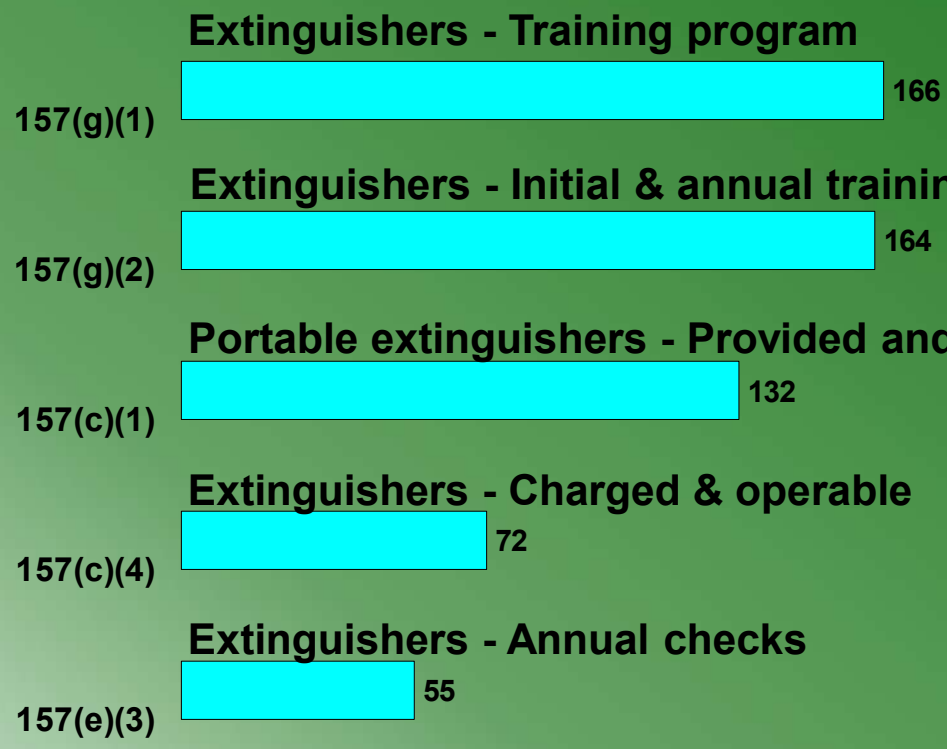
Fire Protection & Prevention

Subpart L - Fire Protection (1910.155 - 165)

Standard: 1910.



Introduction

- Workplace fires and explosions kill 200 and injure more than 5,000 workers each year.
- In 1995, more than 75,000 workplace fires cost businesses more than $2.3 billion.

Subpart L - Scope

- This subpart contains requirements for:
  - Fire brigades, and
  - All portable and fixed fire suppression equipment,
  - Fire detection systems, and
  - Fire or employee alarm systems

Subpart L - Definitions

- Equipment is listed if it is of a kind mentioned in a list which is published by a nationally recognized testing laboratory which makes periodic inspections of the production of such equipment and which states that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner;

Underwriters Laboratories Inc. UL)

Subpart L - Definitions

- "Carbon dioxide" means a colorless, odorless, electrically nonconductive inert gas (chemical formula CO(2)) that is a medium for extinguishing fires by reducing the concentration of oxygen or fuel vapor in the air to the point where combustion is impossible

Subpart L - Definitions

- "Class A fire" means a fire involving ordinary combustible materials such as paper, wood, cloth, and some rubber and plastic materials

Subpart L - Definitions

- "Class B fire" means a fire involving flammable or combustible liquids, flammable gases, greases and similar materials, and some rubber and plastic materials

Subpart L - Definitions

- "Class C fire" means a fire involving energized electrical equipment where safety to the employee requires the use of electrically nonconductive extinguishing media

Subpart L - Definitions

- "Class D fire" means a fire involving combustible metals such as magnesium, titanium, zirconium, sodium, lithium and potassium

"Dry powder" means an compound used to extinguish or control Class D fires

There is a newly designated class K fire

- Not mentioned in the OSHA regulations
- Kitchen grease fires
- No ABC dry chemical units
- Wet chemical
- Dry chemical units
- Avoid splashing
- Never pick up a burning pan of grease!

Subpart L - Definitions

- "Fire brigade" (private fire department, industrial fire department) means an organized group of employees who are knowledgeable, trained, and skilled in at least basic fire fighting operations

Subpart L - Definitions

- "Incipient stage fire" means a fire which is in the initial or beginning stage and which can be controlled or extinguished by portable fire extinguishers, Class II standpipe or small hose systems without the need for protective clothing or breathing apparatus

Subpart L - Definitions

- "Pre-discharge employee alarm" means an alarm which will sound at a set time prior to actual discharge of an extinguishing system so that employees may evacuate the discharge area prior to system discharge

Portable Fire Extinguishers

- Hand and portable fire extinguishers are considered to be the first line of fire defense for fires of limited size. They are the most mobile equipment available.
- Fire extinguishers are used to suppress small, accessible fires before the fires grow in size in size and intensity.

Leaning Objectives

- At then end of this module, you will be able to:
- Describe the four classes of fires and their classification system
- Provide information for stopping the combustion process
- Describe the inspection and maintenance process
- Explain how each of the most commonly encountered types of portable fire extinguishers are used
- Describe procedures for fighting a fire.

Owner or Occupant Responsibilities

- Owners or occupants of property or vehicles are obligated to care for and maintain fire extinguishers. Personnel should be trained in the applications and limitations of portable extinguishers.
- Even if personnel are trained in using portable extinguishers, it always best to call the fire department, regardless of fire size.

Components of Fire

- It was once thought that a fire consisted of three components: heat, fuel, and oxidizing agent. As the knowledge of fire increased, a series of interconnecting chemical reactions, referred to as a chemical chain reaction, was found to be a fourth component.

Fourth Fire Element

- The chemical chain reaction is now recognized as the fourth fire element along with heat, fuel, and an oxidizing agent.

Fire Process

- The process of combustion (fire) can be represented by the following general equation:

Fuel + Oxidizer + Heat + Chemical Chain Reaction =

Products of Combustion + Energy

Classes of Fire

A	Common Combustibles	Wood, Paper, Cloth, Etc.
B	Flammable Liquids & Gases	Gasoline, Propane other Solvents
C	Live Electrical Equipment	Computers, Fax Machines, Etc.
D	Combustible Metals	Magnesium, Lithium, Titanium
K	Cooking Media	Oils, Lards, Fats

Test your knowledge

- Class B fires involve the following:
  - Wood and paper
  - Electrical equipment
  - Flammable liquids

Stopping the Combustion Process

- There are four methods that may be used to stop the combustion process. Each represents the removal of one of the four fire components:

  - Heat Removal
  - Fuel Removal
  - Oxygen Removal
  - Stopping the Chemical Chain Reaction

Test your knowledge

- There are various types of extinguishing agent (dry chemicals, gaseous/foam, or water) that are appropriate for different types of fires.

Types of Portable Fire Extinguishers

- The two most commonly encountered types of portable fire extinguishers are:
  - Stored pressure
  - Cartridge

Test your knowledge

- Stored pressure fire extinguishers are activated by a CO2 or nitrogen cartridge.

- True

- False

Multi-purpose Dry Chemical Extinguisher

- The most common fire extinguisher used today is the multi-purpose dry chemical. It can be used on fires that include any and all of the classes A, B, and C.
- These general use extinguishers are commonly placed in offices, laboratories, maintenance shops, and vehicles. The typical extinguisher found in most buildings is multi-purpose, and marked with all three emblems: A, B, and C.

Carbon Dioxide Extinguisher

- Carbon Dioxide Extinguishers can be used on class B and C fires.
- They are most commonly placed in computer rooms and computer areas. The carbon dioxide will be effective around this energized electrical equipment and will not leave a dirty chemical residue.

Extinguisher Effectiveness Rating

- The rating is found in the fine print on the side of the fire extinguisher. The number associated with Class A reflects the relative quantity of extinguishing agent that can suppress a fire. For example, a typical multi-purpose dry chemical extinguisher is rated as 2-A: 20B:c. This indicates that the extinguisher will extinguish twice as much Class A fire as an extinguisher rated Class 1-A.
- The numerical rating for Class B is an approximate indication of the area in square feet of a flammable liquid fire that can be extinguished. Therefore, the extinguisher in the example above can be expected to extinguish a fire of twenty square feet.
- The C indicates the extinguisher may be used on energized electrical equipment.

FIRE RATINGS, RANGE AND DISCHARGE

MODEL	CAPACITY/TYPE	FIRE RATING	RANGE mtrs.	DISCHARGE Sec.
	WATER			
W6	6 litre cartridge operated spray	27A	4-6	43
W9	6 litre, stored pressure	13A	7-8	60
	FOAM			
F2	1.8 litre, stored pressure, spray	5A, 34B	2-4	17
F6	6 litre, stored pressure, spray	13A, 144B	4-6	36
F9	9 litre, stored pressure, spray	21A, 183B	4-6	53
	POWDER			
PD1	1kg, stored pressure	8A,34B	4	9,5
PD2	2kg, stored pressure	13A, 70B	4	9,5
PD4	4kg, stored pressure	21A, 144B	4	17
PD6	6kg, stored pressure	34A, 183B	6	17
PD9	9kg, stored pressure	43A, 233B	7	25
	CO_2			
C2	2kg, aluminium	34B	-	9
C5	5kg, aluminium	55B	-	12

Selecting Extinguishers for the Hazard

- The number of extinguishers needed to protect a building depends on the extinguisher rating and the building's hazard classification.
- Building occupancies are classifies as "light," "ordinary," or "extra," according to the hazard that is anticipated.

Types of Hazards

- Light or Low Hazard
- Ordinary or Moderate Hazard
- Extra or High Hazard

Extinguishers for Class A Fires

- This table is a guideline for determining the minimum number and rating of extinguishers for Class A fires. It indicates that:
  - The maximum travel distance from any point to the nearest extinguisher must not exceed 75 feet
  - A 2 ½ gallon stored-pressure water extinguisher (rated 2-A) will protect an area of 3,000 square feet in an ordinary hazard occupancy (I.e., 2 x 1,500 square feet)

Extinguishers for Class B Fires

- This table is a guideline for determining the minimum number and rating of extinguishers for Class B fires. It indicates that:
  - The maximum travel distance to get a Class B extinguishers is 50 feet
  - Remember, flammable liquid fires reach their maximum intensity almost immediately.

Placing Fire Extinguishers

- The most efficient placement is to use multi-purpose dry chemical fire extinguishers than can simultaneously suppress Class A, B, and C fires. In office buildings extinguishers are normally located at the exit doors, in the main corridors, and the large office areas. Extinguishers are also commonly placed near each laboratory door. Extinguishers should be placed such that they are:
  - Visible (or have signs)
  - Accessible
  - Along the exit route.

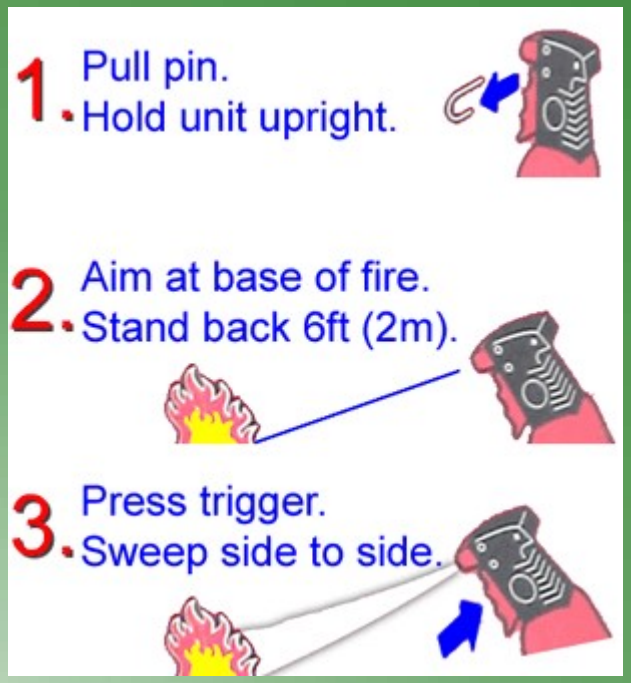
Emergency Procedures and Notification

- OSHA, in 29 CFR 1910.156-157, has established standards for training fire brigades and for training employees to fight fires during emergencies. Most organizations require employees to immediately evacuate the building upon notification of a fire emergency. Ask your supervisor about the correct emergency action plan procedure to follow for your organization.
- In case of a fire emergency, you should:
  - Immediately contact the fire department
  - Activate a nearby manual pull station
  - Notify personnel in the immediate area to evacuate
  - Evacuate and proceed to an appropriate meeting place.

Precautions of Fire Fighting

- Precautions:
  - Make sure the fire extinguisher has the appropriate class emblems (A,B,C, D) and is the appropriate size for the fire
  - Have someone back you up with a second extinguisher
  - Never enter a burning building.

Fire Extinguisher Use



- PASS Procedure:
- After you have assured the fire extinguisher is proper and readied for use, you should initiate the PASS procedure:
  - Pull out the locking in and the plastic seal or push the activator
  - Aim the nozzle at the base of the fire
  - Squeeze the release trigger
  - Sweep the extinguishing material across the base of the fire from side to side.

Fire Fighting Guidelines

- Guidelines:
  - When you approach a fire, be sure you can retreat rapidly in a straight line toward an exit
  - Never turn your back on a flaming or recently extinguished fire
  - Never use water on combustible metals, flammable liquids, or electrical fires while the current is on
  - Keep the wind at your back to avoid flashback.

Test your knowledge

- The following procedure should be observed after you have selected the correct fire extinguisher:
    - Aim, pull, squeeze, sweep
    - Pull, squeeze, aim, sweep
    - Pull, aim, squeeze, sweep

Inspection of Fire Extinguishers

- Inspections:
  - All fires extinguishers are maintained yearly for operational and regulatory reasons
  - Fire extinguishers are thoroughly checked to ensure that they operate effectively and safely
  - This annual inspection is performed by a certified fire extinguisher technician. This technician will normally attach a new service tag to the fire extinguisher.

Fire Extinguisher Monthly Inspection

- Monthly Inspections:
- Both OSHA and EPA require monthly visual fire extinguisher inspections to ensure that:
  - Extinguishers remain in their proper locations
  - Pressure is not lost
  - The pin is in place
  - No leakage or corrosion has taken place.
- These monthly inspections are performed by the local facility staff. This can provide all local staff with familiarity of the fire extinguisher locations and type.

1910.156 Fire Brigades

- Organizational statement. The employer shall prepare and maintain a statement or written policy which establishes:
  - The existence of a fire brigade;
  - The basic organizational structure; the type, amount, and frequency of training to be provided to fire brigade members;
  - The expected number of members in the fire brigade; and
  - The functions that the fire brigade is to perform.

Standard Interpretations
07/03/1990 - Fire brigades and portable fire extinguishers standards

- OSHA defines a fire brigade as "... an organized group of employees who are knowledgeable, trained, and skilled in at least basic fire fighting operations." On the basis of that definition, an organization of employees with the responsibility of fighting interior structural or incipient stage fires is subject to the relevant provisions of both 1910.156 and .157 standards.
- The .156 standard applies to all fire brigades, regardless of whether they are organized to fight interior structural or incipient stage fires. Safety and health requirements are greater for fire brigade members involved in structural fire fighting.

Standard Interpretations
07/03/1990 - Fire brigades and portable fire extinguishers standards

- 1910.156 does not preclude the employer's organization of fire brigades expressly for the purpose of fighting fires only with portable fire extinguishers, Class II standpipes or small hose systems (incipient stage fires) so long as the employer establishes a written organizational policy that, among other requirements, outlines the functions that all fire brigades are to perform at the workplace.

1910.156 Fire Brigades

- Personnel. Assure that employees doing interior structural fire fighting are physically capable of performing duties during emergencies.
- Employees with known heart disease, epilepsy, or emphysema, allowed participate in fire brigade emergency activities unless a physician's certificate of the employees' fitness

1910.156 Fire Brigades

- The employer shall provide training and education for all fire brigade members commensurate with those duties and functions that fire brigade members are expected to perform

Standard Interpretations
04/26/2002 - Training requirements for fire brigade members

- According to 29 CFR 1910.156(c)(3), the quality of fire training education given to the brigade members must be similar to that given by the institutes and academies listed in that section.
- Question: Does this require the company to send the members to one of these schools, or can an experienced fire instructor develop lesson plans for on site classes that would include theory as well as field training with plant equipment and processes?

Standard Interpretations
04/26/2002 - Training requirements for fire brigade members

- For your information, the many fire brigades covered by the OSHA fire brigade standard (29 CFR 1910.156) vary widely in type, function, and size. Therefore, OSHA's requirements are performance-oriented to allow the employer to organize a fire brigade which best reflects the needs of the workplace.

Standard Interpretations
04/26/2002 - Training requirements for fire brigade members

- Furthermore, OSHA's training requirements for instructors are minimal and generalized; they are not divided into different levels of competence such as Instructor I, II, III, and IV as defined by the National Fire Protection Association (NFPA) standard 1041. Also, the appendix to the fire brigade standard contains guidelines which should help you better understand the intent of OSHA's fire brigade training requirements.

1910.156 Fire Brigades

- Fire fighting equipment. Maintain and inspect, at least annually, fire fighting equipment to assure the safe operational condition of the equipment

- Portable fire extinguishers and respirators inspected at least monthly

1910.156 Fire Brigades

- Assure that protective clothing protects the head, body, and extremities, and consists of at least the following components:
  - Foot and leg protection;
  - Hand protection;
  - Body protection;
  - Eye, face and head protection

Standard Interpretations
07/18/1996 - Incipient stage fire brigades

- Your first question requested an interpretation about equipping fire brigade members with SCBA's even though their activities are limited to fighting only those fires which meet the definition of "incipient stage fires." Although OSHA's definition of an incipient stage fire includes a provision that the fire can be controlled/extinguished without the need for protective clothing or breathing apparatus, OSHA recognizes the special circumstances which your facility faces.

Standard Interpretations
07/18/1996 - Incipient stage fire brigades

- Because of your concerns about the potential toxicity of gases, vapors and products of combustion unique to your workplaces, you believe fire brigade members should be equipped with SCBA's. We agree, and accordingly, you may provide "incipient stage fire brigade members" with SCBA's if their activities are limited to fighting "incipient stage fires," and may not include interior fire fighting or situations which would be covered by OSHA's Immediately Dangerous to Life or Health (IDLH) policy.

1910. 157 Portable fire extinguishers

- Scope:
  - The placement,
  - Use,
  - Maintenance, and
  - Testing of portable fire extinguishers provided for the use of employees

1910. 157 Portable fire extinguishers

- Where the written fire safety policy requires the immediate and total evacuation of employees from the workplace upon the sounding of a fire alarm signal and
- Which includes an emergency action plan and a fire prevention plan which meet the requirements of 29 CFR 1910.38 and 29 CFR 1910.39 respectively, and
- When extinguishers are not available in the workplace, ***the employer is exempt from all requirements of this section**** (*all three)

1910. 157 Portable fire extinguishers

- Where the emergency action plan designates certain employees to be the only employees authorized to use the available portable fire extinguishers, and
- Which requires all other employees in the fire area to immediately evacuate the affected work area upon the sounding of the fire alarm, the employer is exempt from the distribution requirements in paragraph (d) of this section

1910. 157(c) General Requirements

- The employer shall provide portable fire extinguishers and shall mount, locate and identify them so that they are readily accessible to employees without subjecting the employees to possible injury

mounted extinguisher is blocked with maintenance items

1910. 157(c) General Requirements

- Only approved portable fire extinguishers shall be used

1910. 157(c) General Requirements

- The employer shall assure that portable fire extinguishers are maintained in a fully charged and operable condition and kept in their designated places at all times except during use

1910. 157(d) Selection and distribution

- Provide portable fire extinguishers provided for employee use
- Selected and distributed based on the classes of anticipated workplace fires and on the size and degree of hazard affecting their use



1910. 157(d) Selection and distribution

- Distribute portable fire extinguishers for use by employees on **Class A** fires so that the travel distance for employees to any extinguisher is **75 feet**

1910. 157(d) Selection and distribution

- Distribute portable fire extinguishers for use by employees on **Class B** fires so that the travel distance from the Class B hazard area to any extinguisher is **50 feet**

1910. 157(d) Selection and distribution

- The employer shall distribute portable fire extinguishers used for Class C hazards on the basis of the appropriate pattern for the existing Class A or Class B hazards

1910. 157(d) Selection and distribution

- Distribute Class D portable fire extinguishers so that the travel distance from the combustible metal working area to any extinguishing agent is 75 feet

1910. 157(d) Selection and distribution

- Portable fire extinguishers for Class D hazards are required in those combustible metal working areas where combustible metal powders, flakes, shavings, or similarly sized products are generated at least once every two weeks

1910. 157(e) Inspection, maintenance and testing

- Portable extinguishers or hose shall be visually inspected monthly

1910. 157(e) Inspection, maintenance and testing

- Portable fire extinguishers are required to receive an annual maintenance check.
- The employer shall record the annual maintenance date and retain this record for one year after the last entry

Standard Interpretations
01/06/1992 - Laws and regulations on fire protection in the workplace

- You requested a listing of what (fire protection) items must be maintained in the work area and place of employment.
- There is no specific listing for the following reasons. Protection requirements may vary considerably from one workplace to another which has different fire hazards.
- Usually, an employer can implement any one of several fire protection options to comply with OSHA standards, for example, those on portable fire extinguishers at 29 CFR 1910.157.

FLAMMABLE & COMBUSTABLE LIQUIDS

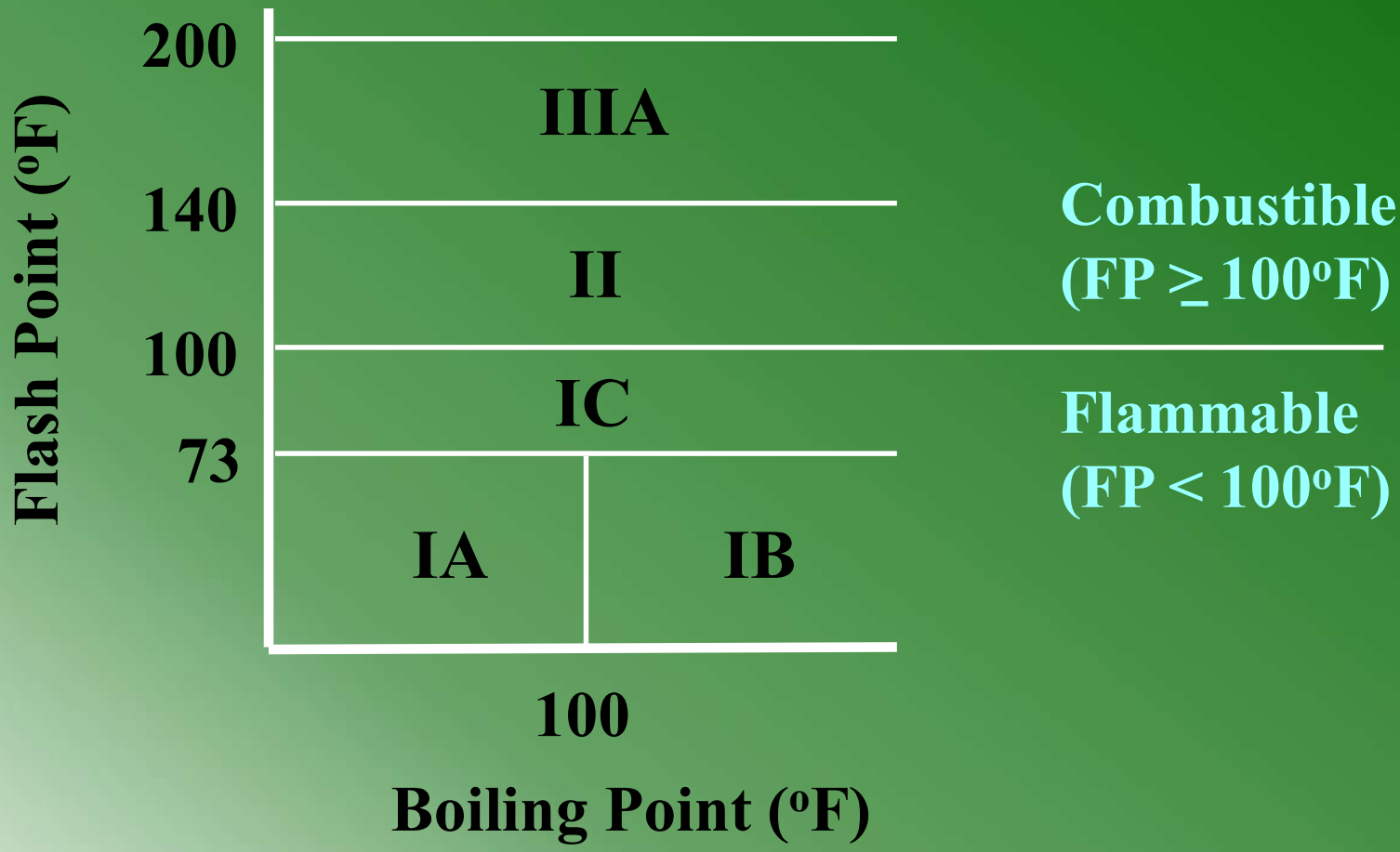
Introduction

- The two primary hazards associated with flammable and combustible liquids are *explosion* and *fire*
- Safe handling and storage of flammable liquids requires the use of approved equipment and practices per OSHA standards

Flash Point

- Flash point means the minimum temperature at which a liquid gives off enough vapor to form an ignitable mixture
- In general, the lower the flash point, the greater the hazard
- Flammable liquids have flash points below 100°F, and are more dangerous than combustible liquids, since they may be ignited at room temperature
- Combustible liquids have flash points at or above 100°F -Although combustible liquids have higher flash points than flammable liquids, they can pose serious fire and/or explosion hazards when heated

Classes of Flammable and Combustible Liquids



Classes of Some Flammable Liquids

	Common Name	Flash Point (°F)
CLASS IA	Ethyl Ether	-49
CLASS IB	Gasoline	-45
	Methyl Ethyl Ketone	21
	Toluene	40
CLASS IC	Xylene	81-115
	Turpentine	95

Program Components

A good plan for safe use of flammable and combustible liquids contains at least these components:

- Control of ignition sources
- Proper storage
- Fire control
- Safe handling

Sources of Ignition

Must take adequate precautions to prevent ignition of flammable vapors. Some sources of ignition include:

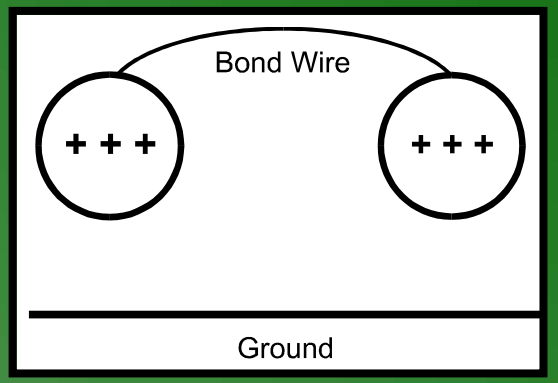
- Open flames
- Smoking
- Static electricity
- Cutting and welding
- Hot surfaces
- Electrical and mechanical sparks
- Lightning

Static Electricity

- Generated when a fluid flows through a pipe or from an opening into a tank
- Main hazards are fire and explosion from sparks containing enough energy to ignite flammable vapors
- Bonding or grounding of flammable liquid containers is necessary to prevent static electricity from causing a spark

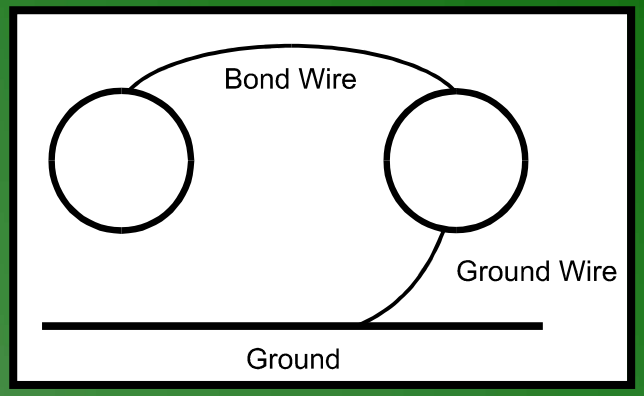
Bonding

- Physically connect two conductive objects together with a bond wire to eliminate a difference in static charge potential between them
- Must provide a bond wire between containers during flammable liquid filling operations, unless a metallic path between them is otherwise present



Grounding

- Eliminates a difference in static charge potential between conductive objects and ground
- Although bonding will eliminate a difference in potential between objects, it will not eliminate a difference in potential between these objects and earth unless one of the objects is connected to earth with a ground wire



Ventilation

Always provide adequate ventilation to reduce the potential for ignition of flammable vapors.

Storage Fundamentals

- Identify incompatible chemicals – check the Material Safety Data Sheet
- Isolate and separate incompatible materials
  - Isolate by storing in another area or room
  - Degree of isolation depends on quantities, chemical properties and packaging
  - Separate by storing in same area or room, but apart from each other

Storage of Flammable and Combustible Liquids

- Storage must not limit the use of exits, stairways, or areas normally used for the safe egress of people
- In office occupancies:
  - Storage prohibited except that which is required for maintenance and operation of equipment
  - Storage must be in:
    - closed metal containers inside a storage cabinet, or
    - safety cans, or
    - an inside storage room

Inside storage room

Safety Cans for Storage and Transfer

- Approved container of not more than 5 gallons capacity
- Spring-closing lid and spout cover
- Safely relieves internal pressure when exposed to fire

Flame Arrester Screen

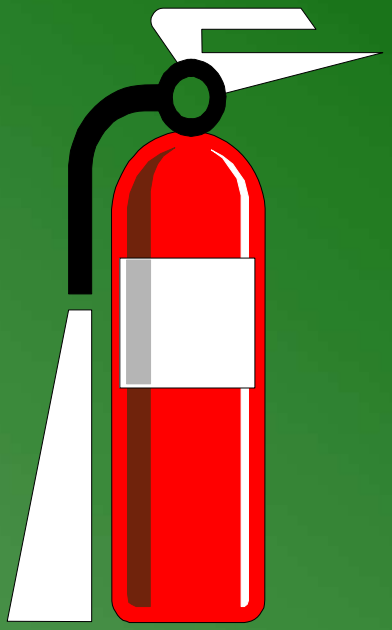
- Prevents fire flashback into can contents
- Double wire-mesh construction
- Large surface area provides rapid dissipation of heat from fire so that vapor temperature inside can remains below ignition point

Storage Cabinets

- Not more than 60 gal of Class I and/or Class II liquids, or not more than 120 gal of Class III liquids permitted in a cabinet
- Must be conspicuously labeled, “Flammable - Keep Fire Away”
- Doors on metal cabinets must have a three-point lock (top, side, and bottom), and the door sill must be raised at least 2 inches above the bottom of the cabinet

Fire Control

- Suitable fire control devices, such as small hose or portable fire extinguishers must be available where flammable or combustible liquids are stored
- Open flames and smoking must not be permitted in these storage areas
- Materials which react with water must not be stored in the same room with flammable or combustible liquids



Transferring Flammable Liquids

Since there is a sizeable risk whenever flammable liquids are handled, OSHA allows only four methods for transferring these materials:

1. Through a closed piping system
2. From safety cans
3. By gravity through an approved self-closing safety faucet
4. By means of a safety pump

Self-Closing Safety Faucet

- Bonding wire between drum and container
- Grounding wire between drum and ground
- Safety vent in drum

Safety Pump

- Faster and safer than using a faucet
- Spills less likely
- No separate safety vents in drum required
- Installed directly in drum bung opening
- Some pump hoses have integral bonding wires

Waste and Residue

Combustible waste and residue must be kept to a minimum, stored in covered metal receptacles and disposed of daily.

Waste drum with disposal funnel

Safety disposal can

Oily-waste can (self-closing lid)

Safe Handling Fundamentals

- Carefully read the manufacturer's label on the flammable liquid container before storing or using it
- Practice good housekeeping in flammable liquid storage areas
- Clean up spills immediately, then place the cleanup rags in a covered metal container
- Only use approved metal safety containers or original manufacturer's container to store flammable liquids
- Keep the containers closed when not in use and store away from exits or passageways
- Use flammable liquids only where there is plenty of ventilation
- Keep flammable liquids away from ignition sources such as open flames, sparks, smoking, cutting, welding, etc.

Summary

- From this lesson, you should understand:
  - Processes involved in stopping combustion
  - Classification of fires, occupancy hazards, and extinguishers
  - Importance of summoning professional fire fighters
  - Owner or occupant responsibility to care for and maintain extinguishers
  - How to recognize and operate an extinguisher.
- To remain safe during a fire, you should:
  - Understand your responsibilities in the event of a fire
  - Be able to identify the four classes of fire and extinguishers
  - Be able to perform all four steps to extinguish a fire
  - Never attempt to extinguish a fire yourself; always have a backup
  - Keep the wind at your back to avoid flashback.

Summary

- The two primary hazards associated with flammable and combustible liquids are explosion and fire
- Safe handling and storage of flammable liquids requires the use of approved equipment and practices per OSHA standards
- An excellent reference on this topic is National Fire Protection Association Standard No. 30, *Flammable and Combustible Liquids Code*