

Evacuation Phases

✗ • Evacuation Phases (Health care Facilities done quarterly)

— I - evacuating a single room

II - entire zone of a building

III - entire Floor + Zones on Floor above incident

— IV - entire building be evacuated

• REACT

Remove anyone in danger

Ensure doors are closed

Activate Fire alarm

Call fire department + give location

Try to extinguish the Fire if safe

Communication

- Communication Cycle

Sender: originator of the message

X Reciever: Person who receives the message

Encode: turning thoughts into communication

how the sender prepares the message

Decode: How the receiver interprets the message

Message: information the sender wants to share

Channel/medium: method used to send message

Feedback: receivers response to the message

- Focusing on the message rather than the sender can help prevent prejudice

Occupancy Classifications

- Mixed: unofficial occupancy category
- Assembly: occupancy classification for 50 or more people
 - A1: Fixed seating for use of viewing productions (theaters)
 - A2: Food or Drink consumption (Restaurants)
 - A3: worship, recreation, or amusement (church/arcade)
 - A4: viewing of indoor sporting events (arenas)
 - A5: Participation or viewing outdoor activities (stadiums)
- Educational: 6 or more persons at one time for educational purposes through 12th grade, >4hrs a day or >12hrs a week
- Day care: provides care, maintenance, & supervision of any age persons for less than 24hrs
- Mercantile: building that is used to display or sell merchandise
- Hotels: sleeping rooms for transient guests & can include meeting rooms, convention rooms, & restaurants >10 people
- Dormitories: any building or portion of a building that provides sleeping accommodations to 16 or more persons not related
- Institutional
 - I1: 16 or more who reside on a 24hr basis supervised
 - I2: 5 or more who reside on a 24hr basis who are not capable of self care; Nursing home
 - I3: 5 or more who are detained
 - I4: 5 or more who receive custodial care for less than 24hrs
- Storage: buildings used for storage
- Residential: uses are for sleeping purposes
 - R1: residents are primarily transient
 - R2: residents are primarily Permanent; >2 dwelling units
 - R3: care facilities <5 people, not classified as R1, 2, or 4
 - R4: >5 + <16 people excluding staff who reside 24hr basis & receive custodial care

Occupancy Classifications

- High hazard occupancy can be changed depending on the model code

H1: High hazard present detonation hazard (explosives)

H2: deflagration hazard, rapid energetic release of energy (flammable gases, pyrophorics - ignite within 5 min if exposed to air)

H3: materials that readily support combustion (oxidizing)

H4: health hazard materials (corrosives + highly toxic materials)

- Healthcare / Ambulatory: 4 or more pt who can not evacuate themselves
4 or more pt is considered out patient

- Nursing home is classified at Group B division 2

- Residential board + care occupancy must be classified as slow, prompt, or impractical

- Lodging / boarding or rooming houses are facilities that provide sleeping for rent

- can't be above mercantile occupancy unless separated by 1 hr fire separation barrier

- Emergency Evac Drill: done in hotels + motels where employees act as Fire wardens to direct occupants

- Healthcare facilities do emergency drills Quarterly for each shift

- Educational occupancies allows 1 person per 50 net sqft for labs, shops, or vocational rooms

occupant load For a classroom is 20 sqft per person

- Architect is responsible for occupancy Classification + load

AHJ approves Classification based on intended use

Inspector Duties

- Mechanical code: includes installation details for smoke, dampers, duct smoke commercial kitchens
- Acceptance testing: final inspection + testing of a newly installed fire protection system
- Results review: inspector discusses results with owner/manager
- An inspector who finds a valve closed should report condition to responsible party + fire department
- Inspectors are responsible for field inspections + new construction
- Evidence that is obtained without scheduled visit or warrant may be inadmissible in court
- The requirement for an administrative warrant protects owner from continuous and frivolous inspections
- AHJ can request assistance from specialty inspector
- ✗ Purpose of permits is community safety, property conservation, emergency responder safety
- Addition or Alterations of approved plans must be approved by the AHJ
- Complaints that aren't serious can be assigned to inspection staff
- Permits authorize right of entry for fire inspector any time
- ✗ When finding a violation start the process that leads to correction. Always refer to complaint records before making an inspection
- ✗ Operational Permit: allows person or group to conduct operation for a specific time
- ✗ Construction Permit: installation or alteration of system or equipment
- ✗ Open burning you must apply for permit before day of flaming foods ie hibachi are considered open burning

Inspections

Categories

Routine: occupancy classification

Issue of permit: conducted when owner is required to obtain a permit for a special event or use of occupancy

Sanction: used if violation is not corrected within a certain time

- Prescriptive based code: describes in detail the types of materials that can be used + how they would be assembled
- Performance based code: acceptable level of performance assembly, material, or system must meet without stating how; gives designer freedom
- Design phase of a building stage is where occupancy load + and room establishment are under design
 - Confirm a pattern of violations sort by location, date, time, + company / owner / occupant
 - Permitting process during plans review can allow errors in building plans
 - Inspector should gain compliance through a cooperative effort with the owner / manager
 - New Construction: review purpose / intended use + materials being used
 - Renovations / Additions: Have purpose or construction materials changed since last inspection + how changes will affect fire life safety provisions
- Preliminary drawings are referred to as concept drawings
- Pre-design conference: preliminary meetings; discuss work that needs to be done before plans are made

Hydrants

- Dry barrel: used in cold climates, opening a stem not allows water into the hydrant
- wet barrel: used in climates above freezing temperature
- Hydrant testing is annual
- violet color hydrant indicates nonpotable water
- X ◦ Pitot testing: hold the gauge $1\frac{1}{2}$ diameter of opening
- Flow tests should be done off of $2\frac{1}{2}$ outlets
- Public water supply include rivers, streams, lakes, ground water, + reservoirs
- X ◦ Fire inspector is responsible for field verification: reliable water source for temporary fire suppression system
- Distributors: small water mains that serve individual fire hydrants + commercial/residential consumers
- Pitot tube + Gauge: instruments used to determine the fire flow from hydrant
- Pitot testing hold the gauge $1\frac{1}{2}$ diameter of outlet
- Open lakes + canals for water supply are examples of reservoirs

Means of Egress

- Revolving Doors
 - collapsible wings
 - located within 10ft of a swinging door or stairs
 - minimum width 36 inch
 - collapsing force of 130 lbs
- >50 people additional exit system requirements
- ✗ • 15lb force applied to open a door with panic hardware
- ✗ • Minimum Psi for misting Spray System
 - Low pressure: under 175 psi
 - Intermediate Pressure: 175 - 500 psi
- ✗ • Means of egress must terminate in Public way
- ✗ • Public way is a street or alley open to the outside;
 - minimum width 10ft
- Exit enclosure: continuous path of protected travel to an exit discharge
- Exit stair enclosures shall have a minimum 1 hr fire resistance rating
- Exit discharge: portion of means of egress that is between exit + public way
- Areas of refuge provides protection for occupants who can't escape
- Stairwells
 - at least 44 inch wide if > 50 people
 - at least 36 inch wide if < 50 people
- Exit access: leads from occupied portion of building to exit
- Smoke proof enclosures: stairways designed to limit penetration of smoke, heat, toxic gas into stairway
- Means of egress: safe continuous path of travel from any point in the structure to a public way
- Common Path of travel: all occupants must travel in one direction before reaching a point where they may choose between two separate + distinct paths leading to two exits

Classes of Fire + Extinguishers

- ✗ Class A: ordinary combustibles
 - Ex: Paper, cloth, wood
 - Dry Chemical extinguishers (Monoammonium phosphate)
- Class B: Flammable liquids + gases
 - Ex: alcohol, ether, oil
 - ordinary dry Chemical (sodium bicarb), CO_2 , Foam
- Class C: Electrical equipment; de-energize first
 - Ex: electrical equipment
 - Carbon dioxide extinguishers, Clean agent
- Class D: Metals
 - Ex: Magnesium, Sodium, potassium
 - Dry powder extinguisher
- Class K Extinguisher kitchen grease fires
 - wet chemical Extinguisher (water + potassium)
- Discharge is controlled by nozzle / lever
- ✗ Fire extinguishers < 40 lbs mounted 5 ft > 40 lbs 3 1/2 ft
 - Both must have 4 inch clearance from ground
- Hood exhaust plenum: commercial kitchens; delivers fresh air known as "make up air" across cooking area near hood
- ✗ • Cooling with water is the most common methods of fire control + extinguishment
- For a special agent extinguishing system to be considered successful, it must completely extinguish the fire
- Dry Chemical application methods:
 - Local application: most common discharges agent onto a specific surface such as cooking in restaurant's kitchen
 - Total Flooding: introduces a concentration of agent into a closed area
 - Handheld hose line:
- Cartridge, Nitrogen, or CO_2 is expellant gas stored in extinguishers

Extinguishers

- Portable extinguishers that leave no residue:
Clean agent, Halon, Halotron, FM-200, Inergen, ECARO-25, FE-36, Carbon dioxide
- Purple K (Potassium Bicarb): dry Chemical extinguisher
Effective on class B flammable liquids + Class C
- Class K Extinguishers put out fires through saponification
these agents turn fats + oils into a soapy foam

Solid

Fire Alarms

- Smoke Dampers: found in duct work + actuated by an associated smoke detector + fire alarm system
- Electronic heat detector: sends an electronic impulse to the fire control panel + sprinkler waterflow control valve
- Initiating devices: fire alarm system component is actuated by the presence of fire, smoke, flame, or heat + sends a signal
- Control valves are used isolate flow of water
- Smoke detectors
 - pneumatic rate of rise line heat detection: metal pneumatic tubing over a wide area of coverage
 - Rate compensation detector: subject to regular temperature changes but at rates slower than fire conditions
 - Electronic spot detection: one or more thermistors that produce marked change in electrical resistance when exposed to heat
 - Photoelectric smoke detectors: use light source to detect smoke particles in the air; good for smoldering fires
 - Detection:
 - Projected beam: uses a beam of light focused across area on to a photodiode
 - Refractory: uses a beam of light from LED that passes through small chamber at a point distant from light source
 - Ionization smoke detectors: uses radioactive material to detect smoke in the air; + and - charged plates
 - Duct smoke detector: in return supply ducts or plenums of hvac systems to prevent smoke + products of combustion
 - Electronic heat detector: actuated by rise of heat rate in a protected area
- Travel distance to a manual pull station should not exceed 200ft; usually red with white lettering
- Tactile response is a notification appliance that warns occupants by touch or vibration

Types of Construction

- Type I: Structural membranes that are composed of only noncombustible materials + high fire rating
Ex: reinforced concrete, steel beams
- Type II: Structural membranes that will not contribute to fire development or spread but do not meet same requirements
Ex: tilt slab, reinforced masonry w/ metal roof
- Type III: Noncombustible materials for exterior walls + combustible materials for the interior + roof. ordinary construction
- Type IV: heavy timber construction; lumber > 8 inch thickness for columns + > 6 inch thickness for beams/girders
- Type V: exterior walls are wood; wood framed construction

Building Construction

- Demolition sites have risk for rapid fire spread due to large quantities of unprotected combustible materials
- ✗ ○ Gross: sqft measured wall to wall with no deductions
- ✗ ○ Net: gross sqft minus space taken up by equipment, corridors, or other space not used for the occupancy
- During Construction of a building the types of materials influence fire development
- ✗ ○ Structural fire load: wall studs, floors, ceiling joists + roof supports
- Dead load: weight of the structure, structural membranes, building components + anything permanently attached
- Fuel load: total quantity of combustible contents of the building
- Flame spread index: number that measures how quickly a flame spreads across a material
- Fire Curtain: barrier of heat resistive material that stops the spread of fire + smoke in a building
- Fire partition: wall that subdivides a floor or area of a building but may not extend continuously through a building
- Fire wall: Extends continuously from the foundation to roof + restricts the spread of fire
- Fire barrier: interior wall designed to restrict fire within a building; must terminate at floor or roof deck
- Enclosure walls: block vertical spread of fire; also used to protect means of egress in stairwells
- Curtain wall: exterior walls that are not load bearing/structural
Fire rated / fire resistive; protect interior

Building Construction

- Lumber can be stored max 20ft due to stability
- Sheathing: used outside of studs to provide structural stability
- Fire retardant wood is impregnation + surface coating
- Dimension stones: removed from a quarry + cut to size
- Engineered wood products: prefabricated from dimensional lumber, panels, metal fasteners, + adhesives
- Foiled back gypsum: used to replace vapor barriers in outside walls
- Coreboard: used for shaft walls + solid partitions
- ✗ ○ Fire resistance rated HVAC equipment with smoke + fire damper must be rated for 2hrs or greater

- ✗ ○ Occupant load - net floor area / total # of people allowed in a room or space based on intended use of space
Calculate Occupancy load:
Add total Square Feet of each area
Divide by individual occupancy load for each area
Always Round up for # of Occupants

Water Based Suppression Systems

- upright: Sprinkler that sits upright on a branched line
- Concealed: sprinkler recessed + covered with a removable plate that releases when exposed to heat; Opening around the head is sealed by an escutcheon plate
- Flush: mounted on the ceiling with body of sprinkler above plane of the ceiling
- Pendent: installed downward from the branched line so that water hits the deflector + distributed
- Sidewall: mounted to the wall, parallel to the floor
- Proprietary Fire Alarm system: large commercial alarms; manufacturer + local service provider are the same company
Tested annually / extensive repair or modification
- Water flow meter: determines quantity of water for billing purposes
- Back flow preventer: prohibits contaminated water from flowing into public water system
- ✗ ○ Wall post indicator: water flow valve that extends from the wall
- Fusible links are in sprinklers. When they heat up they will melt causing activation
- Deluge sprinkler system: open sprinklers attached to dry pipes, activates + all sprinklers discharge at the same time
- Looped sprinkler system: consists of interconnected cross mains that provide multiple routes of water to reach any point in system
- Water mist systems: Controls or extinguishes fires by displacing O_2 + blocking radiant heat production; extinguishes Class A + B fires; prevents Plashover

Water Based Suppression Systems

- Water flow control valve: detection + activation device for a dry pipe + deluge system; sends electronic pulse to the FACP + sprinkler; on all automatic Sprinklers
- Outside Stem + Yolk (OS+Y): yolk on outside with a threaded stem or screw
Stem is out = open
- Post Indicating valve (PIV): hollow metal post attached to valve housing + window with words "open or shut"
- x ◦ Wall Post Indicating Valve (WPIV): same as PIV but comes horizontally out of a wall
- Post Indicator Valve Assembly (PIVA): Similar to PIV but uses a butterfly valve while PIV uses gate valve

Signage

- ✗ Fire lanes are designated by the AHJ + AHJ verify minimum width maintained
150ft long ; 20ft minimum width ; vertical clearance 13 ft 6 inch
Markings must be curbs painted red with white lettering
Street painted white with red lettering
Angle to not exceed 8° ; necessary to allow apparatus to drive on to lane without tailboard or bumper to hit the ground
- DOT placard : Diamond shape , Color coded to provide info on materials being transported

Storage

- Non bulk packaging are used for liquids/gases

X

up to 119 gallons of liquid

up to 882 lbs solids

up to 1001 lbs of water for gases

quantity < 119 gallons = Container

quantity > 119 gallons = Bulk packaging

- Flammable/Combustible liquids are defined by their flash point and vapor pressure

Flammable liquids < 100°F Flash point < 40 psi Vapor pressure

Combustible liquids > 100°F Flash point

- Dry Chemical agent storage containers < 150 lbs must be hydrostatically tested every 12 yrs

- NFPA 704 identification system for first responders to hazards on structures, 0 is lowest 4 is highest

- unstable reactive materials are solids, liquids, gases that can react adversely due to changes in pressure, temp, mechanical/thermal shock

- UN hazard Classes (9): Explosives, Gases, Flammable liquids, Flammable solids, Oxidizers, Poison, radioactive, corrosive, Other
Red = Flammability Blue = health yellow = instability
white = special hazards

- Pressure vessels store liquids, cryogenic fluid, or gases at Pressure > 15 psig

Storage Tanks

- ✗ • Flame vents should be not less than 12 ft above ground level vent outlets 5 ft from building / lot lines
- Non-liquefied compressed gas is entirely gaseous at room temp
- Underground storage tanks are the safest way to store hazardous materials
- Field erected above ground tanks (AST) constructed as cone roof, open floating roof, or internal floating roof
Monthly visual inspections. Authorized inspector every 5 yrs
Removed from service every 20 yrs + internally inspected
- Product reconciliation to verify liquids tightness
- Class 1 Flammable AST must be 25 ft from lot line
- UL 142 requires nameplate on all shop fabricated ATs to indicate required flow rate marked on emergency vent
Formula is expressed in Standard cubic feet / hr

Definitions

- Temperature: measure of average kinetic energy of the particles in a sample of matter
- Watt: SI of power
- BTU: amount of heat needed to raise the temperature of one lb of water by 1°F
- Pyrophoric materials: can ignite within 5 min of being exposed to air
- Flaming Combustion: produces flame above materials surface
- Non-flaming Combustion: occurs at lower temp, producing smoldering glow on materials surface
- Incineration: can reduce bulk of waste as much as 95%. Fuel fired incinerators are preheated for 30min before use
- Radiant heat: Can become dominant mode of heat transfer when fire grows in size/has significant effect on ignition of objects located some distance from the fire
- Piloted Ignition: mix of Fuel + O_2 encounters external heat with sufficient heat to start combustion; spark or flame
- Non Piloted: self ignition
- Heat transfer process raises the temperature of all materials in the compartment. as nearby fuel is heated it pyrolyzes
- Most fundamental fuel characteristics influencing fire development are mass + surface area
- ✗ • Fires beyond incipient stage is or will quickly become ventilation-controlled. Controlling ventilation is key in controlling fire behavior

Definitions

- Non-liquified gas (Permanant gas): gas that remains a gas even at pressures as high as 10,000 psi; only be liquified by lowering temperature below critical temperature
Ex: helium, O_2 , nitrogen, argon, CO_2
- Stages of Fire Development:
 - Incipient: fuel, O_2 , + heat join together in a chemical reaction
 - Growth: fire begins to spread nearly all combustible materials reach ignition temperature
 - Fully developed: peak of fire's intensity, consumed most fuels
 - Decay: fire diminishes due to lack of fuels or O_2
- ✗ • Flash over: simultaneous ignition of everything in a room; between growth + fully developed stage
- Backdraft: explosion occurs when O_2 is introduced to hot gases
- Fire Triangle: Fuel, heat, O_2
- Fire Tetrahedron: fuel, heat, O_2 , uninhibited chain reaction
- Thermal layering: gases tendency to separate into layers by temperature; Hotter at the top - cooler at the bottom
- Isolated flames: While in the growth stage pockets of flames can be observed through the hot gas layer above the neutral plane called ghosting
- Rollover: ignited fire gases or incompletely unburned fuels rise + spread out horizontally
- Transfer of Heat
 - Conduction: heat moves through a solid material by direct contact
 - Convection: heat transfer through air or water
 - Radiation: heat transfer through electromagnetic waves

NFPA's / Organizations

- American Society for Testing Materials (ASTM): develop + publish voluntary consensus standards to improve product quality, safety + performance
- American National Standards Institute (ANSI): develops + manages voluntary standards for products
Includes appeal process for manufacturers who wish to contest test results on their products
- Underwriters Laboratory (UL): sets industry wide standards for products, test products to ensure they meet safety standards
- Occupational Safety + Health Administration (OSHA): ensure safe + healthy work environments
- NFPA 1 Fire code: requirements to provide fire + life safety + property protection
- NFPA 101 Life Safety Code: protect people based on building construction, protection, + occupancy features
- NFPA 704 Standards for Hazmat emergency Response: Provide immediate general sense of hazardous materials (NFPA Hazard Diamond)
- NFPA 70 Electric code: safety measures for electrical design, installation, + inspection
- NFPA 13 Sprinkler Systems: Sprinkler design, installation, and component options
- NFPA 72 Fire alarm + Signaling Code: Fire detection, signaling, + emergency communications
- NFPA 10 Fire Extinguishers: portable fire extinguishers
- NFPA 220 Types of Building Construction: materials + their combustibility
- NFPA 25 Testing + maintenance of Water Based Fire Suppression Systems: sprinklers, standpipes + fire pumps installation, maintenance + inspection

Electrical hazard class where fibers can ignite

Hazard to exterior walls with load bearing problems- ornamental walls

What should portable extinguishers have 2 things

How long do you keep papers if building is demolished

Mud, stones or dead organisms that prevent water flow are called what

DOT label

Pressure vessels at 2-15 psig are what type ...low pressure, immediate, high

What type of storage should the openings be on the top and not under the line of liquid

Heat flux definition

Legal terms and procedures