Storage of Flammable and Combustible Liquids

- *29 CFR 1910.106*

Objectives

29 CFR 1910.106

- In this course, we will discuss the following:
  - Scope of the standard
  - The four elements of the fire tetrahedron and how the standard aims to interrupt those elements
  - Classifying flammable and combustible liquids
  - Storage requirements for liquids covered under the standard

Flammable & Combustible Liquids 1910.106

(a) Definitions

(b) Tank storage

(c) Piping, valves, and fittings

(d) Container and portable tank storage

(e) Industrial plants

(f) Bulk plants

(g) Service stations

(h) Processing plants

(i) Refineries, chemical plants, and distilleries

(j) Scope

Flammable and Combustible Liquids 1910.106

- Are compressed gases in a flammable liquid phase covered under 29 CFR 1910.106? NO!

Scope of the Standard

1910.106(j)

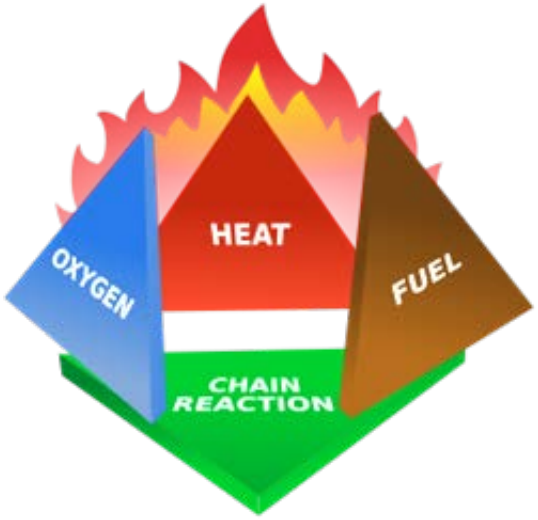
- **"Scope"**
  - This standard applies to the handling, storage, and use of flammable and combustible liquids with a ***flashpoint below 200 degrees F***.
  - The flash point of the liquid determines if it falls within the scope of the standard.

Flammable & Combustible Liquids

- The standard focuses on ***liquid temperature*** by using **Flash Point** (FP) and **Boiling Point** (BP) to establish a **Class Rating**.

- Different classes of flammable and combustible liquids pose different hazards and therefore have different rules.

Fire Tetrahedron and the Standard



Fuel

Heat Source

Oxygen

Sustained Combustion

Suitable Chemical Reaction

Combustible Flammable Liquid

Increased Surface Temperature

Production of Vapor

Flame Established

Flash Point

1910.106(a)(14)

- **Flash point**
  - Temperature where a enough evaporated fuel vapor is generated from a liquid to support a flash of combustion after a heat source has been introduced
  - Not fire point

Boiling Point

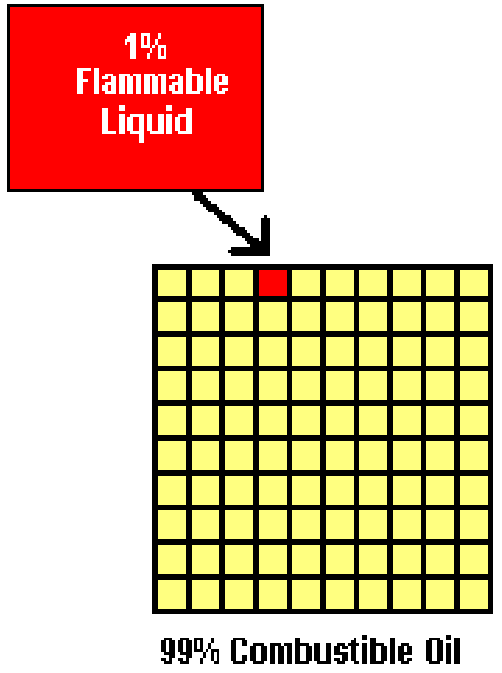
1910.106(a)(5)

- **Boiling point**
  - Temperature at which the saturated vapor pressure of a liquid is equal to atmospheric pressure

Flammable Liquids

1910.106(a)(19)

- **“Flammable liquid”**
  - Under the definition
    - » **Mixtures** containing component/s with a flash point of 100°F or higher which make up 99% or more of the total volume of the mixture, are not considered flammable.
  - Therefore, **mixtures** containing more than 1% of a liquid with a flash point below 100°F are considered flammable.



Classifying Flammable Liquids

Class IA A flash point below 73°F and a boiling point below 100°F

Class IB A flash point below 73°F and a boiling point at or above100°F

Class IC A flash point between 73°F and below 100°F

Note: A liquid having a flash point at or above 100°F will be classified as Class II or III (combustible).

Combustible Liquids

1910.106(a(18)

- **"Combustible liquid"**
  - Under the definition
    - » Means any liquid having a flashpoint at or above 100° F

Classifying Combustible Liquids

Class II A flash point at or above 100°F but below 140°F.

Class IIIA A flash point at or above 140°F but below 200°F.

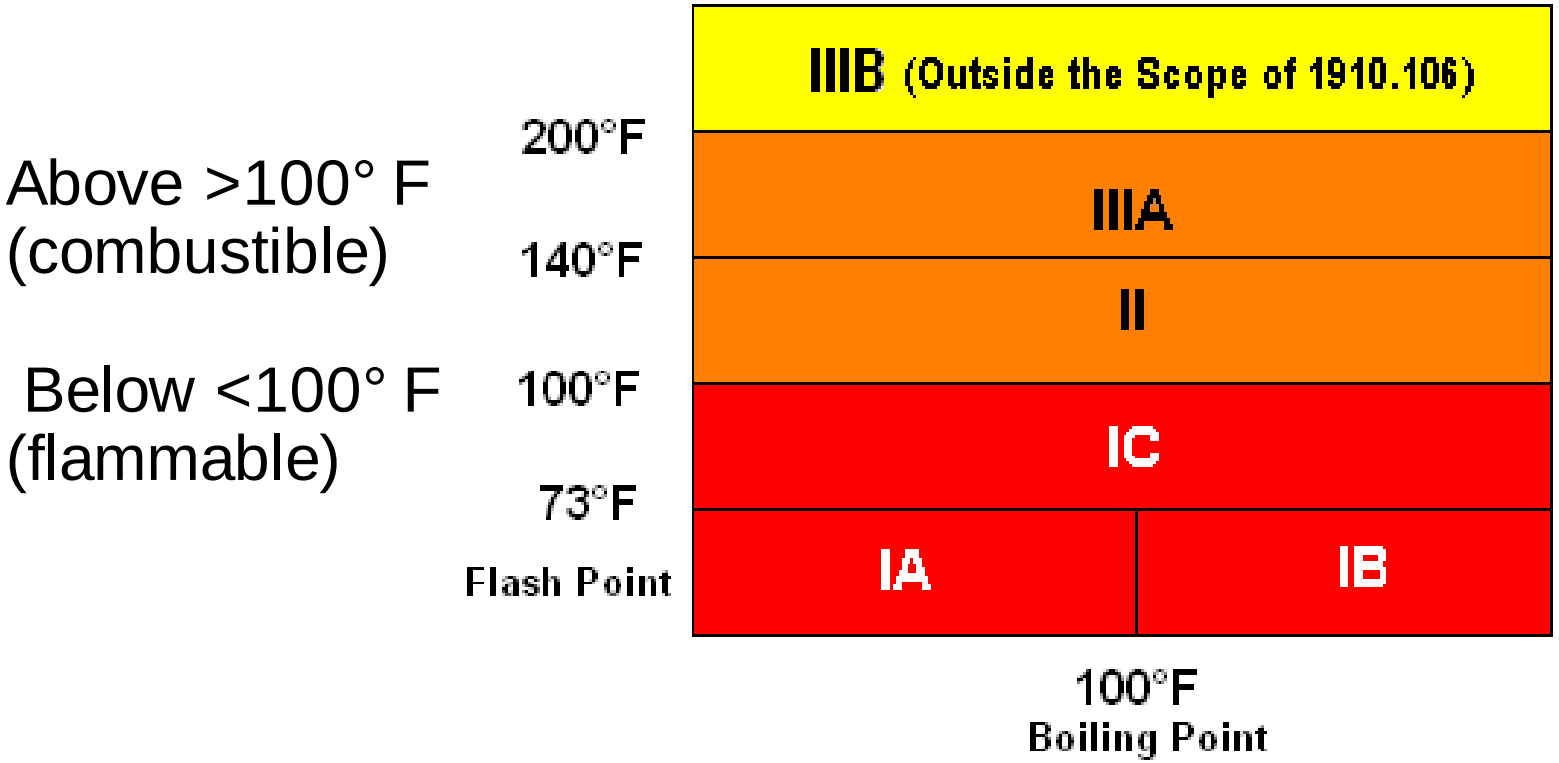
Class IIIB Liquids having a flash point at or above 200°F.

Note: Class IIIB liquids are not covered under the scope of §1910.106.

Flash Point

1910.106(j)

- As stated previously, the **flash point** determines if a substance falls within the scope of the standard.



Class Exercise

	°F	°F	
LIQUID	**F.P.**	**B.P.**	**Class**
Diesel Fuel #2	100-130	300	Class II
Gasoline	-45	200-230	Class IB
Motor Oil	450	>500	Class IIIB
Isoamyl Acetate	77	288	Class IC
Ethyl Ether	-49	94	Class IA
Formalin	133	214	Class II
Mixture 98% Motor Oil and 2% Gasoline			Class IB

Use the FP (Flash Point) and the BP (Boiling Point) to determine the Class using the Flammable Combustible Liquid Chart.

Tank Storage

1910.106(b)(1)(i)

- Shall be made of steel or other approved nonflammable materials
  - Other materials are permitted for underground use
  - Concrete tanks (must have a special interior lining) and be designed with sound engineering practices
  - Operating pressures must never exceed the design pressure

Tank Storage

1910.106(b)(1)(ii)[b]

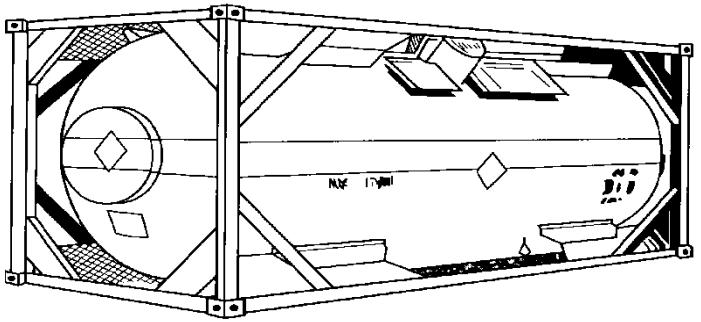
- Metal tanks
  - Shall be welded, riveted, and caulked, brazed, or bolted, or constructed by use of a combination of these methods

- Filler metals used in tank brazing
  - Shall be nonferrous metal or an alloy having a melting point above 1000° F and below that of the metal joined

Tank Storage

1910.106(b)(1)(iii)

- Atmospheric tanks
  - Shall be built in accordance with acceptable standards
  - Not exceed 2500 gallons, if originally designed for underground but placed above ground
  - Not be used to store liquids at or above their boiling points



Tank Storage

1910.106(b)(1)(iv) and (v)

- Low pressure tanks
  - Normal operating pressure of the tank shall not exceed the design pressure of the tank.
  - Pressure vessels may be used as low-pressure tanks.
- Pressure vessels
  - Normal operating pressure of the vessel shall not exceed the design pressure of the vessel.

Tank Storage

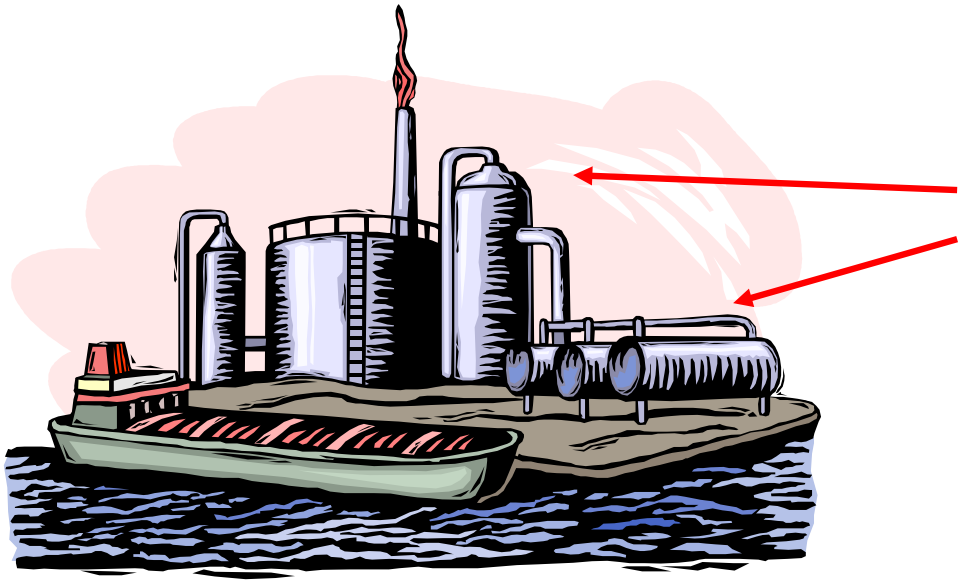
1910.106(b)(2)(ii)

- Outside aboveground tanks
  - **Spacing -** (shell-to-shell) between any two flammable or combustible above ground tanks shall be no less than three feet
  - **Unstable liquid -** Flammable and combustible liquid storage tanks
    - » Distance between tanks shall not be less than ½ the sum of their diameter

Tank Storage

1910.106(b)(2)(ii)(f)

- Outside aboveground tanks
  - **Liquefied Petroleum Gas (LPG)** - containers next to flammable or combustible storage shall have a minimum of 20 feet of separation

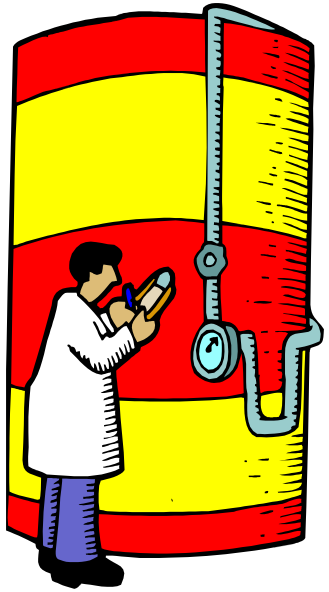


Must be a minimum of 20 feet between these tanks

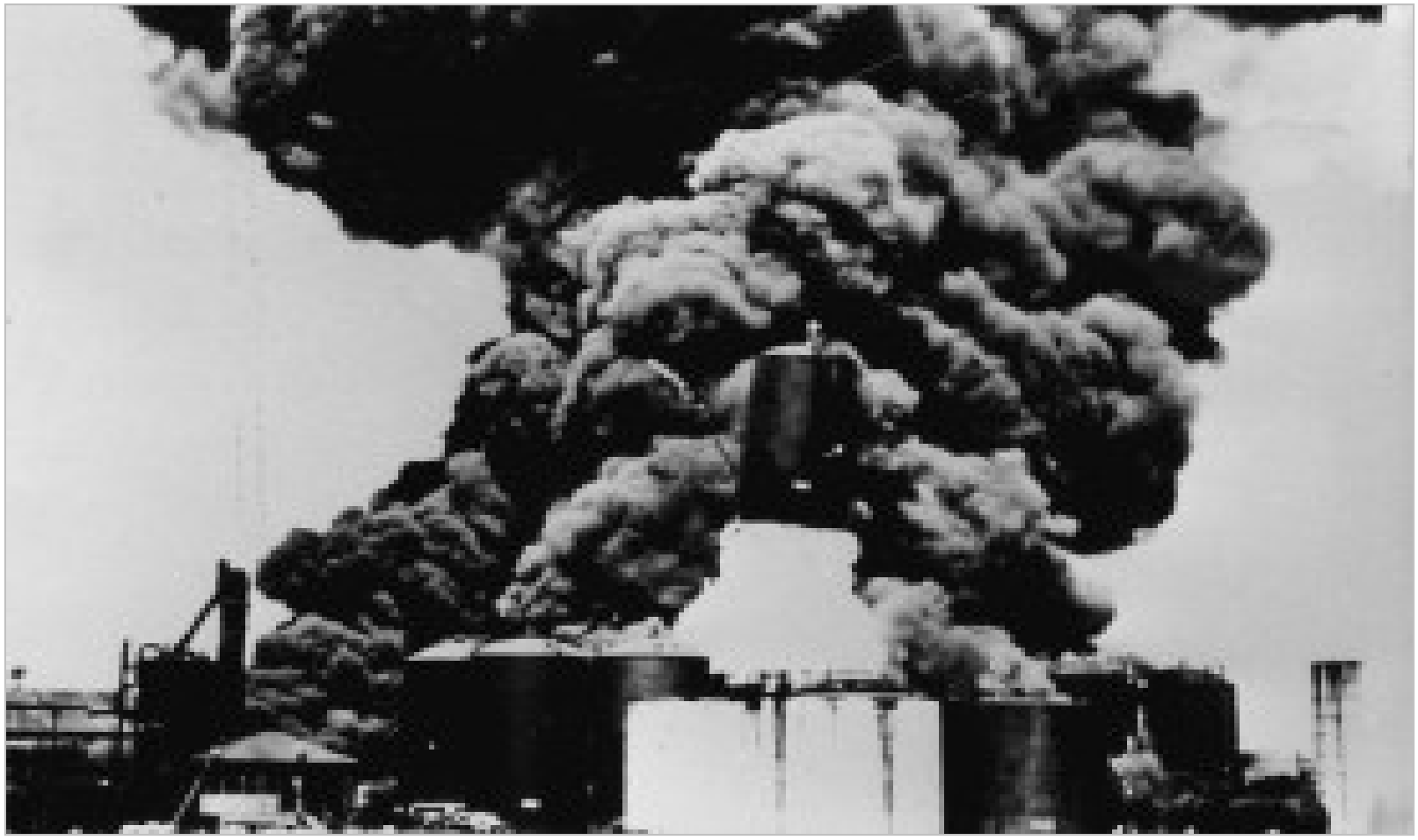
Tank Storage

1910.106(b)(2)

- Normal and emergency venting
  - Required on all above ground tanks
  - Enough venting to prevent vacuum or rupture
  - Refer to Table H-10 for venting flow rates



Results of Improperly Vented Tank



Tank Storage

1910.106(b)(2)(vii)

- Drainage, dikes and walls
  - Area surrounding aboveground tanks shall be provided with drainage or be diked to prevent accidental discharge of liquid.
  - If diked, the area should be able to hold the capacity of a full tank.
  - Walls of the diked area shall be of earth, steel, concrete or solid masonry designed to be liquid tight.

Tank Storage

1910.106(b)(5)

- Supports, foundations and anchorage for all tank locations
  - Tank supports shall be installed on firm foundations.
  - Steel supports or exposed piling shall be protected by materials having a fire resistance rating of not less than 2 hours.
  - Tanks shall rest on the ground or on foundations made of concrete, masonry, piling, or steel.

Tank Storage

1910.106(b)(5)

- Supports, foundations and anchorage in flood zones
  - When a tank is located in an area that may be subjected to flooding, check established flood stage markings.
    - » Liquid level in the tank must never go below the established maximum flood line

Please note: There are many requirements for tanks that are located in flood zones. For more in-depth detail, refer to 1910.106(b)(5)(vi).

Tank Storage

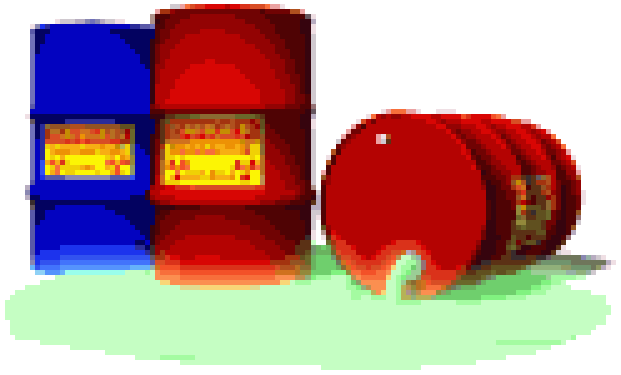
1910.106(b)(6)

- Ignition sources
  - Precautions shall be taken to prevent the ignition of flammable vapors.
    - » Includes but are not limited to open flames; lightning; smoking; cutting and welding; hot surfaces; frictional heat; static, electrical, and mechanical sparks; spontaneous ignition, including heat-producing chemical reactions; and radiant heat.

Pipes, Valves, and Fittings

1910.106(c)

- The design (including selection of materials) fabrication, assembly, test, and inspection of piping systems containing flammable or combustible liquids shall be suitable for the expected working pressures and structural stresses.



Container and Portable Tank Storage 1910.106(d)

- Applies only to the storage of flammable or combustible liquids in drums or other containers (including flammable aerosols) not exceeding 60 gallons individual capacity and those portable tanks not exceeding 660 gallons individual capacity.
  - Exceptions: storage of containers, mixtures used for maintenance, containers of < 1 gallon, liquids in fuel tanks for motor vehicles and boats.*

*Not all inclusive

Container and Portable Tank Storage 1910.106(d)

- Only approved containers and portable tanks shall be used
- Each portable tank shall be provided with one or more devices installed in the top with sufficient emergency venting capacity to limit internal pressure under fire exposure conditions
- Flammable and combustible liquid containers shall be in accordance with Table H-12

Containers - Table H-12

Container Type	Flammable Liquids			Combustible Liquids	
	Class IA	Class IB	Class IC	Class II	Class III
Glass or approved plastic	1 pt.	1 qt.	1 gal.	1 gal.	1 gal.
Metal (other than DOT drums)	1 gal.	5 gal.	5 gal.	5 gal.	5 gal.
Safety cans	2 gal.	5 gal.	5 gal.	5 gal.	5 gal.
Metal drums (DOT specifications)	60 gal.	60 gal.	60 gal.	60 gal.	60 gal.
Approved portable tanks	660 gal.	660 gal.	660 gal.	660 gal.	660 gal.

Note: Container exemptions: (a) Medicines, beverages, foodstuffs, cosmetics, and other common consumer items, when packaged according to commonly accepted practices, shall be exempt from the requirements of §1910.106(d)(2)(i) and (ii).

Container and Portable Tank Storage 1910.106(d)(3)

- Storage cabinets
  - Cabinets shall be labeled in conspicuous lettering, "Flammable Keep Fire Away"
  - Must be fire resistant
  - Contain no more than 60 gallons of Class I or Class II nor contain no more than 120 gallons of Class III liquids
  - Specific requirements for metal and wood

Container and Portable Tank Storage 1910.106(d)(4)

- Inside storage rooms
  - Shall be constructed to meet the required fire-resistive rating for their use
  - If used for Class I liquids, electrical wiring and equipment ***in*** "inside storage" rooms shall be approved for Class I, Division 2 Hazardous Locations
  - Provided with either a gravity or a mechanical exhaust ventilation system

Container and Portable Tank Storage 1910.106(d)(4)

- In “inside” storage rooms
  - Maintain one clear aisle at least 3 feet wide
  - Containers over 30 gallons capacity shall not be stacked one upon the other
  - Dispensing shall be by approved pump or self-closing faucet only
  - Storage shall comply with Table H-13

Storage Inside Rooms - Table H-13

Fire Protection (1) Provided	Fire Resistance	Maximum Size	Total Allowable Quantities – gals./sq. ft/floor area
Yes	2 hours	500 Sq. Ft.	10
No	2 hours	500 Sq. Ft.	4*
Yes	1 hour	150 Sq. Ft.	5*
No	1 hour	150 Sq. Ft.	2

Footnote(1) Fire protection system shall be sprinkler, water spray, carbon dioxide, or other system.
***Note:** These numbers are shown incorrectly in 29 CFR 1910.106.

Container and Portable Tank Storage 1910.106(d)(5)

- Office occupancies
  - Storage prohibited except if required for maintenance, operation of building and operation of equipment
    - » Shall be kept in closed metal containers stored in a storage cabinet or in safety cans or in an inside storage room

Container and Portable Tank Storage 1910.106(d)(5)

- General purpose public warehouses
  - Refer to Table H-14 – Indoor container storage, ***or*** Table H-15 – Indoor portable tank storage

- Flammable and combustible liquid warehouses or storage buildings
  - Refer to Table H-14 – Indoor container storage, ***or*** Table H-15 – Indoor portable tank storage

Container and Portable Tank Storage 1910.106(d)(6)

- Storage outside buildings
  - Maximum of 1,100 gallons of flammable or combustible liquids
  - Area shall be protected against tampering or trespassers
  - Area shall be graded in a manner to divert possible spills away from buildings
  - Storage shall comply with:
    - » Table H-16 – Outdoor container storage, **or**
    - » Table H-17 – Outdoor portable tank storage

Container and Portable Tank Storage 1910.106(d)(7)

- Fire control
  - Fire control devices shall be available at locations where flammable or combustible liquids are stored.
  - Open flames and smoking shall not be permitted in flammable or combustible liquid storage areas.
  - Water reactive materials shall not be stored in the same room with flammable or combustible liquids.

Industrial Plants

1910.106(e)

- Incidental storage or use of flammable and combustible liquids
  - Quantity located outside of an inside storage room or storage cabinet:
    - » 25 gallons of Class IA liquids
    - » 120 gallons of Class IB, IC, II, or III liquids
    - » 660 gallons of Class IB, IC, II, or III liquids
  - Kept in covered containers when not in use

Industrial Plants

1910.106(e)

- Unit physical operations
  - Each building or unit of equipment is accessible from at least one side for firefighting and fire control purposes.
  - Chemical processes shall be separated from the remainder of the plant by a fire wall of 2-hour minimum fire resistance rating.
  - Ventilated at a rate of not less than 1 cubic foot per minute per square foot of solid floor area.

Industrial Plants

1910.106(e)

- Portable fire extinguishment and control equipment shall be provided to meet the special hazards of operation and storage.

- All plant fire protection facilities shall be adequately maintained and periodically inspected and tested.

Industrial Plants

1910.106(e)

- All plant fire protection facilities shall be adequately maintained and periodically inspected and tested to make sure they are always in satisfactory operating condition.

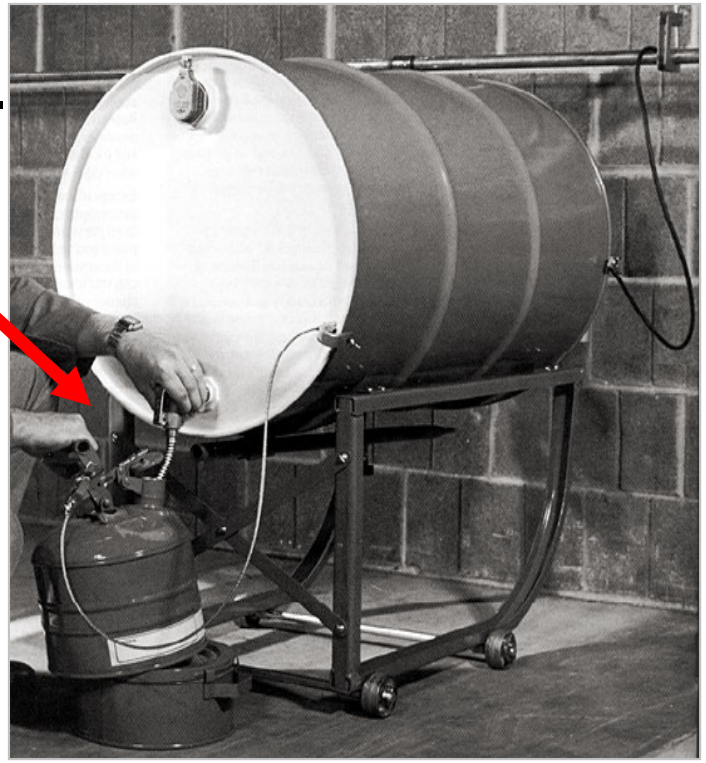
- Adequate aisles shall be maintained for unobstructed movement of personnel.

Industrial Plants

1910.106(e)

- Class I liquids shall not be dispensed into containers unless the nozzle and container are electrically interconnected (grounding).

- Spills shall be cleaned up promptly.



We are not covering…

- (f) Bulk plants
- (g) Service stations
- (h) Processing plants
- (i) Refineries, chemical plants, and distilleries

Summarizing Storage Requirements

- Consider the following:
  - Occupancy
  - Class of liquids that will be present
  - Engineering specifications such as fire wall size, fire suppression systems, tank design, etc.
  - Maximum volume restrictions
  - State, County and Local codes
  - Marking and labeling requirements

HMIS

Summarizing Storage Requirements

- The flash point determines if a substance falls within the scope of the standard.

- The flash point and boiling point together, determine how substances are stored:
  - Container capacity and spacing
  - Maximum amount per location

- The H-Tables help you determine storage limits, venting capacities, allowable sizes of containers and more...

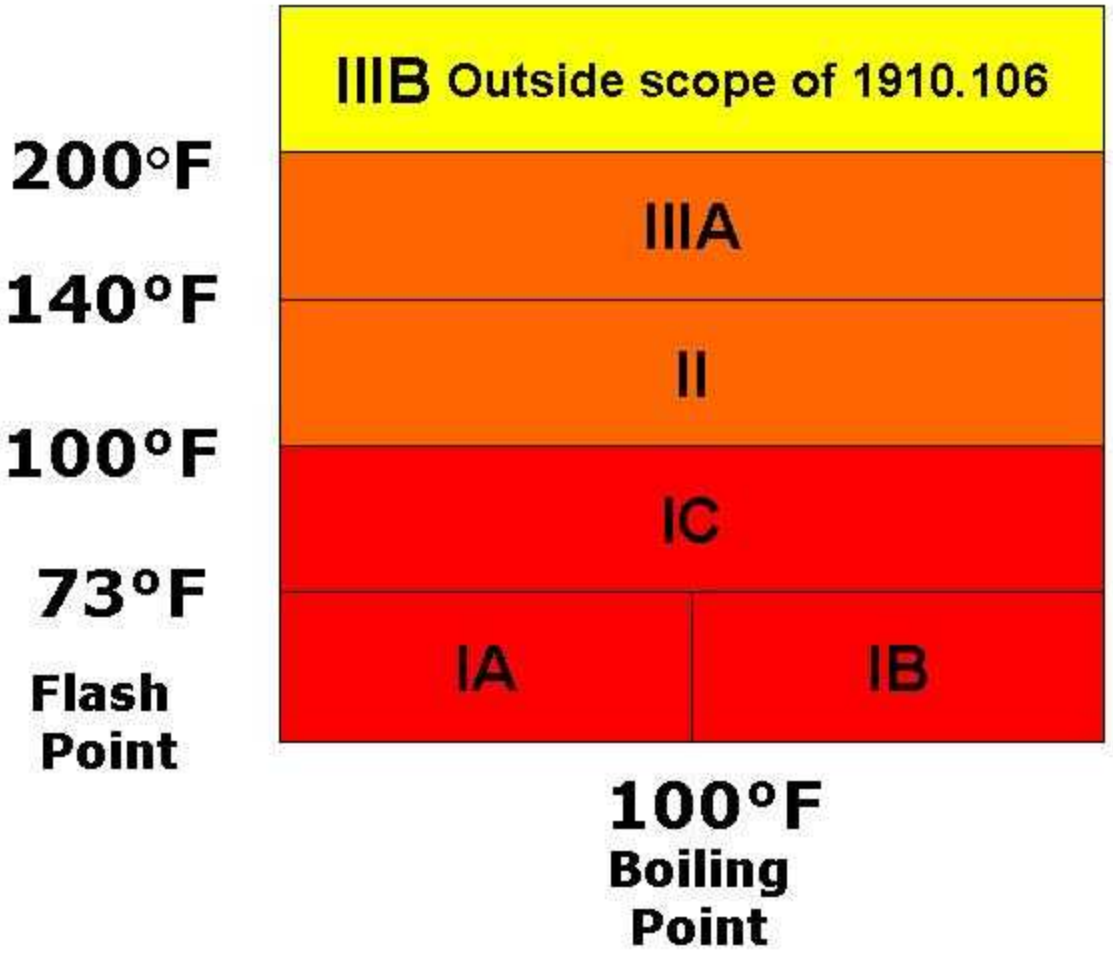
Summary

- In this course, we discussed the following:
  - Scope of the standard
  - The four elements of the fire tetrahedron and how the standard aims to interrupt those elements
  - Classifying flammable and combustible liquids
  - Storage requirements for liquids covered under the standard

Thank You For Attending!

Final Questions?

Flammable Combustible Liquid Chart



Class Exercise

LIQUID	°F F.P.	°F B.P.	Class
Diesel Fuel #2	100-130	300	
Gasoline	-45	99.3	
Motor Oil	450	>500	
Isoamyl Acetate	77	288	
Ethyl Ether	-49	94	
Formalin	133°F	214	
Mixture 98% Motor Oil and 2% Gasoline			

Use the FP (Flash Point) and the BP (Boiling Point) to determine the Class using the Flammable Combustible Liquid Chart.