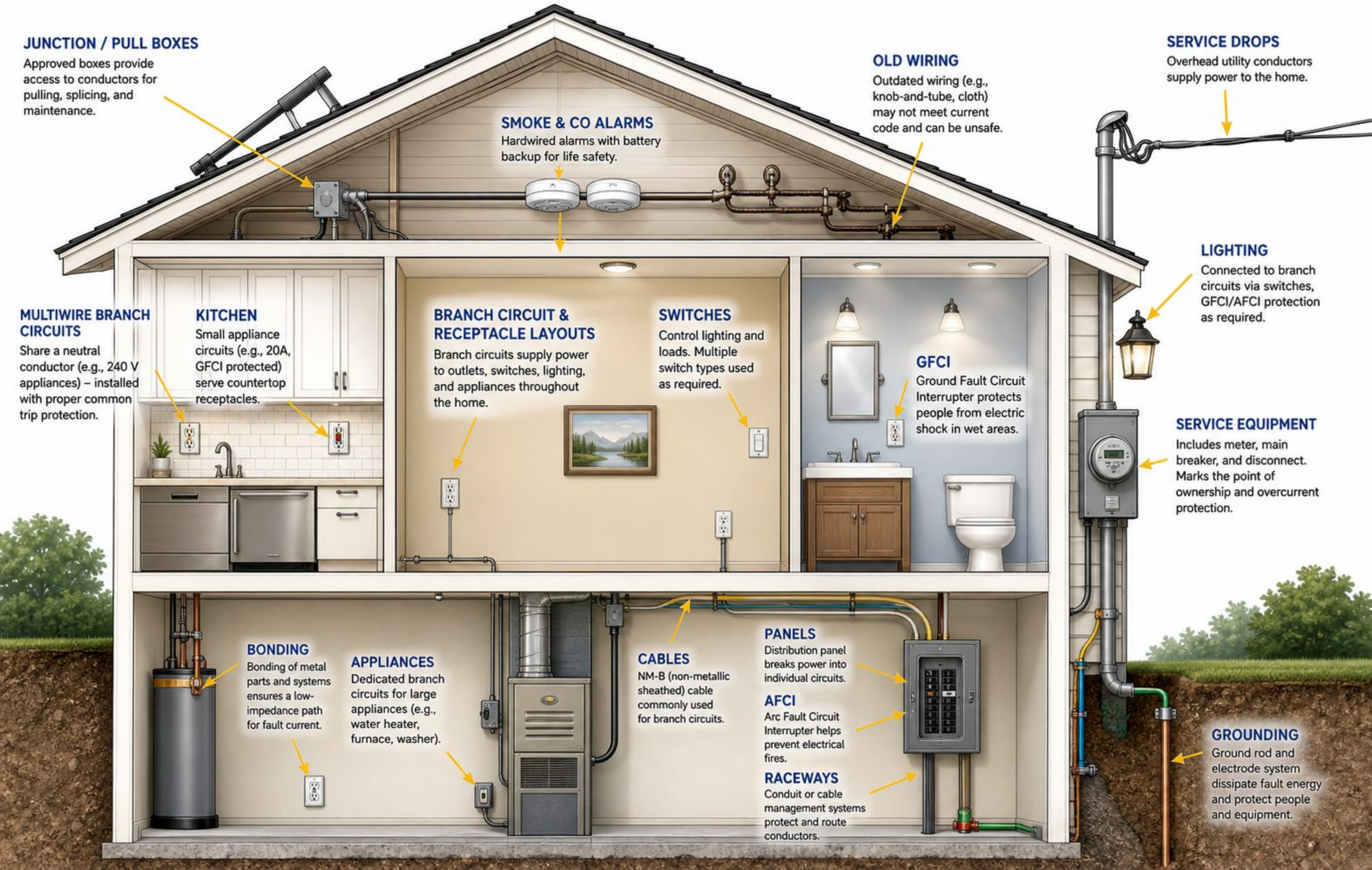
TOOLS RECOMMENDED

- Digital Multimeter (DMM)
- Insulation Resistance Tester (Megger)
- Battery Load Tester
- Screwdrivers, Nut Drivers
- Cable Tester / Continuity Tester

SAFETY NOTES

- Follow lockout/tagout when working on power circuits.
- De-energize circuits where required before servicing.
- Follow NFPA 72 and manufacturer's installation/service instructions.

Note: This flowchart is a guide for common conditions.
Always follow the system manufacturer's documentation and NFPA 72 requirements.


JUNCTION / PULL BOXES
Approved boxes provide access to conductors for pulling, splicing, and maintenance.
SMOKE & CO ALARMS
Hardwired alarms with battery backup for life safety.
OLD WIRING
Outdated wiring (e.g., knob-and-tube, cloth) may not meet current code and can be unsafe.
SERVICE DROPS
Overhead utility conductors supply power to the home.
LIGHTING
Connected to branch circuits via switches, GFCI/AFCI protection as required.
MULTIWIRE BRANCH CIRCUITS
Share a neutral conductor (e.g., 240 V appliances) – installed with proper common trip protection.
KITCHEN
Small appliance circuits (e.g., 20A, GFCI protected) serve countertop receptacles.
BRANCH CIRCUIT & RECEPTACLE LAYOUTS
Branch circuits supply power to outlets, switches, lighting, and appliances throughout the home.
SWITCHES
Control lighting and loads. Multiple switch types used as required.
GFCI
Ground Fault Circuit Interrupter protects people from electric shock in wet areas.
SERVICE EQUIPMENT
Includes meter, main breaker, and disconnect. Marks the point of ownership and overcurrent protection.
BONDING
Bonding of metal parts and systems ensures a low-impedance path for fault current.
APPLIANCES
Dedicated branch circuits for large appliances (e.g., water heater, furnace, washer).
CABLES
NM-B (non-metallic sheathed) cable commonly used for branch circuits.
PANELS
Distribution panel breaks power into individual circuits.
AFCI
Arc Fault Circuit Interrupter helps prevent electrical fires.
RACEWAYS
Conduit or cable management systems protect and route conductors.
GROUNDING
Ground rod and electrode system dissipate fault energy and protect people and equipment.