

# Inspection, Testing, and Maintenance

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- Identify the different types of activities for ITM of alarm systems.
- Distinguish between the roles of different stakeholders for ITM of alarm systems.
- Explain the processes and differences between acceptance, sensitivity, and functionality testing.



# It's All About Ensuring Reliability

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- A Reliable System
  - Detects and correctly responds to every occurrence of fire and does not give a fire alarm except when the fire actually occurs
- Fire alarm system objectives
  - Ensure life safety
  - Conserve property
  - Ensure continuity of the mission of the site
    - Example: production



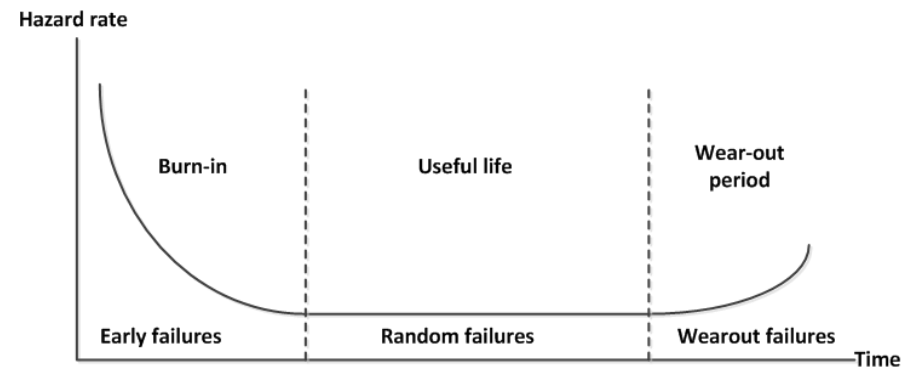
# ITM

- Inspection
  - Visual observation
- Testing
  - Component Activation
- Maintenance
  - Fixing deficiencies



# Reliability

- Design
  - Proper placement
- Installation
  - Proper technique
- Equipment
  - Bathtub curve
- Maintenance
  - Identify problems



# Testing

- Acceptance
  - Before system in service
  - Every device
- Reacceptance
  - Acceptance test after modifications
  - All directly impacted
  - 10 % of others
- Functionality
  - Has the correct response
- Sensitivity
  - Responds to the intended stimulus











**SOLO-423**  
110/120v AC



# Typical Failure Modes

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- Semi conductors
  - Short or open circuit
    - Three causes
      - Internal flaw
      - Overcurrent
      - Overvoltage
- Circuit board solder bonds
  - Broken during shipping and installation



# Typical Failure Modes

- Relays
  - Electromechanical switch is activated by current flowing through and electromagnet such that the magnet poles a switch from one contact to another
  - Involves in mechanical parts that move and will eventually wear out
- Switches
  - Failed to operate when they should
  - Operate when they should not
- Screw terminals
  - Occasionally they vibrate lose



# Typical Failure Modes

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- Fuses
  - Fail to an open circuit resulting in trouble signal
- Batteries
  - Batteries can lose capacity and can lose output voltage
  - Numerous failure modes
- Wires
  - Conductor breakage
  - Damaged insulation



# Interconnections

- Monitoring sprinkler systems
- Controlling auxiliary functions
- Alarms, faults, supervisory
  - Each type on own circuit



# Coordination

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- Ideally test all components
- Avoid
  - Downtime
  - Significant cleanup
  - Non restored impairments



# ITM

- Preparation and coordination of ITM
  - Notify, notify, notify
  - Interruptions to site operations will occur but tests are critical safety and must be conducted
- Test plan
  - NFPA 72 chapter 10 is organized to facilitate the development of a formal test plan
  - Test frequencies very depending on the general class of device



# ITM

- Fire Alarm Control Unit (alarm panel)
  - Test the units capability of checking its relays, fuses, main power, back up power, etc.
    - These will result in what kind of signal?
    - Test system response functions that occur as a result of each input
      - Results in the completion of what document?





# System Outputs

## System Inputs

System Inputs		Control Unit Annunciation																Notification				Required Fire Safety Control										Supplementary			
		Actuate common alarm signal indicator	Actuate audible alarm signal	Actuate common supervisory signal	Actuate audible supervisory signal	Actuate common trouble signal indicator	Actuate audible common trouble signal	Actuate 1st floor (zone 1) alarm indicator	Actuate 1st floor (zone 2) alarm indicator	Actuate 1st floor (zone 3) alarm indicator	Actuate 2nd floor evacuation signals	Actuate 3rd floor evacuation signals	Display/print evacuation signals	Transmit fire alarm signals	Transmit trouble change of status	Transmit supervisory signal to supervising station	Release trouble signal to supervising station	Recall magnetically held smoke doors	Recall elevators to primary recall floor	Recall elevators to alternate recall floor	Actuate 1st floor smoke exhaust	Actuate 2nd floor smoke exhaust	Actuate 3rd floor smoke exhaust	Unlock exits	Actuate suppression system pre-discharge alarms	Energize suppression system releasing sequence	Actuate graphics system - display floor map	Pressurize stairwells	Shutdown process #1	Shutdown process #2	Actuate exterior visual notification appliance at f.d. response point				
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD	EE	FF	GG	
1	Manual fire alarm boxes – 1st floor	●	●					●			●			●	●			●							●					●				●	1
2	Manual fire alarm boxes – 2nd floor	●	●						●			●		●	●			●							●					●				●	2
3	Manual fire alarm boxes – 3rd floor	●	●							●			●	●	●			●							●					●				●	3
4	Smoke detectors – 1st floor	●	●					●			●			●	●			●	●			●			●					●				●	4
5	Smoke detectors – 3rd floor	●	●						●			●		●	●			●	●				●		●					●				●	5
6	Smoke detectors – 1st floor	●	●							●			●	●	●			●	●					●					●					●	6
7	Smoke detectors – 1st floor elev. lobby	●	●					●			●			●	●			●		●				●					●					●	7
8	2nd floor computer rm. smoke det.-zone 1	●	●						●			●		●	●			●	●					●		●			●					●	8
9	2nd floor computer rm. smoke det.-zone 2	●	●						●			●		●	●			●	●					●		●		●		●				●	9
10	In-duct smoke detector – supply fan 1	●	●					●						●	●			●						●					●					●	10
11	In-duct smoke detector – supply fan 2	●	●					●						●	●			●						●					●					●	11
12	In-duct smoke detector – 1st floor return	●	●					●						●	●			●						●					●					●	12
13	In-duct smoke detector – 2nd floor return	●	●						●					●	●			●						●					●					●	13
14	In-duct smoke detector – 3rd floor return	●	●							●				●	●			●						●					●					●	14
15	Heat detectors – 1st floor mech. rm.	●	●					●						●	●			●	●					●					●					●	15
16	Heat detectors – 2nd floor storage room	●	●						●					●	●			●	●					●					●					●	16
17	Heat detectors – 3rd floor janitor's closet	●	●							●				●	●			●	●					●					●					●	17
18	Waterflow – 1st floor	●	●					●						●	●			●	●		●	●		●					●	●	●			●	18
19	Waterflow – 2nd floor	●	●						●					●	●			●	●		●		●		●				●	●		●		●	19
20	Waterflow – 3rd floor	●	●							●				●	●			●	●		●		●		●				●	●			●	●	20
21	Sprinkler control valve – 1st floor			●	●								●			●													●						21
22	Sprinkler control valve – 2nd floor			●	●								●			●													●						22
23	Sprinkler control valve – 3rd floor			●	●								●			●													●						23
24	Fire pump running	●	●										●	●			●							●					●					●	24
25	Fire pump power failure/phase reversal			●	●								●			●													●						25
26	Fire alarm ac power failure					●	●										●																		26
27	Fire alarm system low battery					●	●										●																		27
28	Open circuit					●	●										●																		28
29	Ground fault					●	●										●																		29
30	Notification appliance circuit short					●	●										●																		30

△ FIGURE A.14.6.2.4 Typical Input/Output Matrix.

# ITM

- Testing Initiating Devices
  - Detector testing methods are established by the manufacturer
  - Restorable
    - Spot type, and line-type heat detectors
  - Non-restorable
    - Spot type, line-type detectors
      - Either all are replaced or a sample is removed and sent for testing



# ITM

- Smoke detectors
  - Ensure **three things**
  - Spot-type
    - Can accumulate dust
    - Are commonly painted
  - Line-type
    - Accumulation of dust and dirt on the optical surfaces
    - Sensitivity must be measurable and is tested with filters that simulate smoke
- Sprinkler water flow alarms
  - Tested with inspectors test connection
  - Alarm initiates within 90 seconds
  - Delay is to accommodate surges in the water supply



# ITM

- Manual pull stations
  - Inspect the mechanical portion
  - Activate to verify internal switch operation
- Supervisory initiating devices
  - Require close physical inspection followed by a temporary simulation of a change in the status to verify the signal is transmitted



# ITM

- Notification appliances
  - Simply require the use of a sound meter and/or a light meter to verify operation
- Household fire warning equipment
  - Systems involve detectors, notification appliances and a control panel
  - Smoke detectors must be tested monthly
  - Entire system must be tested every 3 years by a qualified technician



# Responsibilities

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- Owners
  - Manufacturer's recommendations
  - Provide information
  - Keep records
- Inspectors
  - Qualified



# Ensuring Reliability

- Reliability is the measure of the certainty that the system will provide the appropriate response to the conditions that occur, as they occur, during the defined lifetime of the system
- Reliability can be computed because the reliability of the individual electronic components has been thoroughly studied and documented (MTBF)
- These calculations give the ability to recommend maintenance intervals based on the knowledge of when the system or components will fail





# Ensuring Reliability

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- NFPA 72 dictates inspection testing and maintenance schedules
- It is a consensus opinion of what an average system requires, not the actual result of reliability calculations



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A system cannot be expected to achieve its design objectives if the inspection, testing and maintenance program does not confirm the reliability of the system

