TRAIN ▪ SERVE ▪ RESPOND

OSHA TRAINING INSTITUTE SOUTHWEST EDUCATION CENTER

MODULE 14

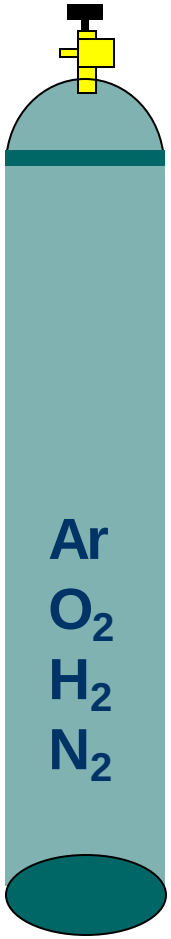
Hazardous Materials

1910.101(a) Compressed gases

- Inspection of all compressed gas cylinders:
  - Visual and other inspections
  - DOT 49 CFR Parts 171-179 and 14 CFR Part 103 if applicable
  - Otherwise, Compressed Gas Association Pamphlets C-6-1968 and C-8-1962
    - Applicable to suppliers & distributors filling compressed gas cylinders

Cylinder Types

High Pressure



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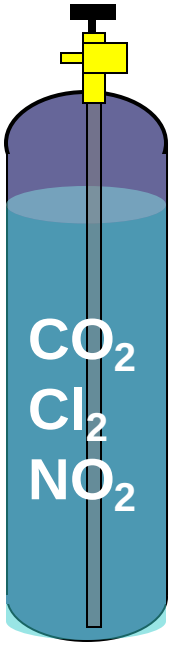
Low Pressure



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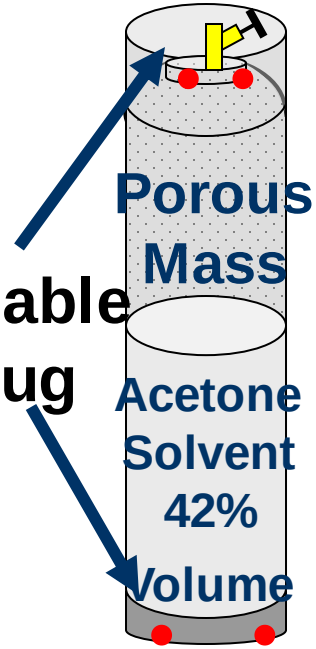
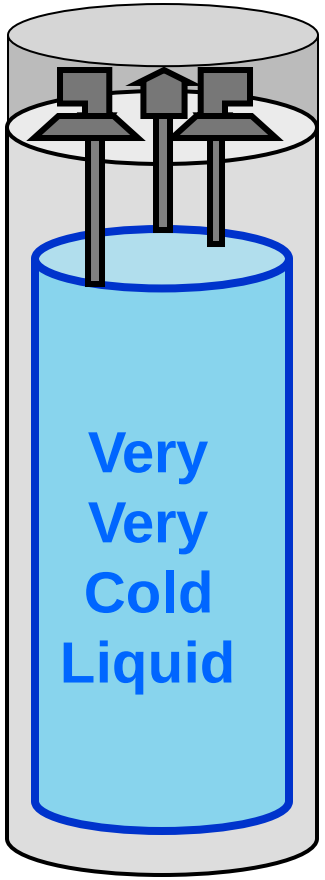
Acetylene



Cryogenic



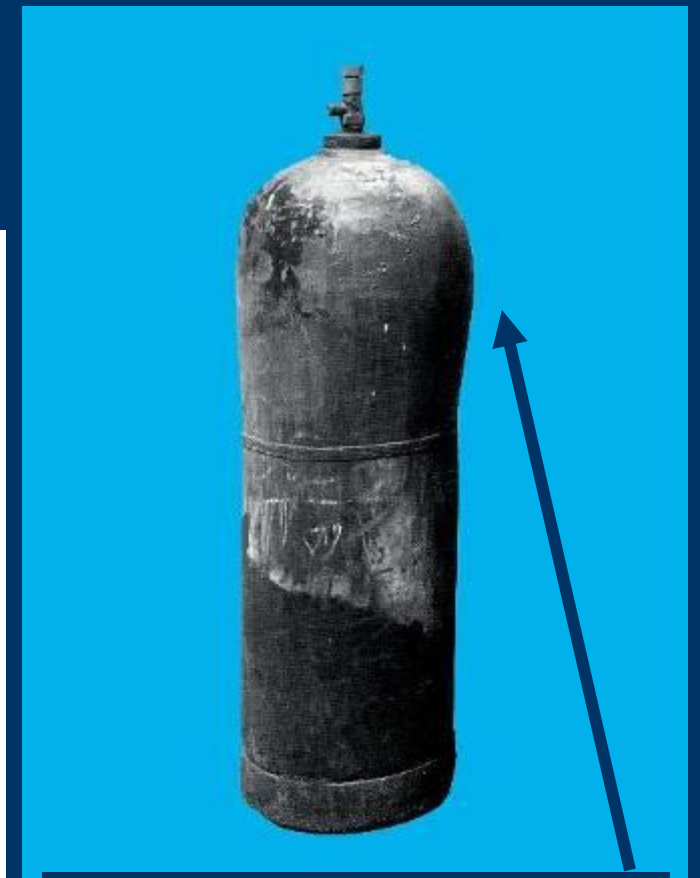
Gas suppliers advise users to:

- Check cylinders as they are received
- Verify labels, tags and shipping papers
- Reject and return cylinders with obvious damage
- Determine required caps & plugs in place

CGA C-6 1968

3.2.6 - Bulges:

- Cylinders are manufactured with reasonably symmetrical shape
- Cylinders which have definite bulges shall be removed from service



Bulged - cylinder wall failure

CGA C-6 1968

5.3.7 - Fire Damage:

- Cylinders shall be carefully inspected for evidence of exposure to fire

Evidence includes:

- Charring or burning of paint
- Burning or scarfing of the metal
- Distortion of the cylinder
- Burning or melting of a valve

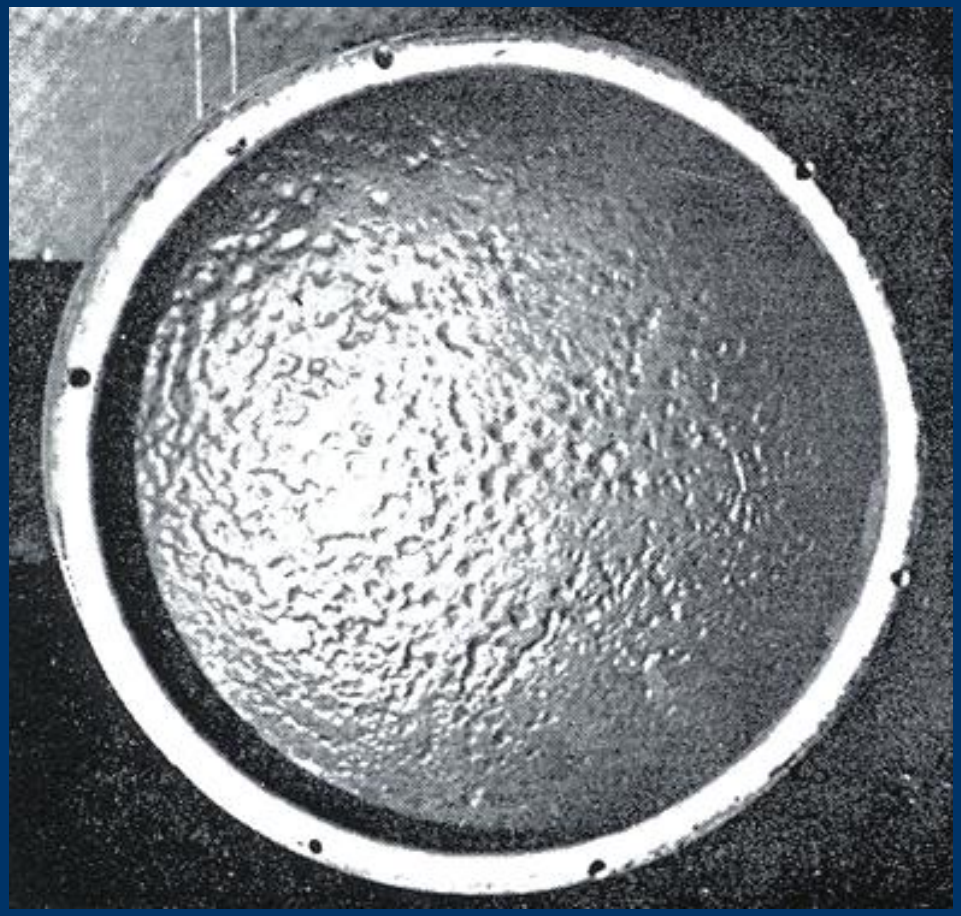
Burn

Cut

Gouge

Gouge with deposit of weld metal

General corrosion with pitting - reducing cylinder strength

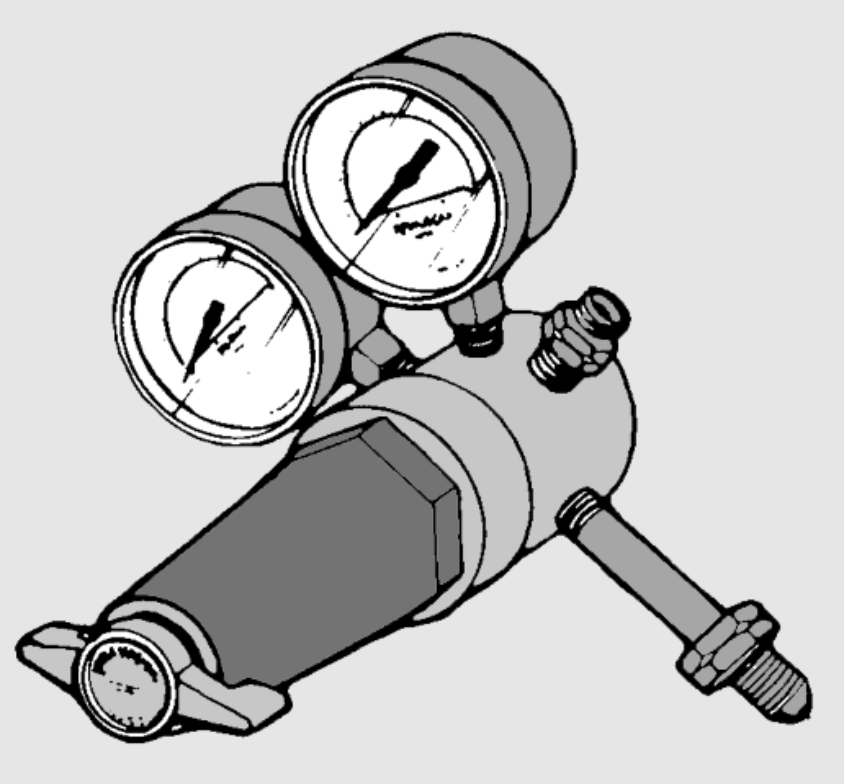


1910.101(b) Compressed gases

- The **in-plant** handling, storage, and utilization of all compressed gases in cylinders, portable tanks, rail tankcars, or motor vehicle cargo tanks shall be in accordance with Compressed Gas Association (CGA) Pamphlet P-1-1965

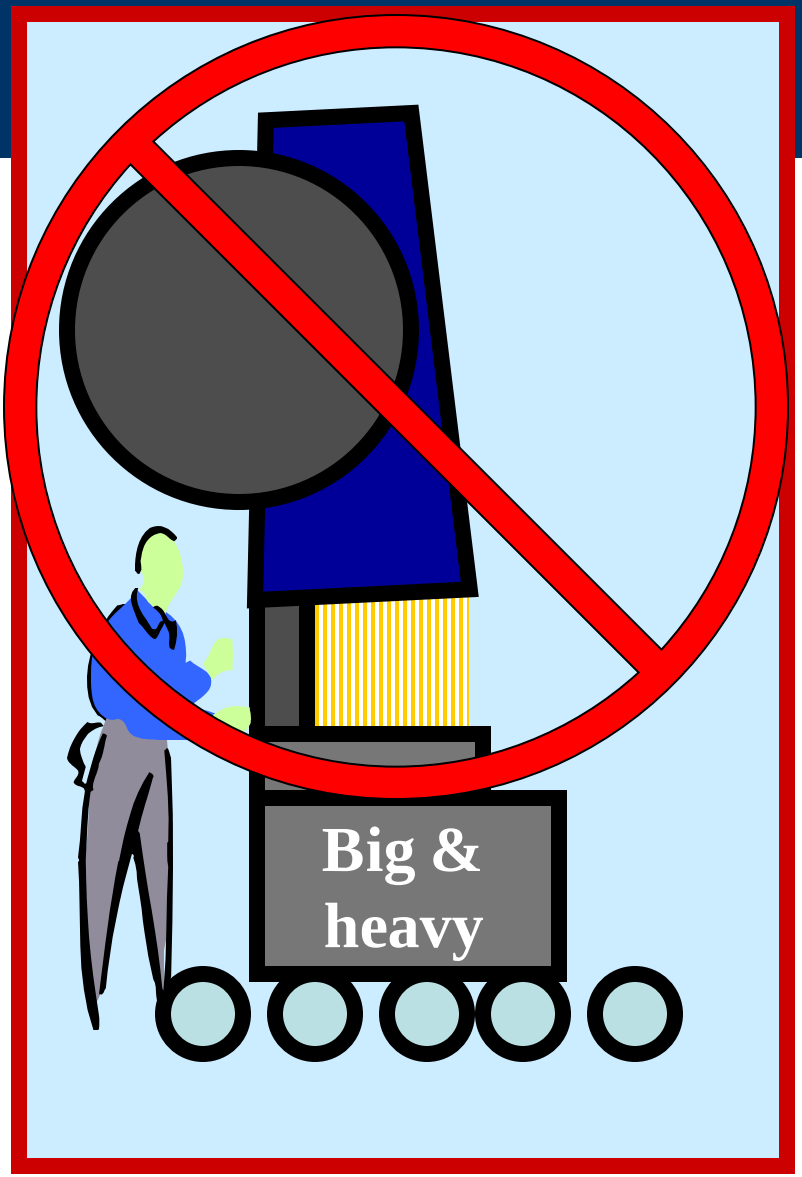
CGA P-1 1965 Section 3.1; General

- 3.1.14 Never tamper with the safety relief devices in valves or cylinders
- 3.1.15 Never attempt to repair or to alter cylinders, valves, or safety relief devices



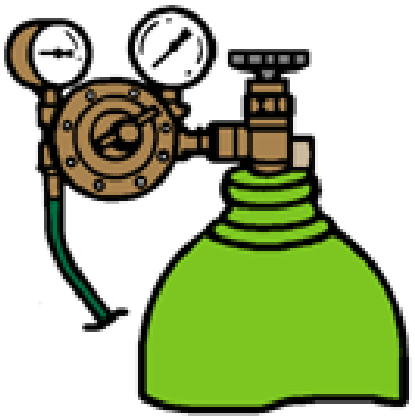
CGA P-1 1965 Section 3.1; General

3.1.16 Never use cylinders as rollers, supports, or for any other purpose than to contain the contents as received



CGA P-1 1965 Section 3.1; General

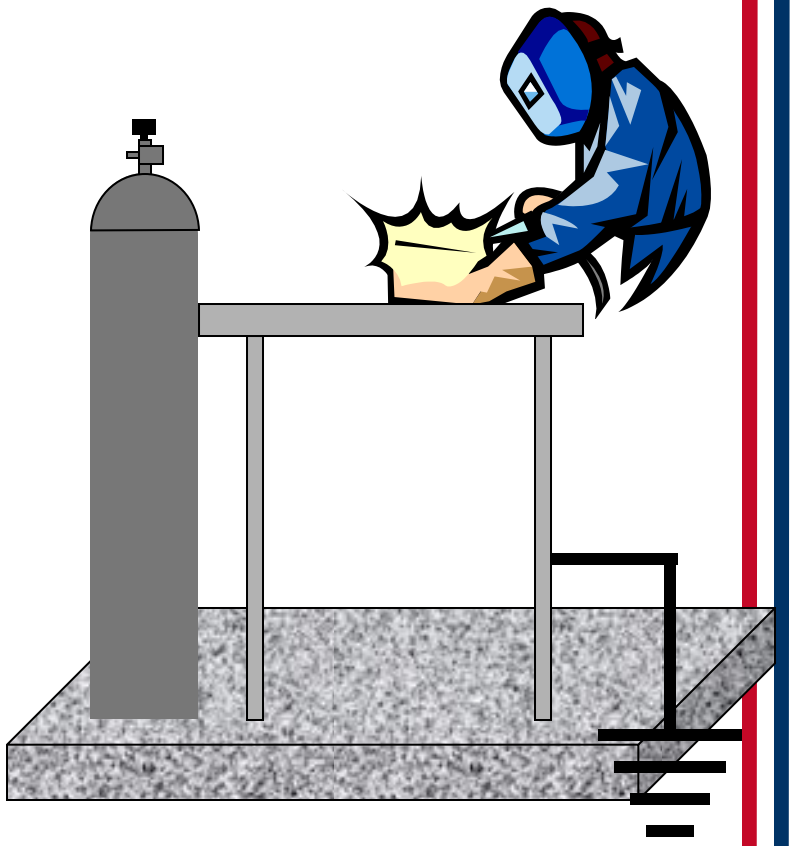
- 3.1.17 Keep cylinder valve closed at all times, except when cylinder is in active use
- 3.1.18 Notify cylinder owner if any condition might have permitted any foreign substance to enter the cylinder or valve:
  - Provide details of incident
  - Provide the cylinder serial number



CGA P-1 1965 Section 3.1; General

3.1.19 Do not place cylinders where they might become part of an electric circuit

- When cylinders are used in conjunction with electric welding, precautions must be taken against accidentally grounding cylinders and allowing them to be burned by electric welding arc

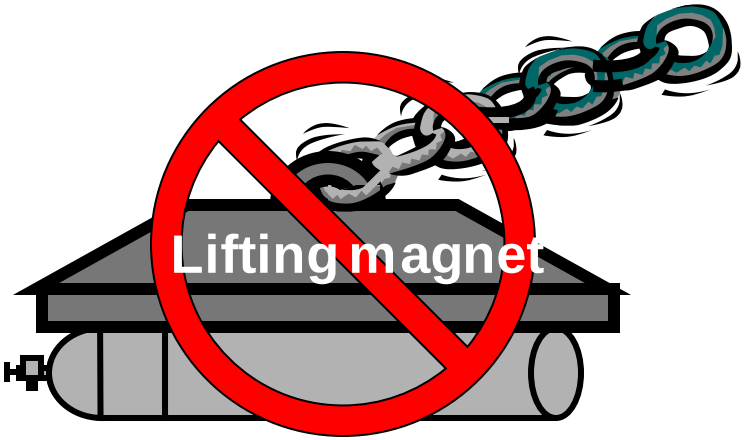


P-1 Section 3.2 Moving cylinders

- 3.2.2 Do not lift cylinders by the cap
- 3.2.3 Never drop cylinders nor permit them to strike against each other or against other surfaces violently

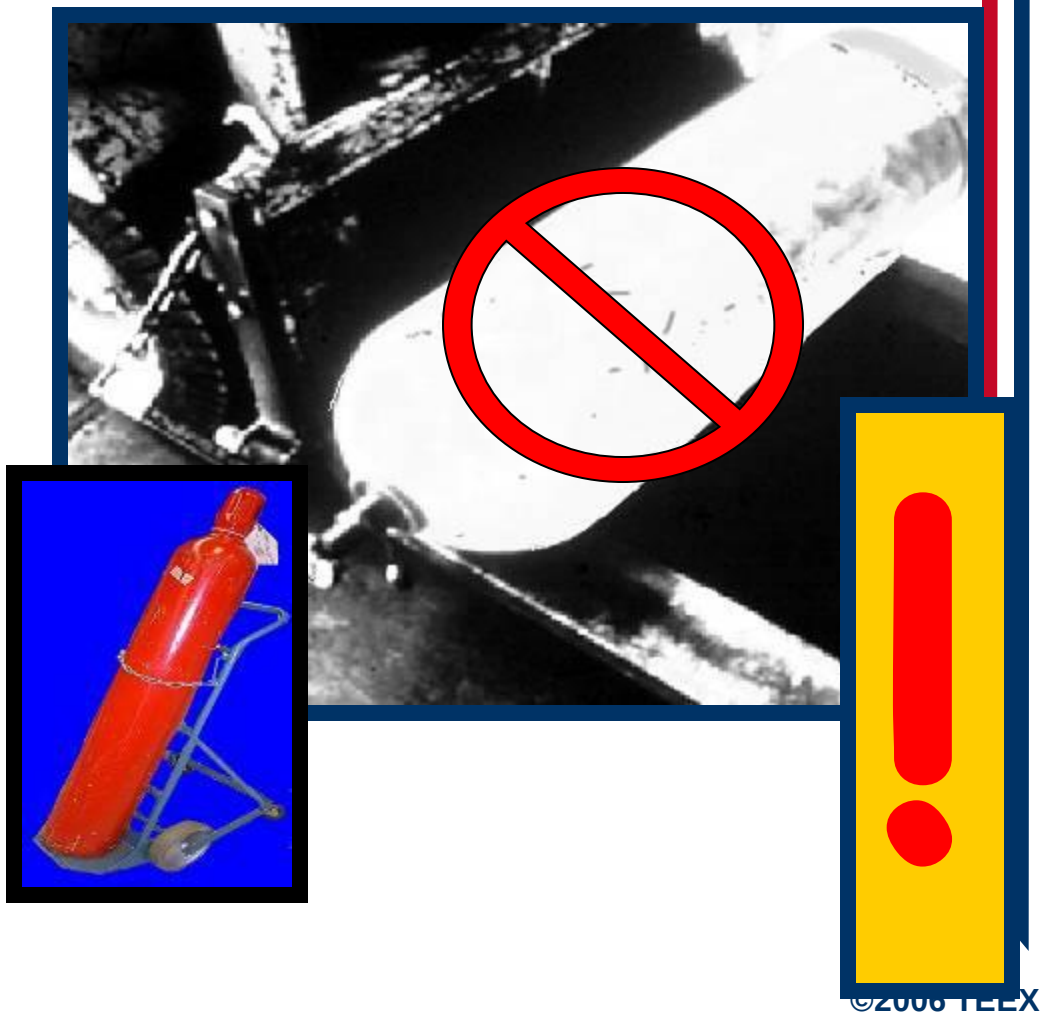
P-1 Section 3.2 Moving cylinders

- 3.2.4 Never handle a cylinder with a lifting magnet
- 3.2.5 Avoid dragging or sliding cylinders



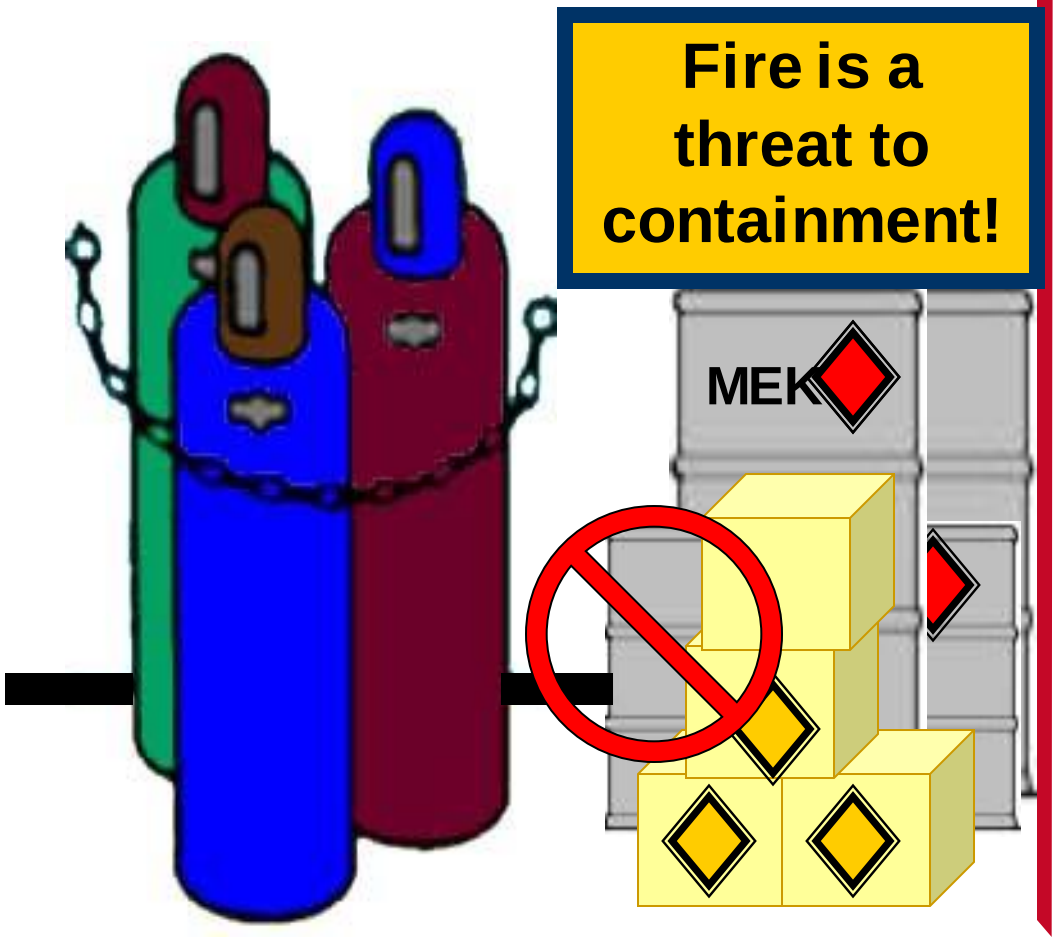
P-1 Section 3.2 Moving cylinders

- 3.2.6 Use suitable hand truck, fork truck, roll platform or similar device with cylinder firmly secured for transporting and unloading



P-1 3.3 Storing cylinders

- 3.3.6 Do not store cylinders near highly flammable substances such as oil, gasoline or combustible waste

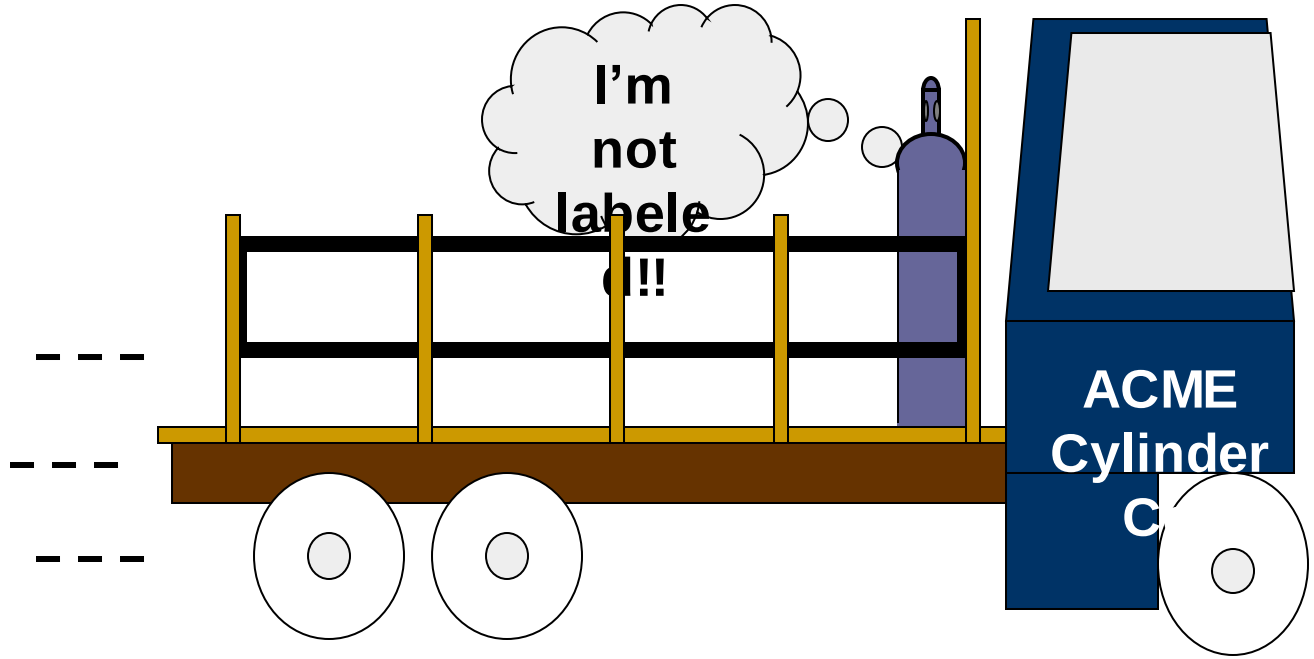


P-1 3.3 Storing cylinders

- 3.3.8 Do not store cylinders near elevators or gangways, or in locations where heavy moving objects may strike or fall on them

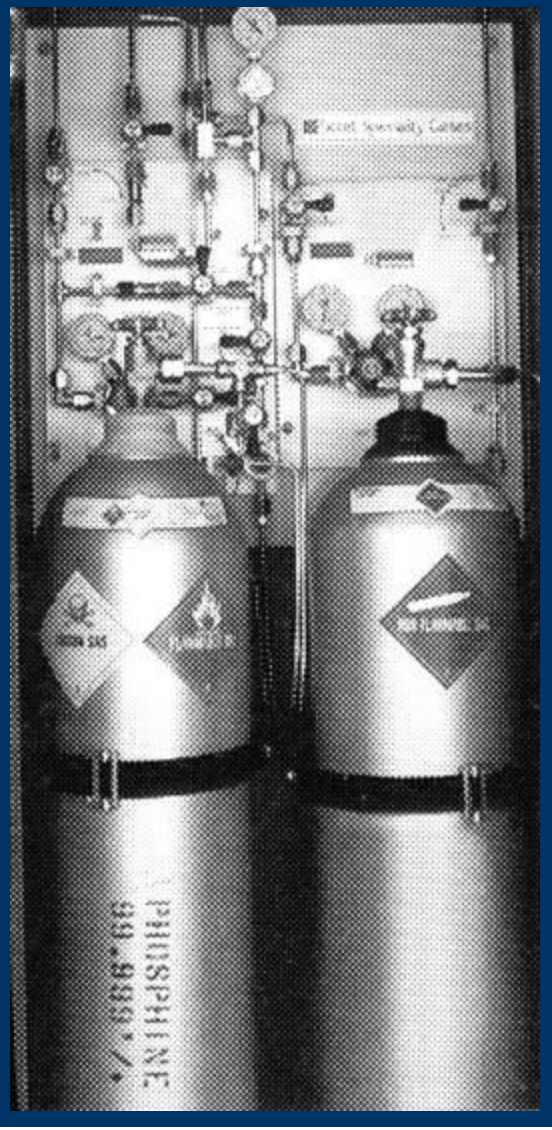
P-1 3.4 Withdrawing cylinder content

- 3.4.2 If cylinder content is not identified by marking, return cylinder to the supplier without using



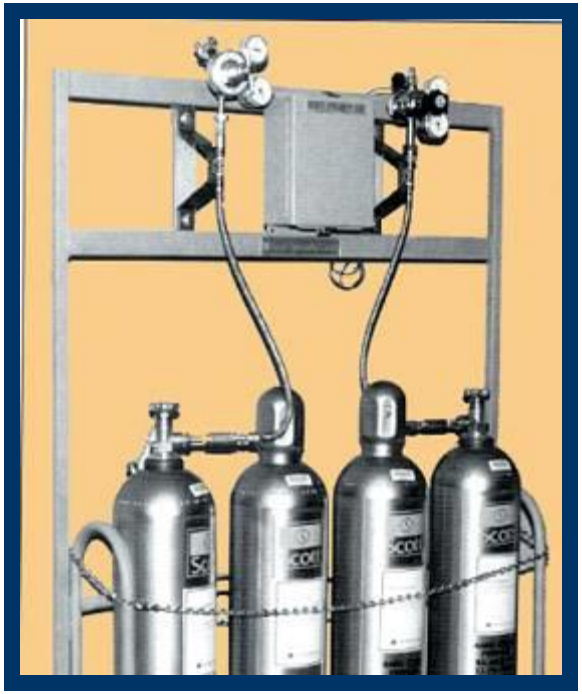
P-1 3.4 Withdrawing cylinder content

- 3.4.4 Before using a cylinder, be sure it is properly supported to prevent it from being knocked over
- 3.4.5 Suitable pressure regulating devices must be used



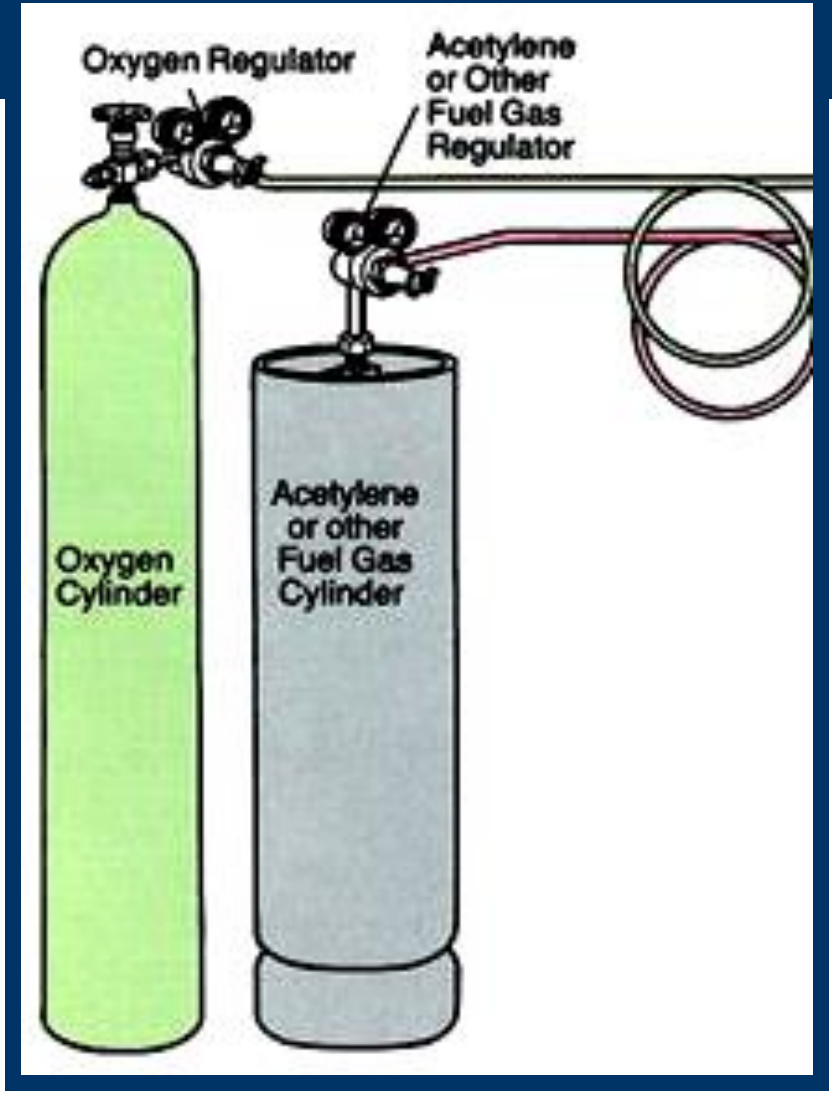
P-1 3.4 Withdrawing cylinder content

- 3.4.6 Never force connections
- 3.4.7 Where compressed gas cylinders are connected to a manifold, all related equipment, such as regulators, must be of proper design



P-1 3.4 Withdrawing cylinder content

- 3.4.8 Do not mix regulators, gages, hoses and other appliances provided for use with a particular gas or group of gases with incompatible materials/gases



P-1 3.4.9 Safe work practices

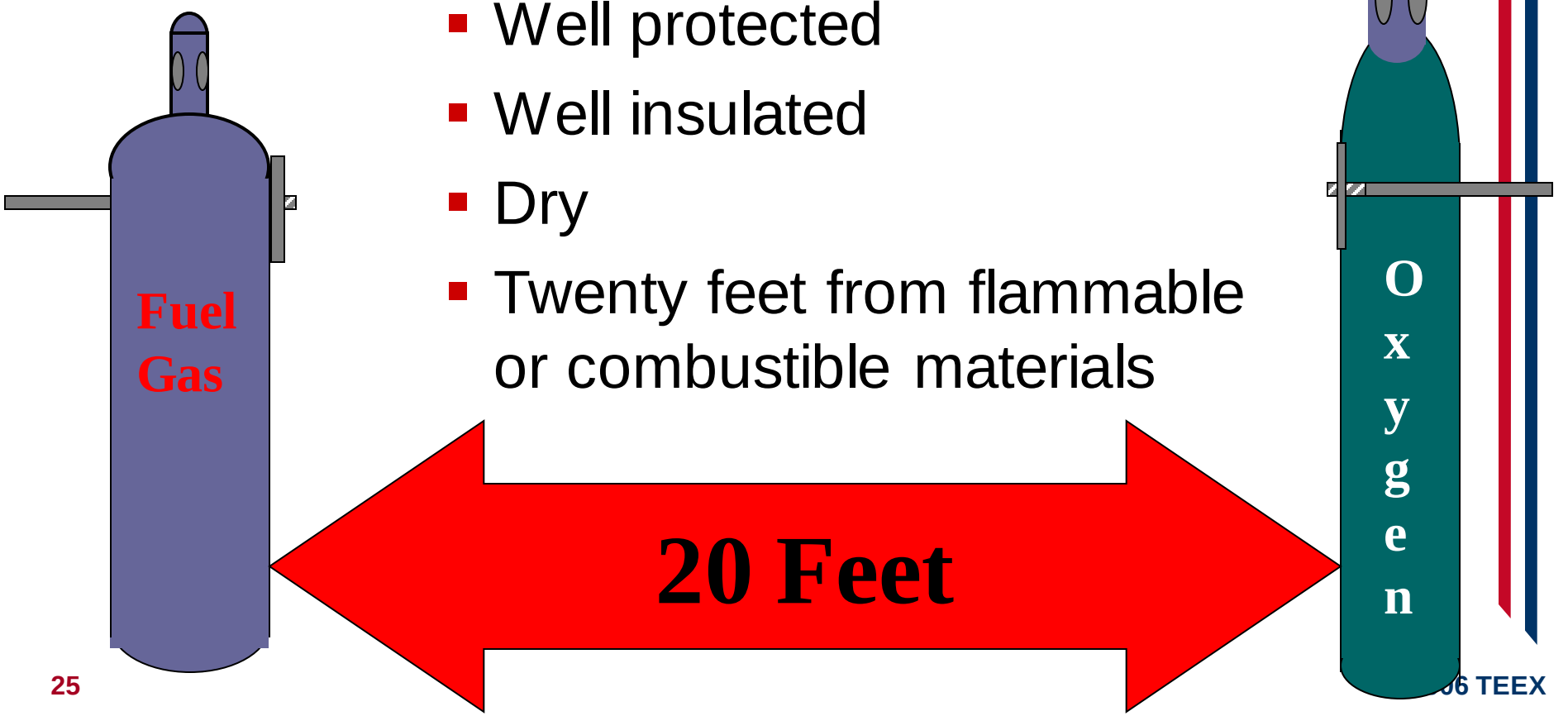
- Open cylinder slowly
- Point valve opening away from yourself & others
- Never use wrenches or tools except those provided by the supplier or approved by the gas manufacturer
- Avoid the use of a wrench on a valve equipped with a handwheel

P-1 3.4.9 Safe work practices

- Never hammer on the valve wheel
- For frozen, corroded valves, contact the supplier
- Use check valves if cylinder is apt to be contaminated by feedback of materials
- Before removing a regulator, close the cylinder valve and release all the pressure from the regulator

P-1 3.5 Flammable gases

- Indoor cylinder storage
  - Well protected
  - Well insulated
  - Dry
  - Twenty feet from flammable or combustible materials

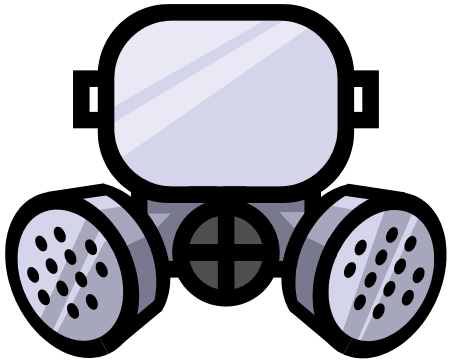


P-1 3.5 Flammable gases

- 3.5.1 Do not store cylinders near highly flammable solvents, combustible waste material and similar substances, or near unprotected electrical connections, gas flames or other sources of ignition
- 3.5.2 Never use a flame to detect flammable gas leaks; use soapy water

P-1 Section 3.6 Poison Gases

- 3.6.1 Personnel handling and using poison gases should have available for immediate use gas masks or self-contained breathing apparatus approved by U.S. Bureau of Mines* for the particular service desired
- *NOTE: This approval for respirators has been up-dated to the requirements of NIOSH (CGA P-1 2000)



1910.102 Acetylene

- Cylinders: In-plant transfer, handling, storage, and utilization of acetylene in cylinders shall be in accordance with Compressed Gas Association Pamphlet G-1-1966

Case report

- “A fitter with a work van left an E size Oxygen and Acetylene cylinder on the back seat of a Toyota dual cab over the weekend. The Acetylene cylinder must not have fully closed and a small leak occurred. Over the weekend the Acetylene had accumulated in the van. ”

Case report, p. 2

- “On the Monday morning the fitter approached the van and opened the door, a large explosion took place. We believe the ignition could have been caused by either the internal light, the automatic door control or by a mobile phone which was on the front seat of the van.
- The fellow was also a smoker. He has damage to his ear drums and facial damage. As you can see by the attached photos he was very lucky.

Why was this dangerous?

- Flammability limits:
  Lower: 2.5% Upper: 100% – an extremely wide range!
- Use or store only in a well-ventilated area. (Inside of the truck is not well ventilated.)
- NFPA RATINGS: Health 1; Flammability 4; Reactivity 3

1910.103 (b) Hydrogen

(1)(i)(c) Each portable container shall be legibly marked with the name "Hydrogen" in accordance with ANSI Z48.1-1954

(1)(iv)(b)Installation of hydrogen systems shall be supervised by personnel familiar with proper practices with reference to their construction and use.

1910.103 (b) Gaseous hydrogen systems

- "Marking." The hydrogen storage location shall be permanently placarded as follows:

HYDROGEN –
FLAMMABLE GAS –
NO SMOKING –
NO OPEN FLAMES

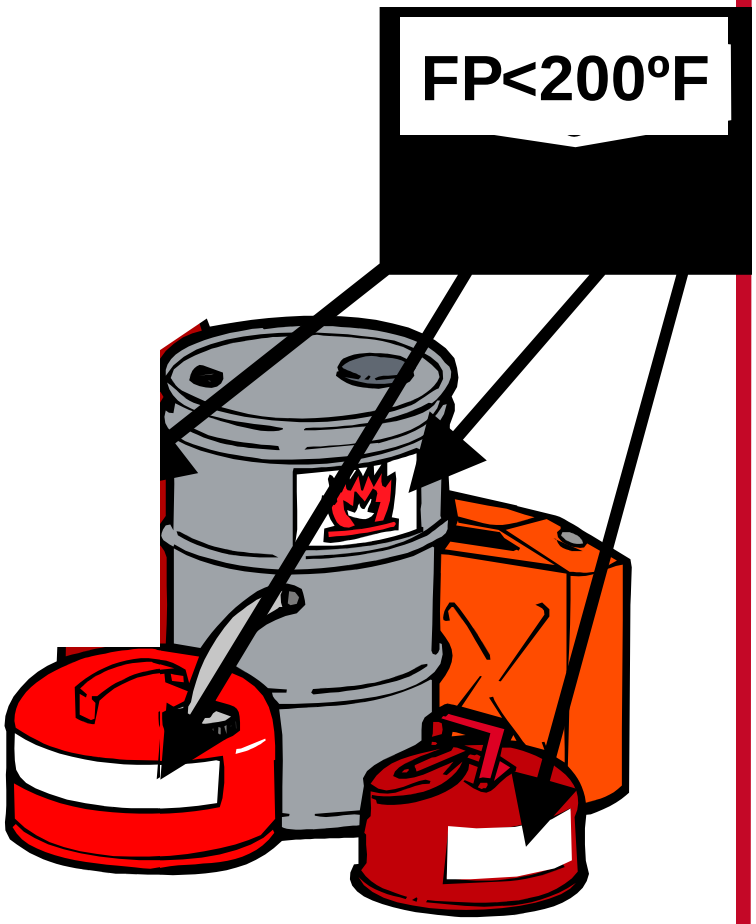
- Or equivalent

29 CFR 1910.106

Flammable & Combustible Liquids

Purpose of Standard

- This standard applies to the handling, storage, and use of flammable and combustible liquids with a flash point (FP) below 200°F



Purpose of Standard

- Primary hazards associated with flammable and combustible liquids: explosion and fire
- To prevent these hazards, this standard addresses the primary concerns:
  - Design and construction,
  - Ventilation,
  - Ignition sources, and
  - Storage

Flash Point

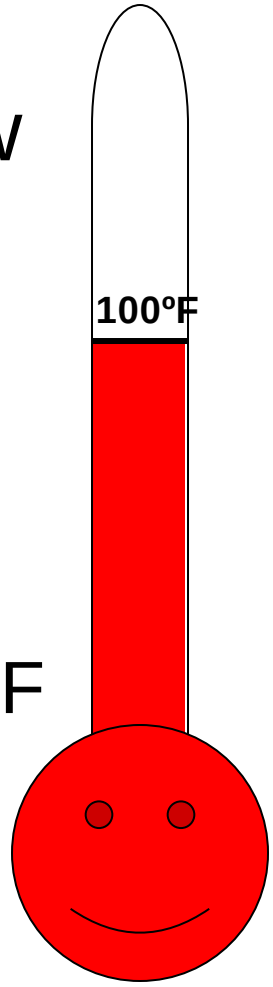
- The minimum **temperature** at which a liquid **gives off vapor** within a test vessel in sufficient concentration to form an **ignitable mixture** with air near the surface of the liquid
- Flash point is normally an indication of susceptibility to ignition

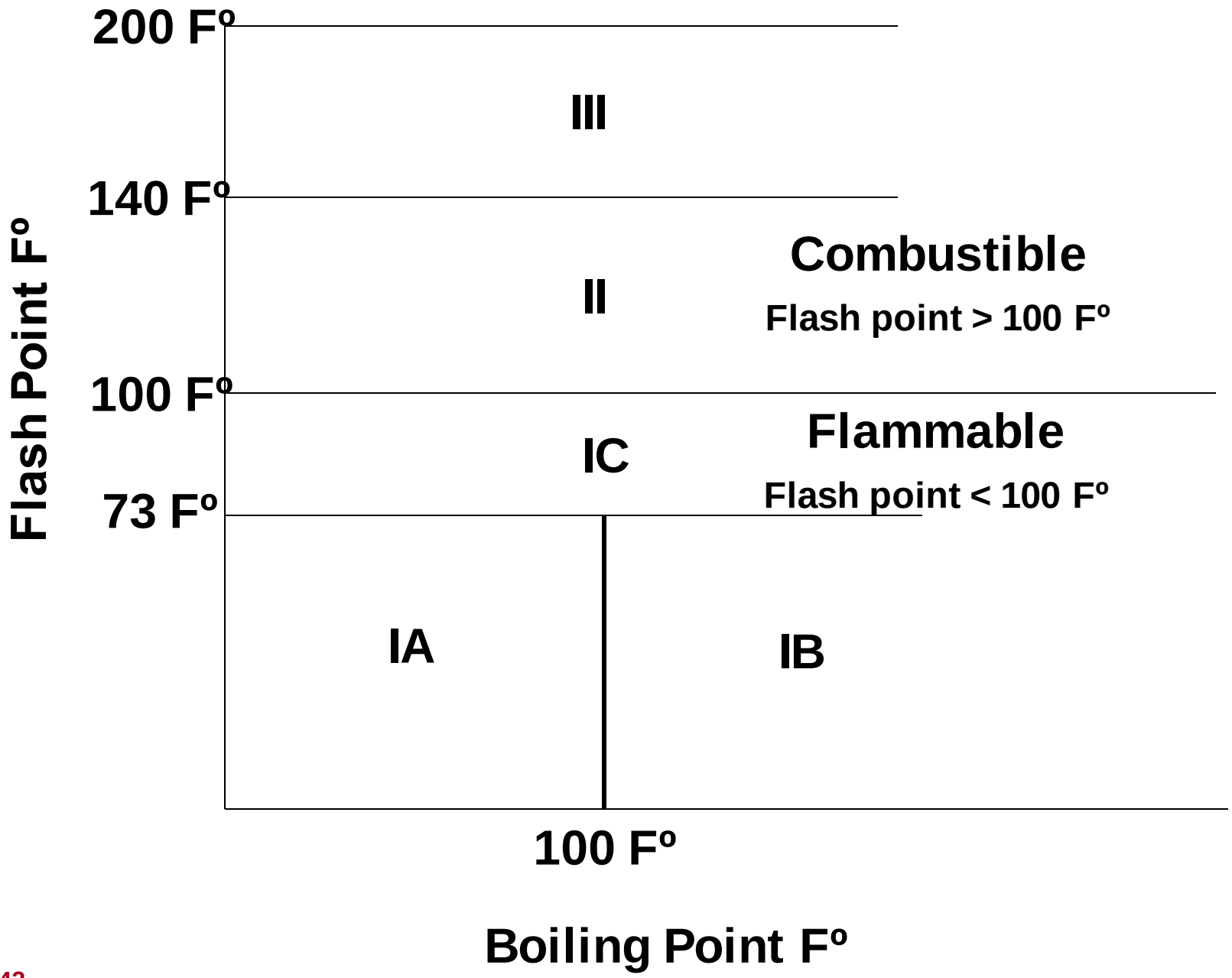
Combustible Liquid

- Any liquid having a flash point (FP) at or above 100°F (37.8°C)
- Divided into two classes:
  - Class II liquids: FP between 100°F and 140°F (60°C)
  - Class III liquids: FP at or above 140°F
    - Class IIIA: FP between 140°F and 200°F (93.3°C)
    - Class IIIB: FP at or above 200°F

Flammable Liquid

- Any liquid having a flash point below 100°F
- Also known as Class I liquids
  - Class IA: FP <73°F, BP <100°F
  - Class IB: FP <73°F, BP >100°F
  - Class IC: FP between 73°F and <100°F




200 Fº
140 Fº
100 Fº
73 Fº
III
II
IC
IA
IB
Combustible
Flash point > 100 Fº
Flammable
Flash point < 100 Fº
Flash Point Fº
100 Fº
Boiling Point Fº

Safety Can

- An approved container:
  - 5 gallons or less
  - With a spring-closing lid
  - With a spout cover
  - Designed to safely relieve internal pressure when subjected to fire exposure

Ventilation

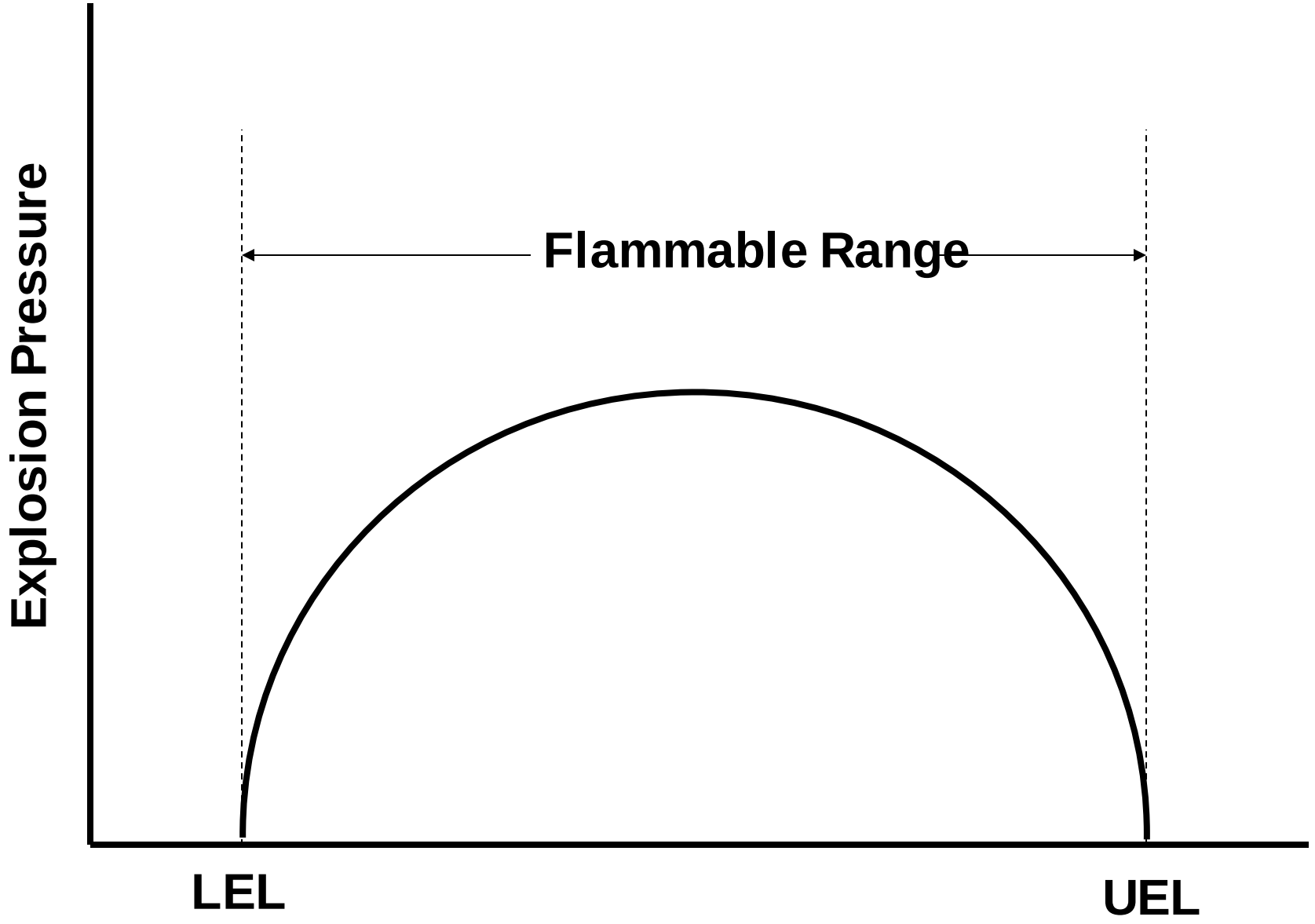
- As specified in this section: for the prevention of fire and explosion
- Considered adequate if it is sufficient to prevent accumulation of significant quantities of vapor-air mixtures in concentration over 1/4 of the lower flammable limit

Flammable (Explosive) Limits

- When vapors of a flammable or combustible liquid are mixed with air in the **proper proportions** in the presence of a source of ignition, rapid combustion or an explosion can occur
- The proper proportion is called the **flammable range** or **explosive range.**

Flammable (Explosive) Limits

- Flammable range includes all concentrations of flammable vapor or gas in air in which
  - a flash will occur or
  - a flame will travel
  - if the mixture is ignited.


Explosion Pressure
Flammable Range
LEL
UEL
Vapor/Gas Concentration in Air (%)

1910.106(b) Tank storage

1. Design and construction of tanks
2. Installation of outside aboveground tanks
   - ii. Spacing
   - iv. Normal venting for
   - v. Emergency relief venting
   - vi. Vent piping
   - vii. Drainage, dikes, and walls
   - viii. Tank openings other than vents

1910.106(b) Tank storage

3. Installation of underground tanks
4. Installation of tanks inside of buildings
5. Supports, foundations, and anchorage
6. Sources of ignition
7. Testing

1910.106(c) Piping, valves, and fittings

- Suitable for expected pressures and stresses
- Not applicable to oil/gas well tubing, casing, or piping connected directly
- Materials
- Joints
- Supports
- Corrosion protection
- Valves
- Testing

1910.106(d) Container and portable tank storage

- Storage of flammable or combustible liquids in
  - Drums or other containers (including flammable aerosols) not exceeding 60 gallons individual capacity and
  - Portable tanks not exceeding 660 gallons individual capacity

1910.106(d) Container and portable tank storage

- Not applicable in bulk plants, service stations, refineries, chemical plants
- Only approved containers and portable tanks shall be used
  - Metal containers & portable tanks meeting DOT Hazardous Materials regs are OK

1910.106(d)(3) Flammable Storage Cabinets

- Not more than 60 gallons of Class I and/or Class II liquids, or 120 gallons of Class III liquids, may be stored in an individual cabinet
- Labeled conspicuously

Are there flammable chemicals outside this cabinet?

1910.106(d)(4) Inside Storage Rooms

- Inside storage rooms constructed and wired for potential hazard
- Must be ventilated – complete change of air at least 6 times per hour
- Aisles necessary

1910.106(d)(5) Egress

- Flammable or combustible liquids shall not be stored so as to limit use of exits, stairways, or areas normally used for the safe egress of people

1910.106(d)(7) Fire control

- Extinguishers available
- Open flames and smoking not permitted in flammable or combustible liquid storage areas
- Water reactive materials not stored in same room

Industrial Facilities in 1910.106

e. Industrial plants (limited, see Scope)
f. Bulk plants (receive, store, blend, distribute)
g. Service stations
h. Refineries, chemical plants, and distilleries

General Principles

- Control evaporation, particularly in closed spaces.
- Prepare to dispose of spills quickly and safely.
- Prevent the ignition of flammable vapors.
- Ground and bond containers to prevent against static electricity discharge.

Sources of ignition

- Open flames
- Lightning
- Smoking
- Cutting and welding
- Hot surfaces, frictional heat
- Sparks (static, electrical, and mechanical)
- Spontaneous ignition
- Chemical and physical-chemical reactions
- Radiant heat

1910.110 Storage and handling of liquefied petroleum gases

- Regulated separately from flammable and combustible liquids
- Does not apply to marine and pipeline terminals
- NFPA standards for utility gas plants or low-pressure LP-Gas piping systems

29 CFR 1910.109

Explosives and Blasting Agents

29 CFR 1910.109 Explosives and Blasting Agents

b. General hazard:
   - "No person shall store, handle, or transport explosives or blasting agents when such… constitutes an **undue hazard to life.**
c. Storage of explosives
d. Transportation of explosives
e. Use of explosives and blasting agents
- Specific types of explosives

General Principles

- No flames, fires or firearms nearby
- Competent person in charge of enforcement of safety precautions
- Authorized persons take precautions to protect others
- Care in storage and handling
- Blasting only in daylight hours
- Notify utilities before blasting
- Loud warning before blast

Perforating Safety

- Electric blasting caps set off by current:
  - Electrical storms
  - Dust storms
  - Power lines
  - Radio or radar
- Recommendations
  - Keep non-essential personnel out of immediate area.
  - Post warning signs and prohibit the use of radios, telephones, or navigational systems.
  - Shut down non-essential electrical systems during gun-arming operations.

Notice of Proposed Rulemaking

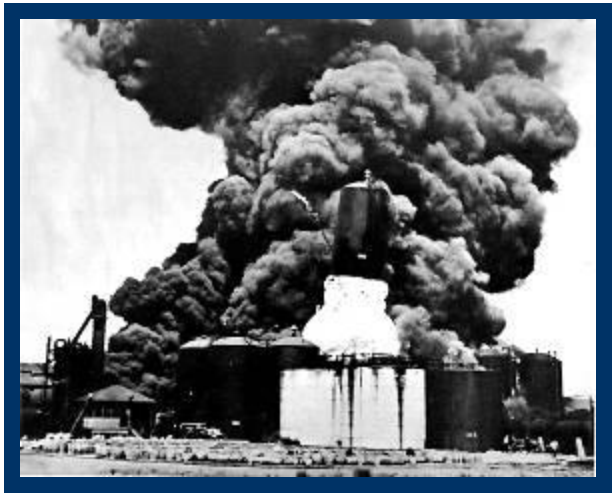
- April 13, 2007 Federal Register
- Comments invited until June 13, 2007
- Press release

29 CFR 1910.119

Process Safety Management

1910.119(a) Purpose

- Preventing or minimizing the consequences of catastrophic releases of:
  - Toxic,
  - Reactive,
  - Flammable, or
  - Explosive chemicals



- These releases may result in toxic, fire or explosion hazards

1910.119(a)(1) Application

- A process which involves a chemical at or above the specified **threshold quantities** listed in Appendix A
  - Highly hazardous chemicals (**HHC**), toxics and reactives
- A process which involves a **flammable liquid or gas** (as defined in 1910.1200(c)) on site
  - in one location,
  - in a quantity of 10,000 pounds (4535.9 kg) or more

1910.119(c) Employee Participation

- **Written** plan requires employee participation:
  - Consult with employees and their representatives on the development of process hazards analyses
  - Provide to employees and their representatives access to process hazard analyses

1910.119(d) Process safety information

- Compile written process safety information before conducting any process hazard analysis:
  - Enables employer and employees involved in the process to identify and understand the hazards posed by those processes
  - Hazards of the process
  - Technology of the process
  - The equipment in the process

1910.119(e) Process hazard analysis

- Must conduct a process hazard analysis (hazard evaluation) by listed methods
  - What-If
  - Checklist
  - What-If/Checklist
  - Hazard and Operability Study (HAZOP)
  - Failure Mode and Effects Analysis (FMEA)
  - Fault Tree Analysis

1910.119(e) Process hazard analysis (PHA)

- PHA must address:
  - Hazards of process
  - Any previous incident with catastrophic potential
  - Engineering and administrative controls and interrelationships
  - Consequences of failure of controls
  - Facility siting
  - Human factors
  - Qualitative evaluation of possible safety & health effects of failure of controls on employees

1910.119(e) Process hazard analysis (PHA)

- PHA must be performed by a team with expertise in engineering and process operations
- At least one employee who has experience and knowledge specific to the process being evaluated
- One team member must be knowledgeable in the specific process hazard analysis methodology being used

1910.119(e) Process hazard analysis (PHA)

- Employer establishes system to:
  - Promptly address findings and recommendations and document resolution
  - Document what actions are to be taken
  - Develop a written schedule of when these actions are to be completed
  - Communicate the actions to operating, maintenance and other employees who may be affected

1910.119(f) Operating procedures

- Develop and implement written operating procedures consistent with the process safety information and addresses at least:
  - Initial start-up, normal and temporary operations
  - Normal and emergency shut-down procedures
  - Operating limits and consequences of deviation
  - Safety and health considerations
- Procedures must be readily accessible to employees

1910.119(f) Operating procedures

- Develop and implement safe work practices* to provide for the control of hazards during operations such as:
  - Lockout/tagout;
  - Confined space entry;
  - Opening process equipment or piping; and
  - Control over entrance into a facility by maintenance, contractor, laboratory, or other support personnel
- Work practices apply to contractors as well

1910.119(g) Training

- Emphasis on the specific safety and health hazards of the process
- Emergency operations including shutdown
- Safe work practices applicable to the employee's job tasks
- Refresher training at least every three years
- Keep records which contain:
  - The identity of the employee,
  - The date of training, and
  - The means used to verify that the employee understood the training

1910.119(h) Contractors

- Applies to contractors performing maintenance or repair, turnaround, major renovation, or specialty work on or adjacent to a covered process
- Employer responsibilities:
  - Obtain and evaluate information regarding the contract employer's safety performance and programs
  - Inform contract employers of the known potential fire, explosion, or toxic release hazards related to the contractor's work and the process
- Incidental services not influencing process safety: exempt

Other sections of 1910.119

i. Pre-startup safety review
j. Mechanical integrity
k. Hot work permit
l. Management of change
m. Incident investigation
n. Emergency planning and response
o. Compliance audits
p. Trade secrets

29 CFR 1910.120

HAZWOPER

1910.120 HAZWOPER

- Hazardous waste operations and emergency response
  - Clean-up operations
  - Treatment, storage and disposal (TSD)
  - Emergency operations for release of hazardous substances