Oregon Administrative Rules

Chapter 437

Division 2

General Occupational Safety and Health

Hazardous Materials (including Hazardous Waste Operations & Emergency Response, PSM)

Subdivision

H

Administrative Order 3-2019

OSHA | Oregon OSHA

Department of Consumer and Business Services

The Oregon Department of Consumer and Business Services adopted these rules pursuant to ORS 654.025(2).

The Secretary of State designated OAR Chapter 437 as the "Oregon Occupational Safety and Health Code." Six general subject areas within this code are designated as "Divisions."

- **Division 1** General Administrative Rules
- **Division 2** General Occupational Safety and Health Rules
- **Division 3** Construction
- **Division 4** Agriculture
- **Division 5** Maritime Activities
- **Division 7** Forest Activities
- **Oregon Revised Statutes (ORS) 654** The Oregon Safe Employment Act (OSEAct)

Oregon-initiated rules in this division of the Oregon Occupational Safety and Health Code are numbered in a uniform system developed by the Secretary of State. This system does not number the rules in sequence (001, 002, 003, etc.). Omitted numbers may be assigned to new rules at the time of their adoption.

Oregon-initiated rules are arranged in the following Basic Codification Structure adopted by the Secretary of State for Oregon Administrative Rules (OAR):

Chapter	Division	Rule	Section	Subsection	Paragraphs
437	*002*	*0322*	*(1)*	*(a)*	*(A)(i)(I)*

The majority of Oregon OSHA rules are adopted by reference from the Code of Federal Regulations (CFR), and are arranged in the following basic federal numbering system:

Chapter	Division	Part	Subpart (Subdivision)	Section	Paragraphs
437	002	1910	G	.303	(a)(1)(i)(A)*(1)*

The terms "Subdivision" and "subpart" are synonymous within OAR 437, Oregon Occupational Safety and Health Code.

To obtain an order form or copies of these codes, address:

Department of Consumer & Business Services
Oregon Occupational Safety & Health Division (Oregon OSHA)
350 Winter St. NE
Salem, OR 97301-3882

Or call the Oregon OSHA Resource Library at 503-378-3272

The rules referenced in this division are available for viewing in the Office of the Secretary of State, Oregon State Archives Building, Salem, Oregon, or the Central Office, Oregon Occupational Safety and Health Division of the Department of Consumer and Business Services, 350 Winter St. NE, Salem, Oregon, and on our website at osha.oregon.gov.

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437-002-0100 Adoption by Reference

In addition to, and not in lieu of, any other safety and health codes contained in OAR Chapter 437, the Department adopts by reference the following federal regulations printed as part of the Code of Federal Regulations, 29 CFR 1910, in the Federal Register:

(1) 29 CFR 1910.101 Compressed gases (General requirements). Repealed. Oregon OSHA Admin. Order 6-2014, f. 10/28/14, ef. 5/1/15. In Oregon, OAR 437-002-2101 applies.

(2) 29 CFR 1910.102 Acetylene. Repealed. Oregon OSHA Admin. Order 1-2010, f. 2/19/10, ef. 2/19/10. In Oregon, OAR 437-002-2102 applies.

(3) 29 CFR 1910.103 Hydrogen, published 12/14/07, FR vol. 72, no. 240, p. 71061.

(4) 29 CFR 1910.104 Oxygen, published 3/7/96, FR vol. 61, no. 46, p. 9237.

(5) 29 CFR 1910.105 Nitrous oxide, published 3/7/96, FR vol. 61, no. 46, p. 9237.

(6) 29 CFR 1910.106 Flammable and combustible liquids, published 3/26/12, FR vol. 77, no. 58, p. 17574.

(7) 29 CFR 1910.107 Spray finishing using flammable and combustible materials, amended with AO 3-2003, repealed 1910.107, and Oregon note added, f. and ef. 4/21/03.

(8) 29 CFR 1910.108 Reserved. Published 3/23/99, Federal Register, vol. 64, no. 55, p. 13909.

(9) 29 CFR 1910.109 Explosives and blasting agents, published 6/18/98, FR vol. 63, no. 117, p. 33466.

(10) 29 CFR 1910.110 Storage and handling of liquefied petroleum gases, published 12/14/07, FR vol. 72, no. 240, p. 71061.

(11) 29 CFR 1910.111 Storage and handling of anhydrous ammonia, published amended with AO 12-2001, Oregon note added, f. and ef. 10/26/01; 12/14/07, FR vol. 72, no. 240, p. 71061.

(12) Reserved for 29 CFR 1910.112 (Reserved)

(13) Reserved for 29 CFR 1910.113 (Reserved)

(14) 29 CFR 1910.114 Removed. Published 3/7/96, Federal Register, vol. 61, no. 46, p. 9238.

(15) 29 CFR 1910.115 Removed. Published 3/7/96, Federal Register, vol. 61, no. 46, p. 9238.

(16) 29 CFR 1910.116 Removed. Published 3/7/96, Federal Register, vol. 61, no. 46, p. 9238.

(17) 29 CFR 1910.119 Process safety management of highly hazardous chemicals, amended 5/14/19, FR vol. 84, no. 93, p. 21416.

(18) 29 CFR 1910.120 Hazardous waste operations and emergency response, amended 5/14/19, FR vol. 84, no. 93, p. 21416.

(19) 29 CFR 1910.121 Reserved. Published 3/23/99, Federal Register, vol. 64, no. 55, p. 13909.

(20) 29 CFR 1910.122 Table of contents. Repealed with OR-OSHA Admin. Order 9-2007, f. and ef. 12/3/07.

(21) 29 CFR 1910.123 Dipping and coating operations: Coverage and definitions. Repealed with OR-OSHA Admin. Order 9-2007, f. and ef. 12/3/07.

(22) 29 CFR 1910.124 General requirements for dipping and coating operations. Repealed with OR-OSHA Admin. Order 9-2007, f. and ef. 12/3/07.

(23) 29 CFR 1910.125 Additional requirements for dipping and coating operations that use flammable or combustible liquids. Repealed with OR-OSHA Admin. Order 9-2007, f. and ef. 12/3/07.

(24) 29 CFR 1910.126 Additional requirements for special dipping and coating applications. Repealed with OR-OSHA Admin. Order 9-2007, f. and ef. 12/3/07.

These standards are on file with the Oregon Occupational Safety and Health Division, Oregon Department of Consumer and Business Services, and the United States Government Printing Office.

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: APD Admin. Order 19-1988, f. 11/17/88, ef. 11/17/88 (Hazardous Wastes – Interim).
APD Admin. Order 12-1989, f. 7/14/89, ef. 7/14/90 (Hazardous Wastes – Final).
OR-OSHA Admin. Order 22-1990, f. 9/28/90, ef. 10/1/90 (Hazwaste).
OR-OSHA Admin. Order 2-1992, f. 2/6/92, ef. 5/1/92 (all except Hazwaste).
OR-OSHA Admin. Order 3-1992, f. 2/6/92, ef. 2/6/92 (Hazwaste).
OR-OSHA Admin. Order 8-1992, f. 8/13/92, ef. 11/24/92 (PSM).
OR-OSHA Admin. Order 6-1994, f. 9/30/94, ef. 9/30/94 (PSM).
OR-OSHA Admin. Order 3-1995, f. 2/22/95, ef. 2/22/95 (Haz Wst/Emg Rsp).
OR-OSHA Admin. Order 4-1997, f. 4/2/97, ef. 4/2/97.
OR-OSHA Admin. Order 3-1998, f. 7/7/98, ef. 7/7/98.
OR-OSHA Admin. Order 4-1999, f. 4/30/99, ef. 4/30/99.
OR-OSHA Admin. Order 8-1999, f. 8/6/99, ef. 8/6/99.
OR-OSHA Admin. Order 12-2001, f. 10/26/01, ef. 10/26/01.
OR-OSHA Admin. Order 4-2002, f. 5/30/02, ef. 5/30/02.
OR-OSHA Admin. Order 3-2003, f. 4/21/03, ef. 4/21/03.
OR-OSHA Admin. Order 4-2004, f. 9/15/04, ef. 9/15/04.
OR-OSHA Admin. Order 4-2005, f. 12/14/05, ef. 12/14/05.
OR-OSHA Admin. Order 4-2006, f. 7/24/06, ef. 7/24/06.

OR-OSHA Admin. Order 9-2007, f. 12/3/07, ef. 12/3/07.
OR-OSHA Admin. Order 7-2008, f. 5/30/08, ef, 5/30/08.
OR-OSHA Admin. Order 1-2010, f. 2/19/10, ef. 2/19/10.
OR-OSHA Admin. Order1-2012, f. 4/10/12, ef. 4/10/12.
OR-OSHA Admin. Order 5-2012, f. 9/25/12, ef. 9/25/12.
OR-OSHA Admin. Order 6-2012, f. 9/28/12, ef. 4/1/13.
OR-OSHA Admin. Order 4-2013, f. 7/19/13, ef. 7/19/13.
OR-OSHA Admin. Order 6-2014, f. 10/28/14, ef. 5/1/15.
OR-OSHA Admin. Order 3-2019, f. 10/29/19, ef. 10/29/19.

Note: Oregon OSHA repealed 1910.101 with Admin. Order 6-2014, f. 10/28/2014, ef. 5/1/2015. In Oregon, OAR 437-002-2101 applies.

1910.101 Repealed

437-002-2101 Compressed Gases (General Requirements)

(1) Inspection of compressed gas cylinders. Each employer must conduct a visual inspection of compressed gas cylinders under their control to determine they are in a safe condition. Visual and other inspections must be conducted as prescribed in the Hazardous Materials Regulations of the Department of Transportation (49 CFR Parts 171-179 and 14 CFR Part 103). Where those regulations are not applicable, visual and other inspections must be conducted in accordance with Compressed Gas Association (CGA) Pamphlet C-6 2013, 11th Edition, Standard for Visual Inspection of Steel Compressed Gas Cylinders and CGA Pamphlet C-8 2005, Reaffirmed 2010, 7th Edition, Standard for Requalification of DOT-3HT, CTC-3HT, and TC-3HTM Seamless Steel Cylinders.

(2) Compressed gases. The handling, storage, and utilization of all compressed gases in cylinders, portable tanks, rail tankcars, or motor vehicle cargo tanks must be in accordance with Compressed Gas Association Pamphlet P-1 2008, 11th Edition, Safe Handling of Compressed Gases in Containers.

(3) Safety relief devices for compressed gas containers. Compressed gas cylinders, portable tanks, and cargo tanks must have pressure relief devices installed and maintained in accordance with Compressed Gas Association CGA S-1.1 2011 14th edition and, CGA S-1.2 2009 9th edition.

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 to 654.295.
Hist: OR-OSHA Admin. Order 6-2014, f. 10/28/14, ef. 5/1/15.

Note: Oregon OSHA declined to follow 1910.102 with Admin. Order 1-2010, f. and ef. 2/19/2010. In Oregon, OAR 437-002-2102 applies.

437-002-2102 Acetylene

(1) Cylinders.

(a) Employers must ensure that the manufacturing, in-plant transfer, transportation, handling, storage, and use of acetylene in cylinders comply with this rule and the provisions of Compressed Gas Association (CGA) Pamphlet G-1-2009 ("Acetylene") (Compressed Gas Association, Inc., 12th ed., 2009).

(b) Definitions.

***Confined space:** A space that meets all of the following:*

(i) Large enough and configured so that an employee can fully enter the space and perform work.

(ii) Has limited or restricted means for entry and/or exit.

(iii) Is not designed for continuous employee occupancy.

***Enclosed space** – Spaces that are surrounded by something, and the only openings are access openings, for example, drawers, closets, unventilated cabinets, automobile trunks, unventilated cylinder compartments, or toolboxes.*

***Handling** – Moving, connecting, or disconnecting a compressed gas container under normal conditions.*

***PSIG (Gauge Pressure)** – Pressure above or below local atmospheric pressure displayed as pounds per square inch.*

***Secure** – Arrange to prevent movement (including lashing and chaining), or a minimum of three points of contact with other cylinders or walls.*

***Use** – Withdrawing and using the gas in a non-recoverable manner for applications other than manufacturing or repackaging of compressed gasses.*

(c) Acetylene Cylinders General Requirements.

(A) You must:

(i) Store and use cylinders valve end up.

***Note:** Gas suppliers and distributors may store secured containers in a horizontal position.*

(ii) Secure cylinder(s) to prevent falling or movement.

(iii) Use a cylinder cart or cylinder pallet to move acetylene cylinders.

***Note:** This rule does not apply to acetylene fill plants, handling, distribution, and maintenance processes where cylinders are tilted and rolled on their bottom edge only the minimal distance necessary to get them on and off carts or pallets.*

(iv) Attach the cylinder to a pressure reducing regulator or blow back manifold before opening the cylinder valve.

(v) Remove pressure regulators before moving cylinders unless they are secured in an upright position on a cylinder cart.

(vi) Back out regulator adjusting screws before opening cylinder valves.

(vii) Protect cylinders from contact with welding spatters and cutting or burning slag.

(viii) Install reverse flow check valves and flashback arresters according to manufacturer recommendation.

(B) You must not:

(i) Drop cylinders.

(ii) Drag cylinders.

(iii) Apply a torch to the side of a cylinder.

(iv) Hoist cylinders using lifting magnets, slings, ropes, chains, or any other device where the cylinders form a part of the carrier.

(v) Handle cylinders so that the bottom fusible metal pressure relief device can strike an object.

(vi) Expose any part of your body to the line of discharge of a fusible metal pressure relief device.

(vii) Use acetylene at a pressure exceeding 15 psig.

(viii) Exceed an acetylene withdrawal rate of one-seventh of the cylinder capacity per hour for welding, cutting, and allied processes.

(d) Transporting Acetylene Cylinders (additional requirements).

(A) You must protect cylinders and attached regulators:

(i) From damage when being transported by any vehicle.

(ii) From abnormal mechanical shock that is likely to damage the cylinder, valve, or fusible metal pressure relief device.

(B) You must not transport cylinders in enclosed spaces.

(C) You must ensure that cylinders are leak checked prior to each placement into the vehicle. Cylinders left in vehicles overnight must be leak checked at the end of the day and again prior to transporting.

(e) Acetylene Cylinder Storage.

(A) You must store cylinders:

(i) In assigned locations.

(ii) In areas posted with signs prohibiting smoking and open flame.

(iii) In well-ventilated locations.

(iv) Away from heat sources.

(v) Where they are protected from corrosion.

***Note:** Cylinders with or without regulators, kept in or on vehicles due to their frequency of use will not be considered as stored when a leak test is performed at the end of the day. When cylinders are used during multiple shifts, they must be leak tested at the end of each shift.*

(B) You must not store cylinders:

(i) Where they contact electrical welding equipment or electrical circuits.

Note: All high and low pressure cylinders in contact with or secured to a conductive table or column without being isolated from electrical current can become part of an electrical circuit.

(ii) Where they can be struck by heavy objects.

(iii) In enclosed spaces.

(iv) In confined spaces.

(v) Within 20 feet of oxygen unless they are separated by a noncombustible partition. Partitions must:

(I) vertically extend at least 18 inches above the tallest container and not less than 5 feet.

(II) laterally extend at least 18 inches beyond the sides of the containers.

(III) have a fire resistance rating of at least one-half hour.

***Note 1** (paragraph (1)(e)(B)(v)): Single cylinders of acetylene and oxygen can be stored secured on a cart or used adjacent to each other without a partition.*

***Note 2** (paragraph (1)(e)(B)(v)): Single cylinders of acetylene and oxygen secured at a work station without attached pressure reducing regulators are considered to be in use.*

(vi) With full and empty cylinders grouped together.

***Note** (paragraph (1)(e)(B)(vi)): This does not apply to the cylinder distribution process.*

(f) Connecting and Disconnecting Acetylene Cylinders for Use.

(A) You must:

(i) Return cylinders with contaminated valves (mud, oil, grease, and similar material) to the supplier.

(ii) Secure the cylinder(s) where it can not contact any electrical circuit or electrical welding equipment.

***Note:** All high and low pressure cylinders in contact with or secured to a conductive table column without being isolated from electrical current can become part of an electrical circuit.*

(iii) Inspect hoses before each shift.

(iv) Remove damaged hoses from service.

(v) Check pressurized cylinder valves, fuse plugs and all connections for leaks prior to use.

(vi) Use industry approved leak detection solution or oil free soapy water.

(vii) Notify the gas supplier of any leaking cylinder, and follow the supplier's instruction for returning the cylinder.

(viii) Back out the regulator adjusting screws before opening cylinder valves.

(ix) Close the system valves and release all gas from the regulators before removing the regulator from a cylinder.

(x) Keep the cylinder key used for opening the cylinder valve on the valve spindle when the cylinder is in use.

(B) You must not attempt to repair or alter cylinders or valves.

(2) Piped Systems.

(a) Employers must comply with Chapter 9 ("Acetylene Piping") of NFPA 51A-2006 ("Standard for Acetylene Charging Plants") (National Fire Protection Association, 2006 ed., 2006).

(b) When employers can demonstrate that the facilities, equipment, structures, or installations used to generate acetylene or to charge (fill) acetylene cylinders were installed prior to February 16, 2006, these employers may comply with the provisions of Chapter 7 ("Acetylene Piping") of NFPA 51A-2001 ("Standard for Acetylene Charging Plants") (National Fire Protection Association, 2001 ed., 2001).

(c) The provisions of 437-002-2102(2)(b) also apply when the facilities, equipment, structures, or installation used to generate acetylene or to charge (fill) acetylene cylinders were approved for construction or installation prior to February 16, 2006, but constructed and installed on or after that date.

(d) For additional information on acetylene piping systems, see CGA G-1.2-2006, Part 3 ("Acetylene piping") (Compressed Gas Association, Inc., 3rd ed., 2006).

(3) Generators and filling cylinders.

(a) Employer must ensure that facilities, equipment, structures, or installations used to generate acetylene or to charge (fill) acetylene cylinders comply with the provisions of NFPA 51A-2006 ("Standard for Acetylene Charging plants") (National Fire Protection Association, 2006 ed., 2006).

(b) When employers can demonstrate that the facilities, equipment, structures, or installations used to generate acetylene or to charge (fill) of acetylene cylinders were constructed or installed prior to February 16, 2006, these employers may comply with the provisions of NFPA 51A-2001 ("Standard for Acetylene Charging Plants") (National Fire Protection Association, 2001 ed., 2001).

(c) The provisions of 437-002-2102(3)(b) also apply when the facilities, equipment, structures, or installation were approved for construction or installation prior to February 16, 2006, but constructed and installed on or after that date.

Stat. Auth.: ORS 654.025(2) and 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: OR-OSHA Admin. Order 1-2010, f. 2/19/10, ef. 2/19/10
OR-OSHA Admin. Order 6-2014, f. 10/28/14, ef. 5/1/15.

1910.103 Hydrogen

(a) General.

(1) Definitions. As used in this section:

(i) **Gaseous hydrogen system** is one in which the hydrogen is delivered, stored and discharged in the gaseous form to consumer's piping. The system includes stationary or movable containers, pressure regulators, safety relief devices, manifolds, interconnecting piping and controls. The system terminates at the point where hydrogen at service pressure first enters the consumer's distribution piping.

(ii) **Approved** – Means, unless otherwise indicated, listed or approved by a nationally recognized testing laboratory. Refer to 1910.7 for definition of nationally recognized testing laboratory.

(iii) **Listed** – See "approved."

(iv) **ASME** – American Society of Mechanical Engineers.

(v) **DOT Specifications** – Regulations of the Department of Transportation published in 49 CFR Chapter I.

(vi) **DOT regulations** – See 1910.103(a)(1)(v).

(2) Scope.

(i) Gaseous hydrogen systems.

(A) Paragraph (b) of this section applies to the installation of gaseous hydrogen systems on consumer premises where the hydrogen supply to the consumer premises originates outside the consumer premises and is delivered by mobile equipment.

(B) Paragraph (b) of this section does not apply to gaseous hydrogen systems having a total hydrogen content of less than 400 cubic feet, nor to hydrogen manufacturing plants or other establishments operated by the hydrogen supplier or his agent for the purpose of storing hydrogen and refilling portable containers, trailers, mobile supply trucks, or tank cars.

(ii) Liquefied hydrogen systems.

(A) Paragraph (c) of this section applies to the installation of liquefied hydrogen systems on consumer premises.

(B) Paragraph (c) of this section does not apply to liquefied hydrogen portable containers of less than 150 liters (39.63 gallons) capacity; nor to liquefied hydrogen manufacturing plants or other establishments operated by the hydrogen supplier or his agent for the sole purpose of storing liquefied hydrogen and refilling portable containers, trailers, mobile supply trucks, or tank cars.

(b) Gaseous hydrogen systems.

(1) Design.

(i) Containers.

(A) Hydrogen containers shall comply with one of the following:

(1) Designed, constructed, and tested in accordance with appropriate requirements of ASME Boiler and Pressure Vessel Code, Section VIII – Unfired Pressure Vessels – 1968, which is incorporated by reference as specified in 1910.6.

(2) Designed, constructed, tested and maintained in accordance with U.S. Department of Transportation Specifications and Regulations.

(B) Permanently installed containers shall be provided with substantial noncombustible supports on firm noncombustible foundations.

(C) Each portable container shall be legibly marked with the name “Hydrogen” in accordance with the marking requirements set forth in 1910.253(b)(1)(ii). Each manifolded hydrogen supply unit shall be legibly marked with the name “Hydrogen” or a legend such as “This unit contains hydrogen.”

(ii) Safety relief devices.

(A) Hydrogen containers shall be equipped with safety relief devices as required by the ASME Boiler and Pressure Vessel Code, Section VIII Unfired Pressure Vessels, 1968 or the DOT Specifications and Regulations under which the container is fabricated.

(B) Safety relief devices shall be arranged to discharge upward and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container, adjacent structure or personnel. This requirement does not apply to DOT Specification containers having an internal volume of 2 cubic feet or less.

(C) Safety relief devices or vent piping shall be designed or located so that moisture cannot collect and freeze in a manner which would interfere with proper operation of the device.

(iii) Piping, tubing, and fittings.

(A) Piping, tubing, and fittings shall be suitable for hydrogen service and for the pressures and temperatures involved. Cast iron pipe and fittings shall not be used.

(B) Piping and tubing shall conform to Section 2 – "Industrial Gas and Air Piping" – Code for Pressure Piping, ANSI B31.1-1967 with addenda B31.1 1969, which is incorporated by reference as specified in 1910.6.

(C) Joints in piping and tubing may be made by welding or brazing or by use of flanged, threaded, socket, or compression fittings. Gaskets and thread sealants shall be suitable for hydrogen service.

(iv) Equipment assembly.

(A) Valves, gauges, regulators, and other accessories shall be suitable for hydrogen service.

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

(C) Storage containers, piping, valves, regulating equipment, and other accessories shall be readily accessible, and shall be protected against physical damage and against tampering.

(D) Cabinets or housings containing hydrogen control or operating equipment shall be adequately ventilated.

(E) Each mobile hydrogen supply unit used as part of a hydrogen system shall be adequately secured to prevent movement.

(F) Mobile hydrogen supply units shall be electrically bonded to the system before discharging hydrogen.

(v) Marking. The hydrogen storage location shall be permanently placarded as follows: "HYDROGEN – FLAMMABLE GAS – NO SMOKING – NO OPEN FLAMES," or equivalent.

(vi) Testing. After installations, all piping, tubing, and fittings shall be tested and proved hydrogen gas-tight at maximum operating pressure.

(2) Location.

(i) General.

(A) The system shall be located so that it is readily accessible to delivery equipment and to authorized personnel.

(B) Systems shall be located above ground.

(C) Systems shall not be located beneath electric power lines.

(D) Systems shall not be located close to flammable liquid piping or piping of other flammable gases.

(E) Systems near above ground flammable liquid storage shall be located on ground higher than the flammable liquid storage except when dikes, diversion curbs, grading, or separating solid walls are used to prevent accumulation of flammable liquids under the system.

(ii) Specific requirements.

(A) The location of a system, as determined by the maximum total contained volume of hydrogen, shall be in the order of preference as indicated by Roman numerals in Table H-1.

Table H-1

Nature of Location	**Size of hydrogen system**		
	Less than 3,000 CF	**3,000 CF to 15,000 CF**	**In excess of 15,000 CF**
Outdoors	I	IDI	
In a separate building	II	II	II
In a special room	III	III	Not permitted
Inside buildings not in a special room and exposed to other occupancies	IV	Not permitted	Not permitted

Table H-2

Type of outdoor exposure		Size of hydrogen system		
		Less than 3,000 CF	3,000 CF to 15,000 CF	In excess of 15,000 CF
Building or structure	Wood frame construction[1]	10	25	50
	Heavy timber, noncombustible or ordinary construction[1]	0	10	[2]25
	Fire-resistive construction[1]	0	0	0
Wall openings	Not above any part of a system	10	10	10
	Above any part of a system	25	25	25
Flammable liquids above ground	0 to 1,000 gallons	10	25	25
	In excess of 1,000 gallons	25	50	50
Flammable liquids below ground – 0 to 1,000 gallons	Tank	10	10	10
	Vent or fill opening of tank	25	25	25
Flammable liquids below ground – in excess of 1,000 gallons	Tank	20	20	20
	Vent or fill opening of tank	25	25	25
Flammable gas storage, either high pressure or low pressure	0 to 15,000 CF capacity	10	25	25
	In excess of 15,000 CF capacity	25	50	50
Oxygen storage	12,000 CF or less[4]			
	More than 12,000 CF[5]			
Fast burning solids such as ordinary lumber, excelsior or paper		50	50	50
		25	25	25
Slow burning solids such as heavy timber or coal		25	25	25
Open flames and other sources of ignition		25	25	25
Air compressor intakes or inlets to ventilating or air-conditioning equipment		50	50	50
Concentration of people[3]		25	50	50

[1]Refer to NFPA No. 220 Standard Types of Building Construction for definitions of various types of construction. (1969 Ed.)
[2]But not less than one-half the height of adjacent side wall of the structure.
[3]In congested areas such as offices, lunchrooms, locker rooms, time clock areas.
[4]Refer to NFPA No. 51, gas systems for welding and cutting (1969).
[5]Refer to NFPA No. 566, bulk oxygen systems at consumer sites (1969).

(B) The minimum distance in feet from a hydrogen system of indicated capacity located outdoors, in separate buildings or in special rooms to any specified outdoor exposure shall be in accordance with Table H-2.

(C) The distances in Table H-2 Items 1 and 3 to 10 inclusive do not apply where protective structures such as adequate fire walls are located between the system and the exposure.

(D) Hydrogen systems of less than 3,000 CF when located inside buildings and exposed to other occupancies shall be situated in the building so that the system will be as follows:

(1) In an adequately ventilated area as in paragraph (b)(3)(ii)(B) of this section.

(2) Twenty feet from stored flammable materials or oxidizing gases.

(3) Twenty-five feet from open flames, ordinary electrical equipment or other sources of ignition.

(4) Twenty-five feet from concentrations of people.

(5) Fifty feet from intakes of ventilation or air-conditioning equipment and air compressors.

(6) Fifty feet from other flammable gas storage.

(7) Protected against damage or injury due to falling objects or working activity in the area.

(8) More than one system of 3,000 CF or less may be installed in the same room, provided the systems are separated by at least 50 feet. Each such system shall meet all of the requirements of this paragraph.

(3) Design consideration at specific locations.

(i) Outdoor locations.

(A) Where protective walls or roofs are provided, they shall be constructed of noncombustible materials.

(B) Where the enclosing sides adjoin each other, the area shall be properly ventilated.

(C) Electrical equipment within 15 feet shall be in accordance with Subpart S of this part.

(ii) Separate buildings.

(A) Separate buildings shall be built of at least noncombustible construction. Windows and doors shall be located so as to be readily accessible in case of emergency. Windows shall be of glass or plastic in metal frames.

(B) Adequate ventilation to the outdoors shall be provided. Inlet openings shall be located near the floor in exterior walls only. Outlet openings shall be located at the high point of the room in exterior walls or roof. Inlet and outlet openings shall each have minimum total area of 1 square foot per 1,000 cubic feet of room volume. Discharge from outlet openings shall be directed or conducted to a safe location.

(C) Explosion venting shall be provided in exterior walls or roof only. The venting area shall be equal to not less than 1 square foot per 30 cubic feet of room volume and may consist of any one or any combination of the following: Walls of light, noncombustible material, preferably single thickness, single strength glass; lightly fastened hatch covers; lightly fastened swinging doors in exterior walls opening outward; lightly fastened walls or roof designed to relieve at a maximum pressure of 25 pounds per square foot.

(D) There shall be no sources of ignition from open flames, electrical equipment, or heating equipment.

(E) Electrical equipment shall be in accordance with Subpart S of this part for Class I, Division 2 locations.

(F) Heating, if provided, shall be by steam, hot water, or other indirect means.

(iii) Special rooms.

(A) Floor, walls, and ceiling shall have a fire-resistance rating of at least 2 hours. Walls or partitions shall be continuous from floor to ceiling and shall be securely anchored. At least one wall shall be an exterior wall. Openings to other parts of the building shall not be permitted. Windows and doors shall be in exterior walls and shall be located so as to be readily accessible in case of emergency. Windows shall be of glass or plastic in metal frames.

(B) Ventilation shall be as provided in paragraph (b)(3)(ii)(B) of this section.

(C) Explosion venting shall be as provided in paragraph (b)(3)(ii)(C) of this section.

(D) There shall be no sources of ignition from open flames, electrical equipment, or heating equipment.

(E) Electrical equipment shall be in accordance with the requirements of Subpart S of this part for Class I, Division 2 locations.

(F) Heating, if provided, shall be by steam, hot water, or indirect means.

(4) Operating instructions. For installations which require any operation of equipment by the user, legible instructions shall be maintained at operating locations.

(5) Maintenance. The equipment and functioning of each charged gaseous hydrogen system shall be maintained in a safe operating condition in accordance with the requirements of this section. The area within 15 feet of any hydrogen container shall be kept free of dry vegetation and combustible material.

(c) Liquefied hydrogen systems.

(1) Design.

(i) Containers.

(A) Hydrogen containers shall comply with the following: Storage containers shall be designed, constructed, and tested in accordance with appropriate requirements of the ASME Boiler and Pressure Vessel Code, Section VIII – Unfired Pressure Vessels (1968) or applicable provisions of API Standard 620, Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks, Second Edition (June 1963) and Appendix R (April 1965), which is incorporated by reference as specified in 1910.6.

(B) Portable containers shall be designed, constructed and tested in accordance with DOT Specifications and Regulations.

(ii) Supports. Permanently installed containers shall be provided with substantial noncombustible supports securely anchored on firm noncombustible foundations. Steel supports in excess of 18 inches in height shall be protected with a protective coating having a 2-hour fire-resistance rating.

(iii) Marking. Each container shall be legibly marked to indicate "LIQUEFIED HYDROGEN – FLAMMABLE GAS."

(iv) Safety relief devices.

(A)

(1) Stationary liquefied hydrogen containers shall be equipped with safety relief devices sized in accordance with CGA Pamphlet S-1, Part 3, Safety Relief Device Standards for Compressed Gas Storage Containers, which is incorporated by reference as specified in 1910.6.

(2) Portable liquefied hydrogen containers complying with the U.S. Department of Transportation Regulations shall be equipped with safety relief devices as required in the U.S. Department of Transportation Specifications and Regulations. Safety relief devices shall be sized in accordance with the requirements of CGA Pamphlet S-1, Safety Relief Device Standards, Part 1, Compressed Gas Cylinders and Part 2, Cargo and Portable Tank Containers.

(B) Safety relief devices shall be arranged to discharge unobstructed to the outdoors and in such a manner as to prevent impingement of escaping liquid or gas upon the container, adjacent structures or personnel. See paragraph (c)(2)(i)(F) of this section for venting of safety relief devices in special locations.

(C) Safety relief devices or vent piping shall be designed or located so that moisture cannot collect and freeze in a manner which would interfere with proper operation of the device.

(D) Safety relief devices shall be provided in piping wherever liquefied hydrogen could be trapped between closures.

(v) Piping, tubing, and fittings.

(A) Piping, tubing, and fittings and gasket and thread sealants shall be suitable for hydrogen service at the pressures and temperatures involved. Consideration shall be given to the thermal expansion and contraction of piping systems when exposed to temperature fluctuations of ambient to liquefied hydrogen temperatures.

(B) Gaseous hydrogen piping and tubing (above -20 degrees F.) shall conform to the applicable sections of Pressure Piping Section 2 – Industrial Gas and Air Piping, ANSI B31.1-1967 with addenda B31.1-1969. Design of liquefied hydrogen or cold (-20 degrees F. or below) gas piping shall use Petroleum Refinery Piping ANSI B31.3-1966 or Refrigeration Piping ANSI B31.5-1966 with addenda B31.5a-1968 as a guide, which is incorporated by reference as specified in 1910.6.

(C) Joints in piping and tubing shall preferably be made by welding or brazing; flanged, threaded, socket, or suitable compression fittings may be used.

(D) Means shall be provided to minimize exposure of personnel to piping operating at low temperatures and to prevent air condensate from contacting piping, structural members, and surfaces not suitable for cryogenic temperatures. Only those insulating materials which are rated nonburning in accordance with ASTM Procedures D1692-68, which is incorporated by reference as specified in 1910.6, may be used. Other protective means may be used to protect personnel. The insulation shall be designed to have a vapor-tight seal in the outer covering to prevent the condensation of air and subsequent oxygen enrichment within the insulation. The insulation material and outside shield shall also be of adequate design to prevent attrition of the insulation due to normal operating conditions.

(E) Uninsulated piping and equipment which operate at liquefied-hydrogen temperature shall not be installed above asphalt surfaces or other combustible materials in order to prevent contact of liquid air with such materials. Drip pans may be installed under uninsulated piping and equipment to retain and vaporize condensed liquid air.

(vi) Equipment assembly.

(A) Valves, gauges, regulators, and other accessories shall be suitable for liquefied hydrogen service and for the pressures and temperatures involved.

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

(C) Storage containers, piping, valves, regulating equipment, and other accessories shall be readily accessible and shall be protected against physical damage and against tampering. A shutoff valve shall be located in liquid product withdrawal lines as close to the container as practical. On containers of over 2,000 gallons capacity, this shutoff valve shall be of the remote control type with no connections, flanges, or other appurtenances (other than a welded manual shutoff valve) allowed in the piping between the shutoff valve and its connection to the inner container.

(D) Cabinets or housings containing hydrogen control equipment shall be ventilated to prevent any accumulation of hydrogen gas.

(vii) Testing.

(A) After installation, all field-erected piping shall be tested and proved hydrogen gas-tight at operating pressure and temperature.

(B) Containers if out of service in excess of 1-year shall be inspected and tested as outlined in (a) of this Subdivision. The safety relief devices shall be checked to determine if they are operable and properly set.

(viii) Liquefied hydrogen vaporizers.

(A) The vaporizer shall be anchored and its connecting piping shall be sufficiently flexible to provide for the effect of expansion and contraction due to temperature changes.

(B) The vaporizer and its piping shall be adequately protected on the hydrogen and heating media sections with safety relief devices.

(C) Heat used in a liquefied hydrogen vaporizer shall be indirectly supplied utilizing media such as air, steam, water, or water solutions.

(D) A low temperature shutoff switch shall be provided in the vaporizer discharge piping to prevent flow of liquefied hydrogen in the event of the loss of the heat source.

(ix) Electrical systems.

(A) Electrical wiring and equipment located within 3 feet of a point where connections are regularly made and disconnected, shall be in accordance with Subpart S of this part, for Class I, Group B, Division 1 locations.

(B) Except as provided in (a) of this Subdivision, electrical wiring, and equipment located within 25 feet of a point where connections are regularly made and disconnected or within 25 feet of a liquid hydrogen storage container, shall be in accordance with Subpart S of this part, for Class I, Group B, Division 2 locations. When equipment approved for Class I, Group B atmospheres is not commercially available, the equipment may be:

(1) Purged or ventilated in accordance with NFPA No. 496-1967, Standard for Purged Enclosures for Electrical Equipment in Hazardous Locations,

(2) Intrinsically safe, or

(3) Approved for Class I, Group C atmospheres. This requirement does not apply to electrical equipment which is installed on mobile supply trucks or tank cars from which the storage container is filled.

(x) Bonding and grounding. The liquefied hydrogen container and associated piping shall be electrically bonded and grounded.

(2) Location of liquefied hydrogen storage.

(i) General requirements.

(A) The storage containers shall be located so that they are readily accessible to mobile supply equipment at ground level and to authorized personnel.

(B) The containers shall not be exposed by electric power lines, flammable liquid lines, flammable gas lines, or lines carrying oxidizing materials.

(C) When locating liquefied hydrogen storage containers near above ground flammable liquid storage or liquid oxygen storage, it is advisable to locate the liquefied hydrogen container on ground higher than flammable liquid storage or liquid oxygen storage.

(D) Where it is necessary to locate the liquefied hydrogen container on ground that is level with or lower than adjacent flammable liquid storage or liquid oxygen storage, suitable protective means shall be taken (such as by diking, diversion curbs, grading), with respect to the adjacent flammable liquid storage or liquid oxygen storage, to prevent accumulation of liquids within 50 feet of the liquefied hydrogen container.

(E) Storage sites shall be fenced and posted to prevent entrance by unauthorized personnel. Sites shall also be placarded as follows: “Liquefied Hydrogen – Flammable Gas – No Smoking – No Open Flames.”

(F) If liquefied hydrogen is located in (as specified in Table H-3) a separate building, in a special room, or inside buildings when not in a special room and exposed to other occupancies, containers shall have the safety relief devices vented unobstructed to the outdoors at a minimum elevation of 25 feet above grade to a safe location as required in paragraph (c)(1)(iv)(B) of this section.

(ii) Specific requirements.

(A) The location of liquefied hydrogen storage, as determined by the maximum total quantity of liquefied hydrogen, shall be in the order of preference as indicated by Roman numerals in the following Table H-3.

Table H-3 Maximum Total Quantity of Liquefied Hydrogen Storage Permitted

Nature of location	Size of hydrogen storage (capacity in gallons)			
	39.63 (150 liters) to 50	51 to 300	301 to 600	In excess of 600
Outdoors	I	I	I	I
In a separate building	II	II	II	Not permitted
In a special room	III	III	Not permitted	Do
Inside buildings not in a special room and exposed to other occupancies	IV	Not permitted	Do	Do

Note: This table does not apply to the storage in dewars of the type generally used in laboratories for experimental purposes.

(B) The minimum distance in feet from liquefied hydrogen systems of indicated storage capacity located outdoors, in a separate building, or in a special room to any specified exposure shall be in accordance with Table H-4.

Table H-4 - Minimum Distance (Feet) From Liquefied Hydrogen Systems to Exposure[1,2]

Type of Exposure	Liquefied hydrogen storage (capacity in gallons)		
	39.63 (150 liters) to 3,500	3,501 to 15,000	15,001 to 30,000
1. Fire-resistive building and fire walls[3]	5	5	5
2. Noncombustible building[3]	25	50	75
3. Other buildings[3]	50	75	100
4. Wall openings, air-compressor intakes, inlets for air-conditioning or ventilating equipment	75	75	75
5. Flammable liquids (above ground and vent or fill openings if below ground) (see 513 and 514)	50	75	100
6. Between stationary liquefied hydrogen containers	5	5	5
7. Flammable gas storage	50	75	100
8. Liquid oxygen storage and other oxidizers (see 513 and 514)	100	100	100
9. Combustible solids	50	75	100
10. Open flames, smoking and welding	50	50	50
11. Concentrations of people	75	75	75

[1]The distance in Nos. 2, 3, 5, 7, 9, and 12 in Table H-4 may be reduced where protective structures, such as firewalls equal to height of top of the container, to safeguard the liquefied hydrogen storage system, are located between the liquefied hydrogen storage installation and the exposure.

[2]Where protective structures are provided, ventilation and confinement of product should be considered. The 5-foot distance in Nos. 1 and 6 facilitates maintenance and enhances ventilation.

[3]Refer to Standard Types of Building Construction, NFPA No. 220-1969 for definitions of various types of construction.

In congested areas such as offices, lunchrooms, locker rooms, time clock areas.

(iii) Handling of liquefied hydrogen inside buildings other than separate buildings and special rooms. Portable liquefied hydrogen containers of 50 gallons or less capacity as permitted in Table H-3 and in compliance with Subdivision (i)(F) of this subparagraph when housed inside buildings not located in a special room and exposed to other occupancies shall comply with the following minimum requirements:

(A) Be located 20 feet from flammable liquids and readily combustible materials such as excelsior or paper.

(B) Be located 25 feet from ordinary electrical equipment and other sources of ignition including process or analytical equipment.

(C) Be located 25 feet from concentrations of people.

(D) Be located 50 feet from intakes of ventilation and air-conditioning equipment or intakes of compressors.

(E) Be located 50 feet from storage of other flammable-gases or storage of oxidizing gases.

(F) Containers shall be protected against damage or injury due to falling objects or work activity in the area.

(G) Containers shall be firmly secured and stored in an upright position.

(H) Welding or cutting operations, and smoking shall be prohibited while hydrogen is in the room.

(I) The area shall be adequately ventilated. Safety relief devices on the containers shall be vented directly outdoors or to a suitable hood. See paragraphs (c)(1)(iv)(B) and (c)(2)(i)(F) of this section.

(3) Design considerations at specific locations.

(i) Outdoor locations.

(A) Outdoor location shall mean outside of any building or structure, and includes locations under a weather shelter or canopy provided such locations are not enclosed by more than two walls set at right angles and are provided with vent-space between the walls and vented roof or canopy.

(B) Roadways and yard surfaces located below liquefied hydrogen piping, from which liquid air may drip, shall be constructed of noncombustible materials.

(C) If protective walls are provided, they shall be constructed of noncombustible materials and in accordance with the provisions of paragraph (c)(3)(i)(A) of this section as applicable.

(D) Electrical wiring and equipment shall comply with paragraphs (c)(1)(ix)(A) and (B) of this section.

(E) Adequate lighting shall be provided for nighttime transfer operation.

(ii) Separate buildings.

(A) Separate buildings shall be of light noncombustible construction on a substantial frame. Walls and roofs shall be lightly fastened and designed to relieve at a maximum internal pressure of 25 pounds per square foot. Windows shall be of shatterproof glass or plastic in metal frames. Doors shall be located in such a manner that they will be readily accessible to personnel in an emergency.

(B) Adequate ventilation to the outdoors shall be provided. Inlet openings shall be located near the floor level in exterior walls only. Outlet openings shall be located at the high point of the room in exterior walls or roof. Both the inlet and outlet vent openings shall have a minimum total area of 1 square foot per 1,000 cubic feet of room volume. Discharge from outlet openings shall be directed or conducted to a safe location.

(C) There shall be no sources of ignition.

(D) Electrical wiring and equipment shall comply with paragraphs (c)(1)(ix)(A) and (B) of this section except that the provisions of paragraph (c)(1)(ix)(B) of this section shall apply to all electrical wiring and equipment in the separate building.

(E) Heating, if provided, shall be by steam, hot water, or other indirect means.

(iii) Special rooms.

(A) Floors, walls, and ceilings shall have a fire resistance rating of at least 2 hours. Walls or partitions shall be continuous from floor to ceiling and shall be securely anchored. At least one wall shall be an exterior wall. Openings to other parts of the building shall not be permitted. Windows and doors shall be in exterior walls and doors shall be located in such a manner that they will be accessible in an emergency. Windows shall be of shatterproof glass or plastic in metal frames.

(B) Ventilation shall be as provided in paragraph (c)(3)(ii)(B) of this section.

(C) Explosion venting shall be provided in exterior walls or roof only. The venting area shall be equal to not less than 1 square foot per 30 cubic feet of room volume and may consist of any one or any combination of the following: Walls of light noncombustible material; lightly fastened hatch covers; lightly fastened swinging doors opening outward in exterior walls; lightly fastened walls or roofs designed to relieve at a maximum pressure of 25 pounds per square foot.

(D) There shall be no sources of ignition.

(E) Electrical wiring and equipment shall comply with paragraphs (c)(1)(ix)(A) and (B) of this section except that the provision of paragraph (c)(1)(ix)(B) of this section shall apply to all electrical wiring and equipment in the special room.

(F) Heating, if provided, shall be steam, hot water, or by other indirect means.

(4) Operating instruction.

(i) Written instructions. For installation which require any operation of equipment by the user, legible instructions shall be maintained at operating locations.

(ii) Attendant. A qualified person shall be in attendance at all times while the mobile hydrogen supply unit is being unloaded.

(iii) Security. Each mobile liquefied hydrogen supply unit used as part of a hydrogen system shall be adequately secured to prevent movement.

(iv) Grounding. The mobile liquefied hydrogen supply unit shall be grounded for static electricity.

(5) Maintenance. The equipment and functioning of each charged liquefied hydrogen system shall be maintained in a safe operating condition in accordance with the requirements of this section. Weeds or similar combustibles shall not be permitted within 25 feet of any liquefied hydrogen equipment.

[39 FR 23502, June 27, 1974, as amended at 43 FR 49746, Oct. 24, 1978; 53 FR 12121, Apr. 12, 1988; 55 FR 32015, Aug. 6, 1990; 58 FR 35309, June 30, 1993; 61 FR 9236, 9237, Mar. 7, 1996; 69 FR 31881, June 8, 2004; 72 FR 71069, Dec. 14, 2007]

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 to 654.295.
Hist: OR-OSHA Admin. Order 2-1992, f. 2/6/92, ef. 5/1/92.
OR-OSHA Admin. Order 4-1997, f. 4/2/97, ef. 4/2/97.
OR-OSHA Admin. Order 4-2004, f. 9/15/04, ef. 9/15/04.
OR-OSHA Admin. Order 7-2008, f. 5/30/08, ef, 5/30/08.

1910.104 Oxygen

(a) Scope. This section applies to the installation of bulk oxygen systems on industrial and institutional consumer premises. This section does not apply to oxygen manufacturing plants or other establishments operated by the oxygen supplier or his agent for the purpose of storing oxygen and refilling portable containers, trailers, mobile supply trucks, or tank cars, nor to systems having capacities less than those stated in paragraph (b)(1) of this section.

(b) Bulk oxygen systems.

(1) Definition. As used in this section: A bulk oxygen system is an assembly of equipment, such as oxygen storage containers, pressure regulators, safety devices, vaporizers, manifolds, and interconnecting piping, which has storage capacity of more than 13,000 cubic feet of oxygen, Normal Temperature and Pressure (NTP), connected in service or ready for service, or more than 25,000 cubic feet of oxygen (NTP) including unconnected reserves on hand at the site. The bulk oxygen system terminates at the point where oxygen at service pressure first enters the supply line. The oxygen containers may be stationary or movable, and the oxygen may be stored as gas or liquid.

(2) Location.

(i) General. Bulk oxygen storage systems shall be located above ground out-of-doors, or shall be installed in a building of noncombustible construction, adequately vented, and used for that purpose exclusively. The location selected shall be such that containers and associated equipment shall not be exposed by electric power lines, flammable or combustible liquid lines, or flammable gas lines.

(ii) Accessibility. The system shall be located so that it is readily accessible to mobile supply equipment at ground level and to authorized personnel.

(iii) Leakage. Where oxygen is stored as a liquid, noncombustible surfacing shall be provided in an area in which any leakage of liquid oxygen might fall during operation of the system and filling of a storage container. For purposes of this paragraph, asphaltic or bituminous paving is considered to be combustible.

(iv) Elevation. When locating bulk oxygen systems near above ground flammable or combustible liquid storage which may be either indoors or outdoors, it is advisable to locate the system on ground higher than the flammable or combustible liquid storage.

(v) Dikes. Where it is necessary to locate a bulk oxygen system on ground lower than adjacent flammable or combustible liquid storage suitable means shall be taken (such as by diking, diversion curbs, or grading) with respect to the adjacent flammable or combustible liquid storage to prevent accumulation of liquids under the bulk oxygen system.

(3) Distance between systems and exposures.

(i) General. The minimum distance from any bulk oxygen storage container to exposures, measured in the most direct line except as indicated in paragraphs (b)(3)(vi) and (viii) of this section, shall be as indicated in paragraphs (b)(3)(ii) to (xviii) of this section inclusive.

(ii) Combustible structures. Fifty feet from any combustible structures.

(iii) Fire resistive structures. Twenty-five feet from any structures with fire-resistive exterior walls or sprinklered buildings of other construction, but not less than one-half the height of adjacent side wall of the structure.

(iv) Openings. At least 10 feet from any opening in adjacent walls of fire resistive structures. Spacing from such structures shall be adequate to permit maintenance, but shall not be less than 1-foot.

(v) Flammable liquid storage above ground.

Distance (feet)	Capacity (gallons)
50	0 to 1000
90	1001 or more

(vi) Flammable liquid storage below ground.

Distance measured horizontally from oxygen storage container to flammable liquid tank (feet)	Distance from oxygen storage container to filling and vent connections or openings to flammable liquid tank (feet)	Capacity (gallons)
15	50	0 to 1000
30	50	1001 or more

(vii) Combustible liquid storage above ground.

Distance (feet)	Capacity (gallons)
25	0 to 1000
50	1001 or more

(viii) Combustible liquid storage below ground.

Distance measured horizontally from oxygen storage container to flammable liquid tank (feet)	Distance from oxygen storage container to filling and vent connections or openings to flammable liquid tank (feet)
15	40

(ix) Flammable gas storage. (Such as compressed flammable gases, liquefied flammable gases and flammable gases in low pressure gas holders)

Distance (feet)	Capacity (cu. ft. NTP)
50	Less than 5000
90	5000 or more

(x) Highly combustible materials. Fifty feet from solid materials which burn rapidly, such as excelsior or paper.

(xi) Slow-burning materials. Twenty-five feet from solid materials which burn slowly, such as coal and heavy timber.

(xii) Ventilation. Seventy-five feet in one direction and 35 feet in approximately 90 degree direction from confining walls (not including firewalls less than 20 feet high) to provide adequate ventilation in courtyards and similar confining areas.

(xiii) Congested areas. Twenty-five feet from congested areas such as offices, lunchrooms, locker rooms, time clock areas, and similar locations where people may congregate.

(xiv) (Reserved)

(xv) (Reserved)

(xvi) (Reserved)

(xvii) (Reserved)

(xviii) Exceptions. The distances in paragraphs (b)(3)(ii), (iii), (v) to (xi) inclusive, of this section do not apply where protective structures such as firewalls of adequate height to safeguard the oxygen storage systems are located between the bulk oxygen storage installation and the exposure. In such cases, the bulk oxygen storage installation may be a minimum distance of 1 foot from the firewall.

(4) Storage containers.

(i) Foundations and supports. Permanently installed containers shall be provided with substantial noncombustible supports on firm noncombustible foundations.

(ii) Construction – liquid. Liquid oxygen storage containers shall be fabricated from materials meeting the impact test requirements of paragraph UG-84 of ASME Boiler and Pressure Vessel Code, Section VIII – Unfired Pressure Vessels – 1968, which is incorporated by reference as specified in 1910.6. Containers operating at pressures above 15 pounds per square inch gage (p.s.i.g.) shall be designed, constructed, and tested in accordance with appropriate requirements of ASME Boiler and Pressure Vessel Code, Section VII – Unfired Pressure Vessels – 1968. Insulation surrounding the liquid oxygen container shall be noncombustible.

(iii) Construction – gaseous. High-pressure gaseous oxygen containers shall comply with one of the following:

(A) Designed, constructed, and tested in accordance with appropriate requirements of ASME Boiler and Pressure Vessel Code, Section VIII – Unfired Pressure Vessels – 1968.

(B) Designed, constructed, tested, and maintained in accordance with DOT Specifications and Regulations.

(5) Piping, tubing, and fittings.

(i) Selection. Piping, tubing, and fittings shall be suitable for oxygen service and for the pressures and temperatures involved.

(ii) Specification. Piping and tubing shall conform to Section 2 – Gas and Air Piping Systems of Code for Pressure Piping, ANSI, B31.1-1967 with addenda B31.10a-1969, which is incorporated by reference as specified in 1910.6.

(iii) Fabrication. Piping or tubing for operating temperatures below -20 degrees F. shall be fabricated from materials meeting the impact test requirements of paragraph UG-84 of ASME Boiler and Pressure Vessel Code, Section VIII – Unfired Pressure Vessels – 1968, when tested at the minimum operating temperature to which the piping may be subjected in service.

(6) Safety relief devices.

(i) General. Bulk oxygen storage containers, regardless of design pressure shall be equipped with safety relief devices as required by the ASME code or the DOT specifications and regulations.

(ii) DOT containers. Bulk oxygen storage containers designed and constructed in accordance with DOT specification shall be equipped with safety relief devices as required thereby.

(iii) ASME containers. Bulk oxygen storage containers designed and constructed in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII – Unfired Pressure Vessel – 1968, shall be equipped with safety relief devices meeting the provisions of the Compressed Gas Association Pamphlet "Safety Relief Device Standards for Compressed Gas Storage Containers," S-1, Part 3, which is incorporated by reference as specified in 1910.6.

(iv) Insulation. Insulation casings on liquid oxygen containers shall be equipped with suitable safety relief devices.

(v) Reliability. All safety relief devices shall be so designed or located that moisture cannot collect and freeze in a manner which would interfere with proper operation of the device.

(7) Liquid oxygen vaporizers.

(i) Mounts and couplings. The vaporizer shall be anchored and its connecting piping be sufficiently flexible to provide for the effect of expansion and contraction due to temperature changes.

(ii) Relief devices. The vaporizer and its piping shall be adequately protected on the oxygen and heating medium sections with safety relief devices.

(iii) Heating. Heat used in an oxygen vaporizer shall be indirectly supplied only through media such as steam, air, water, or water solutions which do not react with oxygen.

(iv) Grounding. If electric heaters are used to provide the primary source of heat, the vaporizing system shall be electrically grounded.

(8) Equipment assembly and installation.

(i) Cleaning. Equipment making up a bulk oxygen system shall be cleaned in order to remove oil, grease or other readily oxidizable materials before placing the system in service.

(ii) Joints. Joints in piping and tubing may be made by welding or by use of flanged, threaded, slip, or compression fittings. Gaskets or thread sealants shall be suitable for oxygen service.

(iii) Accessories. Valves, gages, regulators, and other accessories shall be suitable for oxygen service.

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

(v) Testing. After installation all field erected piping shall be tested and proved gas-tight at maximum operating pressure. Any medium used for testing shall be oil free and nonflammable.

(vi) Security. Storage containers, piping, valves, regulating equipment, and other accessories shall be protected against physical damage and against tampering.

(vii) Venting. Any enclosure containing oxygen control or operating equipment shall be adequately vented.

(viii) Placarding. The bulk oxygen storage location shall be permanently placarded to indicate: "OXYGEN – NO SMOKING – NO OPEN FLAMES," or an equivalent warning.

(ix) Electrical wiring. Bulk oxygen installations are not hazardous locations as defined and covered in Subpart S of this part. Therefore, general purpose or weatherproof types of electrical wiring and equipment are acceptable depending upon whether the installation is indoors or outdoors. Such equipment shall be installed in accordance with the applicable provisions of Subpart S of this part.

(9) Operating instructions. For installations which require any operation of equipment by the user, legible instructions shall be maintained at operating locations.

(10) Maintenance. The equipment and functioning of each charged bulk oxygen system shall be maintained in a safe operating condition in accordance with the requirements of this section. Wood and long dry grass shall be cut back within 15 feet of any bulk oxygen storage container.

[39 FR 23502, June 27, 1974, as amended at 43 FR 49746, Oct. 24, 1978; 61 FR 9237, Mar. 7, 1996]

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 to 654.295.
Hist: OR-OSHA Admin. Order 2-1992, f. 2/6/92, ef. 5/1/92.
OR-OSHA Admin. Order 4-1997, f. 4/2/97, ef. 4/2/97.

1910.105 Nitrous Oxide

The piped systems for the in-plant transfer and distribution of nitrous oxide shall be designed, installed, maintained, and operated in accordance with Compressed Gas Association Pamphlet G-8.1-1964, which is incorporated by reference as specified in 1910.6.

[39 FR 23502, June 27, 1974, as amended at 61 FR 9237, Mar. 7, 1996]

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 to 654.295.

Hist: OR-OSHA Admin. Order 2-1992, f. 2/6/92, ef. 5/1/92.
OR-OSHA Admin. Order 4-1997, f. 4/2/97, ef. 4/2/97.

1910.106 Flammable Liquids

(a) Definitions. As used in this section:

(1) **Aerosol** shall mean a material which is dispensed from its container as a mist, spray, or foam by a propellant under pressure.

(2) **Atmospheric tank** shall mean a storage tank which has been designed to operate at pressures from atmospheric through 0.5 p.s.i.g.

(3) **Automotive service station** shall mean that portion of property where flammable liquids used as motor fuels are stored and dispensed from fixed equipment into the fuel tanks of motor vehicles and shall include any facilities available for the sale and service of tires, batteries, and accessories, and for minor automotive maintenance work. Major automotive repairs, painting, body and fender work are excluded.

(4) **Basement** shall mean a story of a building or structure having one-half or more of its height below ground level and to which access for fire fighting purposes is unduly restricted.

(5) **Boiling point** shall mean the boiling point of a liquid at a pressure of 14.7 pounds per square inch absolute (p.s.i.a.) (760 mm.). Where an accurate boiling point is unavailable for the material in question, or for mixtures which do not have a constant boiling point, for purposes of this section the 10 percent point of a distillation performed in accordance with the Standard Method of Test for Distillation of Petroleum Products, ASTM D-86-62, which is incorporated by reference as specified in 1910.6, may be used as the boiling point of the liquid.

(6) **Boilover** shall mean the expulsion of crude oil (or certain other liquids) from a burning tank. The light fractions of the crude oil burnoff producing a heat wave in the residue, which on reaching a water strata may result in the expulsion of a portion of the contents of the tank in the form of froth.

(7) **Bulk plant** shall mean that portion of a property where flammable liquids are received by tank vessel, pipelines, tank car, or tank vehicle, and are stored or blended in bulk for the purpose of distributing such liquids by tank vessel, pipeline, tank car, tank vehicle, or container.

(8) **Chemical plant** shall mean a large integrated plant or that portion of such a plant other than a refinery or distillery where flammable liquids are produced by chemical reactions or used in chemical reactions.

(9) **Closed container** shall mean a container as herein defined, so sealed by means of a lid or other device that neither liquid nor vapor will escape from it at ordinary temperatures.

(10) **Crude petroleum** shall mean hydrocarbon mixtures that have a flash point below 150 degrees F. and which have not been processed in a refinery.

(11) **Distillery** shall mean a plant or that portion of a plant where flammable liquids produced by fermentation are concentrated, and where the concentrated products may also be mixed, stored, or packaged.

(12) **Fire area** shall mean an area of a building separated from the remainder of the building by construction having a fire resistance of at least 1-hour and having all communicating openings properly protected by an assembly having a fire resistance rating of at least 1-hour.

(13) **Flammable aerosol** shall mean a flammable aerosol as defined by Appendix B to 1910.1200 – Physical Hazard Criteria. For the purposes of paragraph (d) of this section, such aerosols are considered Category 1 flammable liquids.

(14) **Flashpoint** means 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, and shall be determined as follows:

(i) For a liquid which has a viscosity of less than 45 SUS at 100 degrees F. (37.8 degrees C.), does not contain suspended solids, and does not have a tendency to form a surface film while under test, the procedure specified in the Standard Method of Test for Flashpoint by Tag Closed Tester (ASTM D-56-70), which is incorporated by reference as specified in 1910.6, or an equivalent test method as defined in Appendix B to 1910.1200 – Physical Hazard Criteria, shall be used.

(ii) For a liquid which has a viscosity of 45 SUS or more at 100 degrees F. (37.8 degrees C.), or contains suspended solids, or has a tendency to form a surface film while under test, the Standard Method of Test for Flashpoint by Pensky Martens Closed Tester (ASTM D-93-71) or an equivalent method as defined in Appendix B to 1910.1200 – Physical Hazard Criteria, shall be used, except that the methods specified in Note 1 to section 1.1 of ASTM D-93-71 may be used for the respective materials specified in the Note. The preceding ASTM standard is incorporated by reference as specified in 1910.6.

(iii) For a liquid that is a mixture of compounds that have different volatilities and flashpoints, its flashpoint shall be determined by using the procedure specified in paragraph (a)(14)(i) or (ii) of this section on the liquid in the form it is shipped.

(iv) Organic peroxides, which undergo auto-accelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified in this subparagraph.

(15) **Hotel** shall mean buildings or groups of buildings under the same management in which there are sleeping accommodations for hire, primarily used by transients who are lodged with or without meals including but not limited to inns, clubs, motels, and apartment hotels.

(16) **Institutional occupancy** shall mean the occupancy or use of a building or structure or any portion thereof by persons harbored or detained to receive medical, charitable or other care or treatment, or by persons involuntarily detained.

(17) **Liquid** shall mean, for the purpose of this section, any material which has a fluidity greater than that of 300 penetration asphalt when tested in accordance with ASTM Test for Penetration for Bituminous Materials, D-5-65, which is incorporated by reference as specified in 1910.6.

(18) Reserved.

(19) **Flammable liquid** means any liquid having a flashpoint at or below 199.4 degrees F. (93 degrees C.). Flammable liquids are divided into four categories as follows:

(i) Category 1 shall include liquids having flashpoints below 73.4 degrees F. (23 degrees C.) and having a boiling point at or below 95 degrees F. (35 degrees C.).

(ii) Category 2 shall include liquids having flashpoints below 73.4 degrees F. (23 degrees C.) and having a boiling point above 95 degrees F. (35 degrees C.).

(iii) Category 3 shall include liquids having flashpoints at or above 73.4 degrees F. (23 degrees C.) and at or below 140 degrees F. (60 degrees C.). When a Category 3 liquid with a flashpoint at or above 100 degrees F. (37.8 degrees C.) is heated for use to within 30 degrees F. (16.7 degrees C.) of its flashpoint, it shall be handled in accordance with the requirements for a Category 3 liquid with a flashpoint below 100 degrees F. (37.8 degrees C.).

(iv) Category 4 shall include liquids having flashpoints above 140 degrees F. (60 degrees C.) and at or below 199.4 degrees F. (93 degrees C.). When a Category 4 flammable liquid is heated for use to within 30 degrees F. (16.7 degrees C.) of its flashpoint, it shall be handled in accordance with the requirements for a Category 3 liquid with a flashpoint at or above 100 degrees F. (37.8 degrees C.).

(v) When liquid with a flashpoint greater than 199.4 degrees F. (93 degrees C.) is heated for use to within 30 degrees F. (16.7 degrees C.) of its flashpoint, it shall be handled in accordance with the requirements for a Category 4 flammable liquid.

(20) **Unstable (reactive) liquid** shall mean a liquid which in the pure state or as commercially produced or transported will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure, or temperature.

(21) **Low-pressure tank** shall mean a storage tank which has been designed to operate at pressures above 0.5 p.s.i.g. but not more than 15 p.s.i.g.

(22) **Marine service station** shall mean that portion of a property where flammable liquids used as fuels are stored and dispensed from fixed equipment on shore, piers, wharves, or floating docks into the fuel tanks of self-propelled craft, and shall include all facilities used in connection therewith.

(23) **Mercantile occupancy** shall mean the occupancy or use of a building or structure or any portion thereof for the displaying, selling, or buying of goods, wares, or merchandise.

(24) **Office occupancy** shall mean the occupancy or use of a building or structure or any portion thereof for the transaction of business, or the rendering or receiving of professional services.

(25) **Portable tank** shall mean a closed container having a liquid capacity over 60 U.S. gallons and not intended for fixed installation.

(26) **Pressure vessel** shall mean a storage tank or vessel which has been designed to operate at pressures above 15 p.s.i.g.

(27) **Protection for exposure** shall mean adequate fire protection for structures on property adjacent to tanks, where there are employees of the establishment.

(28) **Refinery** shall mean a plant in which flammable liquids are produced on a commercial scale from crude petroleum, natural gasoline, or other hydrocarbon sources.

(29) **Safety can** shall mean an approved container, of not more than 5-gallon capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure.

(30) **Vapor pressure** shall mean the pressure, measured in pounds per square inch (absolute) exerted by a volatile liquid as determined by the "Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method)," American Society for Testing and Materials ASTM D323-68, which is incorporated by reference as specified in 1910.6.

(31) **Ventilation** as specified in this section is for the prevention of fire and explosion. It is considered adequate if it is sufficient to prevent accumulation of significant quantities of vapor-air mixtures in concentration over one-fourth of the lower flammable limit.

(32) **Storage:** Flammable liquids shall be stored in a tank or in a container that complies with paragraph (d)(2) of this section.

(33) **Barrel** shall mean a volume of 42 U.S. gallons.

(34) **Container** shall mean any can, barrel, or drum.

(35) **Approved** unless otherwise indicated, approved, or listed by a nationally recognized testing laboratory. Refer to 1910.7 for definition of nationally recognized testing laboratory.

(36) **Listed** see "approved" in 1910.106(a)(35).

(37) **SUS** means Saybolt Universal Seconds as determined by the Standard Method of Test for Saybolt Viscosity (ASTM D-88-56), and may be determined by use of the SUS conversion tables specified in ASTM Method D2161-66 following determination of viscosity in accordance with the procedures specified in the Standard Method of Test for Viscosity of Transparent and Opaque Liquids (ASTM D445-65).

(38) **Viscous** means a viscosity of 45 SUS or more.

(b) Tank storage.

(1) Design and construction of tanks.

(i) Materials.

(A) Tanks shall be built of steel except as provided in (b)(1)(i)(B) through (E) of this section.

(B) Tanks may be built of materials other than steel for installation underground or if required by the properties of the liquid stored. Tanks located above ground or inside buildings shall be of noncombustible construction.

(C) Tanks built of materials other than steel shall be designed to specifications embodying principles recognized as good engineering design for the material used.

(D) Unlined concrete tanks may be used for storing flammable liquids having a gravity of 40 degrees API or heavier. Concrete tanks with special lining may be used for other services provided the design is in accordance with sound engineering practice.

(E) (Reserved)

(F) Special engineering consideration shall be required if the specific gravity of the liquid to be stored exceeds that of water or if the tanks are designed to contain flammable liquids at a liquid temperature below 0 degrees F.

(ii) Fabrication.

(A) (Reserved)

(B) Metal tanks shall be welded, riveted, and caulked, brazed, or bolted, or constructed by use of a combination of these methods. Filler metal used in brazing shall be nonferrous metal or an alloy having a melting point above 1000 degrees F. and below that of the metal joined.

(iii) Atmospheric tanks.

(A) Atmospheric tanks shall be built in accordance with acceptable good standards of design. Atmospheric tanks may be built in accordance with the following consensus standards that are incorporated by reference as specified in 1910.6:

(1) Underwriters' Laboratories, Inc., Subjects No. 142, Standard for Steel Above ground Tanks for Flammable and Combustible Liquids, 1968; No. 58, Standard for Steel Underground Tanks for Flammable and Combustible Liquids, Fifth Edition, December 1961; or No. 80, Standard for Steel Inside Tanks for Oil-Burner Fuel, September 1963.

(2) American Petroleum Institute Standards No. 650, Welded Steel Tanks for Oil Storage, Third Edition, 1966.

(3) American Petroleum Institute Standards No. 12B, Specification for Bolted Production Tanks, Eleventh Edition, May 1958, and Supplement 1, March 1962; No. 12D, Specification for Large Welded Production Tanks, Seventh Edition, August 1957; or No. 12F, Specification for Small Welded Production Tanks, Fifth Edition, March 1961. Tanks built in accordance with these standards shall be used only as production tanks for storage of crude petroleum in oil-producing areas.

(B) Tanks designed for underground service not exceeding 2,500 gallons capacity may be used above ground.

(C) Low-pressure tanks and pressure vessels may be used as atmospheric tanks.

(D) Atmospheric tanks shall not be used for the storage of a flammable liquid at a temperature at or above its boiling point.

(iv) Low pressure tanks.

(A) The normal operating pressure of the tank shall not exceed the design pressure of the tank.

(B) Low-pressure tanks shall be built in accordance with acceptable standards of design. Low-pressure tanks may be built in accordance with the following consensus standards that are incorporated by reference as specified in 1910.6:

(1) American Petroleum Institute Standard No. 620. Recommended Rules for the Design and Construction of Large, Welded, Low-Pressure Storage Tanks, Third Edition, 1966.

(2) The principles of the Code for Unfired Pressure Vessels, Section VIII of the ASME Boiler and Pressure Vessels Code, 1968.

(C) Atmospheric tanks built according to Underwriters' Laboratories, Inc., requirements in Subdivision (iii)(A) of and shall be limited to 2.5 p.s.i.g. under emergency venting conditions.

This paragraph may be used for operating pressures not exceeding 1 p.s.i.g.

(D) Pressure vessels may be used as low-pressure tanks.

(v) Pressure vessels.

(A) The normal operating pressure of the vessel shall not exceed the design pressure of the vessel.

(B) Pressure vessels shall be built in accordance with the Code for Unfired Pressure Vessels, Section VIII of the ASME Boiler and Pressure Vessel Code 1968.

(vi) Provisions for internal corrosion. When tanks are not designed in accordance with the American Petroleum Institute, American Society of Mechanical Engineers, or the Underwriters' Laboratories, Inc.'s, standards, or if corrosion is anticipated beyond that provided for in the design formulas used, additional metal thickness or suitable protective coatings or linings shall be provided to compensate for the corrosion loss expected during the design life of the tank.

(2) Installation of outside above ground tanks.

(i) (Reserved)

(ii) Spacing (shell-to-shell) between above ground tanks.

(A) The distance between any two flammable liquid storage tanks shall not be less than 3 feet.

(B) Except as provided in paragraph (b)(2)(ii)(C) of this section, the distance between any two adjacent tanks shall not be less than one-sixth the sum of their diameters. When the diameter of one tank is less than one-half the diameter of the adjacent tank, the distance between the two tanks shall not be less than one-half the diameter of the smaller tank.

(C) Where crude petroleum in conjunction with production facilities are located in noncongested areas and have capacities not exceeding 126,000 gallons (3,000 barrels), the distance between such tanks shall not be less than 3 feet.

(D) Where unstable flammable liquids are stored, the distance between such tanks shall not be less than one-half the sum of their diameters.

(E) When tanks are compacted in three or more rows or in an irregular pattern, greater spacing or other means shall be provided so that inside tanks are accessible for firefighting purposes.

(F) The minimum separation between a liquefied petroleum gas container and a flammable liquid storage tank shall be 20 feet, except in the case of flammable liquid tanks operating at pressures exceeding 2.5 p.s.i.g. or equipped with emergency venting which will permit pressures to exceed 2.5 p.s.i.g. in which case the provisions of Subdivisions (A) and (B) of this Subdivision shall apply. Suitable means shall be taken to prevent the accumulation of flammable liquids under adjacent liquefied petroleum gas containers such as by diversion curbs or grading. When flammable liquid storage tanks are within a diked area, the liquefied petroleum gas containers shall be outside the diked area and at least 10 feet away from the centerline of the wall of the diked area. The foregoing provisions shall not apply when liquefied petroleum gas containers of 125 gallons or less capacity are installed adjacent to fuel oil supply tanks of 550 gallons or less capacity.

(iii) (Reserved)

(iv) Normal venting for above ground tanks.

(A) Atmospheric storage tanks shall be adequately vented to prevent the development of vacuum or pressure sufficient to distort the roof of a cone roof tank or exceeding the design pressure in the case of other atmospheric tanks, as a result of filling or emptying, and atmospheric temperature changes.

(B) Normal vents shall be sized either in accordance with: (1) The American Petroleum Institute Standard 2000 (1968), Venting Atmospheric and Low-Pressure Storage Tanks, which is incorporated by reference as specified in 1910.6; or (2) other accepted standard; or (3) shall be at least as large as the filling or withdrawal connection, whichever is larger but in no case less than 1 1/4 inch nominal inside diameter.

(C) Low-pressure tanks and pressure vessels shall be adequately vented to prevent development of pressure or vacuum, as a result of filling or emptying and atmospheric temperature changes, from exceeding the design pressure of the tank or vessel. Protection shall also be provided to prevent overpressure from any pump discharging into the tank or vessel when the pump discharge pressure can exceed the design pressure of the tank or vessel.

(D) If any tank or pressure vessel has more than one fill or withdrawal connection and simultaneous filling or withdrawal can be made, the vent size shall be based on the maximum anticipated simultaneous flow.

(E) Unless the vent is designed to limit the internal pressure 2.5 p.s.i. or less, the outlet of vents and vent drains shall be arranged to discharge in such a manner as to prevent localized overheating of any part of the tank in the event vapors from such vents are ignited.

(F)

(1) Tanks and pressure vessels storing Category 1 flammable liquids shall be equipped with venting devices which shall be normally closed except when venting to pressure or vacuum conditions. Tanks and pressure vessels storing Category 2 flammable liquids and Category 3 flammable liquids with a flashpoint below 100 degrees F. (37.8 degrees C.) shall be equipped with venting devices which shall be normally closed except when venting under pressure or vacuum conditions, or with approved flame arresters.

(2) Exemption: Tanks of 3,000 bbls. (barrels) capacity or less containing crude petroleum in crude-producing areas and outside above ground atmospheric tanks under 1,000 gallons capacity containing other than Category 1 flammable liquids may have open vents. (See paragraph (b)(2)(vi)(B) of this section.)

(G) Flame arresters or venting devices required in paragraph (b)(2)(iv)(F) of this section may be omitted for Category 2 flammable liquids and Category 3 flammable liquids with a flashpoint below 100 degrees F. (37.8 degrees C.) where conditions are such that their use may, in case of obstruction, result in tank damage.

(v) Emergency relief venting for fire exposure for above ground tanks.

(A) Every above ground storage tank shall have some form of construction or device that will relieve excessive internal pressure caused by exposure fires.

(B) In a vertical tank the construction referred to in Subdivision (A) of this Subdivision may take the form of a floating roof, lifter roof, a weak roof-to-shell seam, or other approved pressure relieving construction. The weak roof-to-shell seam shall be constructed to fail preferential to any other seam.

(C) Where entire dependence for emergency relief is placed upon pressure relieving devices, the total venting capacity of both normal and emergency vents shall be enough to prevent rupture of the shell or bottom of the tank if vertical, or of the shell or heads if horizontal. If unstable liquids are stored, the effects of heat or gas resulting from polymerization, decomposition, condensation, or self-reactivity shall be taken into account. The total capacity of both normal and emergency venting devices shall be not less than that derived from Table H-10 except as provided in Subdivision (E) or (F) of this Subdivision. Such device may be a self-closing manhole cover, or one using long bolts that permit the cover to lift under internal pressure, or an additional or larger relief valve or valves. The wetted area of the tank shall be calculated on the basis of 55 percent of the total exposed area of a sphere or spheroid, 75 percent of the total exposed area of a horizontal tank and the first 30 feet above grade of the exposed shell area of a vertical tank.

Table H-10 Wetted Area Versus Cubic Feet Free Air Per Hour (14.7 psia and 60° F.)

Square feet	CFH	Square feet	CFH	Square feet	CFH
20	21,100	160	168,000	900	493,000
30	31,600	180	190,000	1,000	524,000
40	42,100	200	211,000	1,200	557,000
50	52,700	250	239,000	1,400	587,000
60	63,200	300	265,000	1,600	614,000
70	73,700	350	288,000	1,800	639,000
80	84,200	400	312,000	2,000	662,000
90	94,800	500	354,000	2,400	704,000
100	105,000	600	392,000	2,800	742,000
120	126,000	700	428,000	and over	
140	147,000	800	462,000		

(D) For tanks and storage vessels designed for pressure over 1 p.s.i.g., the total rate of venting shall be determined in accordance with Table H-10, except that when the exposed wetted area of the surface is greater than 2,800 square feet, the total rate of venting shall be calculated by the following formula:

$$CFH = 1{,}07A^{0.82}$$

Where:

CFH = Venting requirement, in cubic feet of free air per hour.

A = Exposed wetted surface, in square feet.

Note: The foregoing formula is based on Q = 21,000A0.82.

(E) The total emergency relief venting capacity for any specific stable liquid may be determined by the following formula:

$$V = 1337 \div L\sqrt{M}$$

V = Cubic feet of free air per hour from Table H-10.

L = Latent heat of vaporization of specific liquid in B.t.u. per pound.

M = Molecular weight of specific liquids.

(F) The required airflow rate of Subdivision (C) or (E) of this Subdivision may be multiplied by the appropriate factor listed in the following schedule when protection is provided as indicated. Only one factor may be used for any one tank.

0.5 for drainage in accordance with Subdivision (vii)(B) of this subparagraph for tanks over 200 square feet of wetted area.

0.3 for approved water spray.

0.3 for approved insulation.

0.15 for approved water spray with approved insulation.

(G) The outlet of all vents and vent drains on tanks equipped with emergency venting to permit pressures exceeding 2.5 p.s.i.g. shall be arranged to discharge in such a way as to prevent localized overheating of any part of the tank, in the event vapors from such vents are ignited.

(H) Each commercial tank venting device shall have stamped on it the opening pressure, the pressure at which the valve reaches the full open position, and the flow capacity at the latter pressure, expressed in cubic feet per hour of air at 60 degrees F. and at a pressure of 14.7 p.s.i.a.

(I) The flow capacity of tank venting devices 12 inches and smaller in nominal pipe size shall be determined by actual test of each type and size of vent. These flow tests may be conducted by the manufacturer if certified by a qualified impartial observer, or may be conducted by an outside agency. The flow capacity of tank venting devices larger than 12 inches nominal pipe size, including manhole covers with long bolts or equivalent, may be calculated provided that the opening pressure is actually measured, the rating pressure and corresponding free orifice area are stated, the word “calculated” appears on the nameplate, and the computation is based on a flow coefficient of 0.5 applied to the rated orifice area.

(vi) Vent piping for above ground tanks.

(A) Vent piping shall be constructed in accordance with paragraph (c) of this section.

(B) Where vent pipe outlets for tanks storing Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F. (37.8 degrees C.), are adjacent to buildings or public ways, they shall be located so that the vapors are released at a safe point outside of buildings and not less than 12 feet above the adjacent ground level. In order to aid their dispersion, vapors shall be discharged upward or horizontally away from closely adjacent walls. Vent outlets shall be located so that flammable vapors will not be trapped by eaves or other obstructions and shall be at least 5 feet from building openings.

(C) When tank vent piping is manifolded, pipe sizes shall be such as to discharge, within the pressure limitations of the system, the vapors they may be required to handle when manifolded tanks are subject to the same fire exposure.

(vii) Drainage, dikes, and walls for above ground tanks.

(A) Drainage and diked areas. The area surrounding a tank or a group of tanks shall be provided with drainage as in Subdivision (B) of this Subdivision, or shall be diked as provided in Subdivision (C) of this Subdivision, to prevent accidental discharge of liquid from endangering adjoining property or reaching waterways.

(B) Drainage. Where protection of adjoining property or waterways is by means of a natural or man-made drainage system, such systems shall comply with the following:

(1) (Reserved)

(2) The drainage system shall terminate in vacant land or other area or in an impounding basin having a capacity not smaller than that of the largest tank served. This termination area and the route of the drainage system shall be so located that, if the flammable liquids in the drainage system are ignited, the fire will not seriously expose tanks or adjoining property.

(C) Diked areas. Where protection of adjoining property or waterways is accomplished by retaining the liquid around the tank by means of a dike, the volume of the diked area shall comply with the following requirements:

(1) Except as provided in Subdivision *(2)* of this Subdivision, the volumetric capacity of the diked area shall not be less than the greatest amount of liquid that can be released from the largest tank within the diked area, assuming a full tank. The capacity of the diked area enclosing more than one tank shall be calculated by deducting the volume of the tanks other than the largest tank below the height of the dike.

(2) For a tank or group of tanks with fixed roofs containing crude petroleum with boilover characteristics, the volumetric capacity of the diked area shall be not less than the capacity of the largest tank served by the enclosure, assuming a full tank. The capacity of the diked enclosure shall be calculated by deducting the volume below the height of the dike of all tanks within the enclosure.

(3) Walls of the diked area shall be of earth, steel, concrete or solid masonry designed to be liquid-tight and to withstand a full hydrostatic head. Earthen walls 3 feet or more in height shall have a flat section at the top not less than 2 feet wide. The slope of an earthen wall shall be consistent with the angle of repose of the material of which the wall is constructed.

(4) The walls of the diked area shall be restricted to an average height of 6 feet above interior grade.

(5) (Reserved)

(6) No loose combustible material, empty or full drum or barrel, shall be permitted within the diked area.

(viii) Tank openings other than vents for above ground tanks.

(A) (Reserved)

(B) (Reserved)

(C) (Reserved)

(D) Openings for gaging shall be provided with a vapor-tight cap or cover.

(E) For Category 2 flammable liquids and Category 3 flammable liquids with a flashpoint below 100 degrees F. (37.8 degrees C.), other than crude oils, gasolines, and asphalts, the fill pipe shall be so designed and installed as to minimize the possibility of generating static electricity. A fill pipe entering the top of a tank shall terminate within 6 inches of the bottom of the tank and shall be installed to avoid excessive vibration.

(F) Filling and emptying connections which are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than 5 feet away from any building opening. Such connection shall be closed and liquid-tight when not in use. The connection shall be properly identified.

(3) Installation of underground tanks.

(i) Location. Excavation for underground storage tanks shall be made with due care to avoid undermining of foundations of existing structures. Underground tanks or tanks under buildings shall be so located with respect to existing building foundations and supports that the loads carried by the latter cannot be transmitted to the tank. The distance from any part of a tank storing Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), to the nearest wall of any basement or pit shall be not less than 1 foot, and to any property line that may be built upon, not less than 3 feet. The distance from any part of a tank storing Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) or Category 4 flammable liquids to the nearest wall of any basement, pit or property line shall be not less than 1 foot.

(ii) Depth and cover. Underground tanks shall be set on firm foundations and surrounded with at least 6 inches of noncorrosive, inert materials such as clean sand, earth, or gravel well tamped in place. The tank shall be placed in the hole with care since dropping or rolling the tank into the hole can break a weld, puncture or damage the tank, or scrape off the protective coating of coated tanks. Tanks shall be covered with a minimum of 2 feet of earth, or shall be covered with not less than 1 foot of earth, on top of which shall be placed a slab of reinforced concrete not less than 4 inches thick. When underground tanks are, or are likely to be, subject to traffic, they shall be protected against damage from vehicles passing over them by at least 3 feet of earth cover, or 18 inches of well-tamped earth, plus 6 inches of reinforced concrete or 8 inches of asphaltic concrete. When asphaltic or reinforced concrete paving is used as part of the protection, it shall extend at least 1 foot horizontally beyond the outline of the tank in all directions.

(iii) Corrosion protection. Corrosion protection for the tank and its piping shall be provided by one or more of the following methods:

(A) Use of protective coatings or wrappings;

(B) Cathodic protection; or,

(C) Corrosion resistant materials of construction.

(iv) Vents.

(A) Location and arrangement of vents for Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C). Vent pipes from tanks storing Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall be so located that the discharge point is outside of buildings, higher than the fill pipe opening, and not less than 12 feet above the adjacent ground level. Vent pipes shall discharge only upward in order to disperse vapors. Vent pipes 2 inches or less in nominal inside diameter shall not be obstructed by devices that will cause excessive back pressure. Vent pipe outlets shall be so located that flammable vapors will not enter building openings, or be trapped under eaves or other obstructions. If the vent pipe is less than 10 feet in length, or greater than 2 inches in nominal inside diameter, the outlet shall be provided with a vacuum and pressure relief device or there shall be an approved flame arrester located in the vent line at the outlet or within the approved distance from the outlet.

(B) Size of vents. Each tank shall be vented through piping adequate in size to prevent blow-back of vapor or liquid at the fill opening while the tank is being filled. Vent pipes shall be not less than 1 1/4-inch nominal inside diameter.

Table H-11 - Vent Line Diameters

Maximum flow GPM	Pipe length[1]		
	50 feet	100 feet	200 feet
	Inches	Inches	Inches
100	1 1/4	1 1/4	1 1/4
200	1 1/4	1 1/4	1 1/4
300	1 1/4	1 1/4	1 1/2
400	1 1/4	1 1/2	2
500	1 1/2	1 1/2	2
600	1 1/2	2	2
700	2	2	2
800	2	2	3
900	2	2	3
1000	2	2	3

[1] Vent lines of 50 feet, 100 feet, and 200 feet of pipe plus 7 ells.

(C) Location and arrangement of vents for Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) or Category 4 flammable liquids. Vent pipes from tanks storing Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) or Category 4 flammable liquids shall terminate outside of the building and higher than the fill pipe opening. Vent outlets shall be above normal snow level. They may be fitted with return bends, coarse screens or other devices to minimize ingress of foreign material.

(D) Vent piping shall be constructed in accordance with paragraph (C) of this section. Vent pipes shall be so laid as to drain toward the tank without sags or traps in which liquid can collect. They shall be located so that they will not be subjected to physical damage. The tank end of the vent pipe shall enter the tank through the top.

(E) When tank vent piping is manifolded, pipe sizes shall be such as to discharge, within the pressure limitations of the system, the vapors they may be required to handle when manifolded tanks are filled simultaneously.

(v) Tank openings other than vents.

(A) Connections for all tank openings shall be vapor or liquid-tight.

(B) Openings for manual gaging, if independent of the fill pipe, shall be provided with a liquid-tight cap or cover. If inside a building, each such opening shall be protected against liquid overflow and possible vapor release by means of a spring loaded check valve or other approved device.

(C) Fill and discharge lines shall enter tanks only through the top. Fill lines shall be sloped toward the tank.

(D) For Category 2 flammable liquids and Category 3 flammable liquids with a flashpoint below 100 degrees F. (37.8 degrees C.), other than crude oils, gasolines, and asphalts, the fill pipe shall be so designed and installed as to minimize the possibility of generating static electricity by terminating within 6 inches of the bottom of the tank.

(E) Filling and emptying connections which are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than 5 feet away from any building opening. Such connection shall be closed and liquid-tight when not in use. The connection shall be properly identified.

(4) Installation of tanks inside of buildings.

(i) Location. Tanks shall not be permitted inside of buildings except as provided in paragraphs (e), (g), (h), or (i) of this section.

(ii) Vents. Vents for tanks inside of buildings shall be as provided in subparagraphs (2)(iv), (v), (vi)(B), and (3)(iv) of this paragraph, except that emergency venting by the use of weak roof seams on tanks shall not be permitted. Vents shall discharge vapors outside the buildings.

(iii) Vent piping. Vent piping shall be constructed in accordance with paragraph (c) of this section.

(iv) Tank openings other than vents.

(A) Connections for all tank openings shall be vapor or liquid-tight. Vents are covered in Subdivision (ii) of this subparagraph.

(B) Each connection to a tank inside of buildings through which liquid can normally flow shall be provided with an internal or an external valve located as close as practical to the shell of the tank. Such valves, when external, and their connections to the tank shall be of steel except when the chemical characteristics of the liquid stored are incompatible with steel. When materials other than steel are necessary, they shall be suitable for the pressures, structural stresses, and temperatures involved, including fire exposures.

(C) Flammable liquid tanks located inside of buildings, except in one-story buildings designed and protected for flammable liquid storage, shall be provided with an automatic-closing heat-actuated valve on each withdrawal connection below the liquid level, except for connections used for emergency disposal, to prevent continued flow in the event of fire in the vicinity of the tank. This function may be incorporated in the valve required in (B) of this Subdivision, and if a separate valve, shall be located adjacent to the valve required in (b) of this Subdivision.

(D) Openings for manual gaging, if independent of the fill pipe (see (F) of this Subdivision), shall be provided with a vapor-tight cap or cover. Each such opening shall be protected against liquid overflow and possible vapor release by means of a spring-loaded check valve or other approved device.

(E) For Category 2 flammable liquids and Category 3 flammable liquids with a flashpoint below 100 degrees F (37.7 degrees C) other than crude oils, gasoline, and asphalts, the fill pipe shall be so designed and installed as to minimize the possibility of generating static electricity by terminating within 6 inches of the bottom of the tank.

(F) The fill pipe inside of the tank shall be installed to avoid excessive vibration of the pipe.

(G) The inlet of the fill pipe shall be located outside of buildings at a location free from any source of ignition and not less than 5 feet away from any building opening. The inlet of the fill pipe shall be closed and liquid-tight when not in use. The fill connection shall be properly identified.

(H) Tanks inside buildings shall be equipped with a device, or other means shall be provided, to prevent overflow into the building.

(5) Supports, foundations, and anchorage for all tank locations.

(i) General. Tank supports shall be installed on firm foundations. Tank supports shall be of concrete, masonry, or protected steel. Single wood timber supports (not cribbing) laid horizontally may be used for outside above ground tanks if not more than 12 inches high at their lowest point.

(ii) Fire resistance. Steel supports or exposed piling shall be protected by materials having a fire resistance rating of not less than 2 hours, except that steel saddles need not be protected if less than 12 inches high at their lowest point. Water spray protection or its equivalent may be used in lieu of fire-resistive materials to protect supports.

(iii) Spheres. The design of the supporting structure for tanks such as spheres shall receive special engineering consideration.

(iv) Load distribution. Every tank shall be so supported as to prevent the excessive concentration of loads on the supporting portion of the shell.

(v) Foundations. Tanks shall rest on the ground or on foundations made of concrete, masonry, piling, or steel. Tank foundations shall be designed to minimize the possibility of uneven settling of the tank and to minimize corrosion in any part of the tank resting on the foundation.

(vi) Flood areas. Where a tank is located in an area that may be subjected to flooding, the applicable precautions outlined in this Subdivision shall be observed.

(A) No above ground vertical storage tank containing a flammable liquid shall be located so that the allowable liquid level within the tank is below the established maximum flood stage, unless the tank is provided with a guiding structure such as described in (M), (N), and (O) of this Subdivision.

(B) Independent water supply facilities shall be provided at locations where there is no ample and dependable public water supply available for loading partially empty tanks with water.

(C) In addition to the preceding requirements, each tank so located that more than 70 percent, but less than 100 percent, of its allowable liquid storage capacity will be submerged at the established maximum flood stage, shall be safeguarded by one of the following methods: Tank shall be raised, or its height shall be increased, until its top extends above the maximum flood stage a distance equivalent to 30 percent or more of its allowable liquid storage capacity: Provided, however, That the submerged part of the tank shall not exceed 2 1/2 times the diameter. Or, as an alternative to the foregoing, adequate noncombustible structural guides, designed to permit the tank to float vertically without loss of product, shall be provided.

(D) Each horizontal tank so located that more than 70 percent of its storage capacity will be submerged at the established flood stage, shall be anchored, attached to a foundation of concrete or of steel and concrete, of sufficient weight to provide adequate load for the tank when filled with flammable liquid and submerged by floodwaters to the established flood stage, or adequately secured by other means.

(E) (Reserved)

(F) At locations where there is no ample and dependable water supply, or where filling of underground tanks with liquids is impracticable because of the character of their contents, their use, or for other reasons, each tank shall be safeguarded against movement when empty and submerged by high ground water or floodwaters by anchoring, weighting with concrete or other approved solid loading material, or securing by other means. Each such tank shall be so constructed and installed that it will safely resist external pressures due to high ground water or floodwaters.

(G) At locations where there is an ample and dependable water supply available, underground tanks containing flammable liquids, so installed that more than 70 percent of their storage capacity will be submerged at the maximum flood stage, shall be so anchored, weighted, or secured by other means, as to prevent movement of such tanks when filled with flammable liquids, and submerged by floodwaters to the established flood stage.

(H) Pipe connections below the allowable liquid level in a tank shall be provided with valves or cocks located as closely as practicable to the tank shell. Such valves and their connections to tanks shall be of steel or other material suitable for use with the liquid being stored. Cast iron shall not be permitted.

(I) At locations where an independent water supply is required, it shall be entirely independent of public power and water supply. Independent source of water shall be available when floodwaters reach a level not less than 10 feet below the bottom of the lowest tank on a property.

(J) The self-contained power and pumping unit shall be so located or so designed that pumping into tanks may be carried on continuously throughout the rise in floodwaters from a level 10 feet below the lowest tank to the level of the potential flood stage.

(K) Capacity of the pumping unit shall be such that the rate of rise of water in all tanks shall be equivalent to the established potential average rate of rise of floodwaters at any stage.

(L) Each independent pumping unit shall be tested periodically to insure that it is in satisfactory operating condition.

(M) Structural guides for holding floating tanks above their foundations shall be so designed that there will be no resistance to the free rise of a tank, and shall be constructed of noncombustible material.

(N) The strength of the structure shall be adequate to resist lateral movement of a tank subject to a horizontal force in any direction equivalent to not less than 25 pounds per square foot acting on the projected vertical cross-sectional area of the tank.

(O) Where tanks are situated on exposed points or bends in a shoreline where swift currents in floodwaters will be present, the structures shall be designed to withstand a unit force of not less than 50 pounds per square foot.

(P) The filling of a tank to be protected by water loading shall be started as soon as floodwaters reach a dangerous flood stage. The rate of filling shall be at least equal to the rate of rise of the floodwaters (or the established average potential rate of rise).

(Q) Sufficient fuel to operate the water pumps shall be available at all times to ensure adequate power to fill all tankage with water.

(R) All valves on connecting pipelines shall be closed and locked in closed position when water loading has been completed.

(S) Where structural guides are provided for the protection of floating tanks, all rigid connections between tanks and pipelines shall be disconnected and blanked off or blinded before the floodwaters reach the bottom of the tank, unless control valves and their connections to the tank are of a type designed to prevent breakage between the valve and the tank shell.

(T) All valves attached to tanks other than those used in connection with water loading operations shall be closed and locked.

(U) If a tank is equipped with a swing line, the swing pipe shall be raised to and secured at its highest position.

(V) Inspections. The Assistant Secretary or his designated representative shall make periodic inspections of all plants where the storage of flammable liquids is such as to require compliance with the foregoing requirements, in order to assure the following:

(1) That all flammable liquid storage tanks are in compliance with these requirements and so maintained.

(2) That detailed printed instructions of what to do in flood emergencies are properly posted.

(3) That station operators and other employees depended upon to carry out such instructions are thoroughly informed as to the location and operation of such valves and other equipment necessary to effect these requirements.

(vii) Earthquake areas. In areas subject to earthquakes, the tank supports and connections shall be designed to resist damage as a result of such shocks.

(6) Sources of ignition. In locations where flammable vapors may be present, precautions shall be taken to prevent ignition by eliminating or controlling sources of ignition. Sources of ignition may include open flames, lightning, smoking, cutting and welding, hot surfaces, frictional heat, sparks (static, electrical, and mechanical), spontaneous ignition, chemical and physical-chemical reactions, and radiant heat.

(7) Testing.

(i) General. All tanks, whether shop built or field erected, shall be strength tested before they are placed in service in accordance with the applicable paragraphs of the code under which they were built. The American Society of Mechanical Engineers (ASME) code stamp, American Petroleum Institute (API) monogram, or the label of the Underwriters' Laboratories, Inc., on a tank shall be evidence of compliance with this strength test. Tanks not marked in accordance with the above codes shall be strength tested before they are placed in service in accordance with good engineering principles and reference shall be made to the sections on testing in the codes listed in subparagraphs (1)(iii)(A), (iv)(B), or (v)(B) of this paragraph.

(ii) Strength. When the vertical length of the fill and vent pipes is such that when filled with liquid the static head imposed upon the bottom of the tank exceeds 10 pounds per square inch, the tank and related piping shall be tested hydrostatically to a pressure equal to the static head thus imposed.

(iii) Tightness. In addition to the strength test called for in Subdivisions (i) and (ii) of this subparagraph, all tanks and connections shall be tested for tightness. Except for underground tanks, this tightness test shall be made at operating pressure with air, inert gas, or water prior to placing the tank in service. In the case of field-erected tanks the strength test may be considered to be the test for tank tightness. Underground tanks and piping, before being covered, enclosed, or placed in use, shall be tested for tightness hydrostatically, or with air pressure at not less than 3 pounds per square inch and not more than 5 pounds per square inch.

(iv) Repairs. All leaks or deformations shall be corrected in an acceptable manner before the tank is placed in service. Mechanical caulking is not permitted for correcting leaks in welded tanks except pinhole leaks in the roof.

(v) Derated operations. Tanks to be operated at pressures below their design pressure may be tested by the applicable provisions of Subdivision (i) or (ii) of this subparagraph, based upon the pressure developed under full emergency venting of the tank.

(c) Piping, valves, and fittings.

(1) General.

(i) Design. The design (including selection of materials) fabrication, assembly, test, and inspection of piping systems containing flammable liquids shall be suitable for the expected working pressures and structural stresses. Conformity with the applicable provisions of Pressure Piping, ANSI B31 series and the provisions of this paragraph, shall be considered prima facie evidence of compliance with the foregoing provisions.

(ii) Exceptions. This paragraph does not apply to any of the following:

(A) Tubing or casing on any oil or gas wells and any piping connected directly thereto.

(B) Motor vehicle, aircraft, boat, or portable or stationary engines.

(C) Piping within the scope of any applicable boiler and pressures vessel code.

(iii) Definitions. As used in this paragraph, piping systems consist of pipe, tubing, flanges, bolting, gaskets, valves, fittings, the pressure containing parts of other components such as expansion joints and strainers, and devices which serve such purposes as mixing, separating, snubbing, distributing, metering, or controlling flow.

(2) Materials for piping, valves, and fittings.

(i) Required materials. Materials for piping, valves, or fittings shall be steel, nodular iron, or malleable iron, except as provided in paragraph (c)(2)(ii), (iii) and (iv) of this section.

(ii) Exceptions. Materials other than steel, nodular iron, or malleable iron may be used underground, or if required by the properties of the flammable liquid handled. Material other than steel, nodular iron, or malleable iron shall be designed to specifications embodying principles recognized as good engineering practices for the material used.

(iii) Linings. Piping, valves, and fittings may have combustible or noncombustible linings.

(iv) Low-melting materials. When low-melting point materials such as aluminum and brass or materials that soften on fire exposure such as plastics, or nonductile materials such as cast iron, are necessary, special consideration shall be given to their behavior on fire exposure. If such materials are used in above ground piping systems or inside buildings, they shall be suitably protected against fire exposure or so located that any spill resulting from the failure of these materials could not unduly expose persons, important buildings or structures or can be readily controlled by remote valves.

(3) Pipe joints. Joints shall be made liquid-tight. Welded or screwed joints or approved connectors shall be used. Threaded joints and connections shall be made up tight with a suitable lubricant or piping compound. Pipe joints dependent upon the friction characteristics of combustible materials for mechanical continuity of piping shall not be used inside buildings. They may be used outside of buildings above or below ground. If used above ground, the piping shall either be secured to prevent disengagement at the fitting or the piping system shall be so designed that any spill resulting from such disengagement could not unduly expose persons, important buildings or structures, and could be readily controlled by remote valves.

(4) Supports. Piping systems shall be substantially supported and protected against physical damage and excessive stresses arising from settlement, vibration, expansion, or contraction.

(5) Protection against corrosion. All piping for flammable liquids, both above ground and underground, where subject to external corrosion, shall be painted or otherwise protected.

(6) Valves. Piping systems shall contain a sufficient number of valves to operate the system properly and to protect the plant. Piping systems in connection with pumps shall contain a sufficient number of valves to control properly the flow of liquid in normal operation and in the event of physical damage. Each connection to pipelines, by which equipment such as tankcars or tank vehicles discharge liquids by means of pumps into storage tanks, shall be provided with a check valve for automatic protection against backflow if the piping arrangement is such that backflow from the system is possible.

(7) Testing. All piping before being covered, enclosed, or placed in use shall be hydrostatically tested to 150 percent of the maximum anticipated pressure of the system, or pneumatically tested to 110 percent of the maximum anticipated pressure of the system, but not less than 5 pounds per square inch gage at the highest point of the system. This test shall be maintained for a sufficient time to complete visual inspection of all joints and connections, but for at least 10 minutes.

(d) Container and portable tank storage.

(1) Scope.

(i) General. This paragraph shall apply only to the storage of flammable 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.

(ii) Exceptions. This paragraph shall not apply to the following:

(A) Storage of containers in bulk plants, service stations, refineries, chemical plants, and distilleries;

(B) Category 1, 2, or 3 flammable liquids in the fuel tanks of a motor vehicle, aircraft, boat, or portable or stationary engine;

(C) Flammable paints, oils, varnishes, and similar mixtures used for painting or maintenance when not kept for a period in excess of 30 days;

(D) Beverages when packaged in individual containers not exceeding 1-gallon in size.

(2) Design, construction, and capacity of containers.

(i) General. Only approved containers and portable tanks shall be used. Metal containers and portable tanks meeting the requirements of and containing products authorized by Chapter I, Title 49 of the Code of Federal Regulations (regulations issued by the Hazardous Materials Regulations Board, Department of Transportation), shall be deemed to be acceptable.

(ii) Emergency venting. 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 to 10 p.s.i.g., or 30 percent of the bursting pressure of the tank, whichever is greater. The total venting capacity shall be not less than that specified in paragraphs (b)(2)(v)(C) or (E) of this section. At least one pressure-activated vent having a minimum capacity of 6,000 cubic feet of free air (14.7 p.s.i.a. and 60 degrees F.) shall be used. It shall be set to open at not less than 5 p.s.i.g. If fusible vents are used, they shall be actuated by elements that operate at a temperature not exceeding 300 degrees F.

(iii) Size. Flammable liquid containers shall be in accordance with Table H-12, except that glass or plastic containers of no more than 1-gallon capacity may be used for a Category 1 or 2 flammable liquid if:

(A)

(1) Such liquid either would be rendered unfit for its intended use by contact with metal or would excessively corrode a metal container so as to create a leakage hazard; and

(2) The user's process either would require more than 1 pint of a Category 1 flammable liquid or more than 1 quart of a Category 2 flammable liquid of a single assay lot to be used at one time, or would require the maintenance of an analytical standard liquid of a quality which is not met by the specified standards of liquids available, and the quantity of the analytical standard liquid required to be used in any one control process exceeds 1/16 the capacity of the container allowed under Table H-12 for the class of liquid; or

(B) The containers are intended for direct export outside the United States.

Table H-12 - Maximum Allowable Size of Containers and Portable Tanks for Flammable Liquids

Container type	Category 1	Category 2	Category 3	Category 4
Glass or approved plastic	1 pt	1 qt	1 gal	1 gal
Metal (other than DOT drums)	1 gal	5 gal	5 gal	5 gal
Safety cans	2 gal	5 gal	5 gal	5 gal
Metal drums (DOT specifications)	60 gal	60 gal	60 gal	60 gal
Approved portable tanks	660 gal	660 gal	660 gal	660 gal

Note: Container exemptions: 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).

(3) Design, construction, and capacity of storage cabinets.

(i) Maximum capacity. Not more than 60 gallons of Category 1, 2, or 3 flammable liquids, nor more than 120 gallons of Category 4 flammable liquids may be stored in a storage cabinet.

(ii) Fire resistance. Storage cabinets shall be designed and constructed to limit the internal temperature to not more than 325 degrees F. when subjected to a 10-minute fire test using the standard time-temperature curve as set forth in Standard Methods of Fire Tests of Building Construction and Materials, NFPA 251-1969, which is incorporated by reference as specified in 1910.6. All joints and seams shall remain tight and the door shall remain securely closed during the fire test. Cabinets shall be labeled in conspicuous lettering, “Flammable – Keep Fire Away.”

(A) Metal cabinets constructed in the following manner shall be deemed to be in compliance. The bottom, top, door, and sides of cabinet shall be at least No. 18 gage sheet iron and double walled with 1 1/2-inch air space. Joints shall be riveted, welded or made tight by some equally effective means. The door shall be provided with a three-point lock, and the door sill shall be raised at least 2 inches above the bottom of the cabinet.

(B) Wooden cabinets constructed in the following manner shall be deemed in compliance. The bottom, sides, and top shall be constructed of an approved grade of plywood at least 1 inch in thickness, which shall not break down or delaminate under fire conditions. All joints shall be rabbetted and shall be fastened in two directions with flathead wood screws. When more than one door is used, there shall be a rabbetted overlap of not less than 1 inch. Hinges shall be mounted in such a manner as not to lose their holding capacity due to loosening or burning out of the screws when subjected to the fire test.

(4) Design and construction of inside storage rooms.

(i) Construction. Inside storage rooms shall be constructed to meet the required fire-resistive rating for their use. Such construction shall comply with the test specifications set forth in Standard Methods of Fire Tests of Building Construction and Materials, NFPA 251-1969. Where an automatic sprinkler system is provided, the system shall be designed and installed in an acceptable manner. Openings to other rooms or buildings shall be provided with noncombustible liquid-tight raised sills or ramps at least 4 inches in height, or the floor in the storage area shall be at least 4 inches below the surrounding floor. Openings shall be provided with approved self-closing fire doors. The room shall be liquid-tight where the walls join the floor. A permissible alternate to the sill or ramp is an open-grated trench inside of the room which drains to a safe location. Where other portions of the building or other properties are exposed, windows shall be protected as set forth in the Standard for Fire Doors and Windows, NFPA No. 80-1968, which is incorporated by reference as specified in 1910.6, for Class E or F openings. Wood at least 1-inch nominal thickness may be used for shelving, racks, dunnage, scuffboards, floor overlay, and similar installations.

(ii) Rating and capacity. Storage in inside storage rooms shall comply with Table H-13.

Table H-13 - Storage in Inside Rooms

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.	5
Yes	1 hour	150 sq. ft.	4
No	1 hour	150 sq. ft.	2

[1]Fire protection system shall be sprinkler, water spray, carbon dioxide, or other system.

(iii) Wiring. Electrical wiring and equipment located in inside storage rooms used for Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall be approved under Subpart S of this part for Class I, Division 2 Hazardous Locations; for Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) and Category 4 flammable liquids shall be approved for general use.

(iv) Ventilation. Every inside storage room shall be provided with either a gravity or a mechanical exhaust ventilation system. Such system shall be designed to provide for a complete change of air within the room at least six times per hour. If a mechanical exhaust system is used, it shall be controlled by a switch located outside of the door. The ventilating equipment and any lighting fixtures shall be operated by the same switch. A pilot light shall be installed adjacent to the switch if Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C) are dispensed within the room. Where gravity ventilation is provided, the fresh air intake, as well as the exhaust outlet from the room, shall be on the exterior of the building in which the room is located.

(v) Storage in inside storage rooms. In every inside storage room there shall be maintained 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.

(5) Storage inside building.

(i) Egress. Flammable liquids, including stock for sale, shall not be stored so as to limit use of exits, stairways, or areas normally used for the safe egress of people.

(ii) Containers. The storage of flammable liquids in containers or portable tanks shall comply with Subdivisions (iii) through (v) of this subparagraph.

(iii) Office occupancies. Storage shall be prohibited except that which is required for maintenance and operation of building and operation of equipment. Such storage shall be kept in closed metal containers stored in a storage cabinet or in safety cans or in an inside storage room not having a door that opens into that portion of the building used by the public.

(iv) Mercantile occupancies and other retail stores.

(A) (Reserved)

(B) (Reserved)

(C) (Reserved)

(D) (Reserved)

(E) Leaking containers shall be removed to a storage room or taken to a safe location outside the building and the contents transferred to an undamaged container.

(v) General purpose public warehouses. Storage shall be in accordance with Table H-14 or H-15 and in buildings or in portions of such buildings cut off by standard firewalls. Material creating no fire exposure hazard to the flammable liquids may be stored in the same area.

Table H-14 - Indoor Container Storage

Category liquid	Storage level	Gallons	
		Protected storage maximum per pile	Unprotected storage maximum per pile
1	Ground and upper floors	2,750 (50)	660 (12)
	Basement	Not permitted	Not permitted
2	Ground and upper floors	5,500 (100)	1,375 (25)
	Basement	Not permitted	Not permitted
3 FP<100 F	Ground and upper floors	16,500 (300)	4,125 (75)
	Basement	Not permitted	Not permitted
3 FP≥100 F	Ground and upper floors	16,500 (300)	4,125 (75)
	Basement	5,500 (100)	Not permitted
4	Ground and upper floors	55,000 (1,000)	13,750 (250)
	Basement	8,250 (450)	Not permitted

Note 1: When 2 or more categories of materials are stored in a single pile, the maximum gallonage permitted in that pile shall be the smallest of the 2 or more separate maximum gallonages.

Note 2: Aisles shall be provided so that no container is more than 12 feet from an aisle. Main aisles shall be at least 3 feet wide and side aisles at least 4 feet wide.

Note 3: Each pile shall be separated from each other by at least 4 feet.

Note 4: FP means flashpoint.

(Numbers in parentheses indicate corresponding number of 55-gallon drums.)

Table H-15 - Indoor Portable Tank Storage

Category liquid	Storage level	Gallons	
		Protected storage maximum per pile	**Unprotected storage maximum per pile**
1	Ground and upper floors	Not permitted	Not permitted
	Basement	Not permitted	Not permitted
2	Ground and upper floors	20,000	2,000
	Basement	Not permitted	Not permitted
3 FP<100 F	Ground and upper floors	40,000	5,500
	Basement	Not permitted	Not permitted
3 FP≥100 F	Ground and upper floors	40,000	5,500
	Basement	20,000	Not permitted
4	Ground and upper floors	60,000	22,000
	Basement	20,000	Not permitted

Note 1: When 1 or more categories of materials are stored in a single pile, the maximum gallonage permitted in that pile shall be the smallest of the 2 or more separate maximum gallonages.

Note 2: Aisles shall be provided so that no portable tank is more than 12 feet from an aisle. Main aisles shall be at least 8 feet wide and side aisles at least 4 feet wide.

Note 3: Each pile shall be separated from each other by at least 4 feet.

Note 4: FP means flashpoint.

(vi) Flammable liquid warehouses or storage buildings.

(A) If the storage building is located 50 feet or less from a building or line of adjoining property that may be built upon, the exposing wall shall be a blank wall having a fire-resistance rating of at least 2 hours.

(B) The total quantity of liquids within a building shall not be restricted, but the arrangement of storage shall comply with Table H-14 or H-15.

(C) Containers in piles shall be separated by pallets or dunnage where necessary to provide stability and to prevent excessive stress on container walls.

(D) Portable tanks stored over one tier high shall be designed to nest securely, without dunnage, and adequate materials handing equipment shall be available to handle tanks safely at the upper tier level.

(E) No pile shall be closer than 3 feet to the nearest beam, chord, girder, or other obstruction, and shall be 3 feet below sprinkler deflectors or discharge orifices of water spray, or other overhead fire protection systems.

(F) Aisles of at least 3 feet wide shall be provided where necessary for reasons of access to doors, windows or standpipe connections.

(6) Storage outside buildings.

(i) General. Storage outside buildings shall be in accordance with Table H-16 or H-17, and Subdivisions (ii) and (iv) of this subparagraph.

Table H-16 - Outdoor Container Storage

1 – Category	2 – Maximum per pile	3 – Distance between piles	4 – Distance to property line that can be built upon	5 – Distance to street, alley, public way
	gallons	feet	feet	feet
1	1,100	5	20	10
2	2,200	5	20	10
3 FP<100 F	4,400	5	20	10
3 FP≥100 F	8,800	5	10	5
4	22,000	5	10	5

Note 1: When 2 or more categories of materials are stored in a single pile, the maximum gallonage in that pile shall be the smallest of the 2 or more separate gallonages.

Note 2: Within 200 feet of each container, there shall be a 12-foot wide access way to permit approach of fire control apparatus.

Note 3: The distances listed apply to properties that have protection for exposures as defined. If there are exposures, and such protection for exposures does not exist, the distances in column 4 shall be doubled.

Note 4: When total quantity stored does not exceed 50 percent of maximum per pile, the distances in columns 4 and 5 may be reduced 50 percent, but not less than 3 feet.

Note 5: FP means flashpoint.

(ii) Maximum storage. A maximum of 1,100 gallons of flammable liquids may be located adjacent to buildings located on the same premises and under the same management provided the provisions of Subdivisions (A) and (B) of this Subdivision are complied with.

(A) (Reserved)

(B) Where quantity stored exceeds 1,100 gallons, or provisions of Subdivision (A) of this Subdivision cannot be met, a minimum distance of 10 feet between buildings and nearest container of flammable liquid shall be maintained.

(iii) Spill containment. The storage area shall be graded in a manner to divert possible spills away from buildings or other exposures or shall be surrounded by a curb at least 6 inches high. When curbs are used, provisions shall be made for draining of accumulations of ground or rainwater or spills of flammable liquids. Drains shall terminate at a safe location and shall be accessible to operation under fire conditions.

(iv) Security. The storage area shall be protected against tampering or trespassers where necessary and shall be kept free of weeds, debris and other combustible material not necessary to the storage.

(7) Fire control.

(i) Extinguishers. Suitable fire control devices, such as small hose or portable fire extinguishers, shall be available at locations where flammable liquids are stored.

Table H-17 - Outdoor Portable Tank Storage

1 – Category	2 – Maximum per mile	3 – Distance between piles	4 – Distance to property line that can be built upon	5 – Distance to street, alley, public way
	gallons	feet	feet	feet
1	2,200	5	20	10
2	4,400	5	20	10
3 FP<100 F	8,800	5	20	10
3 FP≥100 F	17,600	5	10	5
4	44,000	5	10	5

Note 1: When 2 or more categories of materials are stored in a single pile, the maximum gallonage in that pile shall be the smallest of the 2 or more separate gallonages.

Note 2: Within 200 feet of each container, there shall be a 12-foot wide access way to permit approach of fire control apparatus.

Note 3: The distances listed apply to properties that have protection for exposures as defined. If there are exposures, and such protection for exposures does not exist, the distances in column 4 **shall be doubled.**

Note 4: When total quantity stored does not exceed 50 percent of maximum per pile, the distances in columns 4 and 5 may be reduced 50 percent, but not less than 3 feet.

Note 5: FP means flashpoint.

(A) At least one portable fire extinguisher having a rating of not less than 12-B units shall be located outside of, but not more than 10 feet from, the door opening into any room used for storage.

(B) At least one portable fire extinguisher having a rating of not less than 12-B units must be located not less than 10 feet, nor more than 25 feet, from any Category 1, 2 or 3 flammable liquid storage area located outside of a storage room but inside a building.

(ii) Sprinklers. When sprinklers are provided, they shall be installed in accordance with 1910.159.

(iii) Open flames and smoking. Open flames and smoking shall not be permitted in flammable liquid storage areas.

(iv) Water reactive materials. Materials which will react with water shall not be stored in the same room with flammable liquids.

(e) Industrial plants.

(1) Scope.

(i) Application. This paragraph shall apply to those industrial plants where:

(A) The use of flammable liquids is incidental to the principal business, or

(B) Where flammable liquids are handled or used only in unit physical operations such as mixing, drying, evaporating, filtering, distillation, and similar operations which do not involve chemical reaction. This paragraph shall not apply to chemical plants, refineries or distilleries.

(ii) Exceptions. Where portions of such plants involve chemical reactions such as oxidation, reduction, halogenation, hydrogenation, alkylation, polymerization, and other chemical processes, those portions of the plant shall be in accordance with paragraph (h) of this section.

(2) Incidental storage or use of flammable liquids.

(i) Application. This subparagraph shall be applicable to those portions of an industrial plant where the use and handling of flammable liquids is only incidental to the principal business, such as automobile assembly, construction of electronic equipment, furniture manufacturing, or other similar activities.

(ii) Containers. Flammable liquids shall be stored in tanks or closed containers.

(A) Except as provided in Subdivisions (B) and (C) of this Subdivision, all storage shall comply with paragraph (d)(3) or (4) of this section.

(B) The quantity of liquid that may be located outside of an inside storage room or storage cabinet in a building or in any one fire area of a building shall not exceed:

(1) 25 gallons of Category 1 flammable liquids in containers

(2) 120 gallons of Category 2, 3, or 4 flammable liquids in containers

(3) 660 gallons of Category 2, 3, or 4 flammable liquids in a single portable tank.

(C) Where large quantities of flammable liquids are necessary, storage may be in tanks which shall comply with the applicable requirements of paragraph (b) of this section.

(iii) Separation and protection. Areas in which flammable liquids are transferred from one tank or container to another container shall be separated from other operations in the building by adequate distance or by construction having adequate fire resistance. Drainage or other means shall be provided to control spills. Adequate natural or mechanical ventilation shall be provided.

(iv) Handling liquids at point of final use.

(A) Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall be kept in covered containers when not actually in use.

(B) Where flammable liquids are used or handled, except in closed containers, means shall be provided to dispose promptly and safely of leakage or spills.

(C) Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), may be used only where there are no open flames or other sources of ignition within the possible path of vapor travel.

(D) Flammable liquids shall be drawn from or transferred into vessels, containers, or portable tanks within a building only through a closed piping system, from safety cans, by means of a device drawing through the top, or from a container or portable tanks by gravity through an approved self-closing valve. Transferring by means of air pressure on the container or portable tanks shall be prohibited.

(3) Unit physical operations.

(i) Application. This subparagraph shall be applicable in those portions of industrial plants where flammable liquids are handled or used in unit physical operations such as mixing, drying, evaporating, filtering, distillation, and similar operations which do not involve chemical change. Examples are plants compounding cosmetics, pharmaceuticals, solvents, cleaning fluids, insecticides, and similar types of activities.

(ii) Location. Industrial plants shall be located so that each building or unit of equipment is accessible from at least one side for firefighting and fire control purposes. Buildings shall be located with respect to lines of adjoining property which may be built upon as set forth in paragraph (h)(2)(i) and (ii) of this section except that the blank wall referred to in paragraph (h)(2)(ii) of this section shall have a fire resistance rating of at least 2 hours.

(iii) Chemical processes. Areas where unstable liquids are handled or small scale unit chemical processes are carried on shall be separated from the remainder of the plant by a fire wall of 2-hour minimum fire resistance rating.

(iv) Drainage.

(A) Emergency drainage systems shall be provided to direct flammable liquid leakage and fire protection water to a safe location. This may require curbs, scuppers, or special drainage systems to control the spread of fire; see paragraph (b)(2)(vii)(B) of this section.

(B) Emergency drainage systems, if connected to public sewers or discharged into public waterways, shall be equipped with traps or separator.

(v) Ventilation.

(A) Areas as defined in paragraph (e)(3)(i) of this section using Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall be ventilated at a rate of not less than 1 cubic foot per minute per square foot of solid floor area. This shall be accomplished by natural or mechanical ventilation with discharge or exhaust to a safe location outside of the building. Provision shall be made for introduction of makeup air in such a manner as not to short circuit the ventilation. Ventilation shall be arranged to include all floor areas or pits where flammable vapors may collect.

(B) Equipment used in a building and the ventilation of the building shall be designed so as to limit flammable vapor-air mixtures under normal operating conditions to the interior of equipment, and to not more than 5 feet from equipment which exposes Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), to the air. Examples of such equipment are dispensing stations, open centrifuges, plate and frame filters, open vacuum filters, and surfaces of open equipment.

(vi) Storage and handling. The storage, transfer, and handling of liquid shall comply with paragraph (h)(4) of this section.

(4) Tank vehicle and tank car loading and unloading.

(i) Tank vehicle and tank car loading or unloading facilities shall be separated from above ground tanks, warehouses, other plant buildings or nearest line of adjoining property which may be built upon by a distance of 25 feet for Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), and 15 feet for Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) and Category 4 flammable liquids, measured from the nearest position of any fill stem. Buildings for pumps or shelters for personnel may be a part of the facility. Operations of the facility shall comply with the appropriate portions of paragraph (f)(3) of this section.

(ii) (Reserved)

(5) Fire control.

(i) Portable and special equipment. Portable fire extinguishment and control equipment shall be provided in such quantities and types as are needed for the special hazards of operation and storage.

(ii) Water supply. Water shall be available in volume and at adequate pressure to supply water hose streams, foam-producing equipment, automatic sprinklers, or water spray systems as the need is indicated by the special hazards of operation, dispensing and storage.

(iii) Special extinguishers. Special extinguishing equipment such as that utilizing foam, inert gas, or dry chemical shall be provided as the need is indicated by the special hazards of operation dispensing and storage.

(iv) Special hazards. Where the need is indicated by special hazards of operation, flammable liquid processing equipment, major piping, and supporting steel shall be protected by approved water spray systems, deluge systems, approved fire-resistant coatings, insulation, or any combination of these.

(v) Maintenance. All plant fire protection facilities shall be adequately maintained and periodically inspected and tested to make sure they are always in satisfactory operating condition, and they will serve their purpose in time of emergency.

(6) Sources of ignition.

(i) General. Adequate precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include 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.

(ii) Grounding. Category 1 or 2 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall not be dispensed into containers unless the nozzle and container are electrically interconnected. Where the metallic floorplate on which the container stands while filling is electrically connected to the fill stem or where the fill stem is bonded to the container during filling operations by means of a bond wire, the provisions of this section shall be deemed to have been complied with.

(7) Electrical.

(i) Equipment.

(A) All electrical wiring and equipment shall be installed according to the requirements of Subpart S of this part.

(B) Locations where flammable vapor-air mixtures may exist under normal operations shall be classified Class I, Division 1 according to the requirements of Subpart S of this part. For those pieces of equipment installed in accordance with subparagraph (3)(v)(B) of this paragraph, the Division 1 area shall extend 5 feet in all directions from all points of vapor liberation. All areas within pits shall be classified Division 1 if any part of the pit is within a Division 1 or 2 classified area, unless the pit is provided with mechanical ventilation.

(C) Locations where flammable vapor-air mixtures may exist under abnormal conditions and for a distance beyond Division 1 locations shall be classified Division 2 according to the requirements of Subpart S of this part. These locations include an area within 20 feet horizontally, 3 feet vertically beyond a Division 1 area, and up to 3 feet above floor or grade level within 25 feet, if indoors, or 10 feet if outdoors, from any pump, bleeder, withdrawal fitting, meter, or similar device handling Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C). Pits provided with adequate mechanical ventilation within a Division 1 or 2 area shall be classified Division 2. If only Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degres C) or Category 4 flammable liquids are handled, then ordinary electrical equipment is satisfactory though care shall be used in locating electrical apparatus to prevent hot metal from falling into open equipment.

(D) Where the provisions of Subdivisions (A), (B), and (C), of this Subdivision require the installation of electrical equipment suitable for Class I, Division 1 or Division 2 locations, ordinary electrical equipment including switch-gear may be used if installed in a room or enclosure which is maintained under positive pressure with respect to the hazardous area. Ventilation makeup air shall be uncontaminated by flammable vapors.

(8) Repairs to equipment. Hot work, such as welding or cutting operations, use of spark-producing power tools, and chipping operations shall be permitted only under supervision of an individual in responsible charge. The individual in responsible charge shall make an inspection of the area to be sure that it is safe for the work to be done and that safe procedures will be followed for the work specified.

(9) Housekeeping.

(i) General. Maintenance and operating practices shall be in accordance with established procedures which will tend to control leakage and prevent the accidental escape of flammable liquids. Spills shall be cleaned up promptly.

(ii) Access. Adequate aisles shall be maintained for unobstructed movement of personnel and so that fire protection equipment can be brought to bear on any part of flammable liquid storage, use, or any unit physical operation.

(iii) Waste and residue. Combustible waste material and residues in a building or unit operating area shall be kept to a minimum, stored in covered metal receptacles and disposed of daily.

(iv) Clear zone. Ground area around buildings and unit operating areas shall be kept free of weeds, trash, or other unnecessary combustible materials.

(f) Bulk plants.

(1) Storage.

(i) Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C). Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall be stored in closed containers, or in storage tanks above ground outside of buildings, or underground in accordance with paragraph (b) of this section.

(ii) Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) and Category 4 flammable liquids. Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) and Category 4 flammable liquids shall be stored in containers, or in tanks within buildings or above ground outside of buildings, or underground in accordance with paragraph (b) of this section.

(iii) Piling containers. Containers of flammable liquids when piled one upon the other shall be separated by dunnage sufficient to provide stability and to prevent excessive stress on container walls. The height of the pile shall be consistent with the stability and strength of containers.

(2) Buildings.

(i) Exits. Rooms in which flammable liquids are stored or handled by pumps shall have exit facilities arranged to prevent occupants from being trapped in the event of fire.

(ii) Heating. Rooms in which Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), are stored or handled shall be heated only by means not constituting a source of ignition, such as steam or hot water. Rooms containing heating appliances involving sources of ignition shall be located and arranged to prevent entry of flammable vapors.

(iii) Ventilation.

(A) Ventilation shall be provided for all rooms, buildings, or enclosures in which Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), are pumped or dispensed. Design of ventilation systems shall take into account the relatively high specific gravity of the vapors. Ventilation may be provided by adequate openings in outside walls at floor level unobstructed except by louvers or coarse screens. Where natural ventilation is inadequate, mechanical ventilation shall be provided.

(B) Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall not be stored or handled within a building having a basement or pit into which flammable vapors may travel, unless such area is provided with ventilation designed to prevent the accumulation of flammable vapors therein.

(C) Containers of Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall not be drawn from or filled within buildings unless provision is made to prevent the accumulation of flammable vapors in hazardous concentrations. Where mechanical ventilation is required, it shall be kept in operation while flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C) are being handled.

(3) Loading and unloading facilities.

(i) Separation. Tank vehicle and tank car loading or unloading facilities shall be separated from above ground tanks, warehouses, other plant buildings or nearest line of adjoining property that may be built upon by a distance of 25 feet for Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C) and 15 feet for Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) and Category 4 flammable liquids measured from the nearest position of any fill spout. Buildings for pumps or shelters for personnel may be a part of the facility.

(ii) Category restriction. Equipment such as piping, pumps, and meters used for the transfer of Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C) between storage tanks and the fill stem of the loading rack shall not be used for the transfer of Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) or Category 4 flammable liquids.

(iii) Valves. Valves used for the final control for filling tank vehicles shall be of the self-closing type and manually held open except where automatic means are provided for shutting off the flow when the vehicle is full or after filling of a preset amount.

(iv) Static protection.

(A) Bonding facilities for protection against static sparks during the loading of tank vehicles through open domes shall be provided:

(1) Where Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), are loaded, or

(2) Where Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) or Category 4 flammable liquids are loaded into vehicles which may contain vapors from previous cargoes of Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C).

(B) Protection as required in (A) of this Subdivision (iv) shall consist of a metallic bond wire permanently electrically connected to the fill stem or to some part of the rack structure in electrical contact with the fill stem. The free end of such wire shall be provided with a clamp or equivalent device for convenient attachment to some metallic part in electrical contact with the cargo tank of the tank vehicle.

(C) Such bonding connection shall be made fast to the vehicle or tank before dome covers are raised and shall remain in place until filling is completed and all dome covers have been closed and secured.

(D) Bonding as specified in (A), (B), and (C) of this Subdivision is not required:

(1) Where vehicles are loaded exclusively with products not having a static accumulating tendency, such as asphalt, most crude oils, residual oils, and water soluble liquids;

(2) Where no Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), are handled at the loading facility and the tank vehicles loaded are used exclusively for Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) and Category 4 flammable liquids; and

(3) Where vehicles are loaded or unloaded through closed bottom or top connections.

(E) Filling through open domes into the tanks of tank vehicles or tank cars, that contain vapor-air mixtures within the flammable range or where the liquid being filled can form such a mixture, shall be by means of a downspout which extends near the bottom of the tank. This precaution is not required when loading liquids which are nonaccumulators of static charges.

(v) Stray currents. Tank car loading facilities where Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), are loaded through open domes shall be protected against stray currents by bonding the pipe to at least one rail and to the rack structure if of metal. Multiple lines entering the rack area shall be electrically bonded together. In addition, in areas where excessive stray currents are known to exist, all pipe entering the rack area shall be provided with insulating sections to electrically isolate the rack piping from the pipelines. No bonding between the tank car and the rack or piping is required during either loading or unloading of Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) and Category 4 flammable liquids.

(vi) Container filling facilities. Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall not be dispensed into containers unless the nozzle and container are electrically interconnected. Where the metallic floorplate on which the container stands while filling is electrically connected to the fill stem or where the fill stem is bonded to the container during filling operations by means of a bond wire, the provisions of this section shall be deemed to have been complied with.

(4) Wharves.

(i) Definition, application. The term wharf shall mean any wharf, pier, bulkhead, or other structure over or contiguous to navigable water used in conjunction with a bulk plant, the primary function of which is the transfer of flammable liquid cargo in bulk between the bulk plant and any tank vessel, ship, barge, lighter boat, or other mobile floating craft; and this subparagraph shall apply to all such installations except Marine Service Stations as covered in paragraph (g) of this section.

(ii) (Reserved)

(iii) (Reserved)

(iv) Design and construction. Substructure and deck shall be substantially designed for the use intended. Deck may employ any material which will afford the desired combination of flexibility, resistance to shock, durability, strength, and fire resistance. Heavy timber construction is acceptable.

(v) (Reserved)

(vi) Pumps. Loading pumps capable of building up pressures in excess of the safe working pressure of cargo hose or loading arms shall be provided with bypasses, relief valves, or other arrangement to protect the loading facilities against excessive pressure. Relief devices shall be tested at not more than yearly intervals to determine that they function satisfactorily at the pressure at which they are set.

(vii) Hoses and couplings. All pressure hoses and couplings shall be inspected at intervals appropriate to the service. The hose and couplings shall be tested with the hose extended and using the “inservice maximum operating pressures.” Any hose showing material deteriorations, signs of leakage, or weakness in its carcass or at the couplings shall be withdrawn from service and repaired or discarded.

(viii) Piping and fittings. Piping, valves, and fittings shall be in accordance with paragraph (c) of this section, with the following exceptions and additions:

(A) Flexibility of piping shall be assured by appropriate layout and arrangement of piping supports so that motion of the wharf structure resulting from wave action, currents, tides, or the mooring of vessels will not subject the pipe to repeated strain beyond the elastic limit.

(B) Pipe joints depending upon the friction characteristics of combustible materials or grooving of pipe ends for mechanical continuity of piping shall not be used.

(C) Swivel joints may be used in piping to which hoses are connected, and for articulated swivel-joint transfer systems, provided that the design is such that the mechanical strength of the joint will not be impaired if the packing material should fail, as by exposure to fire.

(D) Piping systems shall contain a sufficient number of valves to operate the system properly and to control the flow of liquid in normal operation and in the event of physical damage.

(E) In addition to the requirements of paragraph (f)(4)(viii)(D) of this section, each line conveying Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), leading to a wharf shall be provided with a readily accessible block valve located on shore near the approach to the wharf and outside of any diked area. Where more than one line is involved, the valves shall be grouped in one location.

(F) Means of easy access shall be provided for cargo line valves located below the wharf deck.

(G) Pipelines on flammable liquids wharves shall be adequately bonded and grounded. If excessive stray currents are encountered, insulating joints shall be installed. Bonding and grounding connections on all pipelines shall be located on wharfside of hose-riser insulating flanges, if used, and shall be accessible for inspection.

(H) Hose or articulated swivel-joint pipe connections used for cargo transfer shall be capable of accommodating the combined effects of change in draft and maximum tidal range, and mooring lines shall be kept adjusted to prevent the surge of the vessel from placing stress on the cargo transfer system.

(I) Hose shall be supported so as to avoid kinking and damage from chafing.

(ix) Fire protection. Suitable portable fire extinguishers with a rating of not less than 12-BC shall be located within 75 feet of those portions of the facility where fires are likely to occur, such as hose connections, pumps, and separator tanks.

(A) Where piped water is available, ready-connected fire hose in size appropriate for the water supply shall be provided so that manifolds where connections are made and broken can be reached by at least one hose stream.

(B) Material shall not be placed on wharves in such a manner as to obstruct access to firefighting equipment, or important pipeline control valves.

(C) Where the wharf is accessible to vehicle traffic, an unobstructed roadway to the shore end of the wharf shall be maintained for access of firefighting apparatus.

(x) Operations control. Loading or discharging shall not commence until the wharf superintendent and officer in charge of the tank vessel agree that the tank vessel is properly moored and all connections are properly made. Mechanical work shall not be performed on the wharf during cargo transfer, except under special authorization based on a review of the area involved, methods to be employed, and precautions necessary.

(5) Electrical equipment.

(i) Application. This paragraph (f)(5)(i) shall apply to areas where Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), stored or handled. For areas where only Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) or Category 4 flammable liquids are stored or handled, the electrical equipment may be installed in accordance with the provisions of Subpart S of this part, for ordinary locations.

(ii) Conformance. All electrical equipment and wiring shall be of a type specified by and shall be installed in accordance with Subpart S of this part.

(iii) Classification. So far as it applies Table H-18 shall be used to delineate and classify hazardous areas for the purpose of installation of electrical equipment under normal circumstances. In Table H-18 a classified area shall not extend beyond an unpierced wall, roof, or other solid partition. The area classifications listed shall be based on the premise that the installation meets the applicable requirements of this section in all respects.

(6) Sources of ignition. Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall not be handled, drawn, or dispensed where flammable vapors may reach a source of ignition. Smoking shall be prohibited except in designated localities. “No Smoking” signs shall be conspicuously posted where hazard from flammable liquid vapors is normally present.

(7) Drainage and waste disposal. Provision shall be made to prevent flammable liquids which may be spilled at loading or unloading points from entering public sewers and drainage systems, or natural waterways. Connection to such sewers, drains, or waterways by which flammable liquids might enter shall be provided with separator boxes or other approved means whereby such entry is precluded. Crankcase drainings and flammable liquids shall not be dumped into sewers, but shall be stored in tanks or tight drums outside of any building until removed from the premises.

(8) Fire control. Suitable fire-control devices, such as small hose or portable fire extinguishers, shall be available to locations where fires are likely to occur. Additional fire-control equipment may be required where a tank of more than 50,000 gallons individual capacity contains Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), and where an unusual exposure hazard exists from surrounding property. Such additional fire-control equipment shall be sufficient to extinguish a fire in the largest tank. The design and amount of such equipment shall be in accordance with approved engineering standards.

(g) Service stations.

(1) Storage and handling.

(i) General provisions.

(A) Liquids shall be stored in approved closed containers not exceeding 60 gallons capacity, in tanks located underground, in tanks in special enclosures as described in paragraph (g)(1)(i) of this section, or in above ground tanks as provided for in paragraphs (g)(4)(ii), (B), (C) and (D) of this section.

(B) Above ground tanks, located in an adjoining bulk plant, may be connected by piping to service station underground tanks if, in addition to valves at above ground tanks, a valve is also installed within control of service station personnel.

(C) Apparatus dispensing Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), into the fuel tanks of motor vehicles of the public shall not be located at a bulk plant unless separated by a fence or similar barrier from the area in which bulk operations are conducted.

(D) (Reserved)

(E) The provisions of paragraph (g)(1)(i)(A) of this section shall not prohibit the dispensing of flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C) in the open from a tank vehicle to a motor vehicle. Such dispensing shall be permitted provided:

(1) The tank vehicle complies with the requirements covered in the Standard on Tank Vehicles for Flammable Liquids, NFPA 385-1966.

(2) The dispensing is done on premises not open to the public.

(3) (Reserved)

(4) The dispensing hose does not exceed 50 feet in length.

(5) The dispensing nozzle is a listed automatic-closing type without a latch-open device.

Table H-18 - Electrical Equipment Hazardous Areas – Bulk Plants

Location	Class I Group D division	Extent of classified area
Tank vehicle and tank car:[1] Loading through open dome	1	Within 3 feet of edge of dome, extending in all directions.
	2	Area between 3 feet and 5 feet from edge of dome, extending in all directions.
Loading through bottom connections with atmospheric venting	1	Within 3 feet of point of venting to atmosphere extending in all directions.
	2	Area between 3 feet and 5 feet from point of venting to atmosphere, extending in all directions. Also up to 18 inches above grade within a horizontal radius of 10 feet from point of loading connection.
Loading through closed dome with atmospheric venting	1	Within 3 feet of open end of vent, extending in all directions.
	2	Area between 3 feet and 5 feet from open end of vent, extending in all directions. Also within 3 feet of edge of dome, extending in all directions.
Loading through closed dome with vapor recovery	2	Within 3 feet of point of connection of both fill and vapor lines, extending in all directions.
Bottom loading with vapor recovery or any bottom unloading	2	Within 3 feet of point of connections extending in all directions. Also up to 18 inches above grade within a horizontal radius of 10 feet from point of connection.
Drum and container filling: Outdoors, or indoors with adequate ventilation	1	Within 3 feet of vent and fill opening, extending in all directions.
	2	Area between 3 feet and 5 feet from vent or fill opening, extending in all directions. Also up to 18 inches above floor or grade level within a horizontal radius of 10 feet from vent or fill opening.
Tank – Above ground: Shell, ends, or roof and dike area	2	Within 10 feet from shell, ends, or roof of tank. Area inside dikes to level of top of dike.
Vent	1	Within 5 feet of open end of vent, extending in all directions.

Location	Class I Group D division	Extent of classified area
	2	Area between 5 feet and 10 feet from open end of vent, extending in all directions.
Floating roof	1	Area above the roof and within the shell.
Pits: Without mechanical ventilation	1	Entire area within pit if any part is within a Division 1 or 2 classification area.
With mechanical ventilation	2	Entire area within pit if any part is within a Division 1 or 2 classified area.
Containing valves, fittings or piping, and Not within a Division 1 or 2 classified area.	2	Entire pit.
Pumps, bleeders, withdrawal fittings, meters and similar devices:		
Indoors	2	Within 5 feet of any edge of such devices, extending in all directions. Also up to 3 feet above floor or grade level within 25 feet horizontally from any edge of such devices.
Outdoors	2	Within 3 feet of any edge of such devices, extending in all directions. Also up to 18 inches above grade level within 10 feet horizontally from any edge of such devices.
Storage and repair garage for tank vehicles	1	All pits or spaces below floor level.
	2	Area up to 18 inches above floor or grade level for entire storage or repair garage.
Drainage ditches, separators, impounding basins	2	Area up to 18 inches above ditch, separator or basin. Also up to 18 inches above grade within 15 feet horizontally from any edge.
Garages for other than tank vehicles	(2)	If there is any opening to these rooms within the extent of an outdoor classified area, the entire room shall be classified the same as the area classification at the point of the opening.
Outdoor drum storage	(2)	
Indoor warehousing where there is no flammable liquid transfer	(2)	If there is any opening to these rooms within the extent of an indoor classified area, the room shall be classified the same as if the wall, curb or partition did not exist.
Office and rest rooms	(2)	

[1]When classifying the extent of the area, consideration shall be given to the fact that tank cars or tank vehicles may be spotted at varying points. Therefore, the extremities of the loading or unloading positions shall be used.
[2]Ordinary.

(F) Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall not be stored or handled within a building having a basement or pit into which flammable vapors may travel, unless such area is provided with ventilation designed to prevent the accumulation of flammable vapors therein.

(G) (Reserved)

(ii) Special enclosures.

(A) When installation of tanks in accordance with paragraph (b)(3) of this section is impractical because of property or building limitations, tanks for flammable liquids may be installed in buildings if properly enclosed.

(B) The enclosure shall be substantially liquid and vapor tight without backfill. Sides, top, and bottom of the enclosure shall be of reinforced concrete at least 6 inches thick, with openings for inspection through the top only. Tank connections shall be so piped or closed that neither vapors nor liquid can escape into the enclosed space. Means shall be provided whereby portable equipment may be employed to discharge to the outside any liquid or vapors which might accumulate should leakage occur.

(iii) Inside buildings.

(A) Except where stored in tanks as provided in paragraph (g)(1)(ii) of this section, no Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall be stored within any service station building except in closed containers of aggregate capacity not exceeding 60 gallons. One container not exceeding 60 gallons capacity equipped with an approved pump is permitted.

(B) Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), may be transferred from one container to another in lubrication or service rooms of a service station building provided the electrical installation complies with Table H-19 and provided that any heating equipment complies with paragraph (g)(6) of this paragraph.

(C) Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) and Category 4 flammable liquids may be stored and dispensed inside service station buildings from tanks of not more than 120 gallons capacity each.

(iv) (Reserved)

(v) Dispensing into portable containers. No delivery of any Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall be made into portable containers unless the container is constructed of metal, has a tight closure with screwed or spring cover, and is fitted with a spout or so designed that the contents can be poured without spilling.

(2) (Reserved)

(3) Dispensing systems.

(i) Location. Dispensing devices at automotive service stations shall be so located that all parts of the vehicle being served will be on the premises of the service station.

(ii) Inside location. Approved dispensing units may be located inside of buildings. The dispensing area shall be separated from other areas in an approved manner. The dispensing unit and its piping shall be mounted either on a concrete island or protected against collision damage by suitable means and shall be located in a position where it cannot be struck by a vehicle descending a ramp or other slope out of control. The dispensing area shall be provided with an approved mechanical or gravity ventilation system. When dispensing units are located below grade, only approved mechanical ventilation shall be used and the entire dispensing area shall be protected by an approved automatic sprinkler system. Ventilating systems shall be electrically interlocked with gasoline dispensing units so that the dispensing units cannot be operated unless the ventilating fan motors are energized.

(iii) Emergency power cutoff. A clearly identified and easily accessible switch(es) or a circuit breaker(s) shall be provided at a location remote from dispensing devices, including remote pumping systems, to shut off the power to all dispensing devices in the event of an emergency.

(iv) Dispensing units.

(A) Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall be transferred from tanks by means of fixed pumps so designed and equipped as to allow control of the flow and to prevent leakage or accidental discharge.

(B)

(1) Only listed devices may be used for dispensing Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C). No such device may be used if it shows evidence of having been dismantled.

(2) Every dispensing device for Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), installed after December 31, 1978, shall contain evidence of listing so placed that any attempt to dismantle the device will result in damage to such evidence, visible without disassembly or dismounting of the nozzle.

(C) Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall not be dispensed by pressure from drums, barrels, and similar containers. Approved pumps taking suction through the top of the container or approved self-closing faucets shall be used.

(D) The dispensing units, except those attached to containers, shall be mounted either on a concrete island or protected against collision damage by suitable means.

(v) Remote pumping systems.

(A) This paragraph (g)(3)(v) shall apply to systems for dispensing Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), where such liquids are transferred from storage to individual or multiple dispensing units by pumps located elsewhere than at the dispensing units.

(B) Pumps shall be designed or equipped so that no part of the system will be subjected to pressures above its allowable working pressure. Pumps installed above grade, outside of buildings, shall be located not less than 10 feet from lines of adjoining property which may be built upon, and not less than 5 feet from any building opening. When an outside pump location is impractical, pumps may be installed inside of buildings, as provided for dispensers in Subdivision (ii) of this subparagraph, or in pits as provided in Subdivision (C) of this Subdivision. Pumps shall be substantially anchored and protected against physical damage by vehicles.

(C) Pits for subsurface pumps or piping manifolds of submersible pumps shall withstand the external forces to which they may be subjected without damage to the pump, tank, or piping. The pit shall be no larger than necessary for inspection and maintenance and shall be provided with a fitted cover.

(D) A control shall be provided that will permit the pump to operate only when a dispensing nozzle is removed from its bracket on the dispensing unit and the switch on this dispensing unit is manually actuated. This control shall also stop the pump when all nozzles have been returned to their brackets.

(E) An approved impact valve, incorporating a fusible link, designed to close automatically in the event of severe impact or fire exposure shall be properly installed in the dispensing supply line at the base of each individual dispensing device.

(F) Testing. After the completion of the installation, including any paving, that section of the pressure piping system between the pump discharge and the connection for the dispensing facility shall be tested for at least 30 minutes at the maximum operating pressure of the system. Such tests shall be repeated at 5 year intervals thereafter.

(vi) Delivery nozzles.

(A) A listed manual or automatic-closing type hose nozzle valve shall be provided on dispensers used for the dispensing of Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C).

(B) Manual-closing type valves shall be held open manually during dispensing. Automatic-closing type valves may be used in conjunction with an approved latch-open device.

(4) Marine service stations.

(i) Dispensing.

(A) The dispensing area shall be located away from other structures so as to provide room for safe ingress and egress of craft to be fueled. Dispensing units shall in all cases be at least 20 feet from any activity involving fixed sources of ignition.

(B) Dispensing shall be by approved dispensing units with or without integral pumps and may be located on open piers, wharves, or floating docks or on shore or on piers of the solid fill type.

(C) Dispensing nozzles shall be automatic-closing without a hold-open latch.

(ii) Tanks and pumps.

(A) Tanks, and pumps not integral with the dispensing unit, shall be on shore or on a pier of the solid fill type, except as provided in paragraphs (g)(4)(ii)(B) and (C) of this section.

(B) Where shore location would require excessively long supply lines to dispensers, tanks may be installed on a pier provided that applicable portions of paragraph (b) of this section relative to spacing, diking, and piping are complied with and the quantity so stored does not exceed 1,100 gallons aggregate capacity.

Table H-19 - Electrical Equipment Hazardous Areas – Service Stations

Location	Class I Group D division	Extent of classified area
Underground tank: Fill opening	1	Any pit, box or space below grade level, any part of which is within the Division 1 or 2 classified area.
	2	Up to 18 inches above grade level within a horizontal radius of 10 feet from a loose fill connection and within a horizontal radius of 5 feet from a tight fill connection.
Vent – Discharging upward	1	Within 3 feet of open end of vent, extending in all directions.
	2	Area between 3 feet and 5 feet of open end of vent, extending in all directions.
Dispenser: Pits	1	Any pit, box or space below grade level, any part of which is within the Division 1 or 2 classified area.
Dispenser enclosure	1	The area 4 feet vertically above base within the enclosure and 18 inches horizontally in all directions.

Location	Class I Group D division	Extent of classified area
Outdoor	2	Up to 18 inches above grade level within 20 feet horizontally of any edge of enclosure.
Indoor: With mechanical ventilation	2	Up to 18 inches above grade or floor level within 20 feet horizontally of any edge of enclosure.
With gravity ventilation	2	Up to 18 inches above grade or floor level within 25 feet horizontally of any edge of enclosure.
Remote pump – Outdoor	1	Any pit, box or space below grade level if any part is within a horizontal distance of 10 feet from any edge of pump.
	2	Within 3 feet of any edge of pump, extending in all directions. Also up to 18 inches above grade level within 10 feet horizontally from any edge of pump.
Remote pump – Indoor	1	Entire area within any pit.
	2	Within 5 feet of any edge of pump, extending in all directions. Also up to 3 feet above floor or grade level within 25 feet horizontally from any edge of pump.
Lubrication or service room	1	Entire area within any pit.
	2	Area up to 18 inches above floor or grade level within entire lubrication room.
Dispenser for liquids with a flashpoint below 100 degrees F (37.8 degrees C)[1]	2	Within 3 feet of any fill or dispensing point, extending in all directions.
Special enclosure inside building per 1910.106 (f)(1)(ii)	1	Entire enclosure.
Sales, storage and rest rooms	[2]	If there is any opening to these rooms within the extent of a Division 1 area, the entire room shall be classified as Division 1.

[1]Category 1 or 2 flammable liquids, or for Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C).
[2]Ordinary.

(C) Shore tanks supplying marine service stations may be located above ground, where rock ledges or high water table make underground tanks impractical.

(D) Where tanks are at an elevation which would produce gravity head on the dispensing unit, the tank outlet shall be equipped with a pressure control valve positioned adjacent to and outside the tank block valve specified in paragraph (b)(2)(ix)(B) of this section, so adjusted that liquid cannot flow by gravity from the tank in case of piping or hose failure.

(iii) Piping.

(A) Piping between shore tanks and dispensing units shall be as described in paragraph (C) of this section, except that, where dispensing is from a floating structure, suitable lengths of oil-resistant flexible hose may be employed between the shore piping and the piping on the floating structure as made necessary by change in water level or shoreline.

(B) A readily accessible valve to shut off the supply from shore shall be provided in each pipeline at or near the approach to the pier and at the shore end of each pipeline adjacent to the point where flexible hose is attached.

(C) Piping shall be located so as to be protected from physical damage.

(D) Piping handling Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall be grounded to control stray currents.

(5) Electrical equipment.

(i) Application. This subparagraph (g)(5) shall apply to areas where Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), are stored or handled. For areas where Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) or Category 4 flammable liquids are stored or handled the electrical equipment may be installed in accordance with the provisions of Subpart S of this part, for ordinary locations.

(ii) All electrical equipment and wiring shall be of a type specified by and shall be installed in accordance with Subpart S of this part.

(iii) So far as it applies. Table H-19 shall be used to delineate and classify hazardous areas for the purpose of installation of electrical equipment under normal circumstances. A classified area shall not extend beyond an unpierced wall, roof, or other solid partition.

(iv) The area classifications listed shall be based on the assumption that the installation meets the applicable requirements of this section in all respects.

(6) Heating equipment.

(i) Conformance. Heating equipment shall be installed as provided in paragraphs (g)(6)(ii) through (v) of this section.

(ii) Application. Heating equipment may be installed in the conventional manner in an area except as provided in paragraph (g)(6)(iii), (iv), or (v) of this section.

(iii) Special room. Heating equipment may be installed in a special room separated from an area classified by Table H-19 by walls having a fire resistance rating of at least 1-hour and without any openings in the walls within 8 feet of the floor into an area classified in Table H-19. This room shall not be used for combustible storage and all air for combustion purposes shall come from outside the building.

(iv) Work areas. Heating equipment using gas or oil fuel may be installed in the lubrication, sales, or service room where there is no dispensing or transferring of Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), provided the bottom of the combustion chamber is at least 18 inches above the floor and the heating equipment is protected from physical damage by vehicles. Heating equipment using gas or oil fuel listed for use in garages may be installed in the lubrication or service room where Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), are dispensed provided the equipment is installed at least 8 feet above the floor.

(v) Electric heat. Electrical heating equipment shall conform to paragraph (g)(5) of this section.

(7) Drainage and waste disposal. Provision shall be made in the area where Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), are dispensed to prevent spilled liquids from flowing into the interior of service station buildings. Such provision may be by grading driveways, raising door sills, or other equally effective means. Crankcase drainings and flammable or combustible liquids shall not be dumped into sewers but shall be stored in tanks or drums outside of any building until removed from the premises.

(8) Sources of ignition. In addition to the previous restrictions of this paragraph, the following shall apply: There shall be no smoking or open flames in the areas used for fueling, servicing fuel systems for internal combustion engines, receiving or dispensing of flammable or combustible liquids. Conspicuous and legible signs prohibiting smoking shall be posted within sight of the customer being served. The motors of all equipment being fueled shall be shut off during the fueling operation.

(9) Fire control. Each service station shall be provided with at least one fire extinguisher having a minimum approved classification of 6 B, C, located so that an extinguisher, will be within 75 feet of each pump, dispenser, underground fill pipe opening, and lubrication or service room.

(h) Processing plants.

(1) Scope. This paragraph shall apply to those plants or buildings which contain chemical operations such as oxidation, reduction, halogenation, hydrogenation, alkylation, polymerization, and other chemical processes but shall not apply to chemical plants, refineries or distilleries.

(2) Location.

(i) Classification. The location of each processing vessel shall be based upon its flammable liquid capacity.

(ii) (Reserved)

(3) Processing building.

(i) Construction.

(A) Processing buildings shall be of fire-resistance or noncombustible construction, except heavy timber construction with load-bearing walls may be permitted for plants utilizing only stable Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) or Category 4 flammable liquids. Except as provided in paragraph (h)(2)(ii) of this section or in the case of explosion resistant walls used in conjunction with explosion relieving facilities, see paragraph (h)(3)(iv) of this section, load-bearing walls are prohibited. Buildings shall be without basements or covered pits.

(B) Areas shall have adequate exit facilities arranged to prevent occupants from being trapped in the event of fire. Exits shall not be exposed by the drainage facilities described in paragraph (h)(3)(ii) of this section.

(ii) Drainage.

(A) Emergency drainage systems shall be provided to direct flammable liquid leakage and fire protection water to a safe location. This may require curbs, scuppers, or special drainage systems to control the spread of fire, see paragraph (b)(2)(vii)(B) of this section.

(B) Emergency drainage systems, if connected to public sewers or discharged into public waterways, shall be equipped with traps or separators.

(iii) Ventilation.

(A) Enclosed processing buildings shall be ventilated at a rate of not less than 1 cubic foot per minute per square foot of solid floor area. This shall be accomplished by natural or mechanical ventilation with discharge or exhaust to a safe location outside of the building. Provisions shall be made for introduction of makeup air in such a manner as not to short circuit the ventilation. Ventilation shall be arranged to include all floor areas or pits where flammable vapors may collect.

(B) Equipment used in a building and the ventilation of the building shall be designed so as to limit flammable vapor-air mixtures under normal operating conditions to the interior of equipment, and to not more than 5 feet from equipment which exposes Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), to the air. Examples of such equipment are dispensing stations, open centrifuges, plate and frame filters, open vacuum filters, and surfaces of open equipment.

(iv) Explosion relief. Areas where Category 1 or unstable liquids are processed shall have explosion venting through one or more of the following methods:

(A) Open air construction.

(B) Lightweight walls and roof.

(C) Lightweight wall panels and roof hatches.

(D) Windows of explosion venting type.

(4) Liquid handling.

(i) Storage.

(A) The storage of flammable liquids in tanks shall be in accordance with the applicable provisions of paragraph (b) of this section.

(B) If the storage of flammable liquids in outside above ground or underground tanks is not practical because of temperature or production considerations, tanks may be permitted inside of buildings or structures in accordance with the applicable provisions of paragraph (b) of this section.

(C) Storage tanks inside of buildings shall be permitted only in areas at or above grade which have adequate drainage and are separated from the processing area by construction having a fire resistance rating of at least 2 hours.

(D) The storage of flammable liquids in containers shall be in accordance with the applicable provisions of paragraph (d) of this section.

(ii) Piping, valves, and fittings.

(A) Piping, valves, and fittings shall be in accordance with paragraph (c) of this section.

(B) Approved flexible connectors may be used where vibration exists or where frequent movement is necessary. Approved hose may be used at transfer stations.

(C) Piping containing flammable liquids shall be identified.

(iii) Transfer.

(A) The transfer of large quantities of flammable liquids shall be through piping by means of pumps or water displacement. Except as required in process equipment, gravity flow shall not be used. The use of compressed air as a transferring medium is prohibited.

(B) Positive displacement pumps shall be provided with pressure relief discharging back to the tank or to pump suction.

(iv) Equipment.

(A) Equipment shall be designed and arranged to prevent the unintentional escape of liquids and vapors and to minimize the quantity escaping in the event of accidental release.

(B) Where the vapor space of equipment is usually within the flammable range, the probability of explosion damage to the equipment can be limited by inerting, by providing an explosion suppression system, or by designing the equipment to contain the peak explosion pressure which may be modified by explosion relief. Where the special hazards of operation, sources of ignition, or exposures indicate a need, consideration shall be given to providing protection by one or more of the above means.

(5) Tank vehicle and tank car loading and unloading. Tank vehicle and tank car loading or unloading facilities shall be separated from above ground tanks, warehouses, other plant buildings, or nearest line of adjoining property which may be built upon by a distance of 25 feet for Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), and 15 feet for Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) and Category 4 flammable liquids measured from the nearest position of any fill stem. Buildings for pumps or shelters for personnel may be a part of the facility. Operations of the facility shall comply with the appropriate portions of paragraph (f)(3) of this section.

(6) Fire control.

(i) Portable extinguishers. Approved portable fire extinguishers of appropriate size, type, and number shall be provided.

(ii) Other controls. Where the special hazards of operation or exposure indicate a need, the following fire control provision shall be provided.

(A) A reliable water supply shall be available in pressure and quantity adequate to meet the probable fire demands.

(B) Hydrants shall be provided in accordance with accepted good practice.

(C) Hose connected to a source of water shall be installed so that all vessels, pumps, and other equipment containing flammable liquids can be reached with at least one hose stream. Nozzles that are capable of discharging a water spray shall be provided.

(D) Processing plants shall be protected by an approved automatic sprinkler system or equivalent extinguishing system. If special extinguishing systems including but not limited to those employing foam, carbon dioxide, or dry chemical are provided, approved equipment shall be used and installed in an approved manner.

(iii) Alarm systems. An approved means for prompt notification of fire to those within the plant and any public fire department available shall be provided. It may be advisable to connect the plant system with the public system where public fire alarm system is available.

(iv) Maintenance. All plant fire protection facilities shall be adequately maintained and periodically inspected and tested to make sure they are always in satisfactory operating condition and that they will serve their purpose in time of emergency.

(7) Sources of ignition.

(i) General.

(A) Precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include 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.

(B) Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C), shall not be dispensed into containers unless the nozzle and container are electrically interconnected. Where the metallic floorplate on which the container stands while filling is electrically connected to the fill stem or where the fill stem is bonded to the container during filling operations by means of a bond wire, the provisions of this section shall be deemed to have been complied with.

(ii) Maintenance and repair.

(A) When necessary to do maintenance work in a flammable liquid processing area, the work shall be authorized by a responsible representative of the employer.

(B) Hot work, such as welding or cutting operations, use of spark-producing power tools, and chipping operations shall be permitted only under supervision of an individual in responsible charge who shall make an inspection of the area to be sure that it is safe for the work to be done and that safe procedures will be followed for the work specified.

(iii) Electrical.

(A) All electrical wiring and equipment shall be installed in accordance with Subpart S of this part.

(B) Locations where flammable vapor-air mixtures may exist under normal operations shall be classified Class I, Division 1 according to the requirements of Subpart S of this part. For those pieces of equipment installed in accordance with paragraph (h)(3)(iii)(B) of this section, the Division 1 area shall extend 5 feet in all directions from all points of vapor liberation. All areas within pits shall be classified Division 1 if any part of the pit is within a Division 1 or 2 classified area, unless the pit is provided with mechanical ventilation.

(C) Locations where flammable vapor-air mixtures may exist under abnormal conditions and for a distance beyond Division 1 locations shall be classified Division 2 according to the requirements of Subpart S of this part. These locations include an area within 20 feet horizontally, 3 feet vertically beyond a Division 1 area, and up to 3 feet above floor or grade level within 25 feet, if indoors, or 10 feet if outdoors, from any pump, bleeder, withdrawal fitting, meter, or similar device handling Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 degrees F (37.8 degrees C). Pits provided with adequate mechanical ventilation within a Division 1 or 2 area shall be classified Division 2. If Category 3 flammable liquids with a flashpoint at or above 100 degrees F (37.8 degrees C) or Category 4 flammable liquids only are handled, then ordinary electrical equipment is satisfactory though care shall be used in locating electrical apparatus to prevent hot metal from falling into open equipment.

(D) Where the provisions of paragraphs (h)(7)(iii)(A), (B), and (C) of this section require the installation of explosion-proof equipment, ordinary electrical equipment including switchgear may be used if installed in a room or enclosure which is maintained under positive pressure with respect to the hazardous area. Ventilation makeup air shall be uncontaminated by flammable vapors.

(8) Housekeeping.

(i) General. Maintenance and operating practices shall be in accordance with established procedures which will tend to control leakage and prevent the accidental escape of flammable liquids. Spills shall be cleaned up promptly.

(ii) Access. Adequate aisles shall be maintained for unobstructed movement of personnel and so that fire protection equipment can be brought to bear on any part of the processing equipment.

(iii) Waste and residues. Combustible waste material and residues in a building or operating area shall be kept to a minimum, stored in closed metal waste cans, and disposed of daily.

(iv) Clear zone. Ground area around buildings and operating areas shall be kept free of tall grass, weeds, trash, or other combustible materials.

(i) Refineries, chemical plants, and distilleries.

(1) Storage tanks. Flammable liquids shall be stored in tanks, in containers, or in portable tanks. Tanks shall be installed in accordance with paragraph (b) of this section. Tanks for the storage of flammable liquids in tank farms and in locations other than process areas shall be located in accordance with paragraph (b)(2)(i) and (ii) of this section.

(2) Wharves. Wharves handling flammable liquids shall be in accordance with paragraph (f)(4) of this section.

(3) Fired and unfired pressure vessels.

(i) Fired vessels. Fired pressure vessels shall be constructed in accordance with the Code for Fired Pressure Vessels, Section I of the ASME Boiler and Pressure Vessel Code – 1968.

(ii) Unfired vessels shall be constructed in accordance with the Code for Unfired Pressure Vessels, Section VIII of the ASME Boiler and Pressure Vessel Code – 1968.

(4) Location of process units. Process units shall be located so that they are accessible from at least one side for the purpose of fire control.

(5) Fire control.

(i) Portable equipment. Portable fire extinguishment and control equipment shall be provided in such quantities and types as are needed for the special hazards of operation and storage.

(ii) Water supply. Water shall be available in volume and at adequate pressure to supply water hose streams, foam producing equipment, automatic sprinklers, or water spray systems as the need is indicated by the special hazards of operation and storage.

(iii) Special equipment. Special extinguishing equipment such as that utilizing foam, inert gas, or dry chemical shall be provided as the need is indicated by the special hazards of operation and storage.

(j) Scope. This section applies to the handling, storage, and use of flammable liquids with a flashpoint at or below 199.4 degrees F (93 degrees C) unless otherwise noted. This section does not apply to:

(1) Bulk transportation of flammable liquids;

(2) Storage, handling, and use of fuel oil tanks and containers connected with oil burning equipment;

(3) Storage of flammable liquids on farms;

(4) Liquids without flashpoints that may be flammable under some conditions, such as certain halogenated hydrocarbons and mixtures containing halogenated hydrocarbons;

(5) Mists, sprays, or foams, except flammable aerosols covered in paragraph (d) of this section; or

(6) Installations made in accordance with requirements of the following standards, that are incorporated by reference as specified in 1910.6:

(i) National Fire Protection Association Standard for Drycleaning Plants, NFPA No. 32-1970;

(ii) National Fire Protection Association Standard for the Manufacture of Organic Coatings, NFPA No. 35-1970;

(iii) National Fire Protection Association Standard for Solvent Extraction Plants, NFPA No. 36-1967; or

(iv) National Fire Protection Association Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, NFPA No. 37-1970.

[39 FR 23502, June 27, 1974, as amended at 40 FR 3982, Jan. 27, 1975; 40 FR 23743, June 2, 1975; 43 FR 49746, Oct. 24, 1978; 43 FR 51759, Nov. 7, 1978; 47 FR 39164, Sept. 7, 1982; 51 FR 34560, Sept. 29, 1986; 53 FR 12121, Apr. 12, 1988; 55 FR 32015, Aug. 6, 1990; 61 FR 9237, Mar. 7, 1996; 70 FR 53929, Sept. 13, 2005; 77 FR 17765, Mar. 26, 2012]

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 to 654.295.
Hist: OR-OSHA Admin. Order 2-1992, f. 2/6/92, ef. 5/1/92.
OR-OSHA Admin. Order 4-1997, f. 4/2/97, ef. 4/2/97.
OR-OSHA Admin. Order 4-2005, f. 12/14/05, ef. 12/14/05.
OR-OSHA Admin. Order 5-2012, f. 9/25/12, ef. 9/25/12.

1910.107 Repealed

In Oregon, 437-002-0107, Spray Finishing, applies.

437-002-0107 Spray Finishing

(1) Scope. This section applies to finishing materials when applied as a spray by any means in a continuous or intermittent process. This section also covers the application of powders by powder spray guns, electrostatic powder spray guns, fluidized beds, or electrostatic fluidized beds. This section also applies to any sprayed material that produces combustible deposits or residue. This section does not apply to outdoor spray application of buildings, tanks, or other similar structures, nor to small portable spraying apparatus not used repeatedly in the same location.

(2) Definitions:

(a) ***Aerated solid powders*** *– Any powdered material used as a coating material fluidized within a container by passing air uniformly from below. It is common practice to fluidize such materials to form a fluidized powder bed and then dip the part to be coated into the bed in a manner similar to that used in liquid dipping. Such beds are also used as sources for powder spray operations.*

(b) ***Approved*** *– Approved and listed by a nationally recognized testing laboratory. Refer to 1910.7 for definition of nationally recognized testing laboratory.*

(c) ***Electrostatic fluidized bed*** *– A chamber holding powder coating material that is aerated from below to form an air-supported, expanded cloud of the powder. The powder is electrically charged with a charge opposite to that of the object or material being coated.*

(d) ***Fluidized bed*** *– A chamber holding powder coating material that is aerated from below to form an air-supported, expanded cloud of the powder. The object or material being coated is preheated, then immersed into the cloud.*

(e) ***Infrequent and of short duration*** *– Spray finishing that is:*

(A) Less than 9 square feet surface area per job, and

(B) Uses less than 1-gallon of material in 1-day, and

(C) Intermittent spraying where enough time elapses between spraying episodes to dilute the concentration of vapors essentially to zero before spraying is resumed.

(f) ***Listed*** *– See “approved.”*

(g) ***Noncombustible materials*** *– Materials that have a fire resistance rating of at least 1-hour.*

*(h) **Overspray** – Any sprayed material that is not deposited on the intended object.*

*(i) **Spray area** – Any area in which potentially dangerous quantities of flammable vapors or mists, or combustible residues, dusts, or deposits are present due to the operation of spraying processes.*

*(j) **Spray booth** – A power-ventilated structure provided to enclose or accommodate a spraying operation to confine and limit the escape of spray, vapor, and residue, and to safely conduct or direct them to an exhaust system.*

*(k) **Spray room** – A room designed to accommodate a spraying operation. For the purposes of this rule, the term "spray booth" includes spray rooms except where specifically noted.*

(3) Rules for All Spray Finishing Operations.

(a) Conduct spray finishing in a spray booth provided with local exhaust ventilation except:

(A) When spraying is infrequent and of short duration; or

(B) When spraying is a single "air brush;" or

(C) The object to be sprayed is of such weight or proportion as to render it impracticable to move it into a spray booth; or

(D) When only liquids with a flashpoint above 199.4 degrees F. (93 degrees C.) are used. This exception only applies when the liquid is not heated for use to within 30 degrees F. (16.7 degrees C.) of the flashpoint; or

(E) When spray painting is conducted out-of-doors. For the purposes of this rule, out-of-doors means an area away from the main building and completely open at all times on at least two sides.

(b) Spray finishing outside of a booth, as permitted by OAR 437-002-0107(3)(a)(A), (C), and (D) above, must be done only in a spray area that meets the following requirements:

(A) All light switches, fans, receptacles, overhead lights and all other sources of ignition within 20 horizontal feet and 10 vertical feet of the overspray area must be inoperative or consist of Class I, Group D, explosion-proof types as specified in the National Electrical Code, NFPA 33-2000 and ANSI C2-2002.

(B) All building construction including floors, walls, ceilings, beams, etc., within 20 horizontal feet and 10 vertical feet of the overspray area must consist of or be protected by noncombustible materials.

(C) Protect all areas within 20 feet of the overspray area with automatic sprinklers. Where automatic sprinklers are not available, use other automatic extinguishing equipment. Alternatives may be used only when authorized in writing by the local fire authority.

(D) Aisles leading to exits from the spray finishing area must remain clear at all times.

(E) Provide the spray finishing area with at least six air changes per hour of airflow.

(F) Follow the requirements of paragraphs (3)(c) through (3)(e).

(c) Do not allow employees not engaged in spray finishing operations within 20 feet of the spraying and overspray area.

(d) Employees engaged in spray finishing operations must be provided with and wear respiratory protection unless exhaust ventilation is provided and reduces employee exposure to any material in the finish or its solvent to below the limits established in OAR 437-002-0382, Oregon Rules for Air Contaminants. Follow all of the requirements of OAR 437-002-1910.134, Respiratory Protection.

(e) Combustible Materials.

(A) Do not store combustible material or allow combustible material to accumulate in the spraying and overspray area unless specifically authorized in writing by the local fire authority.

(B) Give the spraying and overspray area daily housekeeping and maintenance while in use and keep it free of any accumulations between uses. Use only nonsparking tools for cleaning purposes.

(C) Combustible materials, such as paper, may be used to cover floors and walls in the spray and overspray area, but must be removed at the end of each workshift. The employer may use longer intervals only when the local fire authority has provided written approval to do so.

(f) Spray booths.

(A) Construction:

(i) Construct spray booths of substantially supported steel, concrete, or masonry.

(ii) When the booth is only used for intermittent or low volume spraying, other substantial noncombustible material may be used.

(iii) Design spray booths to sweep air currents toward the exhaust outlet.

(iv) Construct spray booths with materials that have a fire resistance rating of at least 1 hour. All adjacent construction must have a fire resistance rating of at least 1-hour or as otherwise required by the Oregon Building Codes Division.

(B) The interior surfaces of spray booths must be smooth and continuous without edges, designed to prevent residue pocketing, and designed to ease cleaning and washing.

(C) When the floor surface of a spray booth and operators' working area is combustible, it must be covered with a noncombustible material designed to prevent pocketing of residues and ease cleaning and washing.

(D) A spray booth should be equipped with:

(i) A water washing system designed to minimize dusts or residues entering exhaust ducts and to permit the recovery of overspray finishing material; or

(ii) Distribution or baffle plates to promote an even flow of air through the booth or cause the deposit of overspray before it enters the exhaust duct; or

(iii) Overspray dry filters to minimize dusts or residues entering exhaust ducts.

(E) Where dry powders are sprayed, arrange the powder collection systems in the exhaust to capture oversprayed material.

(F) When distribution or baffle plates are used, they must be of noncombustible material and readily removable or accessible on both sides for cleaning. Such plates will not be located in exhaust ducts.

(G) When using conventional dry type spray booths with overspray dry filters or filter rolls:

(i) Inspect filter rolls to ensure proper replacement of filter media.

(ii) Immediately remove all discarded filter pads and filter rolls to a safe area away from the spray finishing operation. Alternatively, place them in a water-filled metal container and dispose of them at the close of the day's operation unless they remain completely submerged.

(iii) Do not use filters or filter rolls when spraying a material known to be highly susceptible to spontaneous heating and ignition.

(iv) Clean filters or filter rolls must be noncombustible or authorized by the local fire authority.

(v) Do not use filters and filter rolls alternately for different types of coating materials, where the combination of materials may be conducive to spontaneous ignition.

(H) Spray booths with an open frontal area larger than 9 square feet must have a metal deflector or curtain at least 4 1/2 inches deep installed at the upper outer edge of the booth over the opening.

(I) Where conveyors are used to carry work into or out of spray booths, the openings must be as small as practical.

(J) Separate each spray booth from all other nonspray finishing operations by at least 3 feet, a wall, or a partition. This requirement does not apply to spray rooms.

(K) All portions of the spray booth must be readily accessible for cleaning.

(L) The exterior of the spray booth must have a clear space of at least 3 feet on all sides. Do not store any materials within this clear space. All construction within 3 feet of all sides of the spray booth must be noncombustible. This requirement does not apply to spray rooms.

(i) Exception: This requirement does not prohibit locating a spray booth closer than 3 feet to an exterior wall or roof assembly, provided that the wall or roof is constructed of a noncombustible material and the booth can be cleaned and maintained.

(M) When spraying areas are illuminated through glass panels or other transparent materials, use only fixed lighting units as a source of illumination.

(i) Seal panels to effectively isolate the spraying area from the area in which the lighting unit is located.

(ii) Use only noncombustible material constructed or protected so that breakage will be unlikely. Arrange panels so that normal accumulations of residue on the exposed surface of the panel will not be raised to a dangerous temperature by radiation or conduction from the source of illumination.

(N) Protect all spaces within the spray booth with automatic sprinklers acceptable to the local fire authority.

(i) Sprinkler heads must provide water distribution throughout the entire booth.

(ii) When filters are used, automatic sprinklers must be on both the downstream and upstream sides of the filters.

(iii) Keep sprinkler heads as free of overspray deposits as possible. Clean them daily if necessary. When sprinkler heads are covered to protect them from overspray, the material and method used must be authorized by the local fire authority.

(iv) When automatic sprinklers are infeasible or not practical, other means of fire protection must be provided and authorized in writing by the local fire authority.

(g) Electrical and other sources of ignition.

(A) Do not allow open flame or spark producing equipment within 20 feet of the spray area, unless separated by a partition.

(B) Do not place space-heating appliances, steampipes, or hot surfaces in a spraying area where deposits of combustible residues may readily accumulate.

(C) Ensure all electrical wiring and equipment conforms to the provisions of this paragraph and OAR 437, Division 2, Subdivision S.

(D) Do not put any electrical equipment in the spray or overspray area unless it is specifically approved for those locations. All wiring must be in rigid conduit or in boxes or fittings that do not contain taps, splices, or terminal connections.

(E) Electrical wiring and equipment not subject to deposits of combustible residues but located in a spraying area must be explosion-proof, approved for Class I, Group D locations, and conform to the provisions of OAR 437, Division 2, Subdivision S, for Class I, Division 1, Hazardous Locations. Electrical wiring, motors, and other equipment outside of but within 20 feet of any spraying area, and not separated by partitions, must not produce sparks under normal operating conditions and must conform to the provisions of OAR 437, Division 2, Subdivision S for Class I, Division 2, Hazardous Locations.

(F) Electric lamps outside of any spraying area but within 20 feet, and not separated by a partition, will be totally enclosed to prevent the falling of hot particles and will be protected from physical damage by appropriate guards or by location.

(G) Do not use portable electric lamps in any spraying area during spraying operations. If portable electric lamps are used during cleaning or repairing operations, use only the type approved for hazardous Class I locations.

(H) Electrically ground all metal parts of spray booths and exhaust ducts. Electrically ground piping systems that convey flammable or combustible liquids or aerated solids.

(h) Ventilation.

(A) Provide all spraying areas with mechanical ventilation adequate to remove flammable vapors, mists, or powders to a safe location and confine and control combustible residues so that life is not endangered. Keep mechanical ventilation in operation at all times while spraying operations are being conducted and for a sufficient time afterwards to exhaust vapors from drying material and residue.

(B) Interlock the spraying equipment with the ventilation system so that spraying operations cannot be conducted unless the ventilation system is operating.

(C) Air velocity throughout the spray booth must be sufficient to keep airborne contaminants below 25 percent of their lower explosive limit (LEL).

(i) Open-faced booths must maintain at least an average of 100 feet per minute (fpm) of airflow across the open face of the booth.

(ii) Enclosed booths must maintain at least an average of 100 fpm of airflow of cross-sectional area at the operators' position.

(iii) Any deviation from the above must be authorized in writing by the local fire authority.

(iv) Install a visible gauge, audible alarm, or pressure activated device on each spray booth to indicate or ensure that the required air velocity is maintained.

(D) Provide each spray booth with an independent exhaust duct system that discharges to the exterior of the building. A common exhaust system may be used for multiple spray booths only when identical materials are sprayed and the combined frontal area of those booths is no more than 18 square feet.

(E) When more than one fan serves one booth, interconnect all fans so that one fan cannot operate without all fans being operated.

(F) The fan-rotating element must be nonferrous or nonsparking or the casing must consist of or be lined with such material.

(i) Maintain ample clearance between the fan-rotating element and the fan casing to avoid a fire by friction. Prevent contact between moving parts and the duct or fan housing by making allowance for ordinary expansion and loading.

(ii) Mount fan blades on a shaft sufficiently heavy to maintain perfect alignment even when the blades of the fan are heavily loaded.

(iii) All bearings must be of the self-lubricating type, or lubricated from the outside duct.

(G) Place electric motors driving exhaust fans outside booths or ducts. See also paragraph (3)(g) of this section.

(H) When belts and pulleys are inside the duct or booth, they must be thoroughly enclosed.

(I) Construct exhaust ducts of substantially supported steel. Exhaust ducts without dampers are preferred; however, if dampers are installed, they must be fully opened when the ventilating system is in operation.

(i) Protect exhaust ducts against mechanical damage and maintain a clearance of at least 18 inches from unprotected combustible construction or other combustible material.

(ii) If combustible construction is provided with the following protection applied to all surfaces within 18 inches of the exhaust duct, clearances may be reduced to the distances indicated:

(I) 28-gage sheet metal on 1/4-inch insulating millboard, 12 inches.

(II) 28-gage sheet metal on 1/8-inch insulating millboard spaced out 1 inch on noncombustible spacers, 9 inches.

(III) 22-gage sheet metal on 1-inch rockwool batts reinforced with wire mesh or the equivalent, 3 inches.

(J) The terminal discharge point must be at least 6 feet from any combustible exterior wall or roof. The discharge point must not discharge in the direction of any combustible construction or unprotected opening in any noncombustible exterior wall within 30 feet.

(K) Keep air exhaust from spray operations away from makeup air or other ventilation intakes. Do not recirculate air exhausted from spray operations.

(L) Supply clean fresh air, free of contamination from adjacent industrial exhaust systems, chimneys, stacks, or vents, to a spray booth in quantities equal to the volume of air exhausted through the spray booth.

(M) Provide exhaust ducts with an ample number of access doors when necessary to facilitate cleaning.

(N) Provide air intake openings to rooms containing spray finishing operations adequate for the efficient operation of exhaust fans and placed to minimize the creation of dead air pockets.

(O) Dry freshly sprayed articles only in spaces provided with adequate ventilation to prevent the formation of explosive vapors. Drying spaces without adequate ventilation will be considered a spraying area. See also paragraph (6) of this section.

(4) Rules for Spray Finishing with Flammable Liquids.

(a) These rules apply to spray finishing with flammable liquids with a flashpoint below 199.4 degrees F. (93 degrees C.). These rules only apply to liquids with a flashpoint above 199.4 degrees F. (93 degrees C.) when they are heated for use to within 30 degrees F (16.7 degrees C) of their flashpoint.

(b) Flammable liquids – storage and handling.

(A) Store flammable liquids in compliance with the requirements of 1910.106.

(B) Keep only the minimum quantity of flammable liquids required for operations in the vicinity of spraying operations and do not exceed a supply for one day or one shift. Bulk storage of portable containers of flammable liquids must be in a separate, constructed building detached from other important buildings or cut off in a standard manner.

(C) Use only the original closed containers, approved portable tanks, approved safety cans, or a properly arranged system of piping for bringing flammable liquids into the spray area. Do not use open or glass containers.

(D) Use approved pumps to withdraw flammable liquids from containers with a capacity of 61 gallons or more except as provided in paragraph (4)(b)(F) of this section.

(E) Withdraw and fill containers with flammable liquids only in a suitable mixing room or in a spraying area when the ventilating system is in operation. Take adequate precautions to protect against spilling liquids and sources of ignition.

(F) Containers must conform to the following requirements:

(i) Use only closed containers to supply spray nozzles. Use metal covers to close containers that are not closed.

(ii) Use metal supports or wire cables to support containers that are not resting on floors.

(iii) When spray nozzles are supplied by gravity flow, do not use containers that exceed 10 gallons capacity.

(iv) Do not use air pressure in the original shipping containers to supply spray nozzles.

(G) Containers under air pressure supplying spray nozzles must also conform to the following requirements

(i) Use only limited capacity containers that only hold enough material for one day's operation.

(ii) Use only containers that are designed and approved for such use.

(iii) Provide containers with a visible pressure gauge.

(iv) Containers must be provided with a relief valve set to operate in conformance with the requirements of the Oregon Building Codes Division OAR 918-225, "Boilers and Pressure Vessels."

(H) Pipes and hoses.

(i) All containers or piping with an attached hose or flexible connection must have a shutoff valve at the connection. Keep such valves shut when not spraying.

(ii) When a pump is used to deliver the liquid used in a spray application process, use only piping, tubing, hoses, and accessories that are designed to withstand the maximum working pressure of the pump. Alternatively, provide automatic means to limit the discharge pressure of the pump to a level within the design working pressure of the piping, tubing, hoses, and accessories.

(iii) Inspect all pressure hose and couplings at regular intervals appropriate to this service. Test the hose and couplings with the hose extended using the "inservice maximum operating pressures." Repair or discard any hose showing material deteriorations, signs of leakage, or weakness in its carcass or at the couplings.

(iv) Piping systems conveying flammable liquids must be of steel or other material having comparable properties of resistance to heat and physical damage. Properly bond and ground piping systems.

(I) Use approved and listed electrically powered spray liquid heaters. Do not put heaters in spray booths or any other location subject to the accumulation of deposits or combustible residue.

(J) If flammable liquids are supplied to spray nozzles by positive displacement pumps, use an approved relief valve on the pump discharge line that discharges to a pump suction or a safe detached location, or use a device provided to stop the prime mover if the discharge pressure exceeds the safe operating pressure of the system.

(K) Whenever flammable liquids are transferred from one container to another, effectively bond and ground both containers to prevent discharge sparks of static electricity.

(c) Install an adequate supply of suitable portable fire extinguishers near all spraying areas.

(d) Operations and maintenance.

(A) Immediately remove and dispose residue scrapings and debris contaminated with residue from the premises. Deposit all rags or waste impregnated with finishing material in tightly-closing metal waste cans immediately after use. Properly dispose of the contents of waste cans at least once daily or at the end of each shift.

(B) Do not leave clothing worn during spray finishing on the premises overnight unless kept in metal lockers.

(C) Only use solvents for cleaning operations with flashpoints at or above the flashpoints of material normally used. Cleaning operations must be done inside a spray booth with the ventilation system on, or an area authorized in writing by the local fire authority.

(D) Do not alternately use spray booths for different types of coating materials when the materials are incompatible with each other, unless all deposits of the first used material are removed from the booth and exhaust ducts prior to spraying with the second material.

(e) Mixing.

(A) Mix materials only in a mixing room, a spray area that meets the requirements of (3)(b), or in a spray booth. When a spray area or spray booth is used for mixing, the ventilation system must be on.

(B) Construct mixing rooms of substantially supported steel, concrete, or masonry. Use only noncombustible materials to construct mixing rooms.

(C) Design mixing rooms so that any spills remain inside the room.

(D) Provide at least 150 cubic feet per minute (CFM) of airflow in each mixing room. When the flooring of the mixing room is greater than 150 square feet, provide at least 1 CFM per square foot of flooring. The ventilation system for each mixing room must be on and operational at all times.

(E) Follow all of the provisions of paragraph (3)(g).

(F) Protect all spaces within the mixing room with automatic sprinklers acceptable to the local fire authority. Where automatic sprinklers are not available, use other automatic extinguishing equipment. Alternatives may be used only when authorized in writing by the local fire authority.

(5) Rules for Electrostatic Spray Finishing.

(a) Fixed electrostatic apparatus.

(A) Use only approved electrostatic apparatus and devices in connection with coating operations.

(B) Transformers, power packs, control apparatus, and all other electrical portions of the equipment, with the exception of high-voltage grids, electrodes, and electrostatic atomizing heads and their connections, must be located outside of the spraying area, or must otherwise conform to the requirements of paragraph (3) of this section.

(C) Adequately support electrodes and electrostatic atomizing heads in permanent locations and effectively insulate them from the ground. Electrodes and electrostatic atomizing heads which are permanently attached to their bases, supports, or reciprocators are considered to comply with this section. Use only nonporous and noncombustible insulators.

(D) Properly insulate and protect high-voltage leads to electrodes from mechanical injury or exposure to destructive chemicals. Effectively and permanently support electrostatic atomizing heads on suitable insulators and effectively guard against accidental contact or grounding. Provide an automatic means for grounding the electrode system when it is electrically de-energized for any reason. Keep all insulators clean and dry.

(E) Maintain a safe distance between goods being painted and electrodes or electrostatic atomizing heads or conductors of at least twice the sparking distance. Conspicuously post a sign indicating this safe distance near the assembly.

(F) Support goods being painted using this process on conveyors. Arrange the conveyors to maintain safe distances between the goods and the electrodes or electrostatic atomizing heads at all times. Any irregularly shaped or other goods subject to possible swinging or movement must be rigidly supported to prevent swinging or movement which would reduce the clearance to less than that specified in paragraph (5)(a)(E) of this section.

(G) Equip electrostatic apparatus with automatic controls that immediately disconnect the power supply to the high voltage transformer and signals the operator when:

(i) Any failure occurs in the ventilation equipment.

(ii) The conveyor carrying goods through the high voltage field stops.

(iii) Occurrence of a ground or of an imminent ground at any point on the high voltage system.

(iv) The safe distance required by (5)(a)(E) is not maintained.

(H) Place adequate booths, fencing, railings, or guards around the equipment to assure, either by their location or character or both, that a safe isolation of the process is maintained from plant storage or personnel. Construct such railings, fencing, and guards of conducting material that is adequately grounded.

(b) Electrostatic hand spraying equipment.

(A) This paragraph applies to any equipment that uses electrostatically charged elements for the atomization and/or, precipitation of materials for coatings on articles, or for other similar purposes in which the atomizing device is hand held and manipulated during the spraying operation.

(B) Use only approved electrostatic hand spray apparatus and devices in connection with coating operations. The high voltage circuits must be designed so it does not produce a spark of sufficient intensity to ignite any vapor-air mixtures or result in appreciable shock hazard upon coming in contact with a grounded object under all normal operating conditions. The electrostatically charged exposed elements of the handgun must be capable of being energized only by a switch which also controls the coating material supply.

(C) Locate transformers, powerpacks, control apparatus, and all other electrical portions of the equipment outside of the spraying area. This requirement does not apply to the handgun itself and its connections to the power supply.

(D) Electrically connect the handle of the spraying gun to ground by a metallic connection. Ensure that the operator in normal operating position is in intimate electrical contact with the grounded handle.

(E) Adequately ground all electrically conductive objects in the spraying area. This requirement applies to paint containers, wash cans, and any other objects or devices in the area. Prominently and permanently install a warning on the equipment regarding the necessity for this grounding feature.

(F) Maintain metallic contact between objects being painted or coated and the conveyor or other grounded support. Regularly clean hooks to ensure this contact.

(G) Areas of contact must be sharp points or knife edges where possible.

(H) Conceal points of support of the object from random spray where feasible.

(I) When objects being sprayed are supported from a conveyor, the point of attachment to the conveyor must not collect spray material during normal operation.

(J) Interlock the electrical equipment with the ventilation of the spraying area so that the equipment cannot be operated unless the ventilation fans are on.

(6) Drying, Curing, or Fusion Apparatus.

(a) Drying, curing, or fusion equipment.

(A) Equipment manufactured or modified on or before June 1, 2003, must comply with the provisions of the Standard for ovens and furnaces, NFPA No. 86A-1969 where applicable.

(B) Equipment manufactured or modified after June 1, 2003, must comply with the provisions of the Standard for Ovens and Furnaces, NFPA No. 86-1999 where applicable.

(b) Do not use a spray area for drying when such drying can increase the surface temperature of the spray area.

(c) Except as specifically provided in paragraph (6)(e) of this section, do not install an open flame heating system for drying, curing, or fusion in a spray area.

(d) Drying, curing, or fusion units may be installed adjacent to spray areas only when equipped with an interlocked ventilating system arranged to:

(A) Thoroughly ventilate the drying space before the heating system can be started;

(B) Maintain a safe atmosphere at any source of ignition;

(C) Automatically shut down the heating system in the event of failure of the ventilating system.

(e) Automobile refinishing spray booths or enclosures, otherwise installed and meeting the requirements of this section, may alternately be used for drying with portable electrical infrared drying apparatus that meets the following:

(A) Keep the interior (especially floors) of spray enclosures free of overspray deposits.

(B) Keep the apparatus out of the spray and overspray area while spray finishing is in progress.

(C) Equip the spraying apparatus, the drying apparatus, and the ventilating system of the spray enclosure with suitable interlocks arranged so:

(i) The spraying apparatus cannot be operated while the drying apparatus is inside the spray enclosure.

(ii) The spray enclosure is purged of spray vapors for at least 3 minutes before the drying apparatus is energized.

(iii) The ventilating system maintains a safe atmosphere within the enclosure during the drying process, and the drying apparatus will automatically shut off in the event of failure of the ventilating system.

(D) All electrical wiring and equipment of the drying apparatus must meet the applicable sections of OAR 437, Division 2, Subdivision S. Only equipment of a type approved for Class I, Division 2 hazardous locations will be located within 18 inches of floor level. All metallic parts of the drying apparatus will be properly electrically bonded and grounded.

(E) Place a warning sign on the drying apparatus indicating that ventilation must be maintained during the drying period and that spraying must not be conducted in the vicinity where spray will deposit on apparatus.

(7) Powder Coating.

(a) Ventilation.

(A) Ensure that exhaust ventilation is sufficient to maintain the atmosphere below the lowest explosive limits for the materials being applied. Ensure that all nondeposited air-suspended powders are safely removed via exhaust ducts to the powder recovery cyclone or receptacle.

(B) Do not release powders to the outside atmosphere.

(b) Operation and maintenance.

(A) Keep all areas free of the accumulation of powder coating dusts, particularly horizontal surfaces as ledges, beams, pipes, hoods, booths, and floors.

(B) Clean surfaces in a manner to avoid scattering dust to other places or creating dust clouds.

(C) Conspicuously post "No Smoking" signs in large letters on contrasting color background at all powder coating areas and powder storage rooms.

(c) Electrostatic fluidized beds.

(A) Use only approved electrostatic fluidized beds and associated equipment.

(B) Ensure that the maximum surface temperature of this equipment in the coating area does not exceed 150 degrees F.

(C) Use only high voltage circuits that will not produce a spark of sufficient intensity to ignite any powder-air mixtures.

(D) Use circuits designed to eliminate shock hazards upon coming in contact with a grounded object under normal operating conditions.

(E) Locate transformers, powerpacks, control apparatus, and all other electrical portions of the equipment outside of the powder coasting area, with the exception of the charging electrodes and their connections to the power supply.

(F) Adequately ground all electrically conductive objects within the charging influence of the electrodes. The powder coating equipment must carry a prominent, permanently installed warning regarding the necessity for grounding these objects.

(G) Objects being coated will be maintained in contact with the conveyor or other support in order to ensure proper grounding. Regularly clean hangers to ensure effective contact and areas of contact will be sharp points or knife edges where possible.

(H) Interlock the electrical equipment with the ventilation system so the equipment cannot be operated unless the ventilation fans are in operation.

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: OR-OSHA Admin. Order 2-1992, f. 2/6/92, ef. 5/1/92.
OR-OSHA Admin. Order 3-2003, f. 4/21/03, ef. 4/21/03.
OR-OSHA Admin. Order 5-2012, f. 9/25/12, ef. 9/25/12.

437-002-0118 Oregon Rules for Reinforced Plastics Manufacturing

(1) Applicability. If a specific type of equipment, process or practice is not limited to the reinforced plastics industry, the provisions contained in other Divisions of OAR 437, Oregon Occupational Safety and Health Code, shall apply.

(2) Scope.

(a) These rules shall apply to reinforced plastics manufacturing operations, in their shop buildings (not field work) involving the use of polyester, vinylester, and other similar products in which styrene monomer is a reactive monomer for the resin. This division applies to chopper gun, gel coating, hand laminating and casting operations utilizing resin and organic peroxide catalyst.

(b) This division does not apply to:

(A) Application of flammable organic materials such as acetone, methyl ethyl ketone (MEK), either alone or mixed as flammable paints or diluents;

(B) Operations, involving polyurethane finishes or foams utilizing isocyanate catalysts;

(C) Operations involving epoxy resin compounds utilizing amine hardeners; or

(D) Cleaning of chopper guns, lines, and associated equipment in which acetone, MEK, or other flammable organic solvents are sprayed into the open air as part of the cleaning process.

(3) Definitions. The following definitions shall apply to OAR 437-002-0118:

*(a) **Chopper Gun** – A device that feeds fiber glass rovings through a chopper and ejects them into a stream of resin and organic peroxide catalyst onto a mold surface. The resin and organic peroxide catalyst are combined and ejected from the chopper gun by either one of two systems:*

(A) One nozzle ejects resin while another nozzle ejects organic peroxide catalyst towards the mold surface; or

(B) The resin and organic peroxide catalyst are fed into a single chopper gun mixing chamber ahead of the nozzle.

Note: *By either method, the resin mixture precoats the strands of glass and the merged product is directed onto a mold surface by the operator.*

(b) ***Flammable liquid*** *means any liquid having a flashpoint at or below 199.4 degrees F (93 degrees C). Flammable liquids are divided into four categories as follows:*

(A) Category 1 shall include liquids having flashpoints below 73.4 degrees F (23 degrees C) and having a boiling point at or below 95 degrees F (35 degrees C).

(B) Category 2 shall include liquids having flashpoints below 73.4 degrees F (23 degrees C) and having a boiling point above 95 degrees F (35 degrees C).

(C) Category 3 shall include liquids having flashpoints at or above 73.4 degrees F (23 degrees C) and at or below 140 degrees F (60 degrees C). When a Category 3 liquid with a flashpoint at or above 100 degrees F (37.8 degrees C) is heated for use to within 30 degrees F (16.7 degrees C) of its flashpoint, it shall be handled in accordance with the requirements for a Category 3 liquid with a flashpoint below 100 degrees F (37.8 degrees C).

(D) Category 4 shall include liquids having flashpoints above 140 degrees F (60 degrees C) and at or below 199.4 degrees F (93 degrees C). When a Category 4 flammable liquid is heated for use to within 30 degrees F (16.7 degrees C) of its flashpoint, it shall be handled in accordance with the requirements for a Category 3 liquid with a flashpoint at or above 100 degrees F (37.8 degrees C).

(c) ***Flashpoint*** *– The minimum temperature at which a liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture shall be determined as follows:*

(A) For a liquid which has a viscosity of less than 45 SUS at 100 degrees F (37.8 degrees C), does not contain suspended solids, and does not have a tendency to form a surface film while under test, the procedure specified in the Standard Method of Test for Flashpoint by Tag Closed Tester (ASTM D-56-70), which is incorporated by reference as specified in 1910.6, or an equivalent test method as defined in Appendix B to 1910.1200 – Physical Hazard Criteria, shall be used.

(B) For a liquid which has a viscosity of 45 SUS or more at 100 degrees F (37.8 degrees C), or contains suspended solids, or has a tendency to form a surface film while under test, the Standard Method of Test for Flashpoint by Pensky-Martens Closed Tester (ASTM D-93-71) or an equivalent method as defined by Appendix B to 1910.1200 – Physical Hazard Criteria, shall be used except that the methods specified in Note 1 to section 1.1 of ASTM D-93-71 may be used for the respective materials specified in the Note. The preceding ASTM standard is incorporated by reference as specified in 1910.6.

(C) For a liquid that is a mixture of compounds that have different volatilites and flashpoints, its flashpoint shall be determined by using the procedures in subsection (3)(c)(A) or (3)(c)(B) of this definition on the liquid in the form it is shipped.

(D) Organic peroxide catalysts are excluded from any of the flashpoint determination methods specified in this section.

(d) ***Gelcoating*** *– A chopper gun pressure pot or similar device is used to apply the resin and organic peroxide catalyst mixture to a mold surface without glass fibers;*

(e) ***Hand Laminating*** *– Resin is mixed with organic peroxide catalyst and applied by hand with a brush, squeegee, or roller with fiber glass reinforcements.*

(f) ***Hazard*** *– A substance, process, practice or condition which could result in an injury or illness to an employee.*

(g) ***Resin*** *– A mixture of true esters dissolved in a polymerizable monomer (styrene).*

(h) ***Threshold-Limit Value*** *– Short Term Exposure Limit (TLV-STEL) – The maximum concentration to which workers can be exposed for a period of up to 15 minutes continuously without suffering from (a) irritation, (b) chronic or irreversible tissue change, or (c) narcosis of sufficient degree to increase accident proneness, impair self-rescue, or materially reduce work efficiency, provided that no more than four excursions per day are permitted, with at least 60 minutes between exposure periods, and provided that the daily TLV-TWA also is not exceeded. The STEL should be considered a maximum allowable concentration, or ceiling, not to be exceeded at any time during the 15-minute excursion period.*

GENERAL REQUIREMENTS

(4) Permissible Exposure Limits.

(a) An employee's exposure to any material listed in Table 1, in any 8-hour workshift of a 40-hour work week, shall not exceed the 8-hour time-weighted average limit for that material in the table.

(b) An employee's exposure to a material listed in Table 1 shall not exceed, at any time during an 8-hour shift, the TLV-STEL level given for the material in the table, except for a time period, and up to a concentration not exceeding the maximum duration and concentration allowed in the column under "Acceptable Maximum Peak."

(c) Employee exposure to other airborne contaminants shall be in accordance with OAR 437, Division 2, Subdivision Z, 1910.1000, Air Contaminants, and other applicable regulations.

***Note:** In the Oregon Rules for Reinforced Plastics Manufacturing, Table 1, Permissible Exposure Limits, in OAR 437-002-0118(4), has been revised to reflect the current limits in OAR 437-002-0382, Oregon Rules for Air Contaminants, which were adopted on 11/15/93 in lieu of 1910.1000, Air Contaminants.*

Table H-20 - Permissible Exposure Limits

Substance	8-Hour Time Weighted Average	Acceptable Ceiling Concentration	Acceptable Max. Peak Above the Acceptable Ceiling Concentration for an 8-Hour Shift	
			Concentration	Maximum Duration
Acetone	1000 ppm			
Methyl Ethyl Ketone (2 Butanone)	200 ppm			
Styrene	100 ppm	200 ppm	600	5 min. in any 3 hrs.

(5) Methods of Compliance.

(a) To achieve compliance with OAR 437-002-0118(4), Permissible Exposure Limits, administrative or engineering controls must first be determined and implemented whenever feasible.

(b) When such controls are not feasible to achieve full compliance, protective measures as prescribed in OAR 437, Division 2/I, Personal Protective Equipment, shall be used to keep the exposure of employees to airborne contaminants within the limits prescribed in OAR 437-002-0118.

(6) Employee Information and Training. A training program shall be established and all affected employees shall be trained regarding the safe handling of materials used in the industry which shall include instruction in storage, handling large and small quantities, cleanup and disposal of spills, first aid for spills, equipment training, potential health and safety hazards, personal hygiene, personal protective measures, and the labeling system.

(7) Personal Protective Equipment.

(a) Safety glasses shall be worn at all times by personnel working in the manufacturing area of reinforced plastics plants.

(b) Face shields and safety glasses shall be worn when opening and filling pressurized catalyst injection equipment.

(c) An eyewash fountain shall be provided no more than 25 feet or 15 seconds of actual travel from a work area where MEK peroxide is being mixed or transferred.

(A) The criteria of 25 feet shall apply if the employee is working alone.

(B) The criteria of 15 seconds shall apply if other employees are close enough under normal working conditions to provide assistance and a formal training program which includes emergency first aid procedures for eye protection has been implemented.

(d) Clothing saturated or impregnated with flammable liquids, corrosive or toxic substances, irritants, or oxidizing agents, that present a health hazard to employees shall be removed and disposed of, or properly cleaned before reuse; however, clothing coated with cured resin may be worn.

(8) Warning Signs and Labels.

(a) Label chemical containers in accordance with 1910.1200, Hazard Communication.

(b) Where extreme occupational health hazards are known to exist in the workplace, the employer shall provide warning signs or other equally effective means of calling attention to such hazards at the location where the hazards exist.

(9) Housekeeping.

(a) Housekeeping shall be sufficient to keep accumulations of combustible residues to a minimum as practical.

(b) All combustible and flammable residues shall be placed in covered noncombustible containers.

(c) To prevent excessive permanent buildup of overspray and overchop, the use of paper, polyethylene film, building or roofing paper or other similar sheet material shall be permitted on side walls and floors of chopper gun and gelcoat areas.

(A) When the accumulated depth of overchop and/or gelcoat has reached an average thickness of 2 inches in the overspray area, it shall be disposed of after at least 4 hours curing.

(B) A single day's accumulation of more than an average of 2 inches shall be permitted provided it is disposed of before operations are resumed the next day.

(d) Excess catalyzed resin inside a building shall be disposed of in open-topped containers provided with bar screens, large mesh wire screens, or other means, to support individual containers across its top through which surplus catalyzed resin can be poured and upon which empty containers that once held catalyzed resin can be placed to cure. The open-topped containers shall contain water at least 2 inches deep in which the resin shall be poured and permitted to cure in a safe fashion. Containers can be used until filled with setup resin and disposed of along with other nontoxic waste.

(10) Hygiene Facilities and Practices. If acetone is used directly on the skin to clean hands, barrier or a therapeutic cream must be made available to the employee. Gloves shall be provided should any employee wish additional protection.

(11) Storage and Handling of Flammable Liquids.

(a) The storage and handling of acetone and other Category 1-3 flammable liquids for cleanup and gun flushing shall be subject to the following requirements:

(A) Category 1-3 flammable solvents shall be kept in containers that are covered during storage;

(B) Areas within the shop where acetone or other Category 1-3 flammable solvents are transferred into containers less than 5 gallons each shall be considered Class I, Division 1 areas for a 5-foot radius around the point of transfer, and Class I Division 2, for an additional 5 feet outside of the area; and

(C) "Dirty" acetone in small individual cleanup containers of less than 5 gallons each may be handled by pouring into a larger container suitable for disposal or recycling which shall be kept covered.

(b) The following subsections shall apply to chopper gun or gelcoating areas:

(A) Areas where flammable liquids are used, shall be protected by automatic sprinklers or equivalent extinguishing systems. If a special extinguishing system including, but not limited to, those employing foam, carbon dioxide, or dry chemical, is provided, approved equipment shall be used and installed in an approved manner.

(B) Exhaust fans mounted 4 feet or less, as measured from the invert (bottom) of the duct above the floor, shall have nonsparking fan blades, and

(i) A motor mounted external to the air stream in a nonexplosive atmosphere. The fan shall be driven by an interconnecting belt.

(ii) Those fans having air suction ducts 4 feet or less above the floor shall comply with subsection (11)(b)(B).

(C) Exhaust fans mounted more than 4 feet above the floor shall have nonsparking fan blades.

(D) All other electrical equipment in chopper gun or gelcoating operations must conform to the requirements of National Fire Protection Association (NFPA) 33-1989.

(c) Acetone and other Category 1-3 flammable liquids shall be transferred only though a closed piping system from a safety can by means of a device drawing through the top or from a container or portable tank by gravity through an approved self-closing valve. The nozzle and container shall be electrically interconnected.

(d) Acetone shall be kept in covered containers when not in use.

(e) Special input and exhaust ventilation shall be provided where employees must be inside or under the item being fabricated (e.g., inside a pipe or boat hull or under a large fabricated shape) to keep air concentrations of hazardous and/or flammable materials at or below 25 percent of the lower explosive limit and employee exposure at or below the permissible exposure limit.

(f) Areas where flammable materials are handled shall either be posted with "No Smoking" signs, or smoking shall be prohibited throughout plant, manufacturing and storage areas.

(g) Storage and handling of flammable liquids not addressed in these rules shall meet the requirements of 1910.106, Flammable Liquids.

(12) Storage and Handling of Organic Peroxide Catalysts.

(a) Organic peroxide catalysts shall be isolated and stored in their original containers in a cool place under 100 degrees F (37.8 degrees C), away from other flammable materials and ignition sources.

(b) Organic peroxide catalyst containers shall be covered or kept closed at all times.

(c) Organic peroxide catalysts shall be brought into the area of use in no more than two consecutive days' supply.

(d) Larger than 8-pound containers of organic peroxide catalyst shall not be permitted outside designated catalyst storage areas, except for hand layup operations or for filling the catalyst reservoir of chopper gun and gelcoat equipment.

(e) When organic peroxide catalyst is being poured into the catalyst reservoir of chopper gun and gelcoat equipment, the catalyst container shall be equipped with a special curved pouring spout or other device which directs the catalyst into the reservoir without splashing.

(A) A supply of water of not less than 1-gallon shall be permanently installed on the chopper gun or gelcoat apparatus to wet down any catalyst spills which may occur due to overfilling. Catalyst spills shall be absorbed in accordance with the manufacturer's recommendations.

(B) Immediately after filling the chopper gun or gelcoat apparatus with catalyst, the empty or partially filled catalyst container shall be removed immediately before commencement of any other operation.

(13) Fire Protection. Areas where flammable materials are handled shall either be posted with "No Smoking" signs, or smoking shall be prohibited throughout plant, manufacturing and storage areas.

(14) Ventilation.

(a) Special input and exhaust ventilation shall be provided where employees must be inside or under the item being fabricated (e.g., inside a pipe or boat hull or under a large fabricated shape) to keep air concentrations of hazardous and/or flammable materials at or below 25 percent of the lower explosive limit and employee exposure at or below the permissible exposure limit.

(b) During cleanup and gun flushing with acetone or other Category 1-3 flammable liquids, sufficient ventilation shall be provided to maintain air concentrations below 25 percent of the lower explosive limit (LEL) and employee exposure at or below the permissible exposure limit.

(c) Where acetone and Category 1-3 flammable solvents are used in physical operations (e.g., mixing), there shall be a minimum ventilation rate of 1 cubic foot per minute per square foot of floor area in the immediate work area.

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: OR-OSHA Admin. Order 2-1992, f. 2/6/92, ef. 5/1/92.
OR-OSHA Admin. Order 6-1994, f. 9/30/94, ef. 9/30/94.
OR-OSHA Admin. Order 5-2012, f. 9/25/12, ef. 9/25/12.

1910.108 Reserved

1910.109 Explosives and Blasting Agents

Note 1: Oregon did NOT adopt the following in 1910.109, Explosives and Blasting Agents:

(a) Tables H-21 and H-22, and their respective Notes; and

(b) The definition of "magazine" in 1910.109(a)(6).

In Oregon, OAR 437-002-0109, Tables OR-H-21 and OR-H-22, and their respective Notes, apply. Also, the definition of "magazine" in Note 5 of OR-H-21 applies.

Note 2: The following Oregon-initiated rules relate to 29 CFR 1910.109, Explosives and Blasting Agents:

437-002-0109 Explosives and Blasting Agents

(1) Blasting and Use of Explosives.

(a) Smoking, firearms, matches, open flame lamps, fires and flame or spark producing devices shall be prohibited in any explosive magazine or within a radius of 100 feet thereof, and with 100 feet of where explosives are being handled, transported, or used;

(b) All blasts shall be fired electronically with an electric blasting machine or properly designed electric power sources, except as provided in sections of this rule;

(c) All explosives shall be accounted for at all times. Explosives not being used shall be kept in a locked magazine, unavailable to persons not authorized to handle them. The employer shall maintain an inventory and use records of all explosives. Appropriate authorities shall be notified of any loss, theft, or in authorized entry into a magazine;

(d) The preparation of primers shall be done in a safe place, well away from fire, possible sparks, magazines or powder boxes. Where practical to do so, primers should be prepared at the point of use and immediately placed in the bore hole.

(2) Recordkeeping and loading.

(a) The blaster shall keep an accurate, up-to-date record of explosives, blasting agents, and blasting supplies used in a blast and shall keep an accurate running inventory of all explosives and blasting agents stored on the operations;

(b) No explosives or blasting agents shall be left unattended at the blast site. No loaded holes shall be left unattended or unprotected. All loaded holes shall be fired before leaving the blast site;

(3) Electric Firing. Flashlight batteries shall not be used when firing a circuit of electric blasting caps. The electric current delivered to the charge shall meet the manufacturer's recommended level.

(4) Locks. Each door shall be equipped with two mortise locks; or with two padlocks fastened in separate hasps and staples; or with a combination or mortise lock and padlock; or with a mortise lock that requires two keys to open; or a three-point lock. Locks shall be five-tumbler proof. All padlocks shall be protected with 1/4-inch steel caps constructed so as to prevent sawing or lever action on the locks or hasps.

(5) Cap Boxes. Storage facilities for blasting caps in quantities of 100 or less shall have sides, bottoms, and covers constructed of No. 12-gauge metal and lined with a nonsparking material. Hinges and hasps shall be attached thereto by welding. A single five-tumbler proof lock shall be sufficient for locking purposes.

Note 1*: Use the AMERICAN TABLE OF DISTANCES FOR STORAGE OF EXPLOSIVE MATERIALS to determine safe distances from inhabited dwellings, highways, passenger railways, and between explosive materials magazines.*

Note 2*: Use the appendix, SEPARATION DISTANCES OF AMMONIUM NITRATE AND BLASTING AGENTS FROM EXPLOSIVES OR BLASTING AGENTS, to determine nonpropagating distances to ammonium nitrate fuel oil (ANFO) blasting agents and to ammonium nitrate.*

Note 3*: Use the greater of the distances shown in the AMERICAN TABLE OF DISTANCES and in the TABLE OF RECOMMENDED SEPARATION DISTANCES to determine the required separation between a magazine for storage of explosives and a magazine for storage of blasting agents.*

(6)

(a) Table of Distances. The provisions contained in Table OR-H-21 below are in lieu of the provisions contained in 29 CFR 1910.109, Table H-21, American Table of Distances for Storage of Explosives. Related Notes are printed following the table for clarity in using Table OR-H-21.

Table OR-H-21 - American Table of Distances for Storage of Explosive Materials

As Revised and Approved by The Institute of Makers of Explosives — June 1991

Quantity of Explosive Materials[1,2,3,4]		**Distance in Feet**							
		Inhabited Buildings[9]		**Public Highways with Volume of less than 3000 Vehicles/Day**[10]		**Passenger Railways - Public Highways with Traffic Volume of more than 3,000 Vehicles/Day**[10,11]		**Separation of Magazines**[12]	
Pounds Over	Pounds Not Over	Barricaded[6,7,8]	Unbarricaded	Barricaded[6,7,8]	Unbarricaded	Barricaded[6,7,8]	Unbarricaded	Barricaded[6,7,8]	Unbarricaded
0	5	70	140	30	60	51	102	6	12
5	10	90	180	35	70	64	128	8	16
10	20	110	220	45	90	81	162	10	20
20	30	125	250	50	100	93	186	11	22
30	40	140	280	55	110	103	206	12	24
40	50	150	300	60	120	110	220	14	28
50	75	170	340	70	140	127	254	15	30
75	100	190	380	75	150	139	278	16	32
100	125	200	400	80	160	150	300	18	36
125	150	215	430	85	170	159	318	19	38
150	200	235	470	95	190	175	350	21	42
200	250	255	510	105	210	189	378	23	46
250	300	270	540	110	220	201	402	24	48
300	400	295	590	120	240	221	442	27	54
400	500	320	640	130	260	238	476	29	58
500	600	340	680	135	270	253	506	31	62
600	700	355	710	145	290	266	532	32	64
700	800	375	750	150	300	278	556	33	66
800	900	390	780	155	310	289	578	35	70
900	1,000	400	800	160	320	300	600	36	72
1,000	1,200	425	850	165	330	318	636	39	78
1,200	1,400	450	900	170	340	336	672	41	82

Quantity of Explosive Materials[1,2,3,4]		Distance in Feet							
		Inhabited Buildings[9]		Public Highways with Volume of less than 3000 Vehicles/Day[10]		Passenger Railways - Public Highways with Traffic Volume of more than 3,000 Vehicles/Day[10,11]		Separation of Magazines[12]	
Pounds Over	Pounds Not Over	Barricaded[6,7,8]	Unbarricaded	Barricaded[6,7,8]	Unbarricaded	Barricaded[6,7,8]	Unbarricaded	Barricaded[6,7,8]	Unbarricaded
1,400	1,600	470	940	175	350	351	702	43	86
1,600	1,800	490	980	180	360	366	732	44	88
1,800	2,000	505	1,010	185	370	378	756	45	90
2,000	2,500	545	1,090	190	380	408	816	49	98
2,500	3,000	580	1,160	195	390	432	864	52	104
3,000	4,000	635	1,270	210	420	474	948	58	116
4,000	5,000	685	1,370	225	450	513	1,026	61	122
5,000	6,000	730	1,460	235	470	546	1,092	65	130
6,000	7,000	770	1,540	245	490	573	1,146	68	136
7,000	8,000	800	1,600	250	500	600	1,200	72	144
8,000	9,000	835	1,670	255	510	624	1,248	75	150
9,000	10,000	865	1,730	260	520	645	1,290	78	156
10,000	12,000	875	1,750	270	540	687	1,374	82	164
12,000	14,000	885	1,770	275	550	723	1,446	87	174
14,000	16,000	900	1,800	280	560	756	1,512	90	180
16,000	18,000	940	1,880	285	570	786	1,572	94	188
18,000	20,000	975	1,950	290	580	813	1,626	98	196
20,000	25,000	1,055	2,000	315	630	876	1,752	105	210
25,000	30,000	1,130	2,000	340	680	933	1,866	112	224
30,000	35,000	1,205	2,000	360	720	981	1,962	119	238
35,000	40,000	1,275	2,000	380	760	1,026	2,000	124	248
40,000	45,000	1,340	2,000	400	800	1,068	2,000	129	258
45,000	50,000	1,400	2,000	420	840	1,104	2,000	135	270
50,000	55,000	1,460	2,000	440	880	1,140	2,000	140	280
55,000	60,000	1,515	2,000	455	910	1,173	2,000	145	290
60,000	65,000	1,565	2,000	470	940	1,206	2,000	150	300
65,000	70,000	1,610	2,000	485	970	1,236	2,000	155	310
70,000	75,000	1,655	2,000	500	1,000	1,263	2,000	160	320
75,000	80,000	1,695	2,000	510	1,020	1,293	2,000	165	330
80,000	85,000	1,730	2,000	520	1,040	1,317	2,000	170	340

Quantity of Explosive Materials[1,2,3,4]		Distance in Feet							
		Inhabited Buildings[9]		Public Highways with Volume of less than 3000 Vehicles/Day[10]		Passenger Railways - Public Highways with Traffic Volume of more than 3,000 Vehicles/Day[10,11]		Separation of Magazines[12]	
Pounds Over	Pounds Not Over	Barricaded[6,7,8]	Unbarricaded	Barricaded[6,7,8]	Unbarricaded	Barricaded[6,7,8]	Unbarricaded	Barricaded[6,7,8]	Unbarricaded
85,000	90,000	1,760	2,000	530	1,060	1,344	2,000	175	350
90,000	95,000	1,790	2,000	540	1,080	1,368	2,000	180	360
95,000	100,000	1,815	2,000	545	1,090	1,392	2,000	185	370
100,000	110,000	1,835	2,000	550	1,100	1,437	2,000	195	390
110,000	120,000	1,855	2,000	555	1,110	1,479	2,000	205	410
120,000	130,000	1,875	2,000	560	1,120	1,521	2,000	215	430
130,000	140,000	1,890	2,000	565	1,130	1,557	2,000	225	450
140,000	150,000	1,900	2,000	570	1,140	1,593	2,000	235	470
150,000	160,000	1,935	2,000	580	1,160	1,629	2,000	245	490
160,000	170,000	1,965	2,000	590	1,180	1,662	2,000	255	510
170,000	180,000	1,990	2,000	600	1,200	1,695	2,000	265	530
180,000	190,000	2,010	2,010	605	1,210	1,725	2,000	275	550
190,000	200,000	2,030	2,030	610	1,220	1,755	2,000	285	570
200,000	210,000	2,055	2,055	620	1,240	1,782	2,000	295	590
210,000	230,000	2,100	2,100	635	1,270	1,836	2,000	315	630
230,000	250,000	2,155	2,155	650	1,300	1,890	2,000	335	670
250,000	275,000	2,215	2,215	670	1,340	1,950	2,000	360	720
275,000	300,000	2,275	2,275	690	1,380	2,000	2,000	385	770

Numbers in ( ) refer to explanatory notes.

Notes to Table OR-H-21

Explanatory notes essential to the application of Table OR-H-21, The American Table of Distances for Storage of Explosive

Note 1: *Explosive materials means explosives, blasting agents and detonators.*

Note 2: *Explosives means any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion. A list of explosives determined to be within the coverage of "18 U.S.C. Chapter 40, Importation, Manufacturer, Distribution and Storage of Explosive Materials" is issued at least annually by the Director of the Bureau of Alcohol, Tobacco and Firearms of the Department of the Treasury. For quantity and distance purposes, detonating cord of 50 grains per foot should be calculated as equivalent to 8 pounds of high explosives per 1,000 feet. Heavier or lighter core loads should be rated proportionately.*

Note 3: *Blasting agents means any material or mixture, consisting of fuel and oxidizer, intended for blasting, not otherwise defined as an explosive: Provided, That the finished product, as mixed for use or shipment, cannot be detonated by means of a No. 8 test blasting cap when unconfined.*

Note 4: *Detonator means any device containing any initiating or primary explosive that is used for initiating detonation. A detonator may not contain more than 10 grams of total explosives by weight, excluding ignition or delay charges. The term includes, but is not limited to, electric blasting caps of instantaneous and delay types, blasting caps for use with safety fuses, detonating cord delay connectors, and nonelectric instantaneous and delay blasting caps which use detonating cord, shock tube, or any other replacement for electric leg wires. All types of detonators in strengths through No. 8 cap should be rated at 1 1/2 pounds of explosives per 1,000 caps. For strengths higher than No. 8 cap, consult the manufacturer.*

Note 5: *Magazine means any building, structure, or container, other than an explosives manufacturing building, approved for the storage of explosive materials.*

Note 6: *Natural Barricade means natural features of the ground, such as hills, or timber of sufficient density that the surrounding exposures which require protection cannot be seen from the magazine when the trees are bare of leaves.*

Note 7: *Artificial Barricade means an artificial mound or revetted wall of earth of a minimum thickness of 3 feet.*

Note 8: *Barricaded means the effective screening of a building containing explosive materials from the magazine or other building, railway, or highway by a natural or an artificial barrier. A straight line from the top of any sidewall of the building containing explosive materials to the eave line of any magazine or other building or to a point 12 feet above the center of a railway or highway shall pass through such barrier.*

Note 9: *Inhabited Building means a building regularly occupied in whole or part as a habitation for human beings, or any church, schoolhouse, railroad station, store, or other structure where people are accustomed to assemble, except any building or structure occupied in connection with the manufacture, transportation, storage or use of explosive materials.*

Note 10: *Railway means any steam, electric, or other railroad or railway which carries passengers for hire.*

Note 11: *Highway means any public street, public alley, or public road.*

Note 12: *When two or more storage magazines are located on the same property, each magazine must comply with the minimum distances specified from inhabited buildings, railways, and highways, and, in addition, they should be separated from each other by not less than the distances shown for "Separation of Magazines," except that the quantity of explosive materials contained in detonator magazines shall govern in regard to the spacing of said detonator magazines from magazines containing other explosive materials. If any two or more magazines are separated from each other by less than the specified "Separation of Magazines" distances, then such two or more magazines, as a group, must be considered as one magazine, and the total quantity of explosive materials stored in such group must be treated as if stored in a single magazine located on the site of any magazine of the group, and must comply with the minimum of distances specified from other magazines, inhabited buildings, railways, and highways.*

Note 13: *Storage in excess of 300,000 pounds of explosive materials, in one magazine is generally not required for commercial enterprises.*

Note 14: *This Table applies only to the manufacture and permanent storage of commercial explosive materials. It is not applicable to transportation of explosives or any handling or temporary storage necessary or incident thereto. It is not intended to apply to bombs, projectiles, or other heavily encased explosives.*

Note 15: *When a manufacturing building on an explosive materials plant site is designed to contain explosive materials, such building shall be located from inhabited buildings, public highways and passenger railways in accordance with the American Table of Distances based on the maximum quantity of explosive materials permitted to be in the building at one time.*

Note 16: *The American Table of Distances applies to the manufacture and permanent storage of commercial explosive materials. The distances specified are those measured from the explosive materials storage facility to the inhabited building, highway or passenger railway, irrespective of property lines.*

The American Table of Distances covers all commercial explosive materials, including, but not limited to, high explosives, blasting agents, detonators, initiating systems and explosives materials in process. The Table is not designed to be altered or adjusted to accommodate varying explosive characteristics such as blast effect, weight strength, density, bulk strength, detonation velocity, etc.

The American Table of Distances should not be used to determine safe distances for blasting work, the firing of explosive charges for testing or quality control work, or the open detonation of waste explosive materials. The American Table of Distances may be utilized as a guide for developing distances for the unconfined, open burning of waste explosive materials where the probability of transition from burning to high order detonation is improbable.

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(b) Table of Recommended Separation Distances. The provisions contained in Table OR-H-22 below are in lieu of the provisions contained in 29 CFR 1910.109, Table H-22, Table of Recommended Separation Distances of Ammonium Nitrate and Blasting Agents from Explosives or Blasting Agents. Related notes are printed following the table for clarity in using Table OR-H-22.

Table OR-H-22 - Table of Recommended Separation Distances of Ammonium Nitrate and Blasting Agents from Explosives of Blasting Agents[1,6]

Donor Weight		Minimum Separation Distance of Acceptor when Barricaded[2](ft.)		Minimum Thickness of Artificial Barricades[6](in.)
Pounds Over	Pounds Not Over	Ammonium Nitrate[3]	Blasting Agent[4]	
	100	3	11	12
100	300	4	14	12
300	600	5	18	12
600	1000	6	22	12
1,000	1,600	7	25	12
1,600	2,000	8	29	12
2,000	3,000	9	32	15
3,000	4,000	10	36	15
4,000	6,000	11	40	15
6,000	8,000	12	43	20
8,000	10,000	13	47	20
10,000	12,000	14	50	20
12,000	16,000	15	54	25
16,000	20,000	16	58	25
20,000	25,000	18	65	25
25,000	30,000	19	68	30
30,000	35,000	20	72	30
35,000	40,000	21	76	30
40,000	45,000	22	79	35
45,000	50,000	23	83	35
50,000	55,000	24	86	35
55,000	60,000	25	90	35
60,000	70,000	26	94	40
70,000	80,000	28	101	40
80,000	90,000	30	108	40
90,000	100,000	32	115	40
100,000	120,000	32	122	50
120,000	140,000	37	133	50
140,000	160,000	40	144	50
160,000	180,000	44	158	50
180,000	200,000	48	173	50
200,000	220,000	52	187	60
220,000	250,000	56	202	60
250,000	275,000	60	216	60

Donor Weight		Minimum Separation Distance of Acceptor when Barricaded[2](ft.)		Minimum Thickness of Artificial Barricades[6](in.)
Pounds Over	Pounds Not Over	Ammonium Nitrate[3]	Blasting Agent[4]	
275,000	300,000	64	230	60

Notes to Table OR-H-22

Explanatory notes for OR-H-22, Table of Recommended Separation Distances of Ammonium Nitrate and Blasting Agents from Explosives or Blasting Agents

Note 1: *Recommended separation distances to prevent explosion of ammonium nitrate and ammonium nitrate-based blasting agents by propagation from nearby stores of high explosives or blasting agents referred to in the Table as the "donor." Ammonium nitrate, by itself, is not considered to be a donor when applying this Table. Ammonium nitrate, ammonium nitrate-fuel oil or combinations thereof are acceptors. If stores of ammonium nitrate are located within the sympathetic detonation distance of explosives or blasting agents, one-half the mass of the ammonium nitrate should be included in the mass of the donor.*

Note 2: *When the ammonium nitrate and/or blasting agent is not barricaded, the distances shown in the Table shall be multiplied by six. These distances allow for the possibility of high velocity metal fragments from mixers, hoppers, truck bodies, sheet metal structures, metal containers, and the like which may enclose the "donor." Where storage is in bullet-resistant magazines1 recommended for explosives or where the storage is protected by a bullet-resistant wall, distances and barricade thicknesses in excess of those prescribed in OR-H-21, American Table of Distances, are not required.*

Note 3: *The distances in the Table apply to ammonium nitrate that passes the insensitivity test prescribed in the definition of ammonium nitrate fertilizer promulgated by the Fertilizer Institute;2 and ammonium nitrate failing to pass said test shall be stored at separation distances determined by competent persons and approved by the authority having jurisdiction.*

Note 4: *These distances apply to blasting agents which pass the insensitivity test prescribed in regulations of the U.S. Department of Transportation and the U.S. Department of the Treasury, Bureau of Alcohol, Tobacco and Firearms.*

Note 5: *Earth, or sand dikes, or enclosures filled with the prescribed minimum thickness of earth or sand are acceptable artificial barricades. Natural barricades, such as hills or timber of sufficient density that the surrounding exposures which require protection cannot be seen from the "donor" when the trees are bare of leaves, are also acceptable.*

Note 6: *For determining the distances to be maintained from inhabited buildings, passenger railways, and public highways, use Table OR-H-21, American Table of Distances for Storage of Explosive Materials.*

[1] *For construction of bullet-resistant magazines see Bureau of Alcohol, Tobacco and Firearms, Department of the Treasury, Publication ATF P 5400.7 (6/90), ATF-Explosives Law and Regulations.*

[2] *Definition and Test Procedures for Ammonium Nitrate Fertilizer, Fertilizer Institute, May 8, 1971.*

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: OR-OSHA Admin. Order 2-1992, f. 2/6/92, ef. 5/1/92.

1910.109 Explosives and Blasting Agents

(a) Definitions applicable to this section.

(1) **Blasting agent.** Blasting agent – any material or mixture, consisting of a fuel and oxidizer, intended for blasting, not otherwise classified as an explosive and in which none of the ingredients are classified as an explosive, provided that the finished product, as mixed and packaged for use or shipment, cannot be detonated by means of a No. 8 test blasting cap when unconfined.

(2) **Explosive-actuated power devices.** Explosive-actuated power device – any tool or special mechanized device which is actuated by explosives, but not including propellant-actuated power devices. Examples of explosive-actuated power devices are jet tappers and jet perforators.

(3) **Explosive.** Explosive – any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion, i.e., with substantially instantaneous release of gas and heat, unless such compound, mixture, or device is otherwise specifically classified by the U.S. Department of Transportation; see 49 CFR Chapter I. The term “explosives” shall include all material which is classified as Class A, Class B, and Class C explosives by the U.S. Department of Transportation, and includes, but is not limited to dynamite, black powder, pellet powders, initiating explosives, blasting caps, electric blasting caps, safety fuse, fuse lighters, fuse igniters, squibs, cordeau detonant fuse, instantaneous fuse, igniter cord, igniters, small arms ammunition, small arms ammunition primers, smokeless propellant, cartridges for propellant-actuated power devices, and cartridges for industrial guns. Commercial explosives are those explosives which are intended to be used in commercial or industrial operations.

Note 1: Classification of explosives is described by the U.S. Department of Transportation as follows (see 49 CFR Chapter I):

(i) Class A explosives. Possessing, detonating, or otherwise maximum hazard; such as dynamite, nitroglycerin, picric acid, lead azide, fulminate of mercury, black powder, blasting caps, and detonating primers.

(ii) Class B explosives. Possessing flammable hazard, such as propellant explosives (including some smokeless propellants), photographic flash powders, and some special fireworks.

(iii) Class C explosives. Includes certain types of manufactured articles which contain Class A or Class B explosives, or both, as components but in restricted quantities.

(iv) Forbidden or not acceptable explosives. Explosives which are forbidden or not acceptable for transportation by common carriers by rail freight, rail express, highway, or water in accordance with the regulations of the U.S. Department of Transportation, 49 CFR Chapter I.

(4) **Highway.** Highway – any public street, public alley, or public road.

(5) (Reserved)

Note: 1910.109(a)(6) was NOT adopted by OR-OSHA. In Oregon, the definition for “magazine” in Note 5 of Table OR-H-21 of OAR 437-002-0109(6) applies.

(7) **Motor vehicle.** Motor vehicle – any self-propelled vehicle, truck, tractor, semitrailer, or truck-full trailers used for the transportation of freight over public highways.

(8) **Propellant-actuated power devices.** Propellant-actuated power devices – any tool or special mechanized device or gas generator system which is actuated by a smokeless propellant or which releases and directs work through a smokeless propellant charge.

(9) (Reserved)

(10) **Pyrotechnics.** Pyrotechnics – any combustible or explosive compositions or manufactured articles designed and prepared for the purpose of producing audible or visible effects which are commonly referred to as fireworks.

(11) (Reserved)

(12) **Semiconductive hose**. Semiconductive hose – a hose with an electrical resistance high enough to limit flow of stray electric currents to safe levels, yet not so high as to prevent drainage of static electric charges to ground; hose of not more than 2 megohms resistance over its entire length and of not less than 5,000 ohms per foot meets the requirement.

(13) **Small arms ammunition.** Small arms ammunition – any shotgun, rifle, pistol, or revolver cartridge, and cartridges for propellant-actuated power devices and industrial guns. Military-type ammunition containing explosive-bursting charges, incendiary, tracer, spotting, or pyrotechnic projectiles is excluded from this definition.

(14) **Small arms ammunition primers**. Small arms ammunition primers – small percussion-sensitive explosive charges, encased in a cup, used to ignite propellant powder.

(15) **Smokeless propellants.** Smokeless propellants – solid propellants, commonly called smokeless powders in the trade, used in small arms ammunition, cannon, rockets, propellant-actuated power devices, etc.

(16) **Special industrial explosives devices.** Special industrial explosives devices – explosive-actuated power devices and propellant-actuated power devices.

(17) **Special industrial explosives materials.** Special industrial explosives materials – shaped materials and sheet forms and various other extrusions, pellets, and packages of high explosives, which include dynamite, trinitrotoluene (TNT), pentaerythritol tetranitrate (PETN), hexa-hydro-1,3,5-trinitro-s-triazine (RDX), and other similar compounds used for high-energy-rate forming, expanding, and shaping in metal fabrication, and for dismemberment and quick reduction of scrap metal.

(18) **Water gels or slurry explosives.** These comprise a wide variety of materials used for blasting. They all contain substantial proportions of water and high proportions of ammonium nitrate, some of which is in solution in the water. Two broad classes of water gels are (i) those which are sensitized by a material classed as an explosive, such as TNT or smokeless powder, (ii) those which contain no ingredient classified as an explosive; these are sensitized with metals such as aluminum or with other fuels. Water gels may be premixed at an explosives plant or mixed at the site immediately before delivery into the borehole.

(19) **DOT specifications.** Regulations of the Department of Transportation published in 49 CFR Chapter I.

(b) Miscellaneous provisions.

(1) General hazard. No person shall store, handle, or transport explosives or blasting agents when such storage, handling, and transportation of explosives or blasting agents constitutes an undue hazard to life.

(2) (Reserved)

(c) Storage of explosives.

(1) General provisions.

(i) All Class A, Class B, Class C explosives, and special industrial explosives, and any newly developed and unclassified explosives, shall be kept in magazines which meet the requirements of this paragraph.

(ii) Blasting caps, electric blasting caps, detonating primers, and primed cartridges shall not be stored in the same magazine with other explosives.

(iii) Ground around magazines shall slope away for drainage. The land surrounding magazines shall be kept clear of brush, dried grass, leaves, and other materials for a distance of at least 25 feet.

(iv) Magazines as required by this paragraph shall be of two classes; namely, Class I magazines, and Class II magazines.

(v) Class I magazines shall be required where the quantity of explosives stored is more than 50 pounds. Class II magazines may be used where the quantity of explosives stored is 50 pounds or less.

(vi) Class I magazines shall be located away from other magazines in conformity with Table H-21.

Note: 1910.109 Table H-21 and footnotes were NOT adopted by OR-OSHA. In Oregon, OAR 437-002-0109(6)(a), Table OR-H-21 and Notes, apply.

(vii) Except as provided in Subdivision (viii) of this subparagraph, class II magazines shall be located in conformity with Table H-21, but may be permitted in warehouses and in wholesale and retail establishments when located on a floor which has an entrance at outside grade level and the magazine is located not more than 10 feet from such an entrance. Two class II magazines may be located in the same building when one is used only for blasting caps in quantities not in excess of 5,000 caps and a distance of 10 feet is maintained between magazines.

(viii) When used for temporary storage at a site for blasting operations, class II magazines shall be located away from other magazines. A distance of at least 150 feet shall be maintained between class II magazines and the work in progress when the quantity of explosives kept therein is in excess of 25 pounds, and at least 50 feet when the quantity of explosives is 25 pounds, or less.

(ix) This paragraph (c) does not apply to:

(A) Stocks of small arms ammunition, propellant-actuated power cartridges, small arms ammunition primers in quantities of less than 750,000, or of smokeless propellants in quantities less than 750 pounds;

(B) Explosive-actuated power devices when in quantities less than 50 pounds net weight of explosives;

(C) Fuse lighters and fuse igniters;

(D) Safety fuses other than cordeau detonant fuses.

(2) Construction of magazines – general.

(i) Magazines shall be constructed in conformity with the provisions of this paragraph.

(ii) Magazines for the storage of explosives, other than black powder, Class B and Class C explosives shall be bullet resistant, weather resistant, fire resistant, and ventilated sufficiently to protect the explosive in the specific locality. Magazines used only for storage of black powder, Class B and Class C explosives shall be weather resistant, fire-resistant, and have ventilation. Magazines for storage of blasting and electric blasting caps shall be weather resistant, fire-resistant, and ventilated.

(iii) Property upon which Class I magazines are located and property where Class II magazines are located outside of buildings shall be posted with signs reading "Explosives – Keep Off."

(iv) Magazines requiring heat shall be heated by either hot-water radiant heating with the magazine building; or air directed into the magazine building over either hot water or low pressure steam (15 p.s.i.g.) coils located outside the magazine building.

(v) The magazine heating systems shall meet the following requirements:

(A) The radiant heating coils within the building shall be installed in such a manner that the explosives or explosives containers cannot contact the coils and air is free to circulate between the coils and the explosives or explosives containers.

(B) The heating ducts shall be installed in such a manner that the hot-air discharge from the duct is not directed against the explosives or explosives containers.

(C) The heating device used in connection with a magazine shall have controls which prevent the ambient building temperature from exceeding 130 degrees F.

(D) The electric fan or pump used in the heating system for a magazine shall be mounted outside and separate from the wall of the magazine and shall be grounded.

(E) The electric fan motor and the controls for electrical heating devices used in heating water or steam shall have overloads and disconnects, which comply with Subpart S of this part. All electrical switch gear shall be located a minimum distance of 25 feet from the magazine.

(F) The heating source for water or steam shall be separated from the magazine by a distance of not less than 25 feet when electrical and 50 feet when fuel fired. The area between the heating unit and the magazine shall be cleared of all combustible materials.

(G) The storage of explosives and explosives containers in the magazine shall allow uniform air circulation so product temperature uniformity can be maintained.

(vi) When lights are necessary inside the magazine, electric safety flashlight, or electric safety lanterns shall be used.

(3) Construction of Class I magazines.

(i) Class I magazines shall be of masonry construction or of wood or of metal construction, or a combination of these types. Thickness of masonry units shall not be less than 8 inches. Hollow masonry units used in construction required to be bullet resistant shall have all hollow spaces filled with weak cement or well-tamped sand. Wood constructed walls, required to be bullet resistant, shall have at least a 6-inch space between interior and exterior sheathing and the space between sheathing shall be filled with well-tamped sand. Metal wall construction, when required to be bullet resistant, shall be lined with brick at least 4 inches in thickness or shall have at least a 6-inch sandfill between interior and exterior walls.

(ii) Floors and roofs of masonry magazines may be of wood construction. Wood floors shall be tongue and grooved lumber having a nominal thickness of 1 inch.

(iii) Roofs required to be bullet resistant shall be protected by a sand tray located at the line of eaves and covering the entire area except that necessary for ventilation. Sand in the sand tray shall be maintained at a depth of not less than 4 inches.

(iv) All wood at the exterior of magazines, including eaves, shall be protected by being covered with black or galvanized steel or aluminum metal of thickness of not less than No. 26 gage. All nails exposed to the interior of magazines shall be well countersunk.

(v) Foundations for magazines shall be of substantial construction and arranged to provide good cross ventilation.

(vi) Magazines shall be ventilated sufficiently to prevent dampness and heating of stored explosives. Ventilating openings shall be screened to prevent the entrance of sparks.

(vii) Openings to magazines shall be restricted to that necessary for the placement and removal of stocks of explosives. Doors for openings in magazines for Class A explosives shall be bullet resistant. Doors for magazines not required to be bullet resistant shall be designed to prevent unauthorized entrance to the magazine.

(viii) (Reserved)

(ix) Provisions shall be made to prevent the piling of stocks of explosives directly against masonry walls, brick-lined or sand-filled metal walls and single-thickness metal walls; such protection, however, shall not interfere with proper ventilation at the interior of side and end walls.

(4) Construction of Class II magazines.

(i) Class II magazines shall be of wood or metal construction, or a combination thereof.

(ii) Wood magazines of this class shall have sides, bottom, and cover constructed of 2-inch hardwood boards well braced at corners and protected by being entirely covered with sheet metal of not less than No. 20 gage. All nails exposed to the interior of the magazine shall be well countersunk. All metal magazines of this class shall have sides, bottom, and cover constructed of sheet metal, and shall be lined with 3/8-inch plywood or equivalent. Edges of metal covers shall overlap sides at least 1 inch.

(iii) Covers for both wood- and metal-constructed magazines of this class shall be provided with substantial strap hinges and shall be provided with substantial means for locking.

(iv) Magazines of this class shall be painted red and shall bear lettering in white, on all sides and top, at least 3 inches high, "Explosives – Keep Fire Away." Class II magazines when located in warehouses, and in wholesale and retail establishments shall be provided with substantial wheels or casters to facilitate easy removal in the case of fire. Where necessary due to climatic conditions, Class II magazines shall be ventilated.

(5) Storage within magazines.

(i) Packages of explosives shall be laid flat with top side up. Black powder when stored in magazines with other explosives shall be stored separately. Black powder stored in kegs shall be stored on ends, bungs down, or on side, seams down. Corresponding grades and brands shall be stored together in such a manner that brands and grade marks show. All stocks shall be stored so as to be easily counted and checked. Packages of explosives shall be piled in a stable manner. When any kind of explosive is removed from a magazine for use, the oldest explosive of that particular kind shall always be taken first.

(ii) Packages of explosives shall not be unpacked or repacked in a magazine nor within 50 feet of a magazine or in close proximity to other explosives. Tools used for opening packages of explosives shall be constructed of nonsparking materials, except that metal slitters may be used for opening fiberboard boxes. A wood wedge and a fiber, rubber, or wood mallet shall be used for opening or closing wood packages of explosives. Opened packages of explosives shall be securely closed before being returned to a magazine.

(iii) Magazines shall not be used for the storage of any metal tools nor any commodity except explosives, but this restriction shall not apply to the storage of blasting agents and blasting supplies.

(iv) Magazine floors shall be regularly swept, kept clean, dry, free of grit, paper, empty used packages, and rubbish. Brooms and other cleaning utensils shall not have any spark-producing metal parts. Sweepings from floors of magazines shall be properly disposed of. Magazine floors stained with nitroglycerin shall be cleaned according to instructions by the manufacturer.

(v) When any explosive has deteriorated to an extent that it is in an unstable or dangerous condition, or if nitroglycerin leaks from any explosives, then the person in possession of such explosive shall immediately proceed to destroy such explosive in accordance with the instructions of the manufacturer. Only experienced persons shall be allowed to do the work of destroying explosives.

(vi) When magazines need inside repairs, all explosives shall be removed therefrom and the floors cleaned. In making outside repairs, if there is a possibility of causing sparks or fire the explosives shall be removed from the magazine. Explosives removed from a magazine under repair shall either be placed in another magazine or placed a safe distance from the magazine where they shall be properly guarded and protected until repairs have been completed, when they shall be returned to the magazine.

(vii) Smoking, matches, open flames, spark-producing devices, and firearms (except firearms carried by guards) shall not be permitted inside of or within 50 feet of magazines. The land surrounding a magazine shall be kept clear of all combustible materials for a distance of at least 25 feet. Combustible materials shall not be stored within 50 feet of magazines.

(viii) Magazines shall be in the charge of a competent person at all times and who shall be held responsible for the enforcement of all safety precautions.

(ix) Explosives recovered from blasting misfires shall be placed in a separate magazine until competent personnel has determined from the manufacturer the method of disposal. Caps recovered from blasting misfires shall not be reused. Such explosives and caps shall then be disposed of in the manner recommended by the manufacturer.

(d) Transportation of explosives.

(1) General provisions.

(i) No employee shall be allowed to smoke, carry matches or any other flame-producing device, or carry any firearms or loaded cartridges while in or near a motor vehicle transporting explosives; or drive, load, or unload such vehicle in a careless or reckless manner.

(ii) (Reserved)

(iii) Explosives shall not be transferred from one vehicle to another within the confines of any jurisdiction (city, county, State, or other area) without informing the fire and police departments thereof. In the event of breakdown or collision the local fire and police departments shall be promptly notified to help safeguard such emergencies. Explosives shall be transferred from the disabled vehicle to another only, when proper and qualified supervision is provided.

(iv) Blasting caps or electric blasting caps shall not be transported over the highways on the same vehicles with other explosives, unless packaged, segregated, and transported in accordance with the Department of Transportation’s Hazardous Materials Regulations (49 CFR parts 177-180).

(2) Transportation vehicles.

(i) Vehicles used for transporting explosives shall be strong enough to carry the load without difficulty and be in good mechanical condition. If vehicles do not have a closed body, the body shall be covered with a flameproof and moisture-proof tarpaulin or other effective protection against moisture and sparks. All vehicles used for the transportation of explosives shall have tight floors and any exposed spark-producing metal on the inside of the body shall be covered with wood or other nonsparking materials to prevent contact with packages of explosives. Packages of explosives shall not be loaded above the sides of an open-body vehicle.

(ii) Every vehicle used for transporting explosives and oxidizing materials listed in paragraph (d)(2)(ii)(A) of this section shall be marked as follows:

(A) Exterior markings or placards required on applicable vehicles shall be as follows for the various classes of commodities:

Commodity	Type of marking or placard
Explosives, Class A, any quantity or a combination of Class A and Class B explosives	Explosives A (Red letters on white background)
Explosives, Class B, and quantity	Explosives B (Red letters on white background)
Oxidizing material (blasting agents, ammonium nitrate, etc.), 1,000 pounds or more gross weight	Oxidizers (Yellow letters on black background)

(B) (Reserved)

(C) Such markings or placards shall be displayed at the front, rear, and on each side of the motor vehicle or trailer, or other cargo carrying body while it contains explosives or other dangerous articles of such type and in such quantity as specified in paragraph (d)(1)(ii)(A) of this Subdivision. The front marking or placard may be displayed on the front of either the truck, truck body, truck tractor or the trailer.

(D) Any motor vehicle, trailer, or other cargo-carrying body containing more than one kind of explosive as well as an oxidizing material requiring a placard under the provisions of paragraph (d)(2)(ii)(A), the aggregate gross weight of which totals 1,000 pounds or more, shall be marked or placarded “Dangerous” as well as “Explosive A” or “Explosive B” as appropriate. If explosives Class A and explosives Class B are loaded on the same vehicle, the “Explosives B” marking need not be displayed.

(E) In any combination of two or more vehicles containing explosives or other dangerous articles each vehicle shall be marked or placarded as to its contents and in accordance with paragraphs (d)(2)(ii)(A) and (C) of this Subdivision.

(iii) Each motor vehicle used for transporting explosives shall be equipped with a minimum of two extinguishers, each having a rating of at least 10-BC.

(A) Only extinguishers listed or approved by a nationally recognized testing laboratory shall be deemed suitable for use on explosives-carrying vehicles. Refer to 1910.155(c)(3)(iv)(A) for definition of listed, and 1910.7 for nationally recognized testing laboratory.

(B) Extinguishers shall be filled and ready for immediate use and located near the driver’s seat. Extinguishers shall be examined periodically by a competent person.

(iv) A motor vehicle used for transporting explosives shall be given the following inspection to determine that it is in proper condition for safe transportation of explosives:

(A) Fire extinguishers shall be filled and in working order.

(B) All electrical wiring shall be completely protected and securely fastened to prevent short-circuiting.

(C) Chassis, motor, pan, and underside of body shall be reasonably clean and free of excess oil and grease.

(D) Fuel tank and feedline shall be secure and have no leaks.

(E) Brakes, lights, horn, windshield wipers, and steering apparatus shall function properly.

(F) Tires shall be checked for proper inflation and defects.

(G) The vehicle shall be in proper condition in every other respect and acceptable for handling explosives.

(3) Operation of transportation vehicles.

(i) Vehicles transporting explosives shall only be driven by and be in the charge of a driver who is familiar with the traffic regulations, State laws, and the provisions of this section.

(ii) Except under emergency conditions, no vehicle transporting explosives shall be parked before reaching its destination, even though attended, on any public street adjacent to or in proximity to any place where people work.

(iii) Every motor vehicle transporting any quantity of Class A or Class B explosives shall, at all times, be attended by a driver or other attendant of the motor carrier. This attendant shall have been made aware of the class of the explosive material in the vehicle and of its inherent dangers, and shall have been instructed in the measures and procedures to be followed in order to protect the public from those dangers. He shall have been made familiar with the vehicle he is assigned, and shall be trained, supplied with the necessary means, and authorized to move the vehicle when required.

(A) For the purpose of this Subdivision, a motor vehicle shall be deemed "attended" only when the driver or other attendant is physically on or in the vehicle, or has the vehicle within his field of vision and can reach it quickly and without any kind of interference "attended" also means that the driver or attendant is awake, alert, and not engaged in other duties or activities which may divert his attention from the vehicle, except for necessary communication with public officers, or representatives of the carrier shipper, or consignee, or except for necessary absence from the vehicle to obtain food or to provide for his physical comfort.

(B) However, an explosive-laden vehicle may be left unattended if parked within a securely fenced or walled area with all gates or entrances locked where parking of such vehicle is otherwise permissible, or at a magazine site established solely for the purpose of storing explosives.

(iv) No spark-producing metal, spark-producing metal tools, oils, matches, firearms, electric storage batteries, flammable substances, acids, oxidizing materials, or corrosive compounds shall be carried in the body of any motor truck and/or vehicle transporting explosives, unless the loading of such dangerous articles and the explosives comply with U.S. Department of Transportation regulations.

(v) Vehicles transporting explosives shall avoid congested areas and heavy traffic. Where routes through congested areas have been designated by local authorities such routes shall be followed.

(vi) Delivery shall only be made to authorized persons and into authorized magazines or authorized temporary storage or handling areas.

(e) Use of explosives and blasting agents.

(1) General provisions.

(i) While explosives are being handled or used, smoking shall not be permitted and no one near the explosives shall possess matches, open light or other fire or flame. No person shall be allowed to handle explosives while under the influence of intoxicating liquors, narcotics, or other dangerous drugs.

(ii) Original containers or Class II magazines shall be used for taking detonators and other explosives from storage magazines to the blasting area.

(iii) When blasting is done in congested areas or in close proximity to a structure, or any other installation that may be damaged, the blast shall be covered before firing with a mat constructed so that it is capable of preventing fragments from being thrown.

(iv) Persons authorized to prepare explosive charges or conduct blasting operations shall use every reasonable precaution, including but not limited to warning signals, flags, barricades, or woven wire mats to insure the safety of the general public and workmen.

(v) Blasting operations shall be conducted during daylight hours.

(vi) Whenever blasting is being conducted in the vicinity of gas, electric, water, fire alarm, telephone, telegraph, and steam utilities, the blaster shall notify the appropriate representatives of such utilities at least 24 hours in advance of blasting, specifying the location and intended time of such blasting. Verbal notice shall be confirmed with written notice.

(vii) Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by radar, radio transmitters, lightning, adjacent powerlines, dust storms, or other sources of extraneous electricity. These precautions shall include:

(A) The suspension of all blasting operations and removal of persons from the blasting area during the approach and progress of an electric storm.

(B) The posting of signs warning against the use of mobile radio transmitters on all roads within 350 feet of the blasting operations.

(2) Storage at use sites.

(i) Empty containers and paper and fiber packing materials which have previously contained explosive materials shall be disposed of in a safe manner, or reused in accordance with the Department of Transportation's Hazardous Materials Regulations (49 CFR parts 177-180).

(ii) Containers of explosives shall not be opened in any magazine or within 50 feet of any magazine. In opening kegs or wooden cases, no sparking metal tools shall be used; wooden wedges and either wood, fiber or rubber mallets shall be used. Nonsparking metallic slitters may be used for opening fiberboard cases.

(iii) Explosives or blasting equipment that are obviously deteriorated or damaged shall not be used.

(iv) No explosives shall be abandoned.

(3) Loading of explosives in blast holes.

(i) All drill holes shall be sufficiently large to admit freely the insertion of the cartridges of explosives.

(ii) Tamping shall be done only with wood rods without exposed metal parts, but nonsparking metal connectors may be used for jointed poles. Violent tamping shall be avoided. Primed cartridges shall not be tamped.

(iii) When loading blasting agents pneumatically over electric blasting caps, semiconductive delivery hose shall be used and the equipment shall be bonded and grounded.

(iv) No holes shall be loaded except those to be fired in the next round of blasting. After loading, all remaining explosives shall be immediately returned to an authorized magazine.

(v) Drilling shall not be started until all remaining butts of old holes are examined with a wooden stick for unexploded charges, and if any are found, they shall be refired before work proceeds.

(vi) No person shall be allowed to deepen drill holes which have contained explosives.

(vii) After loading for a blast is completed, all excess blasting caps or electric blasting caps and other explosives shall immediately be returned to their separate storage magazines.

(4) Initiation of explosive charges.

(i) (Reserved)

(ii) When fuse is used, the blasting cap shall be securely attached to the safety fuse with a standard-ring type cap crimper. All primers shall be assembled at least 50 feet from any magazine.

(iii) Primers shall be made up only as required for each round of blasting.

(iv) No blasting cap shall be inserted in the explosives without first making a hole in the cartridge for the cap with a wooden punch of proper size or standard cap crimper.

(v) Explosives shall not be extracted from a hole that has once been charged or has misfired unless it is impossible to detonate the unexploded charge by insertion of a fresh additional primer.

(vi) If there are any misfires while using cap and fuse, all persons shall be required to remain away from the charge for at least 1 hour. If electric blasting caps are used and a misfire occurs, this waiting period may be reduced to 30 minutes. Misfires shall be handled under the direction of the person in charge of the blasting and all wires shall be carefully traced and search made for unexploded charges.

(vii) Blasters, when testing circuits to charged holes, shall use only blasting galvanometers designed for this purpose.

(viii) Only the employee making leading wire connections in electrical firing shall be allowed to fire the shot. Leading wires shall remain shorted and not be connected to the blasting machine or other source of current until the charge is to be fired.

(5) Warning required. Before a blast is fired, the employer shall require that a loud warning signal be given by the person in charge, who has made certain that all surplus explosives are in a safe place, all persons and vehicles are at a safe distance or under sufficient cover, and that an adequate warning has been given.

(f) Explosives at piers, railway stations, and cars or vessels not otherwise specified in this standard.

(1) Railway cars. Except in an emergency and with permission of the local authority, no person shall have or keep explosives in a railway car unless said car and contents and methods of loading are in accordance with the U.S. Department of Transportation Regulations for the Transportation of Explosives, 49 CFR Chapter I.

(2) Packing and marking. No person shall deliver any explosive to any carrier unless such explosive conforms in all respects, including marking and packing, to the U.S. Department of Transportation Regulations for the Transportation of Explosives.

(3) Marking cars. Every railway car containing explosives which has reached its designation, or is stopped in transit so as no longer to be in interstate commerce, shall have attached to both sides and ends of the car, cards with the words "Explosives – Handle Carefully – Keep Fire Away" in red letters at least 1 1/2 inches high on a white background.

(4) Storage. Any explosives at a railway facility, truck terminal, pier, wharf harbor facility, or airport terminal whether for delivery to a consignee, or forwarded to some other destination shall be kept in a safe place, isolated as far as practicable and in such manner that they can be easily and quickly removed.

(5) Hours of transfer. Explosives shall not be delivered to or received from any railway station, truck terminal, pier, wharf, harbor facility, or airport terminal between the hours of sunset and sunrise.

(g) Blasting agents.

(1) General. Unless otherwise set forth in this paragraph, blasting agents, excluding water gels, shall be transported, stored, and used in the same manner as explosives. Water gels are covered in paragraph (h) of this section.

(2) Fixed location mixing.

(i) (Reserved)

(ii) Buildings used for the mixing of blasting agents shall conform to the requirements of this section.

(A) Buildings shall be of noncombustible construction or sheet metal on wood studs.

(B) Floors in a mixing plant shall be of concrete or of other nonabsorbent materials.

(C) All fuel oil storage facilities shall be separated from the mixing plant and located in such a manner that in case of tank rupture, the oil will drain away from the mixing plant building.

(D) The building shall be well-ventilated.

(E) Heating units which do not depend on combustion processes, when properly designed and located, may be used in the building. All direct sources of heat shall be provided exclusively from units located outside the mixing building.

(F) All internal-combustion engines used for electric power generation shall be located outside the mixing plant building, or shall be properly ventilated and isolated by a firewall. The exhaust systems on all such engines shall be located so any spark emission cannot be a hazard to any materials in or adjacent to the plant.

(iii) Equipment used for mixing blasting agents shall conform to the requirements of this Subdivision.

(A) The design of the mixer shall minimize the possibility of frictional heating, compaction, and especially confinement. All bearings and drive assemblies shall be mounted outside the mixer and protected against the accumulation of dust. All surfaces shall be accessible for cleaning.

(B) Mixing and packaging equipment shall be constructed of materials compatible with the fuel-ammonium nitrate composition.

(C) Suitable means shall be provided to prevent the flow of fuel oil to the mixer in case of fire. In gravity flow systems an automatic spring-loaded shutoff valve with fusible link shall be installed.

(iv) The provisions of this Subdivision shall be considered when determining blasting agent compositions.

(A) The sensitivity of the blasting agent shall be determined by means of a No. 8 test blasting cap at regular intervals and after every change in formulation.

(B) Oxidizers of small particle size, such as crushed ammonium nitrate prills or fines, may be more sensitive than coarser products and shall, therefore, be handled with greater care.

(C) No hydrocarbon liquid fuel with flashpoint lower than that of No. 2 diesel fuel oil 125 degrees F. minimum shall be used.

(D) Crude oil and crankcase oil shall not be used.

(E) Metal powders such as aluminum shall be kept dry and shall be stored in containers or bins which are moisture-resistant or weather-tight. Solid fuels shall be used in such manner as to minimize dust explosion hazards.

(F) Peroxides and chlorates shall not be used.

(v) All electrical switches, controls, motors, and lights located in the mixing room shall conform to the requirements in Subpart S of this part for Class II, Division 2 locations; otherwise they shall be located outside the mixing room. The frame of the mixer and all other equipment that may be used shall be electrically bonded and be provided with a continuous path to the ground.

(vi) Safety precautions at mixing plants shall include the requirements of this Subdivision.

(A) Floors shall be constructed so as to eliminate floor drains and piping into which molten materials could flow and be confined in case of fire.

(B) The floors and equipment of the mixing and packaging room shall be cleaned regularly and thoroughly to prevent accumulation of oxidizers or fuels and other sensitizers.

(C) The entire mixing and packaging plant shall be cleaned regularly and thoroughly to prevent excessive accumulation of dust.

(D) Smoking, matches, open flames, spark-producing devices, and firearms (except firearms carried by guards) shall not be permitted inside of or within 50 feet of any building or facility used for the mixing of blasting agents.

(E) The land surrounding the mixing plant shall be kept clear of brush, dried grass, leaves, and other materials for a distance of at least 25 feet.

(F) Empty ammonium nitrate bags shall be disposed of daily in a safe manner.

(G) No welding shall be permitted or open flames used in or around the mixing or storage area of the plant unless the equipment or area has been completely washed down and all oxidizer material removed.

(H) Before welding or repairs to hollow shafts, all oxidizer material shall be removed from the outside and inside of the shaft and the shaft vented with a minimum 1/2-inch diameter opening.

(I) Explosives shall not be permitted inside of or within 50 feet of any building or facility used for the mixing of blasting agents.

(3) Bulk delivery and mixing vehicles.

(i) The provisions of this paragraph shall apply to off-highway private operations as well as to all public highway movements.

(ii) A bulk vehicle body for delivering and mixing blasting agents shall conform with the requirements of this paragraph (ii).

(A) The body shall be constructed of noncombustible materials.

(B) Vehicles used to transport bulk premixed blasting agents on public highways shall have closed bodies.

(C) All moving parts of the mixing system shall be designed as to prevent a heat buildup. Shafts or axles which contact the product shall have outboard bearings with 1-inch minimum clearance between the bearings and the outside of the product container. Particular attention shall be given to the clearances on all moving parts.

(D) A bulk delivery vehicle shall be strong enough to carry the load without difficulty and be in good mechanical condition.

(iii) Operation of bulk delivery vehicles shall conform to the requirements of this Subdivision. These include the placarding requirements as specified by Department of Transportation.

(A) The operator shall be trained in the safe operation of the vehicle together with its mixing, conveying, and related equipment. The employer shall assure that the operator is familiar with the commodities being delivered and the general procedure for handling emergency situations.

(B) The hauling of either blasting caps or other explosives but not both, shall be permitted on bulk trucks provided that a special wood or nonferrous-lined container is installed for the explosives. Such blasting caps or other explosives shall be in DOT-specified shipping containers: see 49 CFR Chapter I.

(C) No person shall smoke, carry matches or any flame-producing device, or carry any firearms while in or about bulk vehicles effecting the mixing transfer or down-the-hole loading of blasting agents at or near the blasting site.

(D) Caution shall be exercised in the movement of the vehicle in the blasting area to avoid driving the vehicle over or dragging hoses over firing lines, cap wires, or explosive materials. The employer shall assure that the driver, in moving the vehicle, has assistance of a second person to guide his movements.

(E) No intransit mixing of materials shall be performed.

(iv) Pneumatic loading from bulk delivery vehicles into blastholes primed with electric blasting caps or other static-sensitive systems shall conform to the requirements of this Subdivision.

(A) A positive grounding device shall be used to prevent the accumulation of static electricity.

(B) A discharge hose shall be used that has a resistance range that will prevent conducting stray currents, but that is conductive enough to bleed off static buildup.

(C) A qualified person shall evaluate all systems to determine if they will adequately dissipate static under potential field conditions.

(v) Repairs to bulk delivery vehicles shall conform to the requirements of this section.

(A) No welding or open flames shall be used on or around any part of the delivery equipment unless it has been completely washed down and all oxidizer material removed.

(B) Before welding or making repairs to hollow shafts, the shaft shall be thoroughly cleaned inside and out and vented with a minimum 1/2-inch diameter opening.

(4) Bulk storage bins.

(i) The bin, including supports, shall be constructed of compatible materials, waterproof, and adequately supported and braced to withstand the combination of all loads including impact forces arising from product movement within the bin and accidental vehicle contact with the support legs.

(ii) The bin discharge gate shall be designed to provide a closure tight enough to prevent leakage of the stored product. Provision shall also be made so that the gate can be locked.

(iii) Bin loading manways or access hatches shall be hinged or otherwise attached to the bin and be designed to permit locking.

(iv) Any electrically driven conveyors for loading or unloading bins shall conform to the requirements of Subpart S of this part. They shall be designed to minimize damage from corrosion.

(v) Bins containing blasting agent shall be located, with respect to inhabited buildings, passenger railroads, and public highways, in accordance with Table H-21 and separation from other blasting agent storage and explosives storage shall be in conformity with Table H-22.

(**Note:** Tables H-21 and H-22 and their footnotes were NOT adopted by OR-OSHA. In Oregon, OAR 437-002-0109(6)(a) and (b), and Tables OR-H-21 and OR-H-22 and their Notes, apply.)

(vi) Bins containing ammonium nitrate shall be separated from blasting agent storage and explosives storage in conformity with Table H-22.

(See Note below paragraph (v).)

(A) Sketch location of all potential donor and acceptor materials together with the maximum mass of material to be allowed in that vicinity. (Potential donors are high explosives, blasting agents, and combination of masses of detonating materials. Potential acceptors are high explosives, blasting agents, and ammonium nitrate.)

(B) Consider separately each donor mass in combination with each acceptor mass. If the masses are closer than table allowance (distances measured between nearest edges), the combination of masses becomes a new potential donor of weight equal to the total mass. When individual masses are considered as donors, distances to potential acceptors shall be measured between edges. When combined masses within propagating distance of each other are considered as a donor, the appropriate distance to the edge of potential acceptors shall be computed as a weighted distance from the combined masses.

Calculation of weighted distance from combined masses:

Let M_2, M_3 . . . M_n be donor masses to be combined.

M_1 is a potential acceptor mass.

D_{12} is distance from M_1 to M_2 (edge-to-edge).

D_{13} is distance from M_1 to M_3 (edge-to-edge), etc.

To find weighted distance [$D_1(_{2,3} \ldots _n)$] from combined masses to M_1, add the products of the individual masses and distances and divide the total by the sum of the masses thus:

$$D_1(_{2,3}. \ldots _n) = M_2 \text{ x } D_{12} + M_3 \text{ x } D_{12} \ldots + M_n \text{ x } D_{12} M_2 + M_3 \ldots + M_n$$

Propagation is possible if either an individual donor mass is less than the tabulated distance from an acceptor or a combined mass is less than the weighted distance from an acceptor.

(C) In determining the distances separating highways, railroads, and inhabited buildings from potential explosions (as prescribed in Table H-21), the sum of all masses which may propagate (i.e., lie at distances less than prescribed in the Table) from either individual or combined donor masses are included. However, when the ammonium nitrate must be included, only 50 percent of its weight shall be used because of its reduced blast effects. In applying Table H-21 to distances from highways, railroads, and inhabited buildings, distances are measured from the nearest edge of potentially explodable material as prescribed in Table H-21, Note 5.

(D) When all or part of a potential acceptor comprises Explosives Class A as defined in DOT regulations, storage in bullet-resistant magazines is required. Safe distances to stores in bullet-resistant magazines may be obtained from the intermagazine distances prescribed in Table H-21.

(E) Barricades must not have line-of-sight openings between potential donors and acceptors which permit blast or missiles to move directly between masses.

(F) Good housekeeping practices shall be maintained around any bin containing ammonium nitrate or blasting agent. This includes keeping weeds and other combustible materials cleared within 25 feet of such bin. Accumulation of spilled product on the ground shall be prevented.

(5) Storage of blasting agents and supplies.

(i) Blasting agents and oxidizers used for mixing of blasting agents shall be stored in the manner set forth in this Subdivision.

(A) Blasting agents or ammonium nitrate, when stored in conjunction with explosives, shall be stored in the manner set forth in paragraph (c) of this section for explosives. The mass of blasting agents and one-half the mass of ammonium nitrate shall be included when computing the total quantity of explosives for determining distance requirements.

(B) Blasting agents, when stored entirely separate from explosives, may be stored in the manner set forth in paragraph (c) of this section or in one-story warehouses (without basements) which shall be:

(1) Noncombustible or fire-resistive;

(2) Constructed so as to eliminate open floor drains and piping into which molten materials could flow and be confined in case of fire;

(3) Weather-resistant;

(4) Well-ventilated; and

(5) Equipped with a strong door kept securely locked except when open for business.

(C) Semitrailer or full-trailer vans used for highway or onsite transportation of the blasting agents are satisfactory for temporarily storing these materials, provided they are located in accordance with Table H-22 with respect to one another. Trailers shall be provided with substantial means for locking, and the trailer doors shall be kept locked, except during the time of placement and removal of stocks of blasting agents.

(ii) Warehouses used for the storage of blasting agents separate from explosives shall be located as set forth in this Subdivision.

(A) Warehouses used for the storage of blasting agents shall be located in Table H-22 with respect to one another.

(B) If both blasting agents and ammonium nitrate are handled or stored within the distance limitations prescribed through paragraph (g)(2) of this section, one-half the mass of the ammonium nitrate shall be added to the mass of the blasting agent when computing the total quantity of explosives for determining the proper distance for compliance with Table H-21.

(iii) Smoking, matches, open flames, spark producing devices, and firearms are prohibited inside of or within 50 feet of any warehouse used for the storage of blasting agents. Combustible materials shall not be stored within 50 feet of warehouses used for the storage of blasting agents.

(iv) The interior of warehouses used for the storage of blasting agents shall be kept clean and free from debris and empty containers. Spilled materials shall be cleaned up promptly and safely removed. Combustible materials, flammable liquids, corrosive acids, chlorates, or nitrates shall not be stored in any warehouse used for blasting agents unless separated therefrom by a fire-resistive separation of not less than 1 hour resistance. The provisions of this Subdivision shall not prohibit the storage of blasting agents together with nonexplosive blasting supplies.

(v) Piles of ammonium nitrate and warehouses containing ammonium nitrate shall be adequately separated from readily combustible fuels.

(vi) Caked oxidizers, either in bags or in bulk, shall not be loosened by blasting.

(vii) Every warehouse used for the storage of blasting agents shall be under the supervision of a competent person.

(6) Transportation of packaged blasting agents.

(i) When blasting agents are transported in the same vehicle with explosives, all of the requirements of paragraph (d) of this section shall be complied with.

(ii) Vehicles transporting blasting agents shall only be driven by and be in charge of a driver in possession of a valid motor vehicle operator's license. Such a person shall also be familiar with the State's vehicle and traffic laws.

(iii) No matches, firearms, acids, or other corrosive liquids shall be carried in the bed or body of any vehicle containing blasting agents.

(iv) No person shall be permitted to ride upon, drive, load, or unload a vehicle containing blasting agents while smoking or under the influence of intoxicants, narcotics, or other dangerous drugs.

(v) (Reserved)

(vi) Vehicles transporting blasting agents shall be in safe operating condition at all times.

(7) Use of blasting agents. Persons using blasting agents shall comply with all of the applicable provisions of paragraph (e) of this section.

(h) Water gel (Slurry) explosives and blasting agents.

(1) General provisions. Unless otherwise set forth in this paragraph, water gels shall be transported, stored and used in the same manner as explosives or blasting agents in accordance with the classification of the product.

(2) Types and classifications.

(i) Water gels containing a substance in itself classified as an explosive shall be classified as an explosive and manufactured, transported, stored, and used as specified for “explosives” in this section, except as noted in Subdivision (iv) of this subparagraph.

(ii) Water gels containing no substance in itself classified as an explosive and which are cap-sensitive as defined in paragraph (a) of this section under Blasting Agent shall be classified as an explosive and manufactured, transported, stored and used as specified for “explosives” in this section.

(iii) Water gels containing no substance in itself classified as an explosive and which are not cap-sensitive as defined in paragraph (a) of this section under Blasting Agent shall be classified as blasting agents and manufactured, transported, stored, and used as specified for “blasting agents” in this section.

(iv) When tests on specific formulations of water gels result in Department of Transportation classification as a Class B explosive, bullet-resistant magazines are not required, see paragraph (c)(2)(ii) of this section.

(3) Fixed location mixing.

(i) (Reserved)

(ii) Buildings used for the mixing of water gels shall conform to the requirements of this Subdivision.

(A) Buildings shall be of noncombustible construction or sheet metal on wood studs.

(B) Floors in a mixing plant shall be of concrete or of other nonabsorbent materials.

(C) Where fuel oil is used all fuel oil storage facilities shall be separated from the mixing plant and located in such a manner that in case of tank rupture, the oil will drain away from the mixing plant building.

(D) The building shall be well-ventilated.

(E) Heating units that do not depend on combustion processes, when properly designed and located, may be used in the building. All direct sources of heat shall be provided exclusively from units located outside of the mixing building.

(F) All internal-combustion engines used for electric power generation shall be located outside the mixing plant building, or shall be properly ventilated and isolated by a firewall. The exhaust systems on all such engines shall be located so any spark emission cannot be a hazard to any materials in or adjacent to the plant.

(iii) Ingredients of water gels shall conform to the requirements of this Subdivision.

(A) Ingredients in themselves classified as Class A or Class B explosives shall be stored in conformity with paragraph (c) of this section.

(B) Nitrate-water solutions may be stored in tank cars, tank trucks, or fixed tanks without quantity or distance limitations. Spills or leaks which may contaminate combustible materials shall be cleaned up immediately.

(C) Metal powders such as aluminum shall be kept dry and shall be stored in containers or bins which are moisture-resistant or weather-tight. Solid fuels shall be used in such manner as to minimize dust explosion hazards.

(D) Ingredients shall not be stored with incompatible materials.

(E) Peroxides and chlorates shall not be used.

(iv) Mixing equipment shall comply with the requirements of this Subdivision.

(A) The design of the processing equipment, including mixing and conveying equipment, shall be compatible with the relative sensitivity of the materials being handled. Equipment shall be designed to minimize the possibility of frictional heating, compaction, overloading, and confinement.

(B) Both equipment and handling procedures shall be designed to prevent the introduction of foreign objects or materials.

(C) Mixers, pumps, valves, and related equipment shall be designed to permit regular and periodic flushing, cleaning, dismantling, and inspection.

(D) All electrical equipment including wiring, switches, controls, motors, and lights, shall conform to the requirements of Subpart S of this part.

(E) All electric motors and generators shall be provided with suitable overload protection devices. Electrical generators, motors, proportioning devices, and all other electrical enclosures shall be electrically bonded. The grounding conductor to all such electrical equipment shall be effectively bonded to the service-entrance ground connection and to all equipment ground connections in a manner so as to provide a continuous path to ground.

(v) Mixing facilities shall comply with the fire prevention requirements of this Subdivision.

(A) The mixing, loading, and ingredient transfer areas where residues or spilled materials may accumulate shall be cleaned periodically. A cleaning and collection system for dangerous residues shall be provided.

(B) A daily visual inspection shall be made of mixing, conveying, and electrical equipment to establish that such equipment is in good operating condition. A program of systematic maintenance shall be conducted on regular schedule.

(C) Heaters which are not dependent on the combustion process within the heating unit may be used within the confines of processing buildings, or compartments, if provided with temperature and safety controls and located away from combustible materials and the finished product.

(4) Bulk delivery and mixing vehicles.

(i) The design of vehicles shall comply with the requirements of this Subdivision.

(A) Vehicles used over public highways for the bulk transportation of water gels or of ingredients classified as dangerous commodities, shall meet the requirements of the Department of Transportation and shall meet the requirements of paragraphs (d) and (g)(6) of this section.

(B) When electric power is supplied by a self-contained motor generator located on the vehicle the generator shall be at a point separate from where the water gel is discharged.

(C) The design of processing equipment and general requirements shall conform to subparagraphs (3)(iii) and (iv) of this paragraph.

(D) A positive action parking brake, which will set the wheel brakes on at least one axle shall be provided on vehicles when equipped with air brakes and shall be used during bulk delivery operations. Wheel chocks shall supplement parking brakes whenever conditions may require.

(ii) Operation of bulk delivery and mixing vehicles shall comply with the requirements of this Subdivision.

(A) The placarding requirements contained in DOT regulations apply to vehicles carrying water gel explosives or blasting agents.

(B) The operator shall be trained in the safe operation of the vehicle together with its mixing, conveying, and related equipment. He shall be familiar with the commodities being delivered and the general procedure for handling emergency situations.

(C) The hauling of either blasting caps or other explosives, but not both, shall be permitted on bulk trucks provided that a special wood or nonferrous-lined container is installed for the explosives. Such blasting caps or other explosives shall be in DOT-specified shipping containers; see 49 CFR Chapter I.

(D) No person shall be allowed to smoke, carry matches or any flame-producing device, or carry any firearms while in or about bulk vehicles effecting the mixing, transfer, or down-the-hole loading of water gels at or near the blasting site.

(E) Caution shall be exercised in the movement of the vehicle in the blasting area to avoid driving the vehicle over or dragging hoses over firing lines, cap wires, or explosive materials. The employer shall furnish the driver the assistance of a second person to guide the driver's movements.

(F) No intransit mixing of materials shall be performed.

(G) The location chosen for water gel or ingredient transfer from a support vehicle into the borehole loading vehicle shall be away from the blasthole site when the boreholes are loaded or in the process of being loaded.

(i) Storage of ammonium nitrate.

(1) Scope and definitions.

(i)

(A) Except as provided in paragraph (i)(1)(i)(D) of this paragraph applies to the storage of ammonium nitrate in the form of crystals, flakes, grains, or prills including fertilizer grade, dynamite grade, nitrous oxide grade, technical grade, and other mixtures containing 60 percent or more ammonium nitrate by weight but does not apply to blasting agents.

(B) This paragraph does not apply to the transportation of ammonium nitrate.

(C) This paragraph does not apply to storage under the jurisdiction of and in compliance with the regulations of the U.S. Coast Guard (see 46 CFR Parts 146-149).

(D) The storage of ammonium nitrate and ammonium nitrate mixtures that are more sensitive than allowed by the "Definition of Test Procedures for Ammonium Nitrate Fertilizer" is prohibited.

(ii)

(A) (Reserved)

(B) The standards for ammonium nitrate (nitrous oxide grade) are those found in the "Specifications, Properties, and Recommendations for Packaging, Transportation, Storage, and Use of Ammonium Nitrate," available from the Compressed Gas Association, Inc., which is incorporated by reference as specified in 1910.6.

(2) General provisions.

(i) This paragraph applies to all persons storing, having, or keeping ammonium nitrate, and to the owner or lessee of any building, premises, or structure in which ammonium nitrate is stored in quantities of 1,000 pounds or more.

(ii) Approval of large quantity storage shall be subject to due consideration of the fire and explosion hazards, including exposure to toxic vapors from burning or decomposing ammonium nitrate.

(iii)

(A) Storage buildings shall not have basements unless the basements are open on at least one side. Storage buildings shall not be over one story in height.

(B) Storage buildings shall have adequate ventilation or be of a construction that will be self-ventilating in the event of fire.

(C) The wall on the exposed side of a storage building within 50 feet of a combustible building, forest, piles of combustible materials and similar exposure hazards shall be of fire-resistive construction. In lieu of the fire-resistive wall, other suitable means of exposure protection such as a free standing wall may be used. The roof coverings shall be Class C or better, as defined in the Manual on Roof Coverings, NFPA 203M-1970, which is incorporated by reference as specified in 1910.6.

(D) All flooring in storage and handling areas, shall be of noncombustible material or protected against impregnation by ammonium nitrate and shall be without open drains, traps, tunnels, pits, or pockets into which any molten ammonium nitrate could flow and be confined in the event of fire.

(E) The continued use of an existing storage building or structure not in strict conformity with this paragraph may be approved in cases where such continued use will not constitute a hazard to life.

(F) Buildings and structures shall be dry and free from water seepage through the roof, walls, and floors.

(3) Storage of ammonium nitrate in bags, drums, or other containers.

(i)

(A) Bags and containers used for ammonium nitrate must comply with specifications and standards required for use in interstate commerce (see 49 CFR Chapter I).

(B) Containers used on the premises in the actual manufacturing or processing need not comply with provisions of paragraph (i)(3)(i)(A) of this paragraph.

(ii)

(A) Containers of ammonium nitrate shall not be accepted for storage when the temperature of the ammonium nitrate exceeds 130 degrees F.

(B) Bags of ammonium nitrate shall not be stored within 30 inches of the storage building walls and partitions.

(C) The height of piles shall not exceed 20 feet. The width of piles shall not exceed 20 feet and the length 50 feet except that where the building is of noncombustible construction or is protected by automatic sprinklers the length of piles shall not be limited. In no case shall the ammonium nitrate be stacked closer than 36 inches below the roof or supporting and spreader beams overhead.

(D) Aisles shall be provided to separate piles by a clear space of not less than 3 feet in width. At least one service or main aisle in the storage area shall be not less than 4 feet in width.

(4) Storage of bulk ammonium nitrate.

(i)

(A) Warehouses shall have adequate ventilation or be capable of adequate ventilation in case of fire.

(B) Unless constructed of noncombustible material or unless adequate facilities for fighting a roof fire are available, bulk storage structures shall not exceed a height of 40 feet.

(ii)

(A) Bins shall be clean and free of materials which may contaminate ammonium nitrate.

(B) Due to the corrosive and reactive properties of ammonium nitrate, and to avoid contamination, galvanized iron, copper, lead, and zinc shall not be used in a bin construction unless suitably protected. Aluminum bins and wooden bins protected against impregnation by ammonium nitrate are permissible. The partitions dividing the ammonium nitrate storage from other products which would contaminate the ammonium nitrate shall be of tight construction.

(C) The ammonium nitrate storage bins or piles shall be clearly identified by signs reading “Ammonium Nitrate” with letters at least 2 inches high.

(iii)

(A) Piles or bins shall be so sized and arranged that all material in the pile is moved out periodically in order to minimize possible caking of the stored ammonium nitrate.

(B) Height or depth of piles shall be limited by the pressure-setting tendency of the product. However, in no case shall the ammonium nitrate be piled higher at any point than 36 inches below the roof or supporting and spreader beams overhead.

(C) Ammonium nitrate shall not be accepted for storage when the temperature of the product exceeds 130 degrees F.

(D) Dynamite, other explosives, and blasting agents shall not be used to break up or loosen caked ammonium nitrate.

(5) Contaminants.

(i)

(A) Ammonium nitrate shall be in a separate building or shall be separated by approved type firewalls of not less than 1-hour fire-resistance rating from storage of organic chemicals, acids, or other corrosive materials, materials that may require blasting during processing or handling, compressed flammable gases, flammable and combustible materials or other contaminating substances, including but not limited to animal fats, baled cotton, baled rags, baled scrap paper, bleaching powder, burlap or cotton bags, caustic soda, coal, coke, charcoal, cork, camphor, excelsior, fibers of any kind, fish oils, fish meal, foam rubber, hay, lubricating oil, linseed oil, or other oxidizable or drying oils, naphthalene, oakum, oiled clothing, oiled paper, oiled textiles, paint, straw, sawdust, wood shavings, or vegetable oils. Walls referred to in this Subdivision need extend only to the underside of the roof.

(B) In lieu of separation walls, ammonium nitrate may be separated from the materials referred to in paragraph (a) of this section by a space of at least 30 feet.

(C) Flammable liquids such as gasoline, kerosene, solvents, and light fuel oils shall not be stored on the premises except when such storage conforms to 1910.106, and when walls and sills or curbs are provided in accordance with paragraphs (i)(5)(i)(A) or (B) of this section.

(D) LP-Gas shall not be stored on the premises except when such storage conforms to 1910.110.

(ii)

(A) Sulfur and finely divided metals shall not be stored in the same building with ammonium nitrate except when such storage conforms to paragraphs (a) through (h) of this section.

(B) Explosives and blasting agents shall not be stored in the same building with ammonium nitrate except on the premises of makers, distributors, and user compounders of explosives or blasting agents.

(C) Where explosives or blasting agents are stored in separate buildings, other than on the premises of makers, distributors, and user-compounders of explosives or blasting agents, they shall be separated from the ammonium nitrate by the distances and/or barricades specified in Table H-22 of this subpart, but by not less than 50 feet.

(D) Storage and/or operations on the premises of makers, distributors, and user-compounders of explosives or blasting agents shall be in conformity with paragraphs (a) through (h) of this section.

(6) General precautions.

(i) Electrical installations shall conform to the requirements of Subpart S of this part, for ordinary locations. They shall be designed to minimize damage from corrosion.

(ii) In areas where lightning storms are prevalent, lightning protection shall be provided. (See the Lightning Protection Code, NFPA 78-1968, which is incorporated by reference as specified in 1910.6.)

(iii) Provisions shall be made to prevent unauthorized personnel from entering the ammonium nitrate storage area.

(7) Fire protection.

(i) Not more than 2,500 tons (2270 tonnes) of bagged ammonium nitrate shall be stored in a building or structure not equipped with an automatic sprinkler system. Sprinkler systems shall be of the approved type and installed in accordance with 1910.159.

(ii)

(A) Suitable fire control devices such as small hose or portable fire extinguishers shall be provided throughout the warehouse and in the loading and unloading areas. Suitable fire control devices shall comply with the requirements of 1910.157 and 1910.158.

(B) Water supplies and fire hydrants shall be available in accordance with recognized good practices.

(j) Small arms ammunition, small arms primers, and small arms propellants.

(1) Scope. This paragraph does not apply to in-process storage and intraplant transportation during manufacture of small arms ammunition, small arms primers, and smokeless propellants.

(2) Small arms ammunition.

(i) No quantity limitations are imposed on the storage of small arms ammunition in warehouses, retail stores, and other general occupancy facilities, except those imposed by limitations of storage facilities.

(ii) Small arms ammunition shall be separated from flammable liquids, flammable solids as classified in 49 CFR Part 172, and from oxidizing materials, by a fire-resistive wall of 1 hour rating or by a distance of 25 feet.

(iii) Small arms ammunition shall not be stored together with Class A or Class B explosives unless the storage facility is adequate for this latter storage.

(3) Smokeless propellants.

(i) All smokeless propellants shall be stored in shipping containers specified in 49 CFR 173.93 for smokeless propellants.

(ii) (Reserved)

(iii) Commercial stocks of smokeless propellants over 20 pounds and not more than 100 pounds shall be stored in portable wooden boxes having walls of at least 1 inch nominal thickness.

(iv) Commercial stocks in quantities not to exceed 750 pounds shall be stored in nonportable storage cabinets having wooden walls of at least 1-inch nominal thickness. Not more than 400 pounds shall be permitted in any one cabinet.

(v) Quantities in excess of 750 pounds shall be stored in magazines in accordance with paragraph (c) of this section.

(4) Small arms ammunition primers.

(i) Small arms ammunition primers shall not be stored except in the original shipping container in accordance with the requirements of 49 CFR 173.107 for small arms ammunition primers.

(ii) (Reserved)

(iii) Small arms ammunition primers shall be separated from flammable liquids, flammable solids as classified in 49 CFR Part 172, and oxidizing materials by a fire-resistive wall of 1-hour rating or by a distance of 25 feet.

(iv) Not more than 750,000 small arms ammunition primers shall be stored in any one building, except as provided in paragraph (j)(4)(v) of this paragraph. Not more than 100,000 shall be stored in any one pile. Piles shall be at least 15 feet apart.

(v) Quantities of small arms ammunition primers in excess of 750,000 shall be stored in magazines in accordance with paragraph (c) of this section.

(k) Scope.

(1) This section applies to the manufacture, keeping, having, storage, sale, transportation, and use of explosives, blasting agents, and pyrotechnics. This section does not apply to the sale and use (public display) of pyrotechnics, commonly known as fireworks, nor to the use of explosives in the form prescribed by the official U.S. Pharmacopeia.

(2) The manufacture of explosives as defined in paragraph (a)(3) of this section shall also meet the requirements contained in 1910.119.

(3) The manufacture of pyrotechnics as defined in paragraph (a)(10) of this section shall also meet the requirements contained in 1910.119.

[39 FR 23502, June 27, 1974, as amended at 43 FR 49747, Oct. 24, 1978; 45 FR 60704, Sept. 12, 1980; 53 FR 12122, Apr. 12, 1988; 57 FR 6403, Feb. 24, 1992; 58 FR 16496, March 29, 1993; 58 FR 35309, June 30, 1993; 61 FR 9237, 9238, Mar. 7, 1996; 63 FR 33466, June 18, 1998.]

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 to 654.295.
Hist: OR-OSHA Admin. Order 2-1992, f. 2/6/92, ef. 5/1/92.
OR-OSHA Admin. Order 8-1992, f. 8/13/92, ef. 11/24/92.
OR-OSHA Admin. Order 4-1997, f. 4/2/97, ef. 4/2/97.
OR-OSHA Admin. Order 4-1999, f. 4/30/99, ef. 4/30/99.

1910.110 Storage and Handling of Liquefied Petroleum Gases

(a) Definitions applicable to this section. As used in this section:

(1) **API-ASME container** – A container constructed in accordance with the requirements of paragraph (b)(3)(iii) of this section.

(2) **ASME container** – A container constructed in accordance with the requirements of paragraph (b)(3)(i) of this section.

(3) **Container assembly** – An assembly consisting essentially of the container and fittings for all container openings, including shutoff valves, excess flow valves, liquid-level gaging devices, safety relief devices, and protective housing.

(4) **Containers** – All vessels, such as tanks, cylinders, or drums, used for transportation or storing liquefied petroleum gases.

(5) **DOT** – Department of Transportation.

(6) **DOT container** – A container constructed in accordance with the applicable requirements of 49 CFR Chapter 1.

(7) **Liquefied petroleum gases** – "LPG" and "LP-Gas" – Any material which is composed predominantly of any of the following hydrocarbons, or mixtures of them; propane, propylene, butanes (normal butane or isobutane), and butylenes.

(8) **Movable fuel storage tenders or farm carts** – Containers not in excess of 1,200 gallons water capacity, equipped with wheels to be towed from one location of usage to another. They are basically nonhighway vehicles, but may occasionally be moved over public roads or highways. They are used as a fuel supply for farm tractors, construction machinery and similar equipment.

(9) **P.S.I.G.** – pounds per square inch gauge.

(10) **P.S.I.A.** – pounds per square inch absolute.

(11) **Systems** – an assembly of equipment consisting essentially of the container or containers, major devices such as vaporizers, safety relief valves, excess flow valves, regulators, and piping connecting such parts.

(12) **Vaporizer-burner** – an integral vaporizer-burner unit, dependent upon the heat generated by the burner as the source of heat to vaporize the liquid used for dehydrators or dryers.

(13) **Ventilation, adequate** – when specified for the prevention of fire during normal operation, ventilation shall be considered adequate when the concentration of the gas in a gas-air mixture does not exceed 25 percent of the lower flammable limit.

(14) **Approved** – unless otherwise indicated, listing or approval by a nationally recognized testing laboratory. Refer to 1910.7 for definition of nationally recognized testing laboratory.

(15) **Listed** – see "approved" in 1910.110(14).

(16) **DOT Specifications** – regulations of the Department of Transportation published in 49 CFR Chapter I.

(17) (Reserved)

(18) (Reserved)

(19) **DOT cylinders** – cylinders meeting the requirements of 49 CFR Chapter I.

(b) Basic rules.

(1) Odorizing gases.

(i) All liquefied petroleum gases shall be effectively odorized by an approved agent of such character as to indicate positively, by distinct odor, the presence of gas down to concentration in air of not over one-fifth the lower limit of flammability. Odorization, however, is not required if harmful in the use of further processing of the liquefied petroleum gas, or if odorization will serve no useful purpose as a warning agent in such use or further processing.

(ii) The odorization requirement of paragraph (b)(1)(i) of this section shall be considered to be met by the use of 1.0 pounds of ethyl mercaptan, 1.0 pounds of thiophane or 1.4 pounds of amyl mercaptan per 10,000 gallons of LP-Gas. However, this listing of odorants and quantities shall not exclude the use of other odorants that meet the odorization requirements of paragraph (b)(1)(i) of this section.

(2) Approval of equipment and systems.

(i) Each system utilizing DOT containers in accordance with 49 CFR Part 178 shall have its container valves, connectors, manifold valve assemblies, and regulators approved.

(ii) Each system for domestic or commercial use utilizing containers of 2,000 gallons or less water capacity, other than those constructed in accordance with 49 CFR Part 178, shall consist of a container assembly and one or more regulators, and may include other parts. The system as a unit or the container assembly as a unit, and the regulator or regulators, shall be individually listed.

(iii) In systems utilizing containers of over 2,000 gallons water capacity, each regulator, container valve, excess flow valve, gaging device, and relief valve installed on or at the container, shall have its correctness as to design, construction, and performance determined by listing by a nationally recognized testing laboratory. Refer to 1910.7 for definition of nationally recognized testing laboratory.

(3) Requirements for construction and original test of containers.

(i) Containers used with systems embodied in paragraphs (d), (e), (g), and (h) of this section, except as provided in paragraphs (e)(3)(iii) and (g)(2)(i) of this section, shall be designed, constructed, and tested in accordance with the Rules for Construction of Unfired Pressure Vessels, section VIII, Division 1, American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, 1968 edition, which is incorporated by reference as specified in 1910.6.

(ii) Containers constructed according to the 1949 and earlier editions of the ASME Code do not have to comply with paragraphs U-2 through U-10 and U-19 thereof. Containers constructed according to paragraph U-70 in the 1949 and earlier editions are not authorized.

(iii) Containers designed, constructed, and tested prior to July 1, 1961, according to the Code for Unfired Pressure Vessels for Petroleum Liquids and Gases, 1951 edition with 1954 Addenda, of the American Petroleum Institute and the American Society of Mechanical Engineers, which is incorporated by reference as specified in 1910.6, shall be considered in conformance. Containers constructed according to API-ASME Code do not have to comply with section I or with appendix to section I. Paragraphs W-601 to W-606 inclusive in the 1943 and earlier editions do not apply.

(iv) The provisions of paragraph (b)(3)(i) of this section shall not be construed as prohibiting the continued use or reinstallation of containers constructed and maintained in accordance with the standard for the Storage and Handling of Liquefied Petroleum Gases NFPA No. 58 in effect at the time of fabrication.

(v) Containers used with systems embodied in paragraph (b), (d)(3)(iii), and (f) of this section, shall be constructed, tested, and stamped in accordance with DOT specifications effective at the date of their manufacture.

(4) Welding of containers.

(i) Welding to the shell, head, or any other part of the container subject to internal pressure, shall be done in compliance with the code under which the tank was fabricated. Other welding is permitted only on saddle plates, lugs, or brackets attached to the container by the tank manufacturer.

(ii) Where repair or modification involving welding of DOT containers is required, the container shall be returned to a qualified manufacturer making containers of the same type, and the repair or modification made in compliance with DOT regulations.

(5) Markings on containers.

(i) Each container covered in paragraph (b)(3)(i) of this section, except as provided in paragraph (b)(3)(iv) of this section shall be marked as specified in the following:

(A) With a marking identifying compliance with, and other markings required by, the rules of the reference under which the container is constructed; or with the stamp and other markings required by the National Board of Boiler and Pressure Vessel Inspectors.

(B) With notation as to whether the container is designed for underground or above ground installation or both. If intended for both and different style hoods are provided, the marking shall indicate the proper hood for each type of installation.

(C) With the name and address of the supplier of the container, or with the trade name of the container.

(D) With the water capacity of the container in pounds or gallons, U.S. Standard.

(E) With the pressure in p.s.i.g., for which the container is designed.

(F) With the wording “This container shall not contain a product having a vapor pressure in excess of — p.s.i.g. at 100 degrees F.,” see subparagraph (14)(viii) of this paragraph.

(G) With the tare weight in pounds or other identified unit of weight for containers with a water capacity of 300 pounds or less.

(H) With marking indicating the maximum level to which the container may be filled with liquid at temperatures between 20 degrees F. and 130 degrees F., except on containers provided with fixed maximum level indicators or which are filled by weighing. Markings shall be increments of not more than 20 degrees F. This marking may be located on the liquid level gaging device.

(I) With the outside surface area in square feet.

(ii) Markings specified shall be on a metal nameplate attached to the container and located in such a manner as to remain visible after the container is installed.

(iii) When LP-Gas and one or more other gases are stored or used in the same area, the containers shall be marked to identify their content. Marking shall conform to the marking requirements set forth in 1910.253(b)(1)(ii).

(6) Location of containers and regulating equipment.

(i) Containers, and first stage regulating equipment if used, shall be located outside of buildings, except under one or more of the following:

(A) In buildings used exclusively for container charging, vaporization pressure reduction, gas mixing, gas manufacturing, or distribution.

(B) When portable use is necessary and in accordance with paragraph (c)(5) of this section.

(C) LP-Gas fueled stationary or portable engines in accordance with paragraph (e)(11) or (12) of this section.

(D) LP-Gas fueled industrial trucks used in accordance with paragraph (e)(13) of this section.

(E) LP-Gas fueled vehicles garaged in accordance with paragraph (e)(14) of this section.

(F) Containers awaiting use or resale when stored in accordance with paragraph (f) of this section.

(ii) Each individual container shall be located with respect to the nearest important building or group of buildings in accordance with Table H-23.

Table H-23

Water capacity per container	Minimum distances		
	Containers		Between above ground containers
	Underground	Above ground	
Less than 125 gals.[1]	10 feet	None	None
125 to 250 gals	10 feet	10 feet	None
251 to 500 gals	10 feet	10 feet	3 feet
501 to 2,000 gals	25 feet[2]	25 feet[2]	3 feet
2,001 to 30,000 gals	50 feet	50 feet	5 feet
30,001 to 70,000 gals	50 feet	75 feet[3]	
70,001 to 90,000 gals	50 feet	100 feet[3]	

[1] If the aggregate water capacity of a multi-container installation at a consumer site is 501 gallons or greater, the minimum distance shall comply with the appropriate portion of this table, applying the aggregate capacity rather than the capacity per container. If more than one installation is made, each installation shall be separated from another installation by at least 25 feet. Do not apply the MINIMUM DISTANCES BETWEEN ABOVE GROUND CONTAINERS to such installations.
[2] The above distance requirements may be reduced to not less than 10 feet for a single container of 1,200 gallons water capacity or less, providing such a container is at least 25 feet from any other LP-Gas container of more than 125 gallons water capacity.
[3] 1/4 of sum of diameters of adjacent containers.

(iii) Containers installed for use shall not be stacked one above the other.

(iv) (Reserved)

(v) In the case of buildings devoted exclusively to gas manufacturing and distributing operations, the distances required by Table H-23 may be reduced provided that in no case shall containers of water capacity exceeding 500 gallons be located closer than 10 feet to such gas manufacturing and distributing buildings.

(vi) Readily ignitible material such as weeds and long dry grass shall be removed within 10 feet of any container.

(vii) The minimum separation between liquefied petroleum gas containers and flammable liquid tanks shall be 20 feet, and the minimum separation between a container and the centerline of the dike shall be 10 feet. The foregoing provision shall not apply when LP-Gas containers of 125 gallons or less capacity are installed adjacent to Class III flammable liquid tanks of 275 gallons or less capacity.

(viii) Suitable means shall be taken to prevent the accumulation of flammable liquids under adjacent liquified petroleum gas containers, such as by diking, diversion curbs, or grading.

(ix) When dikes are used with flammable liquid tanks, no liquefied petroleum gas containers shall be located within the diked area.

(7) Container valves and container accessories.

(i) Valves, fittings, and accessories connected directly to the container including primary shutoff valves, shall have a rated working pressure of at least 250 p.s.i.g. and shall be of material and design suitable for LP-Gas service. Cast iron shall not be used for container valves, fittings, and accessories. This does not prohibit the use of container valves made of malleable or nodular iron.

(ii) Connections to containers, except safety relief connections, liquid level gaging devices, and plugged openings, shall have shutoff valves located as close to the container as practicable.

(iii) Excess flow valves, where required shall close automatically at the rated flows of vapor or liquid as specified by the manufacturer. The connections or line including valves, fittings, etc., being protected by an excess flow valve shall have a greater capacity than the rated flow of the excess flow valve.

(iv) Liquid level gaging devices which are so constructed that outward flow of container contents shall not exceed that passed by a No. 54 drill size opening, need not be equipped with excess flow valves.

(v) Openings from container or through fittings attached directly on container to which pressure gage connection is made, need not be equipped with shutoff or excess flow valves if such openings are restricted to not larger than No. 54 drill size opening.

(vi) Except as provided in paragraph (c)(5)(i)(B) of this section, excess flow and back pressure check valves where required by this section shall be located inside of the container or at a point outside where the line enters the container; in the latter case, installation shall be made in such manner that any undue strain beyond the excess flow or back pressure check valve will not cause breakage between the container and such valve.

(vii) Excess flow valves shall be designed with a bypass, not to exceed a No. 60 drill size opening to allow equalization of pressures.

(viii) Containers of more than 30 gallons water capacity and less than 2,000 gallons water capacity, filled on a volumetric basis, and manufactured after December 1, 1963, shall be equipped for filling into the vapor space.

(8) Piping – including pipe, tubing, and fittings.

(i) Pipe, except as provided in paragraphs (e)(6)(i) and (g)(10)(iii), of this section shall be wrought iron or steel (black or galvanized), brass, copper, or aluminum alloy. Aluminum alloy pipe shall be at least Schedule 40 in accordance with the specifications for Aluminum Alloy Pipe, American National Standards Institute (ANSI) H38.7-1969 (ASTM, B241-69), which is incorporated by reference as specified in 1910.6, except that the use of alloy 5456 is prohibited and shall be suitably marked at each end of each length indicating compliance with American National Standard Institute Specifications. Aluminum Alloy pipe shall be protected against external corrosion when it is in contact with dissimilar metals other than galvanized steel, or its location is subject to repeated wetting by such liquids as water (except rainwater), detergents, sewage, or leaking from other piping, or it passes through flooring, plaster, masonry, or insulation. Galvanized sheet steel or pipe, galvanized inside and out, may be considered suitable protection. The maximum nominal pipe size for aluminum pipe shall be 3/4-inch and shall not be used for pressures exceeding 20 p.s.i.g. Aluminum alloy pipe shall not be installed within 6 inches of the ground.

(A) Vapor piping with operating pressures not exceeding 125 p.s.i.g. shall be suitable for a working pressure of at least 125 p.s.i.g. Pipe shall be at least Schedule 40 (ASTM A-53-69, Grade B Electric Resistance Welded and Electric Flash Welded Pipe, which is incorporated by reference as specified in 1910.6, or equal).

(B) Vapor piping with operating pressures over 125 p.s.i.g. and all liquid piping shall be suitable for a working pressure of at least 250 p.s.i.g. Pipe shall be at least Schedule 80 if joints are threaded or threaded and back welded. At least Schedule 40 (ASTM A-53-69 Grade B Electric Resistance Welded and Electric Flash Welded Pipe or equal) shall be used if joints are welded, or welded and flanged.

(ii) Tubing shall be seamless and of copper, brass, steel, or aluminum alloy. Copper tubing shall be of type K or L or equivalent as covered in the Specification for Seamless Copper Water Tube, ANSI H23.1-1970 (ASTM B88-69), which is incorporated by reference as specified in 1910.6. Aluminum alloy tubing shall be of Type A or B or equivalent as covered in Specification ASTM B210-68 (which is incorporated by reference as specified in 1910.6) and shall be suitably marked every 18 inches indicating compliance with ASTM Specifications. The minimum nominal wall thickness of copper tubing and aluminum alloy tubing shall be as specified in Table H-24 and Table H-25.

Aluminum alloy tubing shall be protected against external corrosion when it is in contact with dissimilar metals other than galvanized steel, or its location is subject to repeated wetting by liquids such as water (except rainwater), detergents, sewage, or leakage from other piping, or it passes through flooring, plaster, masonry, or insulation. Galvanized sheet steel or pipe, galvanized inside and out, may be considered suitable protection. The maximum outside diameter for aluminum alloy tubing shall be 3/4-inch and shall not be used for pressures exceeding 20 p.s.i.g. Aluminum alloy tubing shall not be installed within 6 inches of the ground.

Table H-24 - Wall Thickness of Copper Tubing[1]

Standard size (inches)	Nominal outside diameter (inches)	Nominal wall thickness (inches)	
		Type K	Type L
1/4	0.375	0.035	0.030
3/8	0.500	0.049	0.035
1/2	0.625	0.049	0.040
5/8	0.750	0.049	0.042
3/4	0.875	0.065	0.045
1	1.125	0.065	0.050
1 1/4	1.375	0.065	0.055
1 1/2	1.625	0.072	0.060
2	2.125	0.083	0.070

[1] Based on data in Specification for Seamless Copper Water Tube, ANSI H23.1-1970 (ASTM B-88-69).

Note: The standard size by which tube is designated is 1/8-inch smaller than its nominal outside diameter.

Table H-25 - Wall Thickness of Aluminum Alloy Tubing [1]

Outside diameter (inches)	Nominal wall thickness (inches)	
	Type A	Type B
3/8	0.035	0.049
1/2	0.035	0.049
5/8	0.042	0.049
3/4	0.049	0.058

[1] Based on data in Standard Specification for Aluminum-Alloy Drawn Seamless Coiled Tubes for Special Purpose Applications, ASTM B210-68.

(iii) In systems where the gas in liquid form without pressure reduction enters the building, only heavy walled seamless brass or copper tubing with an internal diameter not greater than 3/32-inch, and a wall thickness of not less than 3/64-inch shall be used. This requirement shall not apply to research and experimental laboratories, buildings, or separate fire divisions of buildings used exclusively for housing internal combustion engines, and to commercial gas plants or bulk stations where containers are charged, nor to industrial vaporizer buildings, nor to buildings, structures, or equipment under construction or undergoing major renovation.

(iv) Pipe joints may be screwed, flanged, welded, soldered, or brazed with a material having a melting point exceeding 1,000 degrees F. Joints on seamless copper, brass, steel, or aluminum alloy gas tubing shall be made by means of approved gas tubing fittings, or soldered or brazed with a material having a melting point exceeding 1,000 degrees F.

(v) For operating pressures of 125 p.s.i.g. or less, fittings shall be designed for a pressure of at least 125 p.s.i.g. For operating pressures above 125 p.s.i.g., fittings shall be designed for a minimum of 250 p.s.i.g.

(vi) The use of threaded cast iron pipe fittings such as ells, tees, crosses, couplings, and unions is prohibited. Aluminum alloy fittings shall be used with aluminum alloy pipe and tubing. Insulated fittings shall be used where aluminum alloy pipe or tubing connects with a dissimilar metal.

(vii) Strainers, regulators, meters, compressors, pumps, etc., are not to be considered as pipe fittings. This does not prohibit the use of malleable, nodular, or higher strength gray iron for such equipment.

(viii) All materials such as valve seats, packing, gaskets, diaphragms, etc., shall be of such quality as to be resistant to the action of liquefied petroleum gas under the service conditions to which they are subjected.

(ix) All piping, tubing, or hose shall be tested after assembly and proved free from leaks at not less than normal operating pressures. After installation, piping and tubing of all domestic and commercial systems shall be tested and proved free of leaks using a manometer or equivalent device that will indicate a drop in pressure. Test shall not be made with a flame.

(x) Provision shall be made to compensate for expansion, contraction, jarring, and vibration, and for settling. This may be accomplished by flexible connections.

(xi) Piping outside buildings may be buried, above ground, or both, but shall be well supported and protected against physical damage. Where soil conditions warrant, all piping shall be protected against corrosion. Where condensation may occur, the piping shall be pitched back to the container, or suitable means shall be provided for revaporization of the condensate.

(9) Hose specifications.

(i) Hose shall be fabricated of materials that are resistant to the action of LP-Gas in the liquid and vapor phases. If wire braid is used for reinforcing the hose, it shall be of corrosion-resistant material such as stainless steel.

(ii) Hose subject to container pressure shall be marked "LP-Gas" or "LPG" at not greater than 10-foot intervals.

(iii) Hose subject to container pressure shall be designed for a bursting pressure of not less than 1,250 p.s.i.g.

(iv) Hose subject to container pressure shall have its correctness as to design construction and performance determined by being listed (see 1910.110(a)(15)).

(v) Hose connections subject to container pressure shall be capable of withstanding, without leakage, a test pressure of not less than 500 p.s.i.g.

(vi) Hose and hose connections on the low-pressure side of the regulator or reducing valve shall be designed for a bursting pressure of not less than 125 p.s.i.g. or five times the set pressure of the relief devices protecting that portion of the system, whichever is higher.

(vii) Hose may be used on the low-pressure side of regulators to connect to other than domestic and commercial gas appliances under the following conditions:

(A) The appliances connected with hose shall be portable and need a flexible connection.

(B) For use inside buildings the hose shall be of minimum practical length, but shall not exceed 6 feet except as provided in paragraph (c)(5)(i)(G) of this section and shall not extend from one room to another, nor pass through any walls, partitions, ceilings, or floors. Such hose shall not be concealed from view or used in a concealed location. For use outside of buildings, the hose may exceed this length but shall be kept as short as practical.

(C) The hose shall be approved and shall not be used where it is likely to be subjected to temperatures above 125 degrees F. The hose shall be securely connected to the appliance and the use of rubber slip ends shall not be permitted.

(D) The shutoff valve for an appliance connected by hose shall be in the metal pipe or tubing and not at the appliance end of the hose. When shutoff valves are installed close to each other, precautions shall be taken to prevent operation of the wrong valve.

(E) Hose used for connecting to wall outlets shall be protected from physical damage.

(10) Safety devices.

(i) Every container except those constructed in accordance with DOT specifications and every vaporizer (except motor fuel vaporizers and except vaporizers described in paragraph (b)(11)(ii)(C) of this section and paragraph (d)(4)(v)(A) of this section) whether heated by artificial means or not, shall be provided with one or more safety relief valves of spring-loaded or equivalent type. These valves shall be arranged to afford free vent to the outer air with discharge not less than 5 feet horizontally away from any opening into the building which is below such discharge. The rate of discharge shall be in accordance with the requirements of paragraph (b)(10)(ii) or (b)(10)(iii) of this section in the case of vaporizers.

(ii) Minimum required rate of discharge in cubic feet per minute of air at 120 percent of the maximum permitted start to discharge pressure for safety relief valves to be used on containers other than those constructed in accordance with DOT specification shall be as follows:

Surface area (sq. ft.)	**Flow rate CFM air**	**Surface area (sq. ft.)**	**Flow rate CFM air**	**Surface area (sq. ft.)**	**Flow rate CFM air**
20 or less	626	170	3,620	600	10,170
25	751	175	3,700	650	10,860
30	872	180	3,790	700	11,500
35	990	185	3,880	750	12,220
40	1,100	190	3,960	800	12,880
45	1,220	195	4,050	850	13,540
50	1,330	200	4,130	900	14,190
55	1,430	210	4,300	950	14,830
60	1,540	220	4,470	1,000	15,470
65	1,640	230	4,630	1,050	16,100
70	1,750	240	4,800	1,100	16,720
75	1,850	250	4,960	1,150	17,350
80	1,950	260	5,130	1,200	17,960
85	2,050	270	5,290	1,250	18,570
90	2,150	280	5,450	1,300	19,180
95	2,240	290	5,610	1,350	19,780
100	2,340	300	5,760	1,400	20,380
105	2,440	310	5,920	1,450	20,980
110	2,530	320	6,080	1,500	21,570
115	2,630	330	6,230	1,550	22,160
120	2,720	340	6,390	1,600	22,740

Surface area (sq. ft.)	Flow rate CFM air	Surface area (sq. ft.)	Flow rate CFM air	Surface area (sq. ft.)	Flow rate CFM air
125	2,810	350	6,540	1,650	23,320
130	2,900	360	6,690	1,700	23,900
135	2,990	370	6,840	1,750	24,470
140	3,080	380	7,000	1,800	25,050
145	3,170	390	7,150	1,850	25,620
150	3,260	400	7,300	1,900	26,180
155	3,350	450	8,040	1,950	26,750
160	3,440	500	8,760	2,000	27,310
165	3,530	550	9,470		

Surface area = total outside surface area of container in square feet.

When the surface area is not stamped on the nameplate or when the marking is not legible, the area can be calculated by using one of the following formulas:

(1) Cylindrical container with hemispherical heads:

Area = Overall length X outside diameter X 3.1416.

(2) Cylindrical container with other than hemispherical heads:

Area = (Overall length + 0.3 outside diameter) X outside diameter X 3.1416.

Note: This formula is not exact, but will give results within the limits of practical accuracy for the sole purpose of sizing relief valves.

(3) Spherical container:

Area = Outside diameter squared X 3.1416.

Flow Rate - CFM Air = required flow capacity in cubic feet per minute of air at standard conditions, 60 degrees F. and atmospheric pressure (14.7 p.s.i.a.).

The rate of discharge may be interpolated for intermediate values of surface area. For containers with total outside surface area greater than 2,000 square feet, the required flow rate can be calculated using the formula, Flow Rate - CFM Air = 53.632 A0.82.

A = total outside surface area of the container in square feet.

Valves not marked “Air” have flow rate marking in cubic feet per minute of liquefied petroleum gas. These can be converted to ratings in cubic feet per minute of air by multiplying the liquefied petroleum gas ratings by factors listed below. Air flow ratings can be converted to ratings in cubic feet per minute of liquefied petroleum gas by dividing the air ratings by the factors listed below.

Air Conversion Factors					
Container type	100	125	150	175	200
Air conversion factor	1.162	1.142	1.113	1.078	1.010

(iii) Minimum Required Rate of Discharge for Safety Relief Valves for Liquefied Petroleum Gas Vaporizers (Steam Heated, Water Heated, and Direct Fired).

The minimum required rate of discharge for safety relief valves shall be determined as follows:

(A) Obtain the total surface area by adding the surface area of vaporizer shell in square feet directly in contact with LP-Gas and the heat exchanged surface area in square feet directly in contact with LP-Gas.

(B) Obtain the minimum required rate of discharge in cubic feet of air per minute, at 60 degrees F. and 14.7 p.s.i.a. from paragraph (b)(10)(ii) of this section, for this total surface area.

(iv) Container and vaporizer safety relief valves shall be set to start-to-discharge, with relation to the design pressure of the container, in accordance with Table H-26.

(v) Safety relief devices used with systems employing containers other than those constructed according to DOT specifications shall be so constructed as to discharge at not less than the rates shown in paragraph (b)(10)(ii) of this section, before the pressure is in excess of 120 percent of the maximum (not including the 10 percent referred to in paragraph (b)(10)(iv) of this section) permitted start to discharge pressure setting of the device.

Table H-26

Containers	Minimum (percent)	Maximum (percent)
ASME Code; Par. U-68, U-69 – 1949 and earlier editions	110	[1]25
ASME Code; Par. U-200, U-201 – 1949 edition	88	[1]100
ASME Code – 1950, 1952, 1956, 1959, 1962, 1965 and 1968 (Division I) editions	88	[1]100
API–ASME Code – all editions	88	[1]100
DOT – As prescribed in 49 CFR Chapter I		

[1]Manufacturers of safety relief valves are allowed a plus tolerance not exceeding 10 percent of the set pressure marked on the valve.

(vi) In certain locations sufficiently sustained high temperatures prevail which require the use of a lower vapor pressure product to be stored or the use of a higher designed pressure vessel in order to prevent the safety valves opening as the result of these temperatures. As an alternative the tanks may be protected by cooling devices such as by spraying, by shading, or other effective means.

(vii) Safety relief valves shall be arranged so that the possibility of tampering will be minimized. If pressure setting or adjustment is external, the relief valves shall be provided with approved means for sealing adjustment.

(viii) Shutoff valves shall not be installed between the safety relief devices and the container, or the equipment or piping to which the safety relief device is connected except that a shutoff valve may be used where the arrangement of this valve is such that full required capacity flow through the safety relief device is always afforded.

(ix) Safety relief valves shall have direct communication with the vapor space of the container at all times.

(x) Each container safety relief valve used with systems covered by paragraphs (d), (e), (g), and (h) of this section, except as provided in paragraph (e)(3)(iii) of this section shall be plainly and permanently marked with the following: “Container Type” of the pressure vessel on which the valve is designed to be installed; the pressure in p.s.i.g. at which the valve is set to discharge; the actual rate of discharge of the valve in cubic feet per minute of air at 60 degrees F. and 14.7 p.s.i.a.; and the manufacturer’s name and catalog number, for example: T200-250-4050 AIR-indicating that the valve is suitable for use on a Type 200 container, that it is set to start to discharge at 250 p.s.i.g.; and that its rate of discharge is 4,050 cubic feet per minute of air as determined in Subdivision (ii) of this subparagraph.

(xi) Safety relief valve assemblies, including their connections, shall be of sufficient size so as to provide the rate of flow required for the container on which they are installed.

(xii) A hydrostatic relief valve shall be installed between each pair of shut-off valves on liquefied petroleum gas liquid piping so as to relieve into a safe atmosphere. The start-to-discharge pressure setting of such relief valves shall not be in excess of 500 p.s.i.g. The minimum setting on relief valves installed in piping connected to other than DOT containers shall not be lower than 140 percent of the container relief valve setting and in piping connected to DOT containers not lower than 400 p.s.i.g. The start-to-discharge pressure setting of such a relief valve, if installed on the discharge side of a pump, shall be greater than the maximum pressure permitted by the recirculation device in the system.

(xiii) The discharge from any safety relief device shall not terminate in or beneath any building, except relief devices covered by paragraphs (b)(6)(i)(A) through (E) of this section, or paragraphs (c)(4)(i) or (5) of this section.

(xiv) Container safety relief devices and regulator relief vents shall be located not less than 5 feet in any direction from air openings into sealed combustion system appliances or mechanical ventilation air intakes.

(11) Vaporizer and housing.

(i) Indirect fired vaporizers utilizing steam, water, or other heating medium shall be constructed and installed as follows:

(A) Vaporizers shall be constructed in accordance with the requirements of paragraph (b)(3)(i) through (iii) of this section and shall be permanently marked as follows:

(1) With the code marking signifying the specifications to which the vaporizer is constructed.

(2) With the allowable working pressure and temperature for which the vaporizer is designed.

(3) With the sum of the outside surface area and the inside heat exchange surface area expressed in square feet.

(4) With the name or symbol of the manufacturer.

(B) Vaporizers having an inside diameter of 6 inches or less exempted by the ASME Unfired Pressure Vessel Code, Section VIII of the ASME Boiler and Pressure Vessel Code-1968 shall have a design pressure not less than 250 p.s.i.g. and need not be permanently marked.

(C) Heating or cooling coils shall not be installed inside a storage container.

(D) Vaporizers may be installed in buildings, rooms, sheds, or lean-tos used exclusively for gas manufacturing or distribution, or in other structures of light, noncombustible construction or equivalent, well-ventilated near the floorline and roof.

When vaporizing and/or mixing equipment is located in a structure or building not used exclusively for gas manufacturing or distribution, either attached to or within such a building, such structure or room shall be separated from the remainder of the building by a wall designed to withstand a static pressure of at least 100 pounds per square foot. This wall shall have no openings or pipe or conduit passing through it. Such structure or room shall be provided with adequate ventilation and shall have a roof or at least one exterior wall of lightweight construction.

(E) Vaporizers shall have, at or near the discharge, a safety relief valve providing an effective rate of discharge in accordance with paragraph (b)(10)(iii) of this section, except as provided in paragraph (d)(4)(v)(A), of this section.

(F) The heating medium lines into and leaving the vaporizer shall be provided with suitable means for preventing the flow of gas into the heat systems in the event of tube rupture in the vaporizer. Vaporizers shall be provided with suitable automatic means to prevent liquid passing through the vaporizers to the gas discharge piping.

(G) The device that supplies the necessary heat for producing steam, hot water, or other heating medium may be installed in a building, compartment, room, or lean-to which shall be ventilated near the floorline and roof to the outside. The device location shall be separated from all compartments or rooms containing liquefied petroleum gas vaporizers, pumps, and central gas mixing devices by a wall designed to withstand a static pressure of at least 100 pounds per square foot. This wall shall have no openings or pipes or conduit passing through it. This requirement does not apply to the domestic water heaters which may supply heat for a vaporizer in a domestic system.

(H) Gas-fired heating systems supplying heat exclusively for vaporization purposes shall be equipped with automatic safety devices to shut off the flow of gas to main burners, if the pilot light should fail.

(I) Vaporizers may be an integral part of a fuel storage container directly connected to the liquid section or gas section or both.

(J) Vaporizers shall not be equipped with fusible plugs.

(K) Vaporizer houses shall not have unprotected drains to sewers or sump pits.

(ii) Atmospheric vaporizers employing heat from the ground or surrounding air shall be installed as follows:

(A) Buried underground, or

(B) Located inside the building close to a point at which pipe enters the building provided the capacity of the unit does not exceed 1-quart.

(C) Vaporizers of less than 1-quart capacity heated by the ground or surrounding air, need not be equipped with safety relief valves provided that adequate tests demonstrate that the assembly is safe without safety relief valves.

(iii) Direct gas-fired vaporizers shall be constructed, marked, and installed as follows:

(A)

(1) In accordance with the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code-1968 that are applicable to the maximum working conditions for which the vaporizer is designed.

(2) With the name of the manufacturer; rated BTU input to the burner; the area of the heat exchange surface in square feet; the outside surface of the vaporizer in square feet; and the maximum vaporizing capacity in gallons per hour.

(B)

(1) Vaporizers may be connected to the liquid section or the gas section of the storage container, or both; but in any case there shall be at the container a manually operated valve in each connection to permit completely shutting off when desired, of all flow of gas or liquid from container to vaporizer.

(2) Vaporizers with capacity not exceeding 35 gallons per hour shall be located at least 5 feet from container shutoff valves. Vaporizers having capacity of more than 35 gallons but not exceeding 100 gallons per hour shall be located at least 10 feet from the container shutoff valves. Vaporizers having a capacity greater than 100 gallons per hour shall be located at least 15 feet from container shutoff valves.

(C) Vaporizers may be installed in buildings, rooms, housings, sheds, or lean-tos used exclusively for vaporizing or mixing of liquefied petroleum gas. Vaporizing housing structures shall be of noncombustible construction, well ventilated near the floorline and the highest point of the roof. When vaporizer and/or mixing equipment is located in a structure or room attached to or within a building, such structure or room shall be separated from the remainder of the building by a wall designed to withstand a static pressure of at least 100 pounds per square foot. This wall shall have no openings or pipes or conduit passing through it. Such structure or room shall be provided with adequate ventilation, and shall have a roof or at least one exterior wall of lightweight construction.

(D) Vaporizers shall have at or near the discharge, a safety relief valve providing an effective rate of discharge in accordance with paragraph (b)(10)(iii) of this section. The relief valve shall be so located as not to be subjected to temperatures in excess of 140 degrees F.

(E) Vaporizers shall be provided with suitable automatic means to prevent liquid passing from the vaporizer to the gas discharge piping of the vaporizer.

(F) Vaporizers shall be provided with means for manually turning off the gas to the main burner and pilot.

(G) Vaporizers shall be equipped with automatic safety devices to shut off the flow of gas to main burners if the pilot light should fail. When the flow through the pilot exceeds 2,000 B.t.u. per hour, the pilot also shall be equipped with an automatic safety device to shut off the flow of gas to the pilot should the pilot flame be extinguished.

(H) Pressure regulating and pressure reducing equipment if located within 10 feet of a direct fire vaporizer shall be separated from the open flame by a substantially air-tight noncombustible partition or partitions.

(I) Except as provided in (C) of this Subdivision, the following minimum distances shall be maintained between direct fired vaporizers and the nearest important building or group of buildings:

Ten feet for vaporizers having a capacity of 15 gallons per hour or less vaporizing capacity.

Twenty-five feet for vaporizers having a vaporizing capacity of 16 to 100 gallons per hour.

Fifty feet for vaporizers having a vaporizing capacity exceeding 100 gallons per hour.

(J) Direct fired vaporizers shall not raise the product pressure above the design pressure of the vaporizer equipment nor shall they raise the product pressure within the storage container above the pressure shown in the second column of Table H-31.

(K) Vaporizers shall not be provided with fusible plugs.

(L) Vaporizers shall not have unprotected drains to sewers or sump pits.

(iv) Direct gas-fired tank heaters shall be constructed and installed as follows:

(A) Direct gas-fired tank heaters, and tanks to which they are applied, shall only be installed above ground.

(B) Tank heaters shall be permanently marked with the name of the manufacturer, the rated B.t.u. input to the burner, and the maximum vaporizing capacity in gallons per hour.

(C) Tank heaters may be an integral part of a fuel storage container directly connected to the container liquid section, or vapor section, or both.

(D) Tank heaters shall be provided with a means for manually turning off the gas to the main burner and pilot.

(E) Tank heaters shall be equipped with an automatic safety device to shut off the flow of gas to main burners, if the pilot light should fail. When flow through pilot exceeds 2,000 B.t.u. per hour, the pilot also shall be equipped with an automatic safety device to shut off the flow of gas to the pilot should the pilot flame be extinguished.

(F) Pressure regulating and pressure reducing equipment if located within 10 feet of a direct fired tank heater shall be separated from the open flame by a substantially air-tight noncombustible partition.

(G) The following minimum distances shall be maintained between a storage tank heated by a direct fired tank heater and the nearest important building or group of buildings:

Ten feet for storage containers of less than 500 gallons water capacity.

Twenty-five feet for storage containers of 500 to 1,200 gallons water capacity.

Fifty feet for storage containers of over 1,200 gallons water capacity.

(H) No direct fired tank heater shall raise the product pressure within the storage container over 75 percent of the pressure set out in the second column of Table H-31.

(v) The vaporizer section of vaporizer-burners used for dehydrators or dryers shall be located outside of buildings; they shall be constructed and installed as follows:

(A) Vaporizer-burners shall have a minimum design pressure of 250 p.s.i.g. with a factor of safety of five.

(B) Manually operated positive shut-off valves shall be located at the containers to shut off all flow to the vaporizer-burners.

(C) Minimum distances between storage containers and vaporizer-burners shall be as follows:

Water capacity per container (gallons)	Minimum distances (feet)
Less than 501	10
501 to 2,000	25
Over 2,000	50

(D) The vaporizer section of vaporizer-burners shall be protected by a hydrostatic relief valve. The relief valve shall be located so as not to be subjected to temperatures in excess of 140 degrees F. The start-to-discharge pressure setting shall be such as to protect the components involved, but not less than 250 p.s.i.g. The discharge shall be directed upward and away from component parts of the equipment and away from operating personnel.

(E) Vaporizer-burners shall be provided with means for manually turning off the gas to the main burner and pilot.

(F) Vaporizer-burners shall be equipped with automatic safety devices to shut off the flow of gas to the main burner and pilot in the event the pilot is extinguished.

(G) Pressure regulating and control equipment shall be located or protected so that the temperatures surrounding this equipment shall not exceed 140 degrees F. except that equipment components may be used at higher temperatures if designed to withstand such temperatures.

(H) Pressure regulating and control equipment when located downstream of the vaporizer shall be designed to withstand the maximum discharge temperature of the vapor.

(I) The vaporizer section of vaporizer-burners shall not be provided with fusible plugs.

(J) Vaporizer coils or jackets shall be made of ferrous metal or high temperature alloys.

(K) Equipment utilizing vaporizer-burners shall be equipped with automatic shutoff devices upstream and downstream of the vaporizer section connected so as to operate in the event of excessive temperature, flame failure, and, if applicable, insufficient airflow.

(12) Filling densities.

(i) The "filling density" is defined as the percent ratio of the weight of the gas in a container to the weight of water the container will hold at 60 degrees F. All containers shall be filled according to the filling densities shown in Table H-27.

Table H-27 - Maximum Permitted Filling Density

Specific gravity at 60° F. (15.6° C.)	Above ground containers: 0 to 1,200 U.S. gals. (1,000 imp. gal., 4,550 liters) total water cap	Above ground containers: Over 1,200 U.S. gals. (1,000 imp. gal., 4,550 liters) total water cap	Underground containers, all capacities
	Percent	Percent	Percent
0.496 - 0.503	41	44	45
0.504 - 0.510	42	45	46
0.511 - 0.519	43	46	47
0.520 - 0.527	44	47	48
0.528 - 0.536	45	48	49
0.537 - 0.544	46	49	50
0.545 - 0.552	47	50	51
0.553 - 0.560	48	51	52
0.561 - 0.568	49	52	53
0.569 - 0.576	50	53	54
0.577 - 0.584	51	54	55
0.585 - 0.592	52	55	56
0.593 - 0.600	53	56	57

(ii) Except as provided in paragraph (b)(12)(iii) of this section, any container including mobile cargo tanks and portable tank containers regardless of size or construction, shipped under DOT jurisdiction or constructed in accordance with 49 CFR Chapter I Specifications shall be charged according to 49 CFR Chapter I requirements.

(iii) Portable containers not subject to DOT jurisdiction (such as, but not limited to, motor fuel containers on industrial and lift trucks, and farm tractors covered in paragraph (e) of this section, or containers recharged at the installation) may be filled either by weight, or by volume using a fixed length dip tube gaging device.

(13) LP-Gas in buildings.

(i) Vapor shall be piped into buildings at pressures in excess of 20 p.s.i.g. only if the buildings or separate areas thereof, (A) are constructed in accordance with this section; (B) are used exclusively to house equipment for vaporization, pressure reduction, gas mixing, gas manufacturing, or distribution, or to house internal combustion engines, industrial processes, research and experimental laboratories, or equipment and processes using such gas and having similar hazard; (C) buildings, structures, or equipment under construction or undergoing major renovation.

(ii) Liquid may be permitted in buildings as follows:

(A) Buildings, or separate areas of buildings, used exclusively to house equipment for vaporization, pressure reduction, gas mixing, gas manufacturing, or distribution, or to house internal combustion engines, industrial processes, research and experimental laboratories, or equipment and processes using such gas and having similar hazard; and when such buildings, or separate areas thereof are constructed in accordance with this section.

(B) Buildings, structures, or equipment under construction or undergoing major renovation provided the temporary piping meets the following conditions:

(1) Liquid piping inside the building shall conform to the requirements of paragraph (b)(8) of this section, and shall not exceed three-fourths iron pipe size. Copper tubing with an outside diameter of 3/4-inch or less may be used provided it conforms to Type K of Specifications for Seamless Water Tube, ANSI H23.1-1970 (ASTM B88-69) (see Table H-24). All such piping shall be protected against construction hazards. Liquid piping inside buildings shall be kept to a minimum. Such piping shall be securely fastened to walls or other surfaces so as to provide adequate protection from breakage and so located as to subject the liquid line to lowest ambient temperatures.

(2) A shutoff valve shall be installed in each intermediate branch line where it takes off the main line and shall be readily accessible. A shutoff valve shall also be placed at the appliance end of the intermediate branch line. Such shutoff valve shall be upstream of any flexible connector used with the appliance.

(3) Suitable excess flow valves shall be installed in the container outlet line supplying liquid LP-Gas to the building. A suitable excess flow valve shall be installed immediately downstream of each shutoff valve. Suitable excess flow valves shall be installed where piping size is reduced and shall be sized for the reduced size piping.

(4) Hydrostatic relief valves shall be installed in accordance with paragraph (b)(10)(xii) of this section.

(5) The use of hose to carry liquid between the container and the building or at any point in the liquid line, except at the appliance connector, shall be prohibited.

(6) Where flexible connectors are necessary for appliance installation, such connectors shall be as short as practicable and shall comply with paragraph (b)(8)(ii) or (9) of this section.

(7) Release of fuel when any section of piping or appliances is disconnected shall be minimized by either of the following methods:

(i) Using an approved automatic quick-closing coupling (a type closing in both directions when coupled in the fuel line), or

(ii) Closing the valve nearest to the appliance and allowing the appliance to operate until the fuel in the line is consumed.

(iii) Portable containers shall not be taken into buildings except as provided in paragraph (b)(6)(i) of this section.

(14) Transfer of liquids. The employer shall assure that:

(i) At least one attendant shall remain close to the transfer connection from the time the connections are first made until they are finally disconnected, during the transfer of the product.

(ii) Containers shall be filled or used only upon authorization of the owner.

(iii) Containers manufactured in accordance with specifications of 49 CFR Part 178 and authorized by 49 CFR Chapter 1 as a “single trip” or “nonrefillable container” shall not be refilled or reused in LP-Gas service.

(iv) Gas or liquid shall not be vented to the atmosphere to assist in transferring contents of one container to another, except as provided in paragraph (e)(5)(iv) of this section and except that this shall not preclude the use of listed pump utilizing LP Gas in the vapor phase as a source of energy and venting such gas to the atmosphere at a rate not to exceed that from a No. 31 drill size opening and provided that such venting and liquid transfer shall be located not less than 50 feet from the nearest important building.

(v) Filling of fuel containers for industrial trucks or motor vehicles from industrial bulk storage containers shall be performed not less than 10 feet from the nearest important masonry-walled building or not less than 25 feet from the nearest important building or other construction and, in any event, not less than 25 feet from any building opening.

(vi) Filling of portable containers, containers mounted on skids, fuel containers on farm tractors, or similar applications, from storage containers used in domestic or commercial service, shall be performed not less than 50 feet from the nearest important building.

(vii) The filling connection and the vent from the liquid level gages in containers, filled at point of installation, shall not be less than 10 feet in any direction from air openings into sealed combustion system appliances or mechanical ventilation air intakes.

(viii) Fuel supply containers shall be gaged and charged only in the open air or in buildings especially provided for that purpose.

(ix) The maximum vapor pressure of the product at 100 degrees F. which may be transferred into a container shall be in accordance with paragraphs (d)(2) and (e)(3) of this section. (For DOT containers use DOT requirements.)

(x) Marketers and users shall exercise precaution to assure that only those gases for which the system is designed, examined, and listed, are employed in its operation, particularly with regard to pressures.

(xi) Pumps or compressors shall be designed for use with LP-Gas. When compressors are used they shall normally take suction from the vapor space of the container being filled and discharge to the vapor space of the container being emptied.

(xii) Pumping systems, when equipped with a positive displacement pump, shall include a recirculating device which shall limit the differential pressure on the pump under normal operating conditions to the maximum differential pressure rating of the pump. The discharge of the pumping system shall be protected so that pressure does not exceed 350 p.s.i.g. If a recirculation system discharges into the supply tank and contains a manual shutoff valve, an adequate secondary safety recirculation system shall be incorporated which shall have no means of rendering it inoperative. Manual shutoff valves in recirculation systems shall be kept open except during an emergency or when repairs are being made to the system.

(xiii) When necessary, unloading piping or hoses shall be provided with suitable bleeder valves for relieving pressure before disconnection.

(xiv) Agricultural air moving equipment, including crop dryers, shall be shut down when supply containers are being filled unless the air intakes and sources of ignition on the equipment are located 50 feet or more from the container.

(xv) Agricultural equipment employing open flames or equipment with integral containers, such as flame cultivators, weed burners, and, in addition, tractors, shall be shut down during refueling.

(15) Tank car or transport truck loading or unloading points and operations.

(i) The track of tank car siding shall be relatively level.

(ii) A "Tank Car Connected" sign, as covered by DOT rules, shall be installed at the active end or ends of the siding while the tank car is connected.

(iii) While cars are on sidetrack for loading or unloading, the wheels at both ends shall be blocked on the rails.

(iv) The employer shall insure that an employee is in attendance at all times while the tank car, cars, or trucks are being loaded or unloaded.

(v) A backflow check valve, excess-flow valve, or a shutoff valve with means of remote closing, to protect against uncontrolled discharge of LP-Gas from storage tank piping shall be installed close to the point where the liquid piping and hose or swing joint pipe is connected.

(vi) Where practical, the distance of the unloading or loading point shall conform to the distances in subparagraph (6)(ii) of this paragraph.

(16) Instructions. Personnel performing installation, removal, operation, and maintenance work shall be properly trained in such function.

(17) Electrical equipment and other sources of ignition.

(i) Electrical equipment and wiring shall be of a type specified by and shall be installed in accordance with Subpart S of this part, for ordinary locations except that fixed electrical equipment in classified areas shall comply with subparagraph (18) of this paragraph.

(ii) Open flames or other sources of ignition shall not be permitted in vaporizer rooms (except those housing direct-fired vaporizers), pumphouses, container charging rooms or other similar locations. Direct-fired vaporizers shall not be permitted in pumphouses or container charging rooms.

(iii) Liquefied petroleum gas storage containers do not require lightning protection.

(iv) Since liquefied petroleum gas is contained in a closed system of piping and equipment, the system need not be electrically conductive or electrically bonded for protection against static electricity.

(v) Open flames (except as provided for in paragraph (b)(11) of this section), cutting or welding, portable electric tools, and extension lights capable of igniting LP-Gas, shall not be permitted within classified areas specified in Table H-28 unless the LP-Gas facilities have been freed of all liquid and vapor, or special precautions observed under carefully controlled conditions.

Table H-28

Part	Location	Extent of classification area[1]	Equipment shall be suitable for Class 1, Group D[2]
A	Storage containers other than DOT cylinders.	When 15 feet in all directions from connections, except connections otherwise covered in Table H-28	Division 2
B	Tank vehicle and tank car loading and unloading[3]	Within 5 feet in all directions from connections regularly made or disconnected for product transfer	Division 1
		Beyond 5 feet but within 15 feet in all directions from a point where connections are regularly made or disconnected and within the cylindrical volume between the horizontal equator of the sphere and grade. (See Figure H-1)	Division 2
C	Gage vent openings other than those on DOT cylinders	Within 5 feet in all directions from point of discharge	Division 1

Part	Location	Extent of classification area[1]	Equipment shall be suitable for Class 1, Group D[2]
C	Gage vent openings other than those on DOT cylinders	Beyond 5 feet but within 15 feet in all directions from point of discharge	Division 2
D	Relief valve discharge other than those on ODT cylinders	Within direct path of discharge	Division 1
		Within 5 feet in all directions from point of discharge	Division 1
		Beyond 5 feet but within 15 feet in all directions from point of discharge except within the direct path of discharge	Division 2
E	Pumps, compressors, gas-air mixers and vaporizers other than direct fired		
	Indoors with adequate ventilation	Entire room and any adjacent room not separated by a gas-tight partition	Division 1
		Within 15 feet of the exterior side of any exterior wall or roof that is not vapor-tight or within 15 feet of any exterior opening	Division 2
	Indoors without ventilation[4]	Entire room and any adjacent room not separated by a gas-tight partition	Division 2
	Outdoors in open air at or abovegrade	Within 15 feet in all directions from this equipment and within the cylindrical volume between the horizontal equator of the sphere and grade. See Figure H-1	Division 2
F	Service Station Dispensing Units	Entire space within dispenser enclosure, and 18 inches horizontally from enclosure exterior up to an elevation 4 feet above dispenser base	Division 1
		Entire pit or open space beneath dispenser	
		Up to 18 inches abovegrade within 20 feet horizontally from any edge of enclosure **Note:** For pits within this area, see Part F of this table.	Division 2

Part	Location	Extent of classification area[1]	Equipment shall be suitable for Class 1, Group D[2]
G	Pits or trenches containing or located beneath LP-Gas valves, pumps, compressors, regulators, and similar equipment		
	Without mechanical ventilation	Entire pit or trench	Division 1
		Entire room and any adjacent room not separated by a gas-tight partition	Division 1
		Within 15 feet in all directions from pit or trench when located outdoors	Division 2
	With adequate mechanical ventilation	Entire pit or trench	Division 2
		Entire room and any adjacent room not separated by a gas-tight partition	Division 2
		Within 15 feet in all directions from pit or trench when located outdoors	Division 2
H	Special buildings or rooms for storage of portable containers	Entire room	Division 2
	Pipelines and connections containing operational bleeds, drips, vents or drains	Within 5 feet in all directions from point of discharge	Division 1
		Beyond 5 feet from point of discharge, same as Part E of this table	
J	Container filling:		
	Indoors without ventilation	Entire room	Division 1
	Indoors with adequate ventilation[4]	Within 5 feet in all directions from connections regularly made or disconnected for product transfer	Division 1
		Beyond 5 feet and entire room	Division 2
	Outdoors in open air	Within 5 feet in all directions from connections regularly made or disconnected for product transfer	Division 1

J	Outdoors in open air	Beyond 5 feet but within 15 feet in all directions from a point where connections are regularly made or disconnected and within the cylindrical volume between the horizontal equator of the sphere and grade. (See Figure H-1)	Division 2

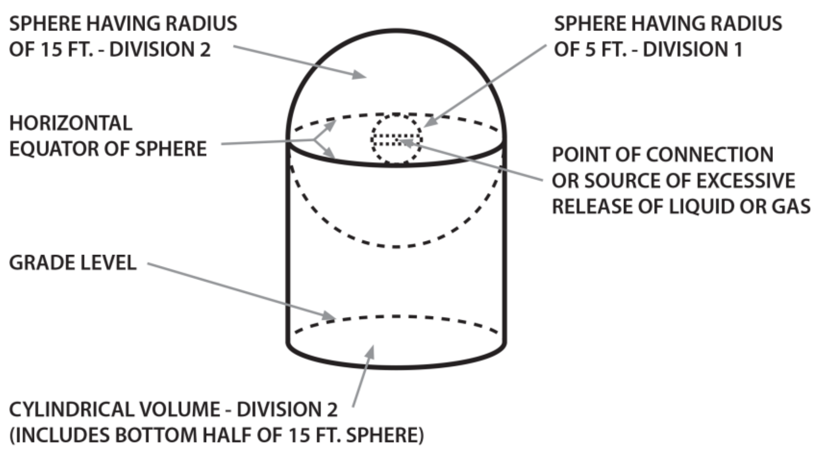
[1]The classified area shall not extend beyond an unpierced wall, roof, or solid vapor-tight partition.

[2]See Subpart S of this part.

[3]When classifying extent of hazardous area, consideration shall be given to possible variations in the spotting of tank cars and tank vehicles at the unloading points and the effect these variations of actual spotting point may have on the point of connection.

[4]Ventilation, either natural or mechanical, is considered adequate when the concentration of the gas in a gas-air mixture does not exceed 25 percent of the lower flammable limit under normal operating conditions.

Figure H-1



(18) Fixed electrical equipment in classified areas. Fixed electrical equipment and wiring installed within classified areas specified in Table H-28 shall comply with Table H 28 and shall be installed in accordance with Subpart S of this part. This provision does not apply to fixed electrical equipment at residential or commercial installations of LP-Gas systems or to systems covered by paragraph (e) or (g) of this section.

(19) Liquid-level gaging device.

(i) Each container manufactured after December 31, 1965, and filled on a volumetric basis shall be equipped with a fixed liquid-level gage to indicate the maximum permitted filling level as provided in paragraph (b)(19)(v) of this section. Each container manufactured after December 31, 1969, shall have permanently attached to the container adjacent to the fixed level gage a marking showing the percentage full that will be shown by that gage. When a variable liquid-level gage is also provided, the fixed liquid-level gage will also serve as a means for checking the variable gage. These gages shall be used in charging containers as required in paragraph (b)(12) of this section.

(ii) All variable gaging devices shall be arranged so that the maximum liquid level for butane, for a 50-50 mixture of butane and propane, and for propane, to which the container may be charged is readily determinable. The markings indicating the various liquid levels from empty to full shall be on the system nameplate or gaging device or part may be on the system nameplate and part on the gaging device. Dials of magnetic or rotary gages shall show whether they are for cylindrical or spherical containers and whether for above ground or underground service. The dials of gages intended for use only on above ground containers of over 1,200 gallons water capacity shall be so marked.

(iii) Gaging devices that require bleeding of the product to the atmosphere, such as the rotary tube, fixed tube, and slip tube, shall be designed so that the bleed valve maximum opening is not larger than a No. 54 drill size, unless provided with excess flow valve.

(iv) Gaging devices shall have a design working pressure of at least 250 p.s.i.g.

(v) Length of tube or position of fixed liquid-level gage shall be designed to indicate the maximum level to which the container may be filled for the product contained. This level shall be based on the volume of the product at 40 degrees F. at its maximum permitted filling density for above ground containers and at 50 degrees F. for underground containers. The employer shall calculate the filling point for which the fixed liquid level gage shall be designed according to the method in this Subdivision.

(A) It is impossible to set out in a table the length of a fixed dip tube for various capacity tanks because of the varying tank diameters and lengths and because the tank may be installed either in a vertical or horizontal position. Knowing the maximum permitted filling volume in gallons, however, the length of the fixed tube can be determined by the use of a strapping table obtained from the container manufacturer. The length of the fixed tube should be such that when its lower end touches the surface of the liquid in the container, the contents of the container will be the maximum permitted volume as determined by the following formula:

[(Water capacity (gals.) of container* x filling density**) ÷ (Specific gravity of LP-Gas* x volume correction factor x 100)] = Maximum volume of LP-Gas

* Measured at 60 degrees F.

** From subparagraph (12) of this paragraph “Filling Densities.”

For above ground containers the liquid temperature is assumed to be 40 degrees F. and for underground containers the liquid temperature is assumed to be 50 degrees F. To correct the liquid volumes at these temperatures to 60 degrees F. the following factors shall be used.

(B) Formula for determining maximum volume of liquefied petroleum gas for which a fixed length of dip tube shall be set:

Table H-29 - Volume Correction Factors

Specific gravity	Above ground	Underground
0.500	1.033	1.017
0.510	1.031	1.016
0.520	1.029	1.015
0.530	1.028	1.014
0.540	1.026	1.013
0.550	1.025	1.013
0.560	1.024	1.012
0.570	1.023	1.011
0.580	1.021	1.011
0.590	1.020	1.010

(C) The maximum volume of LP-Gas which can be placed in a container when determining the length of the dip tube expressed as a percentage of total water content of the container is calculated by the following formula.

(D) The maximum weight of LP-Gas which may be placed in a container for determining the length of a fixed dip tube is determined by multiplying the maximum volume of liquefied petroleum gas obtained by the formula in paragraph (b)(19)(v)(B) of this section by the pounds of liquefied petroleum gas in a gallon at 40 degrees F. for above ground and at 50 degrees F. for underground containers. For example, typical pounds per gallon are specified below:

Example: Assume a 100-gallon total water capacity tank for above ground storage of propane having a specific gravity of 0.510 of 60 degrees F.

[(100 (gals.) x 42 (filling density from subparagraph (12) of this paragraph)) ÷ (0.510 x 1.031 (correction factor from Table H-29) x 100)] = (4200 ÷ 52.6).

(4200 ÷ 52.6) = 79.8 gallons propane, the maximum amount permitted to be placed in a 100-gallon total water capacity above ground container equipped with a fixed dip tube.

[(Maximum volume of LP-Gas (from formula in Subdivision (B) of this Subdivision) x 100) ÷ Total water content of container in gallons] = Maximum percent of LP-Gas.

	Above ground, pounds per gallon	Underground, pounds per gallon
Propane	4.37	4.31
N Butane	4.97	4.92

(vi) Fixed liquid-level gages used on containers other than DOT containers shall be stamped on the exterior of the gage with the letters "DT" followed by the vertical distance (expressed in inches and carried out to one decimal place) from the top of container to the end of the dip tube or to the centerline of the gage when it is located at the maximum permitted filling level. For portable containers that may be filled in the horizontal and/or vertical position the letters "DT" shall be followed by "V" with the vertical distance from the top of the container to the end of the dip tube for vertical filling and with "H" followed by the proper distance for horizontal filling. For DOT containers the stamping shall be placed both on the exterior of the gage and on the container. On above ground or cargo containers where the gages are positioned at specific levels, the marking may be specified in percent of total tank contents and the marking shall be stamped on the container.

(vii) Gage glasses of the columnar type shall be restricted to charging plants where the fuel is withdrawn in the liquid phase only. They shall be equipped with valves having metallic handwheels, with excess flow valves, and with extra-heavy glass adequately protected with a metal housing applied by the gage manufacturer. They shall be shielded against the direct rays of the sun. Gage glasses of the columnar type are prohibited on tank trucks, and on motor fuel tanks, and on containers used in domestic, commercial, and industrial installations.

(viii) Gaging devices of the float, or equivalent type which do not require flow for their operation and having connections extending to a point outside the container do not have to be equipped with excess flow valves provided the piping and fittings are adequately designed to withstand the container pressure and are properly protected against physical damage and breakage.

(20) Requirements for appliances.

(i) Except as provided in paragraph (b)(20)(ii) of this section, new commercial and industrial gas consuming appliances shall be approved.

(ii) Any appliance that was originally manufactured for operation with a gaseous fuel other than LP-Gas and is in good condition may be used with LP-Gas only after it is properly converted, adapted, and tested for performance with LP-Gas before the appliance is placed in use.

(iii) Unattended heaters used inside buildings for the purpose of animal or poultry production or care shall be equipped with an approved automatic device designed to shut off the flow of gas to the main burners, and pilot if used, in the event of flame extinguishment.

(iv) All commercial, industrial, and agricultural appliances or equipment shall be installed in accordance with the requirements of this section and in accordance with the following NFPA consensus standards, which are incorporated by reference as specified in 1910.6:

(A) Domestic and commercial appliances – NFPA 54-1969, Standard for the Installation of Gas Appliances and Gas Piping.

(B) Industrial appliances – NFPA 54A-1969, Standard for the Installation of Gas Piping and Gas Equipment on Industrial Premises and Certain Other Premises.

(C) Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines – NFPA 37-1970.

(D) Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment, NFPA 96-1970.

(c) Cylinder systems.

(1) Application. This paragraph applies specifically to systems utilizing containers constructed in accordance with DOT Specifications. All requirements of paragraph (b) of this section apply to this paragraph unless otherwise noted in paragraph (b) of this section.

(2) Marking of containers. Containers shall be marked in accordance with DOT regulations. Additional markings not in conflict with DOT regulations may be used.

(3) Description of a system. A system shall include the container base or bracket, containers, container valves, connectors, manifold valve assembly, regulators, and relief valves.

(4) Containers and regulating equipment installed outside of buildings or structures.

(i) Containers shall not be buried below ground. However, this shall not prohibit the installation in a compartment or recess below grade level such as a niche in a slope or terrace wall which is used for no other purpose, providing that the container and regulating equipment are not in contact with the ground and the compartment or recess is drained and ventilated horizontally to the outside air from its lowest level, with the outlet at least 3 feet away from any building opening which is below the level of such outlet.

(ii) Except as provided in paragraph (b)(10)(xiii) of this section, the discharge from safety relief devices shall be located not less than 3 feet horizontally away from any building opening which is below the level of such discharge and shall not terminate beneath any building unless such space is well ventilated to the outside and is not enclosed on more than two sides.

(iii) Containers shall be set upon firm foundation or otherwise firmly secured; the possible effect on the outlet piping of settling shall be guarded against by a flexible connection or special fitting.

(5) Containers and equipment used inside of buildings or structures.

(i) When operational requirements make portable use of containers necessary and their location outside of buildings or structure is impracticable, containers and equipment are permitted to be used inside of buildings or structures in accordance with (A) through (L) of this Subdivision, and, in addition, such other provisions of this subparagraph as are applicable to the particular use or occupancy.

(A) Containers in use shall mean connected for use.

(B) Systems utilizing containers having a water capacity greater than 2 1/2 pounds (nominal 1-pound LP-Gas capacity) shall be equipped with excess flow valves. Such excess flow valves shall be either integral with the container valves or in the connections to the container valve outlets. In either case, an excess flow valve shall be installed in such a manner that any undue strain beyond the excess flow valve will not cause breakage between the container and the excess flow valve. The installation of excess flow valves shall take into account the type of valve protection provided.

(C) Regulators, if used, shall be either directly connected to the container valves or to manifolds connected to the container values. The regulator shall be suitable for use with LP-Gas. Manifolds and fittings connecting containers to pressure regulator inlets shall be designed for at least 250 p.s.i.g. service pressure.

(D) Valves on containers having a water capacity greater than 50 pounds (nominal 20 pounds LP-Gas capacity) shall be protected while in use.

(E) Containers shall be marked in accordance with paragraph (b)(5)(iii) of this section and paragraph (c)(2) of this section.

(F) Pipe or tubing shall conform to paragraph (b)(8) of this section except that aluminum pipe or tubing shall not be used.

(G)

(1) Hose shall be designed for a working pressure of at least 250 p.s.i.g. Hose and hose connections shall have their correctness as to design, construction and performance determined by listing by a nationally recognized testing laboratory. The hose length may exceed the length specified in paragraph (b)(9)(vii)(B) of this section, but shall be as short as practicable. Refer to 1910.7 for definition of nationally recognized testing laboratory.

(2) Hose shall be long enough to permit compliance with spacing provisions of this subparagraph without kinking or straining or causing hose to be so close to a burner as to be damaged by heat.

(H) Portable heaters, including salamanders, shall be equipped with an approved automatic device to shut off the flow of gas to the main burner, and pilot if used, in the event of flame extinguishment. Such heaters having inputs above 50,000 B.t.u. manufactured on or after May 17, 1967, and such heaters having inputs above 100,000 B.t.u. manufactured before May 17, 1967, shall be equipped with either.

(1) A pilot which must be lighted and proved before the main burner can be turned on; or

(2) An electric ignition system.

The provisions of this paragraph (H) do not apply to tar kettle burners, torches, melting pots, nor do they apply to portable heaters under 7,500 B.t.u.h. input when used with containers having a maximum water capacity of 2 1/2 pounds. Container valves, connectors, regulators, manifolds, piping, and tubing shall not be used as structural supports for heaters.

(I) Containers, regulating equipment, manifolds, pipe, tubing, and hose shall be located so as to minimize exposure to abnormally high temperatures (such as may result from exposure to convection or radiation from heating equipment or installation in confined spaces), physical damage, or tampering by unauthorized persons.

(J) Heat producing equipment shall be located and used so as to minimize the possibility of ignition of combustibles.

(K) Containers having a water capacity greater than 2 1/2 pounds (nominal 1 pound LP-Gas capacity) connected for use, shall stand on a firm and substantially level surface and, when necessary, shall be secured in an upright position.

(L) Containers, including the valve protective devices, shall be installed so as to minimize the probability of impingement of discharge of safety relief devices upon containers.

(ii) Containers having a maximum water capacity of 2 1/2 pounds (nominal 1-pound LP-Gas capacity) are permitted to be used inside of buildings as part of approved self-contained hand torch assemblies or similar appliances.

(iii) Containers having a maximum water capacity of 12 pounds (nominal 5 pounds LP-Gas capacity) are permitted to be used temporarily inside of buildings for public exhibition or demonstration purposes, including use for classroom demonstrations.

(iv) (Reserved)

(v) Containers are permitted to be used in buildings or structures under construction or undergoing major renovation when such buildings or structures are not occupied by the public, as follows:

(A) The maximum water capacity of individual containers shall be 245 pounds (nominal 100 pounds LP-Gas capacity).

(B) For temporary heating such as curing concrete, drying plaster and similar applications, heaters (other than integral heater-container units) shall be located at least 6 feet from any LP-Gas container. This shall not prohibit the use of heaters specifically designed for attachment to the container or to a supporting standard, provided they are designed and installed so as to prevent direct or radiant heat application from the heater onto the container. Blower and radiant type heaters shall not be directed toward any LP-Gas container within 20 feet.

(C) If two or more heater-container units, of either the integral or nonintegral type, are located in an unpartitioned area on the same floor, the container or containers of each unit shall be separated from the container or containers of any other unit by at least 20 feet.

(D) When heaters are connected to containers for use in an unpartitioned area on the same floor, the total water capacity of containers manifolded together for connection to a heater or heaters shall not be greater than 735 pounds (nominal 300 pounds LP-Gas capacity). Such manifolds shall be separated by at least 20 feet.

(E) On floors on which heaters are not connected for use, containers are permitted to be manifolded together for connection to a heater or heaters on another floor, Provided:

(1) The total water capacity of containers connected to any one manifold is not greater than 2,450 pounds (nominal 1,000 pounds LP-Gas capacity) and;

(2) Where more than one manifold having a total water capacity greater than 735 pounds (nominal 300 pounds LP-Gas capacity) are located in the same unpartitioned area, they shall be separated by at least 50 feet.

(F) Storage of containers awaiting use shall be in accordance with paragraph (f) of this section.

(vi) Containers are permitted to be used in industrial occupancies for processing, research, or experimental purposes as follows:

(A) The maximum water capacity of individual containers shall be 245 pounds (nominal 100 pounds LP-Gas capacity).

(B) Containers connected to a manifold shall have a total water capacity not greater than 735 pounds (nominal 300 pounds LP-Gas capacity) and not more than one such manifold may be located in the same room unless separated at least 20 feet from a similar unit.

(C) The amount of LP-Gas in containers for research and experimental use shall be limited to the smallest practical quantity.

(vii)

(A) Containers are permitted to be used in industrial occupancies with essentially noncombustible contents where portable equipment for space heating is essential and where a permanent heating installation is not practical, as follows:

(B) Containers and heaters shall comply with and be used in accordance with paragraph (c)(5)(v) of this section.

(viii) Containers are permitted to be used in buildings for temporary emergency heating purposes, if necessary to prevent damage to the buildings or contents, when the permanent heating system is temporarily out of service, as follows:

(A) Containers and heaters shall comply with and be used in accordance with paragraph (c)(5)(v) of this section.

(B) The temporary heating equipment shall not be left unattended.

(ix) Containers are permitted to be used temporarily in buildings for training purposes related in installation and use of LP-Gas systems, as follows:

(A) The maximum water capacity of individual containers shall be 245 pounds (nominal 100 pounds LP-Gas capacity), but the maximum quantity of LP-Gas that may be placed in each container shall be 20 pounds.

(B) If more than one such container is located in the same room, the containers shall be separated by at least 20 feet.

(6) Container valves and accessories.

(i) Valves in the assembly of multiple container systems shall be arranged so that replacement of containers can be made without shutting off the flow of gas in the system.

Note: This provision is not to be construed as requiring an automatic changeover device.

(ii) Regulators and low-pressure relief devices shall be rigidly attached to the cylinder valves, cylinders, supporting standards, the building walls or otherwise rigidly secured and shall be so installed or protected that the elements (sleet, snow, or ice) will not affect their operation.

(iii) Valves and connections to the containers shall be protected while in transit, in storage, and while being moved into final utilization, as follows:

(A) By setting into the recess of the container to prevent the possibility of their being struck if the container is dropped upon a flat surface, or

(B) By ventilated cap or collar, fastened to the container capable of withstanding a blow from any direction equivalent to that of a 30-pound weight dropped 4 feet. Construction must be such that a blow will not be transmitted to the valve or other connection.

(iv) When containers are not connected to the system, the outlet valves shall be kept tightly closed or plugged, even though containers are considered empty.

(v) Containers having a water capacity in excess of 50 pounds (approximately 21 pounds LP-Gas capacity), recharged at the installation, shall be provided with excess flow or backflow check valves to prevent the discharge of container contents in case of failure of the filling or equalizing connection.

(7) Safety devices.

(i) Containers shall be provided with safety devices as required by DOT regulations.

(ii) A final stage regulator of an LP-Gas system (excluding any appliance regulator) shall be equipped on the low-pressure side with a relief valve which is set to start to discharge within the limits specified in Table H-30.

Table H-30

Regulator delivery pressure	**Relief valve start-to-discharge pressure setting (percent of regulator delivery pressure)**	
	Minimum	**Maximum**
1 p.s.i.g. or less	200	300
Above 1 p.s.i.g. but not over 3 p.s.i.g	140	200
Above 3 p.s.i.g	125	200

(iii) When a regulator or pressure relief valve is used inside a building for other than purposes specified in paragraphs (b)(6)(i)(A) through (G) of this section, the relief valve and the space above the regulator and relief valve diaphragms shall be vented to the outside air with the discharge outlet located not less than 3 feet horizontally away from any building opening which is below such discharge. These provisions do not apply to individual appliance regulators when protection is otherwise provided nor to paragraph (c)(5) of this section and paragraph (b)(10)(xiii) of this section. In buildings devoted exclusively to gas distribution purposes, the space above the diaphragm need not be vented to the outside.

(8) Reinstallation of containers. Containers shall not be reinstalled unless they are requalified in accordance with DOT regulations.

(9) Permissible product. A product shall not be placed in a container marked with a service pressure less than four-fifths of the maximum vapor pressure of product at 130 degrees F.

(d) Systems utilizing containers other than DOT containers.

(1) Application. This paragraph applies specifically to systems utilizing storage containers other than those constructed in accordance with DOT specifications. Paragraph (b) of this section applies to this paragraph unless otherwise noted in paragraph (b) of this section.

(2) Design pressure and classification of storage containers. Storage containers shall be designed and classified in accordance with Table H-31.

Table H-31

Container type	For gases with vapor press. Not to exceed lb. per sq. in. gage at 100° F. (37.8° C.)	Minimum design pressure of container, lb. per sq. in. gage	
		1949 and earlier editions of ASME Code (Par. U-68, U-69)	1949 edition of ASME Code (Par. U-200, U-201); 1950, 1952, 1956, 1959, 1962, 1965, and 1968 (Division 1) editions of ASME Code; All editions of API-ASME Code[3]
[1]80	[1]80	[1]80	[1]100
100	100	100	125
125	125	125	156
150	150	150	187
175	175	175	219
[2]200	215	200	250

[1]New storage containers of the 80 type have not been authorized since Dec. 31, 1947.

[2]Container type may be increased by increments of 25. The minimum design pressure of containers shall be 100 percent of the container type designation when constructed under 1949 or earlier editions of the ASME Code (Par. U-68 and U-69). The minimum design pressure of containers shall be 125 percent of the container type designation when constructed under: (1) the 1949 ASME Code (Par. U 200 and U-201), (2) 1950, 1952, 1956, 1959, 1962, 1965, and 1968 (Division 1) editions of the ASME Code, and (3) all editions of the API-ASME Code.

[3]Construction of containers under the API-ASME Code is not authorized after July 1, 1961.

(3) Container valves and accessories, filler pipes, and discharge pipes.

(i) The filling pipe inlet terminal shall not be located inside a building. For containers with a water capacity of 125 gallons or more, such terminals shall be located not less than 10 feet from any building (see paragraph (b)(6)(ii) of this section), and preferably not less than 5 feet from any driveway, and shall be located in a protective housing built for the purpose.

(ii) The filling connection shall be fitted with one of the following:

(A) Combination back-pressure check valve and excess flow valve.

(B) One double or two single back-pressure check valves.

(C) A positive shutoff valve, in conjunction with either:

(1) An internal back-pressure valve, or

(2) An internal excess flow valve.

(iii) All openings in a container shall be equipped with approved automatic excess flow valves except in the following: Filling connections as provided in paragraph (d)(3)(ii) of this section; safety relief connections, liquid-level gaging devices as provided in paragraphs (b)(7)(iv), (19)(iii), and (19)(viii) of this section; pressure gage connections as provided in paragraph (b)(7)(v) of this section, as provided in paragraphs (d)(iv), (vi), and (vii) of this section.

(iv) An excess flow valve is not required in the withdrawal service line providing the following are complied with:

(A) Such systems' total water capacity does not exceed 2,000 U.S. gallons.

(B) The discharge from the service outlet is controlled by a suitable manually operated shutoff valve which is:

(1) Threaded directly into the service outlet of the container; or

(2) Is an integral part of a substantial fitting threaded into or on the service outlet of the container; or

(3) Threaded directly into a substantial fitting threaded into or on the service outlet of the container.

(C) The shutoff valve is equipped with an attached handwheel or the equivalent.

(D) The controlling orifice between the contents of the container and the outlet of the shutoff valve does not exceed 5/16-inch in diameter for vapor withdrawal systems and 1/8-inch in diameter for liquid withdrawal systems.

(E) An approved pressure-reducing regulator is directly attached to the outlet of the shutoff valve and is rigidly supported, or that an approved pressure-reducing regulator is attached to the outlet of the shutoff valve by means of a suitable flexible connection, provided the regulator is adequately supported and properly protected on or at the tank.

(v) All inlet and outlet connections except safety relief valves, liquid level gaging devices and pressure gages on containers of 2,000 gallons water capacity, or more, and on any container used to supply fuel directly to an internal combustion engine, shall be labeled to designate whether they communicate with vapor or liquid space. Labels may be on valves.

(vi) In lieu of an excess flow valve openings may be fitted with a quick-closing internal valve which, except during operating periods shall remain closed. The internal mechanism for such valves may be provided with a secondary control which shall be equipped with a fusible plug (not over 220 degrees F. melting point) which will cause the internal valve to close automatically in case of fire.

(vii) Not more than two plugged openings shall be permitted on a container of 2,000 gallons or less water capacity.

(viii) Containers of 125 gallons water capacity or more manufactured after July 1, 1961, shall be provided with an approved device for liquid evacuation, the size of which shall be 3/4-inch National Pipe Thread minimum. A plugged opening will not satisfy this requirement.

(4) Safety devices.

(i) All safety devices shall comply with the following:

(A) All container safety relief devices shall be located on the containers and shall have direct communication with the vapor of space of the container.

(B) In industrial and gas manufacturing plants, discharge pipe from safety relief valves on pipe lines within a building shall discharge vertically upward and shall be piped to a point outside a building.

(C) Safety relief device discharge terminals shall be so located as to provide protection against physical damage and such discharge pipes shall be fitted with loose raincaps. Return bends and restrictive pipefittings shall not be permitted.

(D) If desired, discharge lines from two or more safety relief devices located on the same unit, or similar lines from two or more different units, may be run into a common discharge header, provided that the cross-sectional area of such header be at least equal to the sum of the cross-sectional area of the individual discharge lines, and that the setting of safety relief valves are the same.

(E) Each storage container of over 2,000 gallons water capacity shall be provided with a suitable pressure gage.

(F) A final stage regulator of an LP-Gas system (excluding any appliance regulator) shall be equipped on the low-pressure side with a relief valve which is set to start to discharge within the limits specified in Table H-30.

(G) When a regulator or pressure relief valve is installed inside a building, the relief valve and the space above the regulator and relief valve diaphragms shall be vented to the outside air with the discharge outlet located not less than 3 feet horizontally away from any opening into the building which is below such discharge. (These provisions do not apply to individual appliance regulators when protection is otherwise provided. In buildings devoted exclusively to gas distribution purposes, the space above the diaphragm need not be vented to the outside.)

(ii) Safety devices for above ground containers shall be provided as follows:

(A) Containers of 1,200 gallons water capacity or less which may contain liquid fuel when installed above ground shall have the rate of discharge required by paragraph (b)(10)(ii) of this section provided by a spring-loaded relief valve or valves. In addition to the required spring-loaded relief valve(s), suitable fuse plug(s) may be used provided the total discharge area of the fuse plug(s) for each container does not exceed 0.25 square inch.

(B) The fusible metal of the fuse plugs shall have a yield temperature of 208 degrees F. minimum and 220 degrees F. maximum. Relief valves and fuse plugs shall have direct communication with the vapor space of the container.

(C) On a container having a water capacity greater than 125 gallons, but not over 2,000 gallons, the discharge from the safety relief valves shall be vented away from the container vertically upwards and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container; loose-fitting rain caps shall be used. Suitable provision shall be made for draining condensate which may accumulate in the relief valve or its discharge pipe.

(D) On containers of 125 gallons water capacity or less, the discharge from safety relief devices shall be located not less than 5 feet horizontally away from any opening into the building below the level of such discharge.

(E) On a container having a water capacity greater than 2,000 gallons, the discharge from the safety relief valves shall be vented away from the container vertically upwards to a point at least 7 feet above the container, and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container; loose-fitting rain caps shall be used. Suitable provision shall be made so that any liquid or condensate that may accumulate inside of the safety relief valve or its discharge pipe will not render the valve inoperative. If a drain is used, a means shall be provided to protect the container, adjacent containers, piping, or equipment against impingement of flame resulting from ignition of product escaping from the drain.

(iii) On all containers which are installed underground and which contain no liquid fuel until buried and covered, the rate of discharge of the spring-loaded relief valve installed thereon may be reduced to a minimum of 30 percent of the rate of discharge specified in paragraph (b)(10)(ii) of this section. Containers so protected shall not be uncovered after installation until the liquid fuel has been removed therefrom. Containers which may contain liquid fuel before being installed underground and before being completely covered with earth are to be considered above ground containers when determining the rate of discharge requirement of the relief valves.

(iv) On underground containers of more than 2,000 gallons water capacity, the discharge from safety relief devices shall be piped vertically and directly upward to a point at least 7 feet above the ground.

Where there is a probability of the manhole or housing becoming flooded, the discharge from regulator vent lines shall be above the highest probable water level. All manholes or housings shall be provided with ventilated louvers or their equivalent, the area of such openings equaling or exceeding the combined discharge areas of the safety relief valves and other vent lines which discharge their content into the manhole housing.

(v) Safety devices for vaporizers shall be provided as follows:

(A) Vaporizers of less than 1-quart total capacity, heated by the ground or the surrounding air, need not be equipped with safety relief valves provided that adequate tests certified by any of the authorities referred to in paragraph (b)(2) of this section, demonstrate that the assembly is safe without safety relief valves.

(B) No vaporizer shall be equipped with fusible plugs.

(C) In industrial and gas manufacturing plants, safety relief valves on vaporizers within a building shall be piped to a point outside the building and be discharged upward.

(5) Reinstallation of containers. Containers may be reinstalled if they do not show any evidence of harmful external corrosion or other damage. Where containers are reinstalled underground, the corrosion resistant coating shall be put in good condition (see paragraph (c)(7)(vi) of this section). Where containers are reinstalled above ground, the safety devices and gaging devices shall comply with paragraph (c)(4) of this section and paragraph (b)(19) of this section respectively for above ground containers.

(6) Capacity of containers. A storage container shall not exceed 90,000 gallons water capacity.

(7) Installation of storage containers.

(i) Containers installed above ground, except as provided in paragraph (c)(7)(vii) of this section, shall be provided with substantial masonry or noncombustible structural supports on firm masonry foundation.

(ii) Above ground containers shall be supported as follows:

(A) Horizontal containers shall be mounted on saddles in such a manner as to permit expansion and contraction. Structural metal supports may be employed when they are protected against fire in an approved manner. Suitable means of preventing corrosion shall be provided on that portion of the container in contact with the foundations or saddles.

(B) Containers of 2,000 gallons water capacity or less may be installed with nonfireproofed ferrous metal supports if mounted on concrete pads or footings, and if the distance from the outside bottom of the container shell to the concrete pad, footing, or the ground does not exceed 24 inches.

(iii) Any container may be installed with nonfireproofed ferrous metal supports if mounted on concrete pads or footings, and if the distance from the outside bottom of the container to the ground does not exceed 5 feet, provided the container is in an isolated location.

(iv) Containers may be partially buried providing the following requirements are met:

(A) The portion of the container below the surface and for a vertical distance not less than 3 inches above the surface of the ground is protected to resist corrosion, and the container is protected against settling and corrosion as required for fully buried containers.

(B) Spacing requirements shall be as specified for underground tanks in paragraph (b)(6)(ii) of this section.

(C) Relief valve capacity shall be as required for above ground containers.

(D) Container is located so as not to be subject to vehicular damage, or is adequately protected against such damage.

(E) Filling densities shall be as required for above ground containers.

(v) Containers buried underground shall be placed so that the top of the container is not less than 6 inches below grade. Where an underground container might be subject to abrasive action or physical damage due to vehicular traffic or other causes, then it shall be:

(A) Placed not less than 2 feet below grade, or

(B) Otherwise protected against such physical damage.

It will not be necessary to cover the portion of the container to which manhole and other connections are affixed; however, where necessary, protection shall be provided against vehicular damage. When necessary to prevent floating, containers shall be securely anchored or weighted.

(vi)

(A) Containers shall be given a protective coating before being placed underground. This coating shall be equivalent to hot-dip galvanizing or to two coatings of red lead followed by a heavy coating of coal tar or asphalt. In lowering the container into place, care shall be exercised to prevent damage to the coating. Any damage to the coating shall be repaired before backfilling.

(B) Containers shall be set on a firm foundation (firm earth may be used) and surrounded with earth or sand firmly tamped in place.

(vii) Containers with foundations attached (portable or semiportable containers with suitable steel "runners” or "skids” and popularly known in the industry as "skid tanks”) shall be designed, installed, and used in accordance with these rules subject to the following provisions:

(A) If they are to be used at a given general location for a temporary period not to exceed 6 months they need not have fire-resisting foundations or saddles but shall have adequate ferrous metal supports.

(B) They shall not be located with the outside bottom of the container shell more than 5 feet above the surface of the ground unless fire-resisting supports are provided.

(C) The bottom of the skids shall not be less than 2 inches or more than 12 inches below the outside bottom of the container shell.

(D) Flanges, nozzles, valves, fittings, and the like, having communication with the interior of the container, shall be protected against physical damage.

(E) When not permanently located on fire-resisting foundations, piping connections shall be sufficiently flexible to minimize the possibility of breakage or leakage of connections if the container settles, moves, or is otherwise displaced.

(F) Skids, or lugs for attachment of skids, shall be secured to the container in accordance with the code or rules under which the container is designed and built (with a minimum factor of safety of four) to withstand loading in any direction equal to four times the weight of the container and attachments when filled to the maximum permissible loaded weight.

(viii) Field welding where necessary shall be made only on saddle plates or brackets which were applied by the manufacturer of the tank.

(ix) For above ground containers, secure anchorage or adequate pier height shall be provided against possible container flotation wherever sufficiently high floodwater might occur.

(x) When permanently installed containers are interconnected, provision shall be made to compensate for expansion, contraction, vibration, and settling of containers, and interconnecting piping. Where flexible connections are used, they shall be of an approved type and shall be designed for a bursting pressure of not less than five times the vapor pressure of the product at 100 degrees F. The use of nonmetallic hose is prohibited for permanently interconnecting such containers.

(xi) Container assemblies listed for interchangeable installation above ground or underground shall conform to the requirements for above ground installations with respect to safety relief capacity and filling density. For installation above ground all other requirements for above ground installations shall apply. For installation underground all other requirements for underground installations shall apply.

(8) Protection of container accessories.

(i) Valves, regulating, gaging, and other container accessory equipment shall be protected against tampering and physical damage. Such accessories shall also be so protected during the transit of containers intended for installation underground.

(ii) On underground or combination above ground-underground containers, the service valve handwheel, the terminal for connecting the hose, and the opening through which there can be a flow from safety relief valves shall be at least 4 inches above the container and this opening shall be located in the dome or housing. Underground systems shall be so installed that all the above openings, including the regulator vent, are located above the normal maximum water table.

(iii) All connections to underground containers shall be located within a substantial dome, housing, or manhole and with access thereto protected by a substantial cover.

(9) Drips for condensed gas. Where vaporized gas on the low-pressure side of the system may condense to a liquid at normal operating temperatures and pressures, suitable means shall be provided for revaporization of the condensate.

(10) Damage from vehicles. When damage to LP-Gas systems from vehicular traffic is a possibility, precautions against such damage shall be taken.

(11) Drains. No drains or blowoff lines shall be directed into or in proximity to sewer systems used for other purposes.

(12) General provisions applicable to systems in industrial plants (of 2,000 gallons water capacity and more) and to bulk filling plants.

(i) When standard watch service is provided, it shall be extended to the LP-Gas installation and personnel properly trained.

(ii) If loading and unloading are normally done during other than daylight hours, adequate lights shall be provided to illuminate storage containers, control valves, and other equipment.

(iii) Suitable roadways or means of access for extinguishing equipment such as wheeled extinguishers or fire department apparatus shall be provided.

(iv) To minimize trespassing or tampering, the area which includes container appurtenances, pumping equipment, loading and unloading facilities, and cylinder-filling facilities shall be enclosed with at least a 6-foot high industrial type fence unless otherwise adequately protected. There shall be at least two means of emergency access.

(13) Container-charging plants.

(i) The container-charging room shall be located not less than:

(A) Ten feet from bulk storage containers.

(ii) Tank truck filling station outlets shall be located not less than:

(A) (Reserved)

(B) Ten feet from pumps and compressors if housed in one or more separate buildings.

(iii) The pumps or compressors may be located in the container-charging room or building, in a separate building, or outside of buildings. When housed in a separate building, such building (a small noncombustible weather cover is not to be construed as a building) shall be located not less than:

(A) Ten feet from bulk storage tanks.

(B) (Reserved)

(C) Twenty-five feet from sources of ignition.

(iv) When a part of the container-charging building is to be used for a boiler room or where open flames or similar sources of ignition exist or are employed, the space to be so occupied shall be separated from container charging room by a partition wall or walls of fire-resistant construction continuous from floor to roof or ceiling. Such separation walls shall be without openings and shall be joined to the floor, other walls, and ceiling or roof in a manner to effect a permanent gas-tight joint.

(v) Electrical equipment and installations shall conform with paragraphs (b)(17) and (18) of this section.

(14) Fire protection.

(i) Each bulk plant shall be provided with at least one approved portable fire extinguisher having a minimum rating of 12-B, C.

(ii) In industrial installations involving containers of 150,000 gallons aggregate water capacity or more, provision shall be made for an adequate supply of water at the container site for fire protection in the container area, unless other adequate means for fire control are provided. Water hydrants shall be readily accessible and so spaced as to provide water protection for all containers. Sufficient lengths of firehose shall be provided at each hydrant location on a hose cart, or other means provided to facilitate easy movement of the hose in the container area. It is desirable to equip the outlet of each hose line with a combination fog nozzle. A shelter shall be provided to protect the hose and its conveyor from the weather.

(15) (Reserved)

(16) Lighting. Electrical equipment and installations shall conform to paragraphs (b)(17) and (18) of this section.

(17) Vaporizers for internal combustion engines. The provisions of paragraph (e)(8) of this section shall apply.

(18) Gas regulating and mixing equipment for internal combustion engines. The provisions of paragraph (e)(9) of this section shall apply.

(e) Liquefied petroleum gas as a motor fuel.

(1) Application.

(i) This paragraph applies to internal combustion engines, fuel containers, and pertinent equipment for the use of liquefied petroleum gases as a motor fuel on easily movable, readily portable units including self-propelled vehicles.

(ii) Fuel containers and pertinent equipment for internal combustion engines using liquefied petroleum gas where installation is of the stationary type are covered by paragraph (d) of this section. This paragraph does not apply to containers for transportation of liquefied petroleum gases nor to marine fuel use. All requirements of paragraph (b) of this section apply to this paragraph, unless otherwise noted in paragraph (b) of this section.

(2) General.

(i) Fuel may be used from the cargo tank of a truck while in transit, but not from cargo tanks on trailers or semitrailers. The use of fuel from the cargo tanks to operate stationary engines is permitted providing wheels are securely blocked.

(ii) Passenger-carrying vehicles shall not be fueled while passengers are on board.

(iii) Industrial trucks (including lift trucks) equipped with permanently mounted fuel containers shall be charged outdoors. Charging equipment shall comply with the provisions of paragraph (h) of this section.

(iv) LP-Gas fueled industrial trucks shall comply with the Standard for Type Designations, Areas of Use, Maintenance and Operation of Powered Industrial Trucks, NFPA 505-1969, which is incorporated by reference as specified in 1910.6.

(v) Engines on vehicles shall be shut down while fueling if the fueling operation involves venting to the atmosphere.

(3) Design pressure and classification of fuel containers.

(i) Except as covered in paragraphs (e)(3)(ii) and (iii) of this section, containers shall be in accordance with Table H-32.

(ii) Fuel containers for use in industrial trucks (including lift trucks) shall be either DOT containers authorized for LP-Gas service having a minimum service pressure of 240 p.s.i.g. or minimum Container Type 250. Under 1950 and later ASME codes, this means a 312.5-p.s.i.g. design pressure container.

Table H-32

Container type	For gases with vapor press. Not to exceed lb. per sq. in. gage at 100° F. (37.8° C.)	Minimum design pressure of container, lb. per sq. in. gage	
		1949 and earlier editions of ASME Code (Par. U-68, U-69)	1949 edition of ASME Code (Par. U-200, U-201); 1950, 1952, 1956, 1959, 1962, 1965, and 1968 (Division 1) editions of ASME Code; All editions of API-ASME Code[2]
[1]200	215Z	200	250

[1]Container type may be increased by increments of 25. The minimum design pressure of containers shall be 100 percent of the container type designation when constructed under 1949 or earlier editions of the ASME Code (Par. U-68 and U-69). The minimum design pressure of containers shall be 125 percent of the container type designation when constructed under: (1) the 1949 ASME Code (Par. U-200 and U-201), (2) 1950, 1952, 1956, 1959, 1962, 1965, and 1968 (Division 1) editions of the ASME Code, and (3) all editions of the API-ASME Code.

[2]Construction of containers under the API-ASME Code is not authorized after July 1, 1961.

(iii) Containers manufactured and maintained under DOT specifications and regulations may be used as fuel containers. When so used they shall conform to all requirements of this paragraph.

(iv) All container inlets and outlets except safety relief valves and gaging devices shall be labeled to designate whether they communicate with vapor or liquid space. Labels may be on valves.

(4) Installation of fuel containers.

(i) Containers shall be located in a place and in a manner to minimize the possibility of damage to the container. Containers located in the rear of trucks and buses, when protected by substantial bumpers, will be considered in conformance with this requirement. Fuel containers on passenger-carrying vehicles shall be installed as far from the engine as is practicable, and the passenger space and any space containing radio equipment shall be sealed from the container space to prevent direct seepage of gas to these spaces. The container compartment shall be vented to the outside. In case the fuel container is mounted near the engine or the exhaust system, the container shall be shielded against direct heat radiation.

(ii) Containers shall be installed with as much clearance as practicable but never less than the minimum road clearance of the vehicle under maximum spring deflection. This minimum clearance shall be to the bottom of the container or to the lowest fitting on the container or housing, whichever is lower.

(iii) Permanent and removable fuel containers shall be securely mounted to prevent jarring loose, slipping, or rotating, and the fastenings shall be designed and constructed to withstand static loading in any direction equal to twice the weight of the tank and attachments when filled with fuel using a safety factor of not less than four based on the ultimate strength of the material to be used. Field welding, when necessary, shall be made only on saddle plates, lugs or brackets, originally attached to the container by the tank manufacturer.

(iv) Fuel containers on buses shall be permanently installed.

(v) Containers from which vapor only is to be withdrawn shall be installed and equipped with suitable connections to minimize the accidental withdrawal of liquid.

(5) Valves and accessories.

(i) Container valves and accessories shall have a rated working pressure of at least 250 p.s.i.g., and shall be of a type suitable for liquefied petroleum gas service.

(ii) The filling connection shall be fitted with an approved double back-pressure check valve, or a positive shutoff in conjunction with an internal back-pressure check valve. On a removable container the filler valve may be a hand operated shutoff valve with an internal excess flow valve. Main shutoff valves on the container on liquid and vapor lines must be readily accessible.

(iii) With the exceptions of paragraph (e)(5)(iv)(C) of this section, filling connections equipped with approved automatic back-pressure check valves, and safety relief valves, all connections to containers having openings for the flow of gas in excess of a No. 54 drill size shall be equipped with approved automatic excess flow valves to prevent discharge of content in case connections are broken.

(iv) Liquid-level gaging devices:

(A) Variable liquid-level gages which require the venting of fuel to the atmosphere shall not be used on fuel containers of industrial trucks (including lift trucks).

(B) On portable containers that may be filled in the vertical and/or horizontal position, the fixed liquid-level gage must indicate maximum permitted filling level for both vertical and horizontal filling with the container oriented to place the safety relief valve in communication with the vapor space.

(C) In the case of containers used solely in farm tractor service, and charged at a point at least 50 feet from any important building, the fixed liquid-level gaging device may be so constructed that the outward flow of container content exceeds that passed by a No. 54 drill size opening, but in no case shall the flow exceed that passed by a No. 31 drill-size opening. An excess flow valve is not required. Fittings equipped with such restricted drill size opening and container on which they are used shall be marked to indicate the size of the opening.

(D) All valves and connections on containers shall be adequately protected to prevent damage due to accidental contact with stationary objects or from loose objects thrown up from the road, and all valves shall be safeguarded against damage due to collision, overturning or other accident. For farm tractors where parts of the vehicle provide such protection to valves and fittings, the foregoing requirements shall be considered fulfilled. However, on removable type containers the protection for the fittings shall be permanently attached to the container.

(E) When removable fuel containers are used, means shall be provided in the fuel system to minimize the escape of fuel when the containers are exchanged. This may be accomplished by either of the following methods:

(1) Using an approved automatic quick-closing coupling (a type closing in both directions when uncoupled) in the fuel line, or

(2) Closing the valve at the fuel container and allowing the engine to run until the fuel in the line is consumed.

(6) Piping – including pipe, tubing, and fittings.

(i) Pipe from fuel container to first-stage regulator shall be not less than schedule 80 wrought iron or steel (black or galvanized), brass or copper; or seamless copper, brass, or steel tubing. Steel tubing shall have a minimum wall thickness of 0.049-inch. Steel pipe or tubing shall be adequately protected against exterior corrosion. Copper tubing shall be types K or L or equivalent having a minimum wall thickness of 0.032-inch. Approved flexible connections may be used between container and regulator or between regulator and gas-air mixer within the limits of approval. The use of aluminum pipe or tubing is prohibited. In the case of removable containers an approved flexible connection shall be used between the container and the fuel line.

(ii) All piping shall be installed, braced, and supported so as to reduce to a minimum the possibility of vibration strains or wear.

(7) Safety devices.

(i) Spring-loaded internal type safety relief valves shall be used on all motor fuel containers.

(ii) The discharge outlet from safety relief valves shall be located on the outside of enclosed spaces and as far as practicable from possible sources of ignition, and vented upward within 45 degrees of the vertical in such a manner as to prevent impingement of escaping gas upon containers, or parts of vehicles, or on vehicles in adjacent lines of traffic. A rain cap or other protector shall be used to keep water and dirt from collecting in the valve.

(iii) When a discharge line from the container safety relief valve is used, the line shall be metallic, other than aluminum, and shall be sized, located, and maintained so as not to restrict the required flow of gas from the safety relief valve. Such discharge line shall be able to withstand the pressure resulting from the discharge of vapor when the safety relief valve is in the full open position. When flexibility is necessary, flexible metal hose or tubing shall be used.

(iv) Portable containers equipped for volumetric filling may be filled in either the vertical or horizontal position only when oriented to place the safety relief valve in communication with the vapor space.

(v) Paragraph (b)(10)(xii) of this section for hydrostatic relief valves shall apply.

(8) Vaporizers.

(i) Vaporizers and any part thereof and other devices that may be subjected to container pressure shall have a design pressure of at least 250 p.s.i.g.

(ii) Each vaporizer shall have a valve or suitable plug which will permit substantially complete draining of the vaporizer. It shall be located at or near the lowest portion of the section occupied by the water or other heating medium.

(iii) Vaporizers shall be securely fastened so as to minimize the possibility of becoming loosened.

(iv) Each vaporizer shall be permanently marked at a visible point as follows:

(A) With the design pressure of the fuel-containing portion in p.s.i.g.

(B) With the water capacity of the fuel-containing portion of the vaporizer in pounds.

(v) Devices to supply heat directly to a fuel container shall be equipped with an automatic device to cut off the supply of heat before the pressure inside the fuel container reaches 80 percent of the start to discharge pressure setting of the safety relief device on the fuel container.

(vi) Engine exhaust gases may be used as a direct source of heat supply for the vaporization of fuel if the materials of construction of those parts of the vaporizer in contact with exhaust gases are resistant to the corrosive action of exhaust gases and the vaporizer system is designed to prevent excessive pressures.

(vii) Vaporizers shall not be equipped with fusible plugs.

(9) Gas regulating and mixing equipment.

(i) Approved automatic pressure reducing equipment shall be installed in a secure manner between the fuel supply container and gas-air mixer for the purpose of reducing the pressure of the fuel delivered to the gas-air mixer.

(ii) An approved automatic shutoff valve shall be provided in the fuel system at some point ahead of the inlet of the gas-air mixer, designed to prevent flow of fuel to the mixer when the ignition is off and the engine is not running. In the case of industrial trucks and engines operating in buildings other than those used exclusively to house engines, the automatic shutoff valve shall be designed to operate if the engine should stop. Atmospheric type regulators (zero governors) shall be considered adequate as an automatic shutoff valve only in cases of outdoor operation such as farm tractors, construction equipment, irrigation pump engines, and other outdoor stationary engine installations.

(iii) The source of the air for combustion shall be completely isolated from the passenger compartment, ventilating system, or air-conditioning system.

(10) (Reserved)

(11) Stationary engines in buildings. Stationary engines and gas turbines installed in buildings, including portable engines used instead of or to supplement stationary engines, shall comply with the Standard for the Institution and Use of Stationary Combustion Engines and Gas Turbines, NFPA 37-1970, and the appropriate provisions of paragraphs (b), (c), and (d) of this section.

(12) Portable engines in buildings.

(i) Portable engines may be used in buildings only for emergency use, except as provided by subparagraph (11) of this paragraph.

(ii) Exhaust gases shall be discharged to outside the building or to an area where they will not constitute a hazard.

(iii) Provision shall be made to supply sufficient air for combustion and cooling.

(iv) An approved automatic shutoff valve shall be provided in the fuel system ahead of the engine, designed to prevent flow of fuel to the engine when the ignition is off or if the engine should stop.

(v) The capacity of LP-Gas containers used with such engines shall comply with the applicable occupancy provision of paragraph (c)(5) of this section.

(13) Industrial trucks inside buildings.

(i) LP-Gas-fueled industrial trucks are permitted to be used in buildings and structures.

(ii) No more than two LP-Gas containers shall be used on an industrial truck for motor fuel purposes.

(iii) (Reserved)

(iv) (Reserved)

(v) Industrial trucks shall not be parked and left unattended in areas of possible excessive heat or sources of ignition.

(14) Garaging LP-Gas-fueled vehicles.

(i) LP-Gas-fueled vehicles may be stored or serviced inside garages provided there are no leaks in the fuel system and the fuel tanks are not filled beyond the maximum filling capacity specified in paragraph (b)(12)(i) of this section.

(ii) LP-Gas-fueled vehicles being repaired in garages shall have the container shutoff valve closed except when fuel is required for engine operation.

(iii) Such vehicles shall not be parked near sources of heat, open flames, or similar sources of ignition or near open pits unless such pits are adequately ventilated.

(f) Storage of containers awaiting use or resale.

(1) Application. This paragraph shall apply to the storage of portable containers not in excess of 1,000 pounds water capacity, filled or partially filled, at user location but not connected for use, or in storage for resale by dealers or resellers. This paragraph shall not apply to containers stored at charging plants or at plants devoted primarily to the storage and distribution of LP-Gas or other petroleum products.

(2) General.

(i) Containers in storage shall be located so as to minimize exposure to excessive temperature rise, physical damage, or tampering by unauthorized persons.

(ii) Containers when stored inside shall not be located near exits, stairways, or in areas normally used or intended for the safe exit of people.

(iii) Container valves shall be protected while in storage as follows:

(A) By setting into recess of container to prevent the possibility of their being struck if the container is dropped upon a flat surface, or

(B) By ventilated cap or collar, fastened to container capable of withstanding blow from any direction equivalent to that of a 30-pound weight dropped 4 feet. Construction must be such that a blow will not be transmitted to a valve or other connection.

(iv) The outlet valves of containers in storage shall be closed.

(v) Empty containers which have been in LP-Gas service when stored inside, shall be considered as full containers for the purpose of determining the maximum quantity of LP-Gas permitted by this paragraph.

(3) (Reserved)

(4) Storage within buildings not frequented by the public (such as industrial buildings).

(i) The quantity of LP-Gas stored shall not exceed 300 pounds (approximately 2,550 cubic feet in vapor form) except as provided in subparagraph (5) of this paragraph.

(ii) Containers carried as a part of service equipment on highway mobile vehicles are not to be considered in the total storage capacity in Subdivision (i) of this subparagraph provided such vehicles are stored in private garages, and are limited to one container per vehicle with an LP-Gas capacity of not more than 100 pounds. All container valves shall be closed.

(5) Storage within special buildings or rooms.

(i) The quantity of LP-Gas stored in special buildings or rooms shall not exceed 10,000 pounds.

(ii) The walls, floors, and ceilings of container storage rooms that are within or adjacent to other parts of the building shall be constructed of material having at least a 2-hour fire resistance rating.

(iii) A portion of the exterior walls or roof having an area not less than 10 percent of that of the combined area of the enclosing walls and roof shall be of explosion relieving construction.

(iv) Each opening from such storage rooms to other parts of the building shall be protected by a 1 1/2-hour (B) fire door listed by a nationally recognized testing laboratory. Refer to 1910.7 for definition of nationally recognized testing laboratory.

(v) Such rooms shall have no open flames for heating or lighting.

(vi) Such rooms shall be adequately ventilated both top and bottom to the outside only. The openings from such vents shall be at least 5 feet away from any other opening into any building.

(vii) The floors of such rooms shall not be below ground level. Any space below the floor shall be of solid fill or properly ventilated to the open air.

(viii) Such storage rooms shall not be located adjoining the line of property occupied by schools, churches, hospitals, athletic fields or other points of public gathering.

(ix) Fixed electrical equipment shall be installed in accordance with paragraph (b)(18) of this section.

(6) Storage outside of buildings.

(i) Storage outside of buildings, for containers awaiting use or resale, shall be located in accordance with Table H-33 with respect to:

(A) The nearest important building or group of buildings;

(B) (Reserved)

(C) Busy thoroughfares;

Table H-33

Quantity of LP-Gas Stored	Distances
500 pounds or less	0
501 to 2,500 pounds	[1]0
2,501 to 6,000 pounds	10 feet
6,001 to 10,000 pounds	20 feet
Over 10,000 pounds	25 feet

[1]Container or containers shall be at least 10 feet from any building on adjoining property, any sidewalk, or any of the exposures described in 1910.110(f)(6)(i)(C) or (D) of this paragraph.

(ii) Containers shall be in a suitable enclosure or otherwise protected against tampering.

(7) Fire protection. Storage locations other than supply depots separated and located apart from dealer, reseller, or user establishments shall be provided with at least one approved portable fire extinguisher having a minimum rating of 8-B, C.

(g) (Reserved)

(h) Liquefied petroleum gas service stations.

(1) Application. This paragraph applies to storage containers, and dispensing devices, and pertinent equipment in service stations where LP-Gas is stored and is dispensed into fuel tanks of motor vehicles. See paragraph (e) of this section for requirements covering use of LP-Gas as a motor fuel. All requirements of paragraph (b) of this section apply to this paragraph unless otherwise noted.

(2) Design pressure and classification of storage containers. Storage containers shall be designed and classified in accordance with Table H-34.

Table H-34

Container type	For gases with vapor press. Not to exceed lb. per sq. in. gage at 100° F. (37.8° C.)	Minimum design pressure of container, lb. per sq. in. gage	
		1949 and earlier editions of ASME Code (Par. U-68, U-69)	1949 edition of ASME Code (Par. U-200, U-201); 1950, 1952, 1956, 1959, 1962, 1965, and 1968 (Division 1) editions of ASME Code; All editions of API-ASME Code[2]
[1]200	215	200	250

[1]Container type may be increased by increments of 25. The minimum design pressure of containers shall be 100 percent of the container type designation when constructed under 1949 or earlier editions of the ASME Code (Par. U-68 and U-69). The minimum design pressure of containers shall be 125 percent of the container type designation when constructed under: (1) The 1949 ASME Code (Paragraphs U-200 and U-201), (2) 1950, 1952, 1956, 1959, 1962, 1965, and 1968 (Division 1) editions of the ASME Code, and (3) all editions of the API-ASME Code.

[2]Construction of containers under the API-ASME Code is not authorized after July 1, 1961.

(3) Container valves and accessories.

(i) A filling connection on the container shall be fitted with one of the following:

(A) A combination back-pressure check and excess flow valve.

(B) One double or two single back-pressure valves.

(C) A positive shutoff valve, in conjunction with either,

(1) An internal back-pressure valve, or

(2) On internal excess flow valve.

In lieu of an excess flow valve, filling connections may be fitted with a quick-closing internal valve, which shall remain closed except during operating periods. The mechanism for such valves may be provided with a secondary control which will cause it to close automatically in case of fire. When a fusible plug is used its melting point shall not exceed 220 degrees F.

(ii) A filling pipe inlet terminal not on the container shall be fitted with a positive shutoff valve in conjunction with either:

(A) A black pressure check valve, or

(B) An excess flow check valve.

(iii) All openings in the container except those listed below shall be equipped with approved excess flow check valves:

(A) Filling connections as provided in Subdivision (i) of this subparagraph.

(B) Safety relief connections as provided in paragraph (b)(7)(ii) of this section.

(C) Liquid-level gaging devices as provided in paragraphs (b)(7)(iv) and (19)(iv) of this section.

(D) Pressure gage connections as provided in paragraph (b)(7)(v) of this section.

(iv) All container inlets and outlets except those listed below shall be labeled to designate whether they connect with vapor or liquid (labels may be on valves):

(A) Safety relief valves.

(B) Liquid-level gaging devices.

(C) Pressure gages.

(v) Each storage container shall be provided with a suitable pressure gage.

(4) Safety-relief valves.

(i) All safety-relief devices shall be installed as follows:

(A) On the container and directly connected with the vapor space.

(B) Safety-relief valves and discharge piping shall be protected against physical damage. The outlet shall be provided with loose-fitting rain caps. There shall be no return bends or restrictions in the discharge piping.

(C) The discharge from two or more safety relief valves having the same pressure settings may be run into a common discharge header. The cross-sectional area of such header shall be at least equal to the sum of the cross-sectional areas of the individual discharges.

(D) Discharge from any safety relief device shall not terminate in any building nor beneath any building.

(ii) Above ground containers shall be provided with safety relief valves as follows:

(A) The rate of discharge, which may be provided by one or more valves, shall be not less than that specified in paragraph (b)(10)(ii) of this section.

(B) The discharge from safety relief valves shall be vented to the open air unobstructed and vertically upwards in such a manner as to prevent any impingement of escaping gas upon the container; loose-fitting rain caps shall be used. On a container having a water capacity greater than 2,000 gallons, the discharge from the safety relief valves shall be vented away from the container vertically upwards to a point at least 7 feet above the container. Suitable provisions shall be made so that any liquid or condensate that may accumulate inside of the relief valve or its discharge pipe will not render the valve inoperative. If a drain is used, a means shall be provided to protect the container, adjacent containers, piping, or equipment against impingement of flame resulting from ignition of the product escaping from the drain.

(iii) Underground containers shall be provided with safety relief valves as follows:

(A) The discharge from safety-relief valves shall be piped vertically upward to a point at least 10 feet above the ground. The discharge lines or pipes shall be adequately supported and protected against physical damage.

(B) (Reserved)

(C) If no liquid is put into a container until after it is buried and covered, the rate of discharge of the relief valves may be reduced to not less than 30 percent of the rate shown in paragraph (b)(10)(ii) of this section. If liquid fuel is present during installation of containers, the rate of discharge shall be the same as for above ground containers. Such containers shall not be uncovered until emptied of liquid fuel.

(5) Capacity of liquid containers. Individual liquid storage containers shall not exceed 30,000 gallons water capacity.

(6) Installation of storage containers.

(i)

(A) Each storage container used exclusively in service station operation shall comply with the following table which specifies minimum distances to a building and groups of buildings.

Water capacity per container (gallons)	Minimum distances	
	Above ground and underground (feet)	Between above ground containers (feet)
Up to 2,000	25	3
Over 2,000	50	5

Note: The above distances may be reduced to not less than 10 feet for service station buildings of other than wood frame construction.

(B) Readily ignitible material including weeds and long dry grass, shall be removed within 10 feet of containers.

(C) The minimum separation between LP-Gas containers and flammable liquid tanks shall be 20 feet and the minimum separation between a container and the centerline of the dike shall be 10 feet.

(D) LP-Gas containers located near flammable liquid containers shall be protected against the flow or accumulation of flammable liquids by diking, diversion curbs, or grading.

(E) LP-Gas containers shall not be located within diked areas for flammable liquid containers.

(F) Field welding is permitted only on saddle plates or brackets which were applied by the container manufacturer.

(G) When permanently installed containers are interconnected, provision shall be made to compensate for expansion, contraction, vibration, and settling of containers and interconnecting piping. Where flexible connections are used, they shall be of an approved type and shall be designed for a bursting pressure of not less than five times the vapor pressure of the product at 100 degrees F. The use of nonmetallic hose is prohibited for interconnecting such containers.

(H) Where high water table or flood conditions may be encountered protection against container flotation shall be provided.

(ii) Above ground containers shall be installed in accordance with this Subdivision.

(A) Containers may be installed horizontally or vertically.

(B) Containers shall be protected by crash rails or guards to prevent physical damage unless they are so protected by virtue of their location. Vehicles shall not be serviced within 10 feet of containers.

(C) Container foundations shall be of substantial masonry or other noncombustible material. Containers shall be mounted on saddles which shall permit expansion and contraction, and shall provide against the excessive concentration of stresses. Corrosion protection shall be provided for tank-mounting areas. Structural metal container supports shall be protected against fire. This protection is not required on prefabricated storage and pump assemblies, mounted on a common base, with container bottom not more than 24 inches above ground and whose water capacity is 2,000 gallons or less if the piping connected to the storage and pump assembly is sufficiently flexible to minimize the possibility of breakage or leakage in the event of failure of the container supports.

(iii) Underground containers shall be installed in accordance with this Subdivision.

(A) Containers shall be given a protective coating before being placed underground. This coating shall be equivalent to hot-dip galvanizing or to two coatings of red lead followed by a heavy coating of coal tar or asphalt. In lowering the container into place, care shall be exercised to minimize abrasion or other damage to the coating. Damage to the coating shall be repaired before backfilling.

(B) Containers shall be set on a firm foundation (firm earth may be used) and surrounded with earth or sand firmly tamped in place. Backfill should be free of rocks or other abrasive materials.

(C) A minimum of 2 feet of earth cover shall be provided. Where ground conditions make compliance with this requirement impractical, equivalent protection against physical damage shall be provided. The portion of the container to which manhole and other connections are attached need not be covered. If the location is subjected to vehicular traffic, containers shall be protected by a concrete slab or other cover adequate to prevent the weight of a loaded vehicle imposing concentrated direct loads on the container shell.

(7) Protection of container fittings. Valves, regulators, gages, and other container fittings shall be protected against tampering and physical damage.

(8) Transport truck unloading point.

(i) During unloading, the transport truck shall not be parked on public thoroughfares and shall be at least 5 feet from storage containers, and shall be positioned so that shutoff valves are readily accessible.

(ii) The filling pipe inlet terminal shall not be located within a building nor within 10 feet of any building or driveway. It shall be protected against physical damage.

(9) Piping, valves, and fittings.

(i) Piping may be underground, above ground, or a combination of both. It shall be well supported and protected against physical damage and corrosion.

(ii) Piping laid beneath driveways shall be installed to prevent physical damage by vehicles.

(iii) Piping shall be wrought iron or steel (black or galvanized), brass or copper pipe; or seamless copper, brass, or steel tubing and shall be suitable for a minimum pressure of 250 p.s.i.g. Pipe joints may be screwed, flanged, brazed, or welded. The use of aluminum alloy piping or tubing is prohibited.

(iv) All shutoff valves (liquid or gas) shall be suitable for liquefied petroleum gas service and designed for not less than the maximum pressure to which they may be subjected. Valves which may be subjected to container pressure shall have a rated working pressure of at least 250 p.s.i.g.

(v) All materials used for valve seats, packing, gaskets, diaphragms, etc., shall be resistant to the action of LP-Gas.

(vi) Fittings shall be steel, malleable iron, or brass having a minimum working pressure of 250 p.s.i.g. Cast iron pipe fittings, such as ells, tees, and unions shall not be used.

(vii) All piping shall be tested after assembly and proved free from leaks at not less than normal operating pressures.

(viii) Provision shall be made for expansion, contraction, jarring, and vibration, and for settling. This may be accomplished by flexible connections.

(10) Pumps and accessories. All pumps and accessory equipment shall be suitable for LP-Gas service, and designed for not less than the maximum pressure to which they may be subjected. Accessories shall have a minimum rated working pressure of 250 p.s.i.g. Positive displacement pumps shall be equipped with suitable pressure actuated bypass valves permitting flow from pump discharge to storage container or pump suction.

(11) Dispensing devices.

(i) Meters, vapor separators, valves, and fittings in the dispenser shall be suitable for LP-Gas service and shall be designed for a minimum working pressure of 250 p.s.i.g.

(ii) Provisions shall be made for venting LP-Gas contained in a dispensing device to a safe location.

(iii) Pumps used to transfer LP-Gas shall be equipped to allow control of the flow and to prevent leakage or accidental discharge. Means shall be provided outside the dispensing device to readily shut off the power in the event of fire or accident.

(iv) A manual shutoff valve and an excess flow check valve shall be installed downstream of the pump and ahead of the dispenser inlet.

(v)

(A) Dispensing hose shall be resistant to the action of LP-Gas in the liquid phase and designed for a minimum bursting pressure of 1,250 p.s.i.g.

(B) An excess flow check valve or automatic shutoff valve shall be installed at the terminus of the liquid line at the point of attachment of the dispensing hose.

(vi)

(A) LP-Gas dispensing devices shall be located not less than 10 feet from above ground storage containers greater than 2,000 gallons water capacity. The dispensing devices shall not be less than 20 feet from any building (not including canopies), basement, cellar, pit, or line of adjoining property which may be built upon and not less than 10 feet from sidewalks, streets, or thoroughfares. No drains or blowoff lines shall be directed into or in proximity to the sewer systems used for other purposes.

(B) LP-Gas dispensing devices shall be installed on a concrete foundation or as part of a complete storage and dispensing assembly mounted on a common base, and shall be adequately protected from physical damage.

(C) LP-Gas dispensing devices shall not be installed within a building except that they may be located under a weather shelter or canopy provided this area is not enclosed on more than two sides. If the enclosing sides are adjacent to each other, the area shall be properly ventilated.

(vii) The dispensing of LP-Gas into the fuel container of a vehicle shall be performed by a competent attendant who shall remain at the LP-Gas dispenser during the entire transfer operation.

(12) Additional rules. There shall be no smoking on the driveway of service stations in the dispensing areas or transport truck unloading areas. Conspicuous signs prohibiting smoking shall be posted within sight of the customer being served. Letters on such signs shall be not less than 4 inches high. The motors of all vehicles being fueled shall be shut off during the fueling operations.

(13) Electrical. Electrical equipment and installations shall conform to paragraphs (b)(17) and (18) of this section.

(14) Fire protection. Each service station shall be provided with at least one approved portable fire extinguisher having at least an 8-B, C, rating.

(i) Scope.

(1) Application.

(i) Paragraph (b) of this section applies to installations made in accordance with the requirements of paragraphs (c), (d), (e), (g), and (h) of this section, except as noted in each of those paragraphs.

(ii) Paragraphs (c) through (h) of this section apply as provided in each of those paragraphs.

(2) Inapplicability. This section does not apply to:

(i) Marine and pipeline terminals, natural gas processing plants, refineries, or tank farms other than those at industrial sites.

(ii) LP-Gas refrigerated storage systems;

(iii) LP-Gas when used with oxygen. The requirements of 1910.252 shall apply to such use;

(iv) LP-Gas when used in utility gas plants. The National Fire Protection Association Standard for the Storage and Handling of Liquefied Petroleum Gases at Utility Gas Plants, NFPA No. 59-1968, shall apply to such use;

(v) Low-pressure (not in excess of 1/2-pound per square inch or 14 inches water column) LP-Gas piping systems, and the installation and operation of residential and commercial appliances including their inlet connections, supplied through such systems. For such systems, the National Fire Protection Association Standard for the Installation of Gas Appliances and Gas Piping, NFPA 54-1969 shall apply.

(3) Retroactivity. Unless otherwise stated, it is not intended that the provisions of this section be retroactive.

(i) Existing plants, appliances, equipment, buildings, structures, and installations for the storage, handling or use of LP-Gas, which were in compliance with the current provisions of the National Fire Protection Association Standard for the Storage and Handling of Liquefied Petroleum Gases NFPA No. 58, at the time of manufacture or installation may be continued in use, if such continued use does not constitute a recognized hazard that is causing or is likely to cause death or serious physical harm to employees.

(ii) Stocks of equipment and appliances on hand in such locations as manufacturers' storage, distribution warehouses, and dealers' storage and showrooms, which were in compliance with the current provisions of the National Fire Protection Association Standard for the Storage and Handling of Liquefied Petroleum Gases, NFPA No. 58, at the time of manufacture, may be placed in service, if such use does not constitute a recognized hazard that is causing or is likely to cause death or serious physical harm to employees.

[39 FR 23502, June 27, 1974, as amended at 43 FR 49747, Oct. 24, 1978; 49 FR 5322, Feb. 10, 1984; 53 FR 12122, Apr. 12, 1988; 55 FR 25094, June 20, 1990; 55 FR 32015, Aug. 6, 1990; 58 FR 15089, March 19, 1993; 58 FR 35309, June 30, 1993; 61 FR 9237, 9238, Mar. 7, 1996; 63 FR 33466, June 18, 1998; 72 FR 71069, Dec. 14, 2007.]

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 to 654.295.
Hist: OR-OSHA Admin. Order 2-1992, f. 2/6/92, ef. 5/1/92.
OR-OSHA Admin. Order 4-1997, f. 4/2/97, ef. 4/2/97.
OR-OSHA Admin. Order 4-1999, f. 4/30/99, ef. 4/30/99.
OR-OSHA Admin. Order 7-2008, f. 5/30/08, ef, 5/30/08.

1910.111 Storage and Handling of Anhydrous Ammonia

(a) General.

(1) Scope.

(i) This standard is intended to apply to the design, construction, location, installation, and operation of anhydrous ammonia systems including refrigerated ammonia storage systems.

(ii) This standard does not apply to:

(A) Ammonia manufacturing plants.

(B) Refrigeration plants where ammonia is used solely as a refrigerant.

(2) Definitions. As used in this section.

(i) **Appurtenances** – All devices such as pumps, compressors, safety relief devices, liquid-level gaging devices, valves and pressure gages.

(ii) **Cylinder** – A container of 1,000 pounds of water capacity or less constructed in accordance with Department of Transportation specifications.

(iii) **Code** – The Boiler and Pressure Vessel Code, Section VIII, Unfired Pressure Vessels of the American Society of Mechanical Engineers (ASME) – 1968.

(iv) **Container** – Includes all vessels, tanks, cylinders, or spheres used for transportation, storage, or application of anhydrous ammonia.

(v) **DOT** – U.S. Department of Transportation.

(vi) **Design pressure** is identical to the term "Maximum Allowable Working Pressure" used in the Code.

(vii) **Farm vehicle** (implement of husbandry) – A vehicle for use on a farm on which is mounted a container of not over 1,200 gallons water capacity.

(viii) **Filling density** – the percent ratio of the weight of the gas in a container to the weight of water at 60 degrees F. that the container will hold.

(ix) **Gas** – Anhydrous ammonia in either the gaseous or liquefied state.

(x) **Gas mask** – Gas masks must be approved by the National Institute for Occupational Safety and Health (NIOSH) under 42 CFR part 84 for use with anhydrous ammonia.

(xi) **Capacity** – Total volume of the container in standard U.S. gallons.

(xii) **DOT specifications** – Regulations of the Department of Transportation published in 49 CFR Chapter I.

(b) Basic rules. This paragraph applies to all paragraphs of this section unless otherwise noted.

(1) Approval of equipment and systems. Each appurtenance shall be approved in accordance with paragraph (b)(1)(i), (ii), (iii), or (iv) of this section.

(i) It was installed before February 8, 1973, and was approved, tested, and installed in accordance with either the provisions of the American National Standard for the Storage and Handling of Anhydrous Ammonia, K61.1, or the Fertilizer Institute Standards for the Storage and Handling of Agricultural Anhydrous Ammonia, M-1 (both of which are incorporated by reference as specified in 1910.6), in effect at the time of installation; or

Note: The Fertilizer Institute no longer publishes its "Standards for the Storage and Handling of Agricultural Anhydrous Ammonia, M-1."

(ii) It is accepted, or certified, or listed, or labeled, or otherwise determined to be safe by a nationally recognized testing laboratory; or

(iii) It is a type which no nationally recognized testing laboratory does, or will undertake to, accept, certify, list, label, or determine to be safe; and such equipment is inspected or tested by any Federal, State, municipal, or other local authority responsible for enforcing occupational safety provisions of a Federal, State, municipal or other local law, code, or regulation pertaining to the storage, handling, transport, and use of anhydrous ammonia, and found to be in compliance with either the provisions of the American National Standard for the Storage and Handling of Anhydrous Ammonia, K61.1, or the Fertilizer Institute Standards for the Storage and Handling of Agricultural Anhydrous Ammonia, M-1, in effect at the time of installation; or

(iv) It is a custom-designed and custom-built unit, which no nationally recognized testing laboratory, or Federal, State, municipal or local authority responsible for the enforcement of a Federal, State, municipal, or local law, code or regulation pertaining to the storage, transportation and use of anhydrous ammonia is willing to undertake to accept, certify, list, label or determine to be safe, and the employer has on file a document attesting to its safe condition following the conduct of appropriate tests. The document shall be signed by a registered professional engineer or other person having special training or experience sufficient to permit him to form an opinion as to safety of the unit involved. The document shall set forth the test bases, test data and results, and also the qualifications of the certifying person.

(v) For the purposes of this paragraph (b)(1), the word "listed" means that equipment is of a kind mentioned in a list which is published by a nationally recognized laboratory which makes periodic inspection of the production of such equipment, and states such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner. "Labeled" means there is attached to it a label, symbol, or other identifying mark of a nationally recognized testing laboratory which, makes periodic inspections of the production of such equipment, and whose labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner. "Certified" means it has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner, or is of a kind whose production is periodically inspected by a nationally recognized testing laboratory, and it bears a label, tag, or other record of certification.

(vi) For the purposes of this paragraph (b)(1), refer to 1910.7 for definition of nationally recognized testing laboratory.

(2) Requirements for construction, original test and requalification of nonrefrigerated containers.

(i) Containers used with systems covered in paragraphs (c), (f), (g), and (h) of this section shall be constructed and tested in accordance with the Code except that construction under Table UW12 at a basic joint efficiency of under 80 percent is not authorized.

(ii) Containers built according to the Code do not have to comply with Paragraphs UG125 to UG128 inclusive, and Paragraphs UG132 and UG133 of the Code.

(iii) Containers exceeding 36 inches in diameter or 250 gallons water capacity shall be constructed to comply with one or more of the following:

(A) Containers shall be stress relieved after fabrication in accordance with the Code, or

(B) Cold-form heads when used, shall be stress relieved, or

(C) Hot-formed heads shall be used.

(iv) Welding to the shell, head, or any other part of the container subject to internal pressure shall be done in compliance with the Code. Other welding is permitted only on saddle plates, lugs, or brackets attached to the container by the container manufacturer.

(v) Containers used with systems covered in paragraph (e) of this section shall be constructed and tested in accordance with the DOT specifications.

(vi) The provisions of Subdivision (i) of this subparagraph shall not be construed as prohibiting the continued use or reinstallation of containers constructed and maintained in accordance with the 1949, 1950, 1952, 1956, 1959, and 1962 editions of the Code or any revisions thereof in effect at the time of fabrication.

(3) Marking nonrefrigerated containers.

(i) System nameplates, when required, shall be permanently attached to the system so as to be readily accessible for inspection and shall include markings as prescribed in Subdivision (ii) of this subparagraph.

(ii) Each container or system covered in paragraphs (c), (f), (g), and (h) of this section shall be marked as specified in the following:

(A) With a notation "Anhydrous Ammonia."

(B) With a marking identifying compliance with the rules of the Code under which the container is constructed.

Underground: Container and system nameplate.

Above ground: Container.

(C) With a notation whether the system is designed for underground or above ground installation or both.

(D) With the name and address of the supplier of the system or the trade name of the system and with the date of fabrication.

Underground and above ground: System nameplate.

(E) With the water capacity of the container in pounds at 60 degrees F. or gallons, U.S. Standard.

Underground: Container and system nameplate.

Above ground: Container.

(F) With the design pressure in pounds per square inch.

Underground: Container and system nameplate.

Above ground: Container.

(G) With the wall thickness of the shell and heads.

Underground: Container and system nameplate.

Above ground: Container.

(H) With marking indicating the maximum level to which the container may be filled with liquid anhydrous ammonia at temperatures between 20 degrees F. and 130 degrees F. except on containers provided with fixed level indicators, such as fixed length dip tubes, or containers that are filled with weight. Markings shall be in increments of not more than 20 degrees F.

Above ground and underground: System nameplate or on liquid-level gaging device.

(I) With the total outside surface area of the container in square feet.

Underground: System nameplate.

Above ground: No requirement.

(J) Marking specified on the container shall be on the container itself or on a nameplate permanently attached to it.

(4) Marking refrigerated containers. Each refrigerated container shall be marked with nameplate on the outer covering in an accessible place as specified in the following:

(i) With the notation, “Anhydrous Ammonia.”

(ii) With the name and address of the builder and the date of fabrication.

(iii) With the water capacity of the container in gallons, U.S. Standard.

(iv) With the design pressure.

(v) With the minimum temperature in degrees Fahrenheit for which the container was designed.

(vi) The maximum allowable water level to which the container may be filled for test purposes.

(vii) With the density of the product in pounds per cubic foot for which the container was designed.

(viii) With the maximum level to which the container may be filled with liquid anhydrous ammonia.

(5) Location of containers.

(i) Consideration shall be given to the physiological effects of ammonia as well as to adjacent fire hazards in selecting the location for a storage container. Containers shall be located outside of buildings or in buildings or sections thereof especially provided for this purpose.

(ii) Permanent storage containers shall be located at least 50 feet from a dug well or other sources of potable water supply, unless the container is a part of a water-treatment installation.

(iii) (Reserved)

(iv) (Reserved)

(v) Storage areas shall be kept free of readily ignitible materials such as waste, weeds, and long dry grass.

(6) Container appurtenances.

(i) All appurtenances shall be designed for not less than the maximum working pressure of that portion of the system on which they are installed. All appurtenances shall be fabricated from materials proved suitable for anhydrous ammonia service.

(ii) All connections to containers except safety relief devices, gaging devices, or those fitted with No. 54 drill-size orifice shall have shutoff valves located as close to the container as practicable.

(iii) Excess flow valves where required by these standards shall close automatically at the rated flows of vapor or liquid as specified by the manufacturer. The connections and line including valves and fittings being protected by an excess flow valve shall have a greater capacity than the rated flow of the excess flow valve so that the valve will close in case of failure of the line or fittings.

(iv) Liquid-level gaging devices that require bleeding of the product to the atmosphere and which are so constructed that outward flow will not exceed that passed by a No. 54 drill-size opening need not be equipped with excess flow valves.

(v) Openings from the container or through fittings attached directly on the container to which pressure gage connections are made need not be equipped with excess flow valves if such openings are not larger than No. 54 drill size.

(vi) Excess flow and back pressure check valves where required by the standards in this section shall be located inside of the container or at a point outside as close as practicable to where the line enters the container. In the latter case installation shall be made in such manner that any undue strain beyond the excess flow or back pressure check valve will not cause breakage between the container and the valve.

(vii) Excess flow valves shall be designed with a bypass, not to exceed a No. 60 drill-size opening to allow equalization of pressures.

(viii) All excess flow valves shall be plainly and permanently marked with the name or trademark of the manufacturer, the catalog number, and the rated capacity.

(7) Piping, tubing, and fittings.

(i) All piping, tubing, and fittings shall be made of material suitable for anhydrous ammonia service.

(ii) All piping, tubing, and fittings shall be designed for a pressure not less than the maximum pressure to which they may be subjected in service.

(iii) All refrigerated piping shall conform to the Refrigeration Piping Code, American National Standards Institute, B31.5-1966 with addenda B31.1a-1968, which is incorporated by reference as specified in 1910.6, as it applies to ammonia.

(iv) Piping used on nonrefrigerated systems shall be at least American Society for Testing and Materials (ASTM) A-53-69 Grade B Electric Resistance Welded and Electric Flash Welded Pipe, which is incorporated by reference as specified in 1910.6, or equal. Such pipe shall be at least schedule 40 when joints are welded, or welded and flanged. Such pipe shall be at least schedule 80 when joints are threaded. Threaded connections shall not be back-welded. Brass, copper, or galvanized steel pipe shall not be used.

(v) Tubing made of brass, copper, or other material subject to attack by ammonia shall not be used.

(vi) Cast iron fittings shall not be used but this shall not prohibit the use of fittings made specifically for ammonia service of malleable, nodular, or high strength gray iron meeting American Society for Testing and Materials (ASTM) A47-68, ASTM 395-68, or ASTM A126-66 Class B or C, all of which are incorporated by reference as specified in 1910.6.

(vii) Joint compounds shall be resistant to ammonia.

(8) Hose specifications.

(i) Hose used in ammonia service shall conform to the joint Agricultural Ammonia Institute – Rubber Manufacturers Association Specifications for Anhydrous Ammonia Hose.

(ii) Hose subject to container pressure shall be designed for a minimum working pressure of 350 p.s.i.g. and a minimum burst pressure of 1,750 p.s.i.g. Hose assemblies, when made up, shall be capable of withstanding a test pressure of 500 p.s.i.g.

(iii) Hose and hose connections located on the low-pressure side of flow control of pressure-reducing valves shall be designed for a bursting pressure of not less than five times the pressure setting of the safety relief devices protecting that portion of the system but not less than 125 p.s.i.g. All connections shall be so designed and constructed that there will be no leakage when connected.

(iv) Where hose is to be used for transferring liquid from one container to another, "wet" hose is recommended. Such hose shall be equipped with approved shutoff valves at the discharge end. Provision shall be made to prevent excessive pressure in the hose.

(v) On all hose 1/2-inch outside diameter and larger, used for the transfer of anhydrous ammonia liquid or vapor, there shall be etched, cast, or impressed at 5 foot intervals the following information.

"Anhydrous Ammonia" xxx p.s.i.g. (maximum working pressure), manufacturer's name or trademark, year of manufacture.

In lieu of this requirement the same information may be contained on a nameplate permanently attached to the hose.

Table H-35

[Minimum required rate of discharge in cubic feet per minute of air at 120 percent of the maximum permitted start to discharge pressure of safety relief valves]

Surface area (sq. ft.)	Flow rate CFM air	Surface area (sq. ft.)	Flow rate CFM air	Surface area (sq. ft.)	Flow rate CFM air
20	258	185	1,600	900	5,850
25	310	190	1,640	950	6,120
30	360	195	1,670	1,000	6,380
35	408	200	1,710	1,050	6,640
40	455	210	1,780	1,100	6,900
45	501	220	1,850	1,150	7,160
50	547	230	1,920	1,200	7,410

[Minimum required rate of discharge in cubic feet per minute of air at 120 percent of the maximum permitted start to discharge pressure of safety relief valves]

Surface area (sq. ft.)	Flow rate CFM air	Surface area (sq. ft.)	Flow rate CFM air	Surface area (sq. ft.)	Flow rate CFM air
55	591	240	1,980	1,250	7,660
60	635	250	2,050	1,300	7,910
65	678	260	2,120	1,350	8,160
70	720	270	2,180	1,400	8,410
75	762	280	2,250	1,450	8,650
80	804	290	2,320	1,500	8,900
85	845	300	2,380	1,550	9,140
90	885	310	2,450	1,600	9,380
95	925	320	2,510	1,650	9,620
100	965	330	2,570	1,700	9,860
105	1,010	340	2,640	1,750	10,090
110	1,050	350	2,700	1,800	10,330
115	1,090	360	2,760	1,850	10,560
120	1,120	370	2,830	1,900	10,800
125	1,160	380	2,890	1,950	11,030
130	1,200	390	2,950	2,000	11,260
135	1,240	400	3,010	2,050	11,490
140	1,280	450	3,320	2,100	11,720
145	1,310	500	3,620	2,150	11,950
150	1,350	550	3,910	2,200	12,180
155	1,390	600	4,200	2,250	12,400
160	1,420	650	4,480	2,300	12,630
165	1,460	700	4,760	2,350	12,850
170	1,500	750	5,040	2,400	13,080
175	1,530	800	5,300	2,450	13,300
180	1,570	850	5,590	2,500	13,520

"Surface Area = total outside surface area of container in square feet. When the surface area is not stamped on the nameplate or when the marking is not legible the area can be calculated by using one of the following formulas:

(1) Cylindrical container with hemispherical heads:

Area = overall length in feet times outside diameter in feet times 3.1416.

(2) Cylindrical container with other than hemispherical heads:

Area = (overall length in feet plus 0.3 outside diameter in feet) times outside diameter in feet times 3.1416.

(3) Spherical container:

Area = outside diameter in feet squared times 3.1416."

"Flow Rate-CFM Air = cubic feet per minute of air required at standard conditions, 60 degrees F. and atmospheric pressure (14.7 p.s.i.a.)."

"The rate of discharge may be interpolated for intermediate values of surface area. For containers with total outside surface area greater than 2,500 square feet, the required flow rate can be calculated using the formula: Flow Rate CFM Air = 22.11 A082, where A = outside surface area of the container in square feet."

(9) Safety relief devices.

(i) Every container used in systems covered by paragraphs (c), (f), (g), and (h) of this section shall be provided with one or more safety relief valves of the spring-loaded or equivalent type. The discharge from safety-relief valves shall be vented away from the container upward and unobstructed to the atmosphere. All relief-valve discharge openings shall have suitable rain caps that will allow free discharge of the vapor and prevent entrance of water. Provision shall be made for draining condensate which may accumulate. The rate of the discharge shall be in accordance with the provisions of Table H-36.

(ii) Container safety-relief valves shall be set to start-to-discharge as follows, with relation to the design pressure of the container:

Containers	Minimum (percent)	Maximum (percent)
ASME – U-68, U-69	110	125
ASME – U-200, U-201	95	100
ASME 1959, 1956, 1952, or 1962	95	100
API-ASME	95	100
U.S. Coast Guard	95	100

As required by DOT Regulations.

(iii) Safety relief devices used in systems covered by paragraphs (c), (f), (g), and (h) of this section shall be constructed to discharge at not less than the rates required in paragraph (b)(9)(i) of this section before the pressure is in excess of 120 percent (not including the 10 percent tolerance referred to in paragraph (b)(9)(ii) of this section) of the maximum permitted start-to-discharge pressure setting of the device.

(iv) Safety-relief valves shall be so arranged that the possibility of tampering will be minimized. If the pressure setting adjustment is external, the relief valves shall be provided with means for sealing the adjustment.

(v) Shutoff valves shall not be installed between the safety-relief valves and the container; except, that a shutoff valve may be used where the arrangement of this valve is such as always to afford full required capacity flow through the relief valves.

(vi) Safety-relief valves shall have direct communication with the vapor space of the container.

(vii) Each container safety-relief valve used with systems covered by paragraphs (c), (f), (g), and (h) of this section shall be plainly and permanently marked with the symbol “NH3” or “AA;” with the pressure in pounds-per-square-inch gage at which the valve is set to start-to-discharge; with the actual rate of discharge of the valve at its full open position in cubic feet per minute of air at 60 degrees F. and atmospheric pressure; and with the manufacturer’s name and catalog number.

Example: “NH3 250 4050 Air” indicates that the valve is suitable for use on an anhydrous ammonia container, is set to start-to-discharge at a pressure of 250 p.s.i.g., and that its rate of discharge at full open position (Subdivisions (ii) and (iii) of this subparagraph) is 4,050 cubic feet per minute of air.

(viii) The flow capacity of the relief valve shall not be restricted by any connection to it on either the upstream or downstream side.

(ix) A hydrostatic relief valve shall be installed between each pair of valves in the liquid ammonia piping or hose where liquid may be trapped so as to relieve into the atmosphere at a safe location.

(10) General.

(i) (Reserved)

(ii) Stationary storage installations must have at least two suitable gas masks in readily-accessible locations. Full-face masks with ammonia canisters that have been approved by NIOSH under 42 CFR part 84, are suitable for emergency action involving most anhydrous ammonia leaks, particularly leaks that occur outdoors. For respiratory protection in concentrated ammonia atmospheres, a self-contained breathing apparatus is required.

(iii) Stationary storage installations shall have an easily accessible shower or a 50 gallon drum of water.

(iv) Each vehicle transporting ammonia in bulk except farm applicator vehicles shall carry a container of at least 5 gallons of water and shall be equipped with a full face mask.

(11) Charging of containers.

(i) The filling densities for containers that are not refrigerated shall not exceed the following:

Type of container	Percent by weight	Percent by volume
Above ground – Uninsulated	56	82
Above ground – Uninsulated		87.5
Above ground – Insulated	57	83.5
Underground – Uninsulated	58	85
DOT – In accord with DOT regulations		

(ii) Above ground uninsulated containers may be charged 87.5 percent by volume provided the temperature of the anhydrous ammonia being charged is determined to be not lower than 30 degrees F. or provided the charging of the container is stopped at the first indication of frost or ice formation on its outside surface and is not resumed until such frost or ice has disappeared.

(12) Transfer of liquids.

(i) Anhydrous ammonia shall always be at a temperature suitable for the material of construction and the design of the receiving container.

(ii) The employer shall require the continuous presence of an attendant in the vicinity of the operation during such time as ammonia is being transferred.

(iii) Containers shall be charged or used only upon authorization of the owner.

(iv) Containers shall be gaged and charged only in the open atmosphere or in buildings or areas thereof provided for that purpose.

(v) Pumps used for transferring ammonia shall be those manufactured for that purpose.

(A) Pumps shall be designed for at least 250 p.s.i.g. working pressure.

(B) Positive displacement pumps shall have, installed off the discharged port, a constant differential relief valve discharging into the suction port of the pump through a line of sufficient size to carry the full capacity of the pump at relief valve setting, which setting and installation shall be according to the pump manufacturer's recommendations.

(C) On the discharge side of the pump, before the relief valve line, there shall be installed a pressure gage graduated from 0 to 400 p.s.i.

(D) Plant piping shall contain shutoff valves located as close as practical to pump connections.

(vi) Compressors used for transferring or refrigerating ammonia shall be recommended for ammonia service by the manufacturer.

(A) Compressors shall be designed for at least 250 p.s.i.g. working pressure.

(B) Plant piping shall contain shutoff valves located as close as practical to compressor connections.

(C) A relief valve large enough to discharge the full capacity of the compressor shall be connected to the discharge before any shutoff valve.

(D) Compressors shall have pressure gages at suction and discharge graduated to at least one and one-half times the maximum pressure that can be developed.

(E) Adequate means, such as drainable liquid trap, shall be provided on the compressor suction to minimize the entry of liquid into the compressor.

(vii) Loading and unloading systems shall be protected by suitable devices to prevent emptying of the storage container or the container being loaded or unloaded in the event of severance of the hose. Backflow check valves or properly sized excess flow valves shall be installed where necessary to provide such protection. In the event that such valves are not practical, remotely operated shutoff valves may be installed.

(13) Tank car unloading points and operations.

(i) Provisions for unloading tank cars shall conform to the applicable recommendations contained in the DOT regulations.

(ii) The employer shall insure that unloading operations are performed by reliable persons properly instructed and given the authority to monitor careful compliance with all applicable procedures.

(iii) Caution signs shall be so placed on the track or car as to give necessary warning to persons approaching the car from open end or ends of siding and shall be left up until after the car is unloaded and disconnected from discharge connections. Signs shall be of metal or other suitable material, at least 12 by 15 inches in size and bear the words “STOP – Tank Car Connected” or “STOP – Men at Work” the word, “STOP,” being in letters at least 4 inches high and the other words in letters at least 2 inches high.

(iv) The track of a tank car siding shall be substantially level.

(v) Brakes shall be set and wheels blocked on all cars being unloaded.

(14) Liquid-level gaging device.

(i) Each container except those filled by weight shall be equipped with an approved liquid-level gaging device. A thermometer well shall be provided in all containers not utilizing a fixed liquid-level gaging device.

(ii) All gaging devices shall be arranged so that the maximum liquid level to which the container is filled is readily determined.

(iii) Gaging devices that require bleeding of the product to the atmosphere such as the rotary tube, fixed tube, and slip tube devices shall be designed so that the maximum opening of the bleed valve is not larger than No. 54 drill size unless provided with an excess flow valve. (This requirement does not apply to farm vehicles used for the application of ammonia as covered in paragraph (h) of this section.)

(iv) Gaging devices shall have a design pressure equal to or greater than the design pressure of the container on which they are installed.

(v) Fixed tube liquid-level gages shall be designed and installed to indicate that level at which the container is filled to 85 percent of its water capacity in gallons.

(vi) Gage glasses of the columnar type shall be restricted to stationary storage installations. They shall be equipped with shutoff valves having metallic handwheels, with excess-flow valves, and with extra heavy glass adequately protected with a metal housing applied by the gage manufacturer. They shall be shielded against the direct rays of the sun.

(15) (Reserved)

(16) Electrical equipment and wiring.

(i) Electrical equipment and wiring for use in ammonia installations shall be general purpose or weather resistant as appropriate.

(ii) Electrical systems shall be installed and maintained in accordance with Subpart S of this part.

(c) Systems utilizing stationary, nonrefrigerated storage containers. This paragraph applies to stationary, nonrefrigerated storage installations utilizing containers other than those covered in paragraph (e) of this section. Paragraph (b) of this section applies to this paragraph unless otherwise noted.

(1) Design pressure and construction of containers. The minimum design pressure for nonrefrigerated containers shall be 250 p.s.i.g.

(2) Container valves and accessories, filling and discharge connections.

(i) Each filling connection shall be provided with combination back-pressure check valve and excess-flow valve; one double or two single back-pressure check valves; or a positive shutoff valve in conjunction with either an internal back-pressure check valve or an internal excess flow valve.

(ii) All liquid and vapor connections to containers except filling pipes, safety relief connections, and liquid-level gaging and pressure gage connections provided with orifices not larger than No. 54 drill size as required in paragraphs (b)(6)(iv) and (v) of this section shall be equipped with excess-flow valves.

(iii) Each storage container shall be provided with a pressure gage graduated from 0 to 400 p.s.i. Gages shall be designated for use in ammonia service.

(iv) All containers shall be equipped with vapor return valves.

(3) Safety-relief devices.

(i) Every container shall be provided with one or more safety-relief valves of the spring-loaded or equivalent type in accordance with paragraph (b)(9) of this section.

(ii) The rate of discharge of spring-loaded safety relief valves installed on underground containers may be reduced to a minimum of 30 percent of the rate of discharge specified in Table H-36. Containers so protected shall not be uncovered after installation until the liquid ammonia has been removed. Containers which may contain liquid ammonia before being installed underground and before being completely covered with earth are to be considered above ground containers when determining the rate of discharge requirements of the safety-relief valves.

(iii) On underground installations where there is a probability of the manhole or housing becoming flooded, the discharge from vent lines shall be located above the high water level. All manholes or housings shall be provided with ventilated louvers or their equivalent, the area of such openings equalling or exceeding combined discharge areas of safety-relief valves and vent lines which discharge their content into the manhole housing.

(iv) Vent pipes, when used, shall not be restricted or of smaller diameter than the relief-valve outlet connection.

(v) If desired, vent pipes from two or more safety-relief devices located on the same unit, or similar lines from two or more different units may be run into a common discharge header, provided the capacity of such header is at least equal to the sum of the capacities of the individual discharge lines.

(4) Reinstallation of containers.

(i) Containers once installed underground shall not later be reinstalled above ground or underground, unless they successfully withstand hydrostatic pressure retests at the pressure specified for the original hydrostatic test as required by the code under which constructed and show no evidence of serious corrosion.

(ii) Where containers are reinstalled above ground, safety devices or gaging devices shall comply with paragraph (b)(9) of this section and this paragraph respectively for above ground containers.

(5) Installation of storage containers.

(i) Containers installed above ground, except as provided in paragraph (c)(5)(v) of this section shall be provided with substantial concrete or masonry supports, or structural steel supports on firm concrete or masonry foundations. All foundations shall extend below the frost line.

(ii) Horizontal above ground containers shall be so mounted on foundations as to permit expansion and contraction. Every container shall be supported to prevent the concentration of excessive loads on the supporting portion of the shell. That portion of the container in contact with foundations or saddles shall be protected against corrosion.

(iii) Containers installed underground shall be so placed that the top of the container is below the frost line and in no case less than 2 feet below the surface of the ground. Should ground conditions make compliance with these requirements impracticable, installation shall be made otherwise to prevent physical damage. It will not be necessary to cover the portion of the container to which manhole and other connections are affixed. When necessary to prevent floating, containers shall be securely anchored or weighted.

(iv) Underground containers shall be set on a firm foundation (firm earth may be used) and surrounded with earth or sand well tamped in place. The container, prior to being placed underground, shall be given a corrosion resisting protective coating. The container thus coated shall be so lowered into place as to prevent abrasion or other damage to the coating.

(v) Containers with foundations attached (portable or semi-portable tank containers with suitable steel "runners" or "skids" and commonly known in the industry as "skid tanks") shall be designed and constructed in accordance with paragraph (c)(1) of this section.

(vi) Secure anchorage or adequate pier height shall be provided against container flotation wherever sufficiently high floodwater might occur.

(vii) The distance between underground containers of over 2,000 gallons capacity shall be at least 5 feet.

(6) Protection of appurtenances.

(i) Valves, regulating, gaging, and other appurtenances shall be protected against tampering and physical damage. Such appurtenances shall also be protected during transit of containers.

(ii) All connections to underground containers shall be located within a dome, housing, or manhole and with access thereto by means of a substantial cover.

(7) Damage from vehicles. Precaution shall be taken against damage to ammonia systems from vehicles.

(d) Refrigerated storage systems. This paragraph applies to systems utilizing containers with the storage of anhydrous ammonia under refrigerated conditions. All applicable rules of paragraph (b) of this section apply to this paragraph unless otherwise noted.

(1) Design of containers.

(i) The design temperature shall be the minimum temperature to which the container will be refrigerated.

(ii) Containers with a design pressure exceeding 15 p.s.i.g. shall be constructed in accordance with paragraph (b)(2) of this section, and the materials shall be selected from those listed in API Standard 620, Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks, Fourth Edition, 1970, Tables 2.02, R2.2, R2.2(A), R2.2.1, or R2.3, which are incorporated by reference as specified in 1910.6.

(iii) Containers with a design pressure of 15 p.s.i.g. and less shall be constructed in accordance with the applicable requirements of API Standard 620 including its Appendix R.

(iv) When austenitic steels or nonferrous materials are used, the Code shall be used as a guide in the selection of materials for use at the design temperature.

(v) The filling density for refrigerated storage containers shall be such that the container will not be liquid full at a liquid temperature corresponding to the vapor pressure at the start-to-discharge pressure setting of the safety-relief valve.

(2) Installation of refrigerated storage containers.

(i) Containers shall be supported on suitable noncombustible foundations designed to accommodate the type of container being used.

(ii) Adequate protection against flotation or other water damage shall be provided wherever high floodwater might occur.

(iii) Containers for product storage at less than 32 degrees F. shall be supported in such a way, or heat shall be supplied, to prevent the effects of freezing and consequent frost heaving.

(3) Shutoff valves. When operating conditions make it advisable, a check valve shall be installed on the fill connection and a remotely operated shutoff valve on other connections located below the maximum liquid level.

(4) Safety relief devices.

(i) Safety relief valves shall be set to start-to-discharge at a pressure not in excess of the design pressure of the container and shall have a total relieving capacity sufficient to prevent a maximum pressure in the container of more than 120 percent of the design pressure. Relief valves for refrigerated storage containers shall be self-contained spring-loaded, weight-loaded, or self-contained pilot-operated type.

(ii) The total relieving capacity shall be the larger of:

(A) Possible refrigeration system upset such as (1) cooling water failure, (2) power failure, (3) instrument air or instrument failure, (4) mechanical failure of any equipment, (5) excessive pumping rates.

(B) Fire exposure determined in accordance with Compressed Gas Association (CGA) S-1, Part 3, Safety Relief Device Standards for Compressed Gas Storage Containers, 1959, which is incorporated by reference as specified in 1910.6, except that "A" shall be the total exposed surface area in square feet up to 25 foot above grade or to the equator of the storage container if it is a sphere, whichever is greater. If the relieving capacity required for fire exposure is greater than that required by (A) of this Subdivision, the additional capacity may be provided by weak roof to shell seams in containers operating at essentially atmospheric pressure and having an inherently weak roof-to-shell seam. The weak roof-to-shell seam is not to be considered as providing any of the capacity required in (A) of this Subdivision.

(iii) If vent lines are installed to conduct the vapors from the relief valve, the back pressure under full relieving conditions shall not exceed 50 percent of the start-to-discharge pressure for pressure balanced valves or 10 percent of the start-to-discharge pressure for conventional valves. The vent lines shall be installed to prevent accumulation of liquid in the lines.

(iv) The valve or valve installation shall provide weather protection.

(v) Atmospheric storage shall be provided with vacuum breakers. Ammonia gas, nitrogen, methane, or other inert gases can be used to provide a pad.

(5) Protection of container appurtenances. Appurtenances shall be protected against tampering and physical damage.

(6) Reinstallation of refrigerated storage containers. Containers of such size as to require field fabrication shall, when moved and reinstalled, be reconstructed and reinspected in complete accordance with the requirements under which they were constructed. The containers shall be subjected to a pressure retest and if rerating is necessary, rerating shall be in accordance with applicable requirements.

(7) Damage from vehicles. Precaution shall be taken against damage from vehicles.

(8) Refrigeration load and equipment.

(i) The total refrigeration load shall be computed as the sum of the following:

(A) Load imposed by heat flow into the container caused by the temperature differential between design ambient temperature and storage temperature.

(B) Load imposed by heat flow into the container caused by maximum sun radiation.

(C) Maximum load imposed by filling the container with ammonia warmer than the design storage temperature.

(ii) More than one storage container may be handled by the same refrigeration system.

(9) Compressors.

(i) A minimum of two compressors shall be provided either of which shall be of sufficient size to handle the loads listed in paragraphs (d)(8)(i)(A) and (B) of this section. Where more than two compressors are provided minimum standby equipment equal to the largest normally operating equipment shall be installed. Filling compressors may be used as standby equipment for holding compressors.

(ii) Compressors shall be sized to operate with a suction pressure at least 10 percent below the minimum setting of the safety valve(s) on the storage container and shall withstand a suction pressure at least equal to 120 percent of the design pressure of the container.

(10) Compressor drives.

(i) Each compressor shall have its individual driving unit.

(ii) An emergency source of power of sufficient capacity to handle the loads listed in paragraphs (d)(8)(i)(A) and (B) of this section shall be provided unless facilities are available to safely dispose of vented vapors while the refrigeration system is not operating.

(11) Automatic control equipment.

(i) The refrigeration system shall be arranged with suitable controls to govern the compressor operation in accordance with the load as evidenced by the pressure in the container(s).

(ii) An emergency alarm system shall be installed to function in the event the pressure in the container(s) rises to the maximum allowable operating pressure.

(iii) An emergency alarm and shutoff shall be located in the condenser system to respond to excess discharge pressure caused by failure of the cooling medium.

(iv) All automatic controls shall be installed in a manner to preclude operation of alternate compressors unless the controls will function with the alternate compressors.

(12) Separators for compressors.

(i) An entrainment separator of suitable size and design pressure shall be installed in the compressor suction line of lubricated compression. The separator shall be equipped with a drain and gaging device.

(ii) (Reserved)

(13) Condensers. The condenser system may be cooled by air or water or both. The condenser shall be designed for at least 250 p.s.i.g. Provision shall be made for purging noncondensibles either manually or automatically.

(14) Receiver and liquid drain. A receiver shall be provided with a liquid-level control to discharge the liquid ammonia to storage. The receiver shall be designed for at least 250 p.s.i.g. and be equipped with the necessary connections, safety valves, and gaging device.

(15) Insulation. Refrigerated containers and pipelines which are insulated shall be covered with a material of suitable quality and thickness for the temperatures encountered. Insulation shall be suitably supported and protected against the weather. Weatherproofing shall be of a type which will not support flame propagation.

(e) Systems utilizing portable DOT containers.

(1) Conformance. Cylinders shall comply with DOT specifications and shall be maintained, filled, packaged, marked, labeled, and shipped to comply with 49 CFR chapter I and the marking requirements set forth in 1910.253(b)(1)(ii).

(2) Storage. Cylinders shall be stored in an area free from ignitable debris and in such manner as to prevent external corrosion. Storage may be indoors or outdoors.

(3) Heat protection. Cylinders filled in accordance with DOT regulations will become liquid full at 145 degrees F. Cylinders shall be protected from heat sources such as radiant flame and steampipes. Heat shall not be applied directly to cylinders to raise the pressure.

(4) Protection. Cylinders shall be stored in such manner as to protect them from moving vehicles or external damage.

(5) Valve cap. Any cylinder which is designed to have a valve protection cap shall have the cap securely in place when the cylinder is not in service.

(f) Tank motor vehicles for the transportation of ammonia.

(1) This paragraph applies to containers and pertinent equipment mounted on tank motor vehicles including semitrailers and full trailers used for the transportation of ammonia. This paragraph does not apply to farm vehicles. For requirements covering farm vehicles, refer to paragraphs (g) and (h) of this section.

Paragraph (b) of this section applies to this paragraph unless otherwise noted. Containers and pertinent equipment for tank motor vehicles for the transportation of anhydrous ammonia, in addition to complying with the requirements of this section, shall also comply with the requirements of DOT.

(2) Design pressure and construction of containers.

(i) The minimum design pressure for containers shall be that specified in the regulations of the DOT.

(ii) The shell or head thickness of any container shall not be less than 3/16-inch.

(iii) All container openings, except safety relief valves, liquid-level gaging devices, and pressure gages, shall be labeled to designate whether they communicate with liquid or vapor space.

(3) Container appurtenances.

(i) All appurtenances shall be protected against physical damage.

(ii) All connections to containers, except filling connections, safety relief devices, and liquid-level and pressure gage connections, shall be provided with suitable automatic excess flow valves, or in lieu thereof, may be fitted with quick-closing internal valves, which shall remain closed except during delivery operations. The control mechanism for such valves may be provided with a secondary control remote from the delivery connections and such control mechanism shall be provided with a fusible section (melting point 208 degrees F. to 220 degrees F.) which will permit the internal valve to close automatically in case of fire.

(iii) Filling connections shall be provided with automatic back-pressure check valves, excess-flow valves, or quick-closing internal valves, to prevent backflow in case the filling connection is broken. Where the filling and discharge connect to a common opening in the container shell and that opening is fitted with a quick-closing internal valve as specified in paragraph (f)(3)(ii) of this section, the automatic valve shall not be required.

(iv) All containers shall be equipped for spray loading (filling in the vapor space) or with an approved vapor return valve of adequate capacity.

(4) Piping and fittings.

(i) All piping, tubing, and fittings shall be securely mounted and protected against damage. Means shall be provided to protect hoses while the vehicle is in motion.

(ii) Fittings shall comply with paragraph (b)(6) of this section. Pipe shall be Schedule 80.

(5) Safety relief devices.

(i) The discharge from safety relief valves shall be vented away from the container upward and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container; loose-fitting rain caps shall be used. Size of discharge lines from safety valves shall not be smaller than the nominal size of the safety-relief valve outlet connection. Suitable provision shall be made for draining condensate which may accumulate in the discharge pipe.

(ii) Any portion of liquid ammonia piping which at any time may be closed at both ends shall be provided with a hydrostatic relief valve.

(6) Transfer of liquids.

(i) The content of tank motor vehicle containers shall be determined by weight, by a suitable liquid-level gaging device, or other approved methods. If the content of a container is to be determined by liquid-level measurement, the container shall have a thermometer well so that the internal liquid temperature can be easily determined. This volume when converted to weight shall not exceed the filling density specified by the DOT.

(ii) Any pump, except a constant speed centrifugal pump, shall be equipped with a suitable pressure actuated bypass valve permitting flow from discharge to suction when the discharge pressure rises above a predetermined point. Pump discharge shall also be equipped with a spring-loaded safety relief valve set at a pressure not more than 135 percent of the setting of the bypass valve or more than 400 p.s.i.g., whichever is larger.

(iii) Compressors shall be equipped with manually operated shutoff valves on both suction and discharge connections. Pressure gages of bourdon-tube type shall be installed on the suction and discharge of the compressor before the shutoff valves. The compressor shall not be operated if either pressure gage is removed or is inoperative. A spring-loaded, safety-relief valve capable of discharging to atmosphere the full flow of gas from the compressor at a pressure not exceeding 300 p.s.i.g. shall be connected between the compressor discharge and the discharge shutoff valve.

(iv) Valve functions shall be clearly and legibly identified by metal tags or nameplates permanently affixed to each valve.

(7) (Reserved)

(8) (Reserved)

(9) Chock blocks. At least two chock blocks shall be provided. These blocks shall be placed to prevent rolling of the vehicle whenever it is parked during loading and unloading operations.

(10) Portable tank containers (skid tanks). Where portable tank containers are used for farm storage they shall comply with paragraph (c)(1) of this section. When portable tank containers are used in lieu of cargo tanks and are permanently mounted on tank motor vehicles for the transportation of ammonia, they shall comply with the requirements of this paragraph.

(g) Systems mounted on farm vehicles other than for the application of ammonia.

(1) Application. This paragraph applies to containers of 1,200 gallons capacity or less and pertinent equipment mounted on farm vehicles (implements of husbandry) and used other than for the application of ammonia to the soil. Paragraph (b) of this section applies to this paragraph unless otherwise noted.

(2) Design pressure and classification of containers.

(i) The minimum design pressure for containers shall be 250 p.s.i.g.

(ii) The shell or head thickness of any container shall be not less than 3/16-inch.

(3) Mounting containers.

(i) A suitable “stop” or “stops” shall be mounted on the vehicle or on the container in such a way that the container shall not be dislodged from its mounting due to the vehicle coming to a sudden stop. Back slippage shall also be prevented by proper methods.

(ii) A suitable “hold down” device shall be provided which will anchor the container to the vehicle at one or more places on each side of the container.

(iii) When containers are mounted on four-wheel trailers, care shall be taken to insure that the weight is distributed evenly over both axles.

(iv) When the cradle and the tank are not welded together suitable material shall be used between them to eliminate metal-to-metal friction.

(4) Container appurtenances.

(i) All containers shall be equipped with a fixed liquid-level gage.

(ii) All containers with a capacity exceeding 250 gallons shall be equipped with a pressure gage having a dial graduated from 0-400 p.s.i.

(iii) The filling connection shall be fitted with combination back-pressure check valve and excess-flow valve; one double or two single back-pressure check valves; or a positive shutoff valve in conjunction with either an internal back-pressure check valve or an internal excess flow valve.

(iv) All containers with a capacity exceeding 250 gallons shall be equipped for spray loading or with an approved vapor return valve.

(v) All vapor and liquid connections except safety-relief valves and those specifically exempted by paragraph (b)(6)(v) of this section shall be equipped with approved excess-flow valves or may be fitted with quick-closing internal valves which, except during operating periods, shall remain closed.

(vi) Fittings shall be adequately protected from damage by a metal box or cylinder with open top securely fastened to the container or by rigid guards, well braced, welded to the container on both sides of the fittings or by a metal dome. If a metal dome is used, the relief valve shall be properly vented through the dome.

(vii) If a liquid withdrawal line is installed in the bottom of a container, the connections thereto, including hose, shall not be lower than the lowest horizontal edge of the vehicle axle.

(viii) Provision shall be made to secure both ends of the hose while in transit.

(5) Marking the container. There shall appear on each side and on the rear end of the container in letters at least 4 inches high, the words, "Caution – Ammonia" or the container shall be marked in accordance with DOT regulations.

(6) Farm vehicles.

(i) Farm vehicles shall conform with State regulations.

(ii) All trailers shall be securely attached to the vehicle drawing them by means of drawbars supplemented by suitable safety chains.

(iii) A trailer shall be constructed so that it will follow substantially in the path of the towing vehicle and will not whip or swerve dangerously from side-to-side.

(iv) All vehicles shall carry a can containing 5 gallons or more of water.

(h) Systems mounted on farm vehicles for the application of ammonia.

(1) This paragraph applies to systems utilizing containers of 250 gallons capacity or less which are mounted on farm vehicles (implement of husbandry) and used for the application of ammonia to the soil. Paragraph (b) of this section applies to this paragraph unless otherwise noted. Where larger containers are used, they shall comply with paragraph (g) of this section.

(2) Design pressure and classification of containers.

(i) The minimum design pressure for containers shall be 250 p.s.i.g.

(ii) The shell or head thickness of any container shall not be less than 3/16-inch.

(3) Mounting of containers. All containers and flow-control devices shall be securely mounted.

(4) Container valves and accessories.

(i) Each container shall have a fixed liquid-level gage.

(ii) The filling connection shall be fitted with a combination back-pressure check valve and an excess-flow valve; one double or two single back-pressure check valves: or a positive shutoff valve in conjunction with an internal back-pressure check valve or an internal excess-flow valve.

(iii) The applicator tank may be filled by venting to open air provided the bleeder valve orifice does not exceed 7/16-inch in diameter.

(iv) Regulation equipment may be connected directly to the tank coupling or flange, in which case a flexible connection shall be used between such regulating equipment and the remainder of the liquid withdrawal system. Regulating equipment not so installed shall be flexibly connected to the container shutoff valve.

(v) No excess flow valve is required in the liquid withdrawal line provided the controlling orifice between the contents of the container and the outlet of the shutoff valve does not exceed 7/16-inch in diameter.

[39 FR 23502, June 27, 1974, as amended at 43 FR 49748, Oct. 24, 1978; 49 FR 5322, Feb. 10, 1984; 53 FR 12122, Apr. 12, 1988; 61 FR 9238, Mar. 7, 1996; 63 FR 1269, Jan. 8, 1998; 63 FR 33466, June 18, 1998; 72 FR 71069, Dec. 14, 2007.]

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: OR-OSHA Admin. Order 2-1992, f. 2/6/92, ef. 5/1/92.
OR-OSHA Admin. Order 4-1997, f. 4/2/97, ef. 4/2/97.
OR-OSHA Admin. Order 3-1998, f. 7/7/98, ef. 7/7/98.
OR-OSHA Admin. Order 4-1999, f. 4/30/99, ef. 4/30/99.
OR-OSHA Admin. Order 12-2001, f. 10/26/01, ef. 10/26/01.
OR-OSHA Admin. Order 7-2008, f. 5/30/08, ef, 5/30/08.

1910.112 – 1910.113 (Reserved)

1910.119 Process Safety Management of Highly Hazardous Chemicals

Purpose. This section contains requirements for 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.

(a) Application.

(1) This section applies to the following:

(i) A process which involves a chemical at or above the specified threshold quantities listed in Appendix A to this section;

(ii) A process which involves a Category 1 flammable gas (as defined in 1910.1200(c)) or a flammable liquid with a flashpoint below 100 degrees F. (37.8 degrees C.) on site in one location, in a quantity of 10,000 pounds (4535.9 kg) or more except for:

(A) Hydrocarbon fuels used solely for workplace consumption as a fuel (e.g., propane used for comfort heating, gasoline for vehicle refueling), if such fuels are not a part of a process containing another highly hazardous chemical covered by this standard;

(B) Flammable liquids with a flashpoint below 100 degrees F. (37.8 degrees C.) stored in atmospheric tanks or transferred which are kept below their normal boiling point without benefit of chilling or refrigeration.

(2) This section does not apply to:

(i) Retail facilities;

(ii) Oil or gas well drilling or servicing operations; or,

(iii) Normally unoccupied remote facilities.

(b) Definitions.

Atmospheric tank means a storage tank which has been designed to operate at pressures from atmospheric through 0.5 p.s.i.g. (pounds per square inch gauge, 3.45 Kpa).

Boiling point means the boiling point of a liquid at a pressure of 14.7 pounds per square inch absolute (p.s.i.a.) (760 mm.). For the purposes of this section, where an accurate boiling point is unavailable for the material in question, or for mixtures which do not have a constant boiling point, the 10 percent point of a distillation performed in accordance with the Standard Method of Test for Distillation of Petroleum Products, ASTM D-86-62, which is incorporated by reference as specified in 1910.6, may be used as the boiling point of the liquid.

Catastrophic release means a major uncontrolled emission, fire, or explosion, involving one or more highly hazardous chemicals, that presents serious danger to employees in the workplace.

Facility means the buildings, containers or equipment which contain a process.

Highly hazardous chemical means a substance possessing toxic, reactive, flammable, or explosive properties and specified by paragraph (a)(1) of this section.

Hot work means work involving electric or gas welding, cutting, brazing, or similar flame or spark-producing operations.

Normally unoccupied remote facility means a facility which is operated, maintained or serviced by employees who visit the facility only periodically to check its operation and to perform necessary operating or maintenance tasks. No employees are permanently stationed at the facility. Facilities meeting this definition are not contiguous with, and must be geographically remote from all other buildings, processes or persons.

Process means any activity involving a highly hazardous chemical including any use, storage, manufacturing, handling, or the on-site movement of such chemicals, or combination of these activities. For purposes of this definition, any group of vessels which are interconnected and separate vessels which are located such that a highly hazardous chemical could be involved in a potential release shall be considered a single process.

Replacement in kind means a replacement which satisfies the design specification.

Trade secret means any confidential formula, pattern, process, device, information or compilation of information that is used in an employer's business, and that gives the employer an opportunity to obtain an advantage over competitors who do not know or use it. See Appendix E to 1910.1200 – Definition of a Trade Secret, (which sets out the criteria to be used in evaluating trade secrets).

(c) Employee participation.

(1) Employers shall develop a written plan of action regarding the implementation of the employee participation required by this paragraph.

(2) Employers shall consult with employees and their representatives on the conduct and development of process hazards analyses and on the development of the other elements of process safety management in this standard.

(3) Employers shall provide to employees and their representatives access to process hazard analyses and to all other information required to be developed under this standard.

(d) Process safety information. In accordance with the schedule set forth in paragraph (e)(1) of this section, the employer shall complete a compilation of written process safety information before conducting any process hazard analysis required by the standard. The compilation of written process safety information is to enable the employer and the employees involved in operating the process to identify and understand the hazards posed by those processes involving highly hazardous chemicals. This process safety information shall include information pertaining to the hazards of the highly hazardous chemicals used or produced by the process, information pertaining to the technology of the process, and information pertaining to the equipment in the process.

(1) Information pertaining to the hazards of the highly hazardous chemicals in the process. This information shall consist of at least the following:

(i) Toxicity information;

(ii) Permissible exposure limits;

(iii) Physical data;

(iv) Reactivity data:

(v) Corrosivity data;

(vi) Thermal and chemical stability data; and

(vii) Hazardous effects of inadvertent mixing of different materials that could foreseeably occur.

Note: Safety Data Sheets meeting the requirements of 29 CFR 1910.1200(g) may be used to comply with this requirement to the extent they contain the information required by this subparagraph.

(2) Information pertaining to the technology of the process.

(i) Information concerning the technology of the process shall include at least the following:

(A) A block flow diagram or simplified process flow diagram (see Appendix B to this section);

(B) Process chemistry;

(C) Maximum intended inventory;

(D) Safe upper and lower limits for such items as temperatures, pressures, flows or compositions; and

(E) An evaluation of the consequences of deviations, including those affecting the safety and health of employees.

(ii) Where the original technical information no longer exists, such information may be developed in conjunction with the process hazard analysis in sufficient detail to support the analysis.

(3) Information pertaining to the equipment in the process.

(i) Information pertaining to the equipment in the process shall include:

(A) Materials of construction;

(B) Piping and instrument diagrams (P&ID's);

(C) Electrical classification;

(D) Relief system design and design basis;

(E) Ventilation system design;

(F) Design codes and standards employed;

(G) Information pertaining to the equipment in the process shall include material and energy balances for processes built after May 26, 1992.

(H) Safety systems (e.g., interlocks, detection or suppression systems).

(ii) The employer shall document that equipment complies with recognized and generally accepted good engineering practices.

(iii) For existing equipment designed and constructed in accordance with codes, standards, or practices that are no longer in general use, the employer shall determine and document that the equipment is designed, maintained, inspected, tested, and operating in a safe manner.

(e) Process hazard analysis.

(1) The employer shall perform an initial process hazard analysis (hazard evaluation) on processes covered by this standard. The process hazard analysis shall be appropriate to the complexity of the process and shall identify, evaluate, and control the hazards involved in the process. Employers shall determine and document the priority order for conducting process hazard analyses based on a rationale which includes such considerations as extent of the process hazards, number of potentially affected employees, age of the process, and operating history of the process. The process hazard analysis shall be conducted as soon as possible, but not later than the following schedule:

(i) No less than 25 percent of the initial process hazards analyses shall be completed by May 24, 1994;

(ii) No less than 50 percent of the initial process hazards analyses shall be completed by May 26, 1995;

(iii) No less than 75 percent of the initial process hazards analyses shall be completed by May 26, 1996;

(iv) All initial process hazards analyses shall be completed by May 26, 1997.

(v) Process hazards analyses completed after May 26, 1987, which meet the requirements of this paragraph are acceptable as initial process hazards analyses. These process hazard analyses shall be updated and revalidated, based on their completion date, in accordance with paragraph (e)(6) of this section.

(2) The employer shall use one or more of the following methodologies that are appropriate to determine and evaluate the hazards of the process being analyzed.

(i) What-If;

(ii) Checklist;

(iii) What-If/Checklist;

(iv) Hazard and Operability Study (HAZOP);

(v) Failure Mode and Effects Analysis (FMEA);

(vi) Fault-Tree Analysis; or

(vii) An appropriate equivalent methodology.

(3) The process hazard analysis shall address:

(i) The hazards of the process;

(ii) The identification of any previous incident which had a likely potential for catastrophic consequences in the workplace;

(iii) Engineering and administrative controls applicable to the hazards and their inter-relationships such as appropriate application of detection methodologies to provide early warning of releases. (Acceptable detection methods might include process monitoring and control instrumentation with alarms, and detection hardware such as hydrocarbon sensors.);

(iv) Consequences of failure of engineering and administrative controls;

(v) Facility siting;

(vi) Human factors; and

(vii) A qualitative evaluation of a range of the possible safety and health effects of failure of controls on employees in the workplace.

(4) The process hazard analysis shall be performed by a team with expertise in engineering and process operations, and the team shall include at least one employee who has experience and knowledge specific to the process being evaluated. Also, one member of the team must be knowledgeable in the specific process hazard analysis methodology being used.

(5) The employer shall establish a system to promptly address the team's findings and recommendations; assure that the recommendations are resolved in a timely manner and that the resolution is documented; document what actions are to be taken; complete actions as soon as possible; develop a written schedule of when these actions are to be completed; communicate the actions to operating, maintenance and other employees whose work assignments are in the process and who may be affected by the recommendations or actions.

(6) At least every 5 years after the completion of the initial process hazard analysis, the process hazard analysis shall be updated and revalidated by a team meeting the requirements in paragraph (e)(4) of this section, to assure that the process hazard analysis is consistent with the current process.

(7) Employers shall retain process hazards analyses and updates or revalidations for each process covered by this section, as well as the documented resolution of recommendations described in paragraph (e)(5) of this section for the life of the process.

(f) Operating procedures.

(1) The employer shall develop and implement written operating procedures that provide clear instructions for safely conducting activities involved in each covered process consistent with the process safety information and shall address at least the following elements.

(i) Steps for each operating phase:

(A) Initial startup;

(B) Normal operations;

(C) Temporary operations;

(D) Emergency shutdown including the conditions under which emergency shutdown is required, and the assignment of shutdown responsibility to qualified operators to ensure that emergency shutdown is executed in a safe and timely manner.

(E) Emergency operations;

(F) Normal shutdown; and,

(G) Startup following a turnaround, or after an emergency shutdown.

(ii) Operating limits:

(A) Consequences of deviation; and

(B) Steps required to correct or avoid deviation.

(iii) Safety and health considerations:

(A) Properties of, and hazards presented by, the chemicals used in the process;

(B) Precautions necessary to prevent exposure, including engineering controls, administrative controls, and personal protective equipment;

(C) Control measures to be taken if physical contact or airborne exposure occurs;

(D) Quality control for raw materials and control of hazardous chemical inventory levels; and,

(E) Any special or unique hazards.

(iv) Safety systems and their functions.

(2) Operating procedures shall be readily accessible to employees who work in or maintain a process.

(3) The operating procedures shall be reviewed as often as necessary to assure that they reflect current operating practice, including changes that result from changes in process chemicals, technology, and equipment, and changes to facilities. The employer shall certify annually that these operating procedures are current and accurate.

(4) The employer shall 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. These safe work practices shall apply to employees and contractor employees.

(g) Training.

(1) Initial training.

(i) Each employee presently involved in operating a process, and each employee before being involved in operating a newly assigned process, shall be trained in an overview of the process and in the operating procedures as specified in paragraph (f) of this section. The training shall include emphasis on the specific safety and health hazards, emergency operations including shutdown, and safe work practices applicable to the employee's job tasks.

(ii) In lieu of initial training for those employees already involved in operating a process on May 26, 1992, an employer may certify in writing that the employee has the required knowledge, skills, and abilities to safely carry out the duties and responsibilities as specified in the operating procedures.

(2) Refresher training. Refresher training shall be provided at least every 3 years, and more often if necessary, to each employee involved in operating a process to assure that the employee understands and adheres to the current operating procedures of the process. The employer, in consultation with the employees involved in operating the process, shall determine the appropriate frequency of refresher training.

(3) Training documentation. The employer shall ascertain that each employee involved in operating a process has received and understood the training required by this paragraph. The employer shall prepare a record which contains the identity of the employee, the date of training, and the means used to verify that the employee understood the training.

(h) Contractors.

(1) Application. This paragraph applies to contractors performing maintenance or repair, turnaround, major renovation, or specialty work on or adjacent to a covered process. It does not apply to contractors providing incidental services which do not influence process safety, such as janitorial work, food and drink services, laundry, delivery or other supply services.

(2) Employer responsibilities.

(i) The employer, when selecting a contractor, shall obtain and evaluate information regarding the contract employer's safety performance and programs.

(ii) The employer shall inform contract employers of the known potential fire, explosion, or toxic release hazards related to the contractor's work and the process.

(iii) The employer shall explain to contract employers the applicable provisions of the emergency action plan required by paragraph (n) of this section.

(iv) The employer shall develop and implement safe work practices consistent with paragraph (f)(4) of this section, to control the entrance, presence and exit of contract employers and contract employees in covered process areas.

(v) The employer shall periodically evaluate the performance of contract employers in fulfilling their obligations as specified in paragraph (h)(3) of this section.

(vi) The employer shall maintain a contract employee injury and illness log related to the contractor's work in process areas.

(3) Contract employer responsibilities.

(i) The contract employer shall assure that each contract employee is trained in the work practices necessary to safely perform his/her job.

(ii) The contract employer shall assure that each contract employee is instructed in the known potential fire, explosion, or toxic release hazards related to his/her job and the process, and the applicable provisions of the emergency action plan.

(iii) The contract employer shall document that each contract employee has received and understood the training required by this paragraph. The contract employer shall prepare a record which contains the identity of the contract employee, the date of training, and the means used to verify that the employee understood the training.

(iv) The contract employer shall assure that each contract employee follows the safety rules of the facility including the safe work practices required by paragraph (f)(4) of this section.

(v) The contract employer shall advise the employer of any unique hazards presented by the contract employer's work, or of any hazards found by the contract employer's work.

(i) Pre-startup safety review.

(1) The employer shall perform a pre-startup safety review for new facilities and for modified facilities when the modification is significant enough to require a change in the process safety information.

(2) The pre-startup safety review shall confirm that prior to the introduction of highly hazardous chemicals to a process:

(i) Construction and equipment is in accordance with design specifications;

(ii) Safety, operating, maintenance, and emergency procedures are in place and are adequate;

(iii) For new facilities, a process hazard analysis has been performed and recommendations have been resolved or implemented before startup; and modified facilities meet the requirements contained in management of change, paragraph (l).

(iv) Training of each employee involved in operating a process has been completed.

(j) Mechanical integrity.

(1) Application. Paragraphs (j)(2) through (j)(6) of this section apply to the following process equipment:

(i) Pressure vessels and storage tanks;

(ii) Piping systems (including piping components such as valves);

(iii) Relief and vent systems and devices;

(iv) Emergency shutdown systems;

(v) Controls (including monitoring devices and sensors, alarms, and interlocks) and,

(vi) Pumps.

(2) Written procedures. The employer shall establish and implement written procedures to maintain the ongoing integrity of process equipment.

(3) Training for process maintenance activities. The employer shall train each employee involved in maintaining the ongoing integrity of process equipment in an overview of that process and its hazards and in the procedures applicable to the employee's job tasks to assure that the employee can perform the job tasks in a safe manner.

(4) Inspection and testing.

(i) Inspections and tests shall be performed on process equipment.

(ii) Inspection and testing procedures shall follow recognized and generally accepted good engineering practices.

(iii) The frequency of inspections and tests of process equipment shall be consistent with applicable manufacturers' recommendations and good engineering practices, and more frequently if determined to be necessary by prior operating experience.

(iv) The employer shall document each inspection and test that has been performed on process equipment. The documentation shall identify the date of the inspection or test, the name of the person who performed the inspection or test, the serial number or other identifier of the equipment on which the inspection or test was performed, a description of the inspection or test performed, and the results of the inspection or test.

(5) Equipment deficiencies. The employer shall correct deficiencies in equipment that are outside acceptable limits (defined by the process safety information in paragraph (d) of this section) before further use or in a safe and timely manner when necessary means are taken to assure safe operation.

(6) Quality assurance.

(i) In the construction of new plants and equipment, the employer shall assure that equipment as it is fabricated is suitable for the process application for which they will be used.

(ii) Appropriate checks and inspections shall be performed to assure that equipment is installed properly and consistent with design specifications and the manufacturer's instructions.

(iii) The employer shall assure that maintenance materials, spare parts and equipment are suitable for the process application for which they will be used.

(k) Hot work permit.

(1) The employer shall issue a hot work permit for hot work operations conducted on or near a covered process.

(2) The permit shall document that the fire prevention and protection requirements in 29 CFR 1910.252(a) have been implemented prior to beginning the hot work operations; it shall indicate the date(s) authorized for hot work; and identify the object on which hot work is to be performed. The permit shall be kept on file until completion of the hot work operations.

(l) Management of change.

(1) The employer shall establish and implement written procedures to manage changes (except for "replacements in kind") to process chemicals, technology, equipment, and procedures; and, changes to facilities that affect a covered process.

(2) The procedures shall assure that the following considerations are addressed prior to any change:

(i) The technical basis for the proposed change;

(ii) Impact of change on safety and health;

(iii) Modifications to operating procedures;

(iv) Necessary time period for the change; and

(v) Authorization requirements for the proposed change.

(3) Employees involved in operating a process and maintenance and contract employees whose job tasks will be affected by a change in the process shall be informed of, and trained in, the change prior to start-up of the process or affected part of the process.

(4) If a change covered by this paragraph results in a change in the process safety information required by paragraph (d) of this section, such information shall be updated accordingly.

(5) If a change covered by this paragraph results in a change in the operating procedures or practices required by paragraph (f) of this section, such procedures or practices shall be updated accordingly.

(m) Incident investigation.

(1) The employer shall investigate each incident which resulted in, or could reasonably have resulted in a catastrophic release of highly hazardous chemical in the workplace.

(2) An incident investigation shall be initiated as promptly as possible, but not later than 48 hours following the incident.

(3) An incident investigation team shall be established and consist of at least one person knowledgeable in the process involved, including a contract employee if the incident involved work of the contractor, and other persons with appropriate knowledge and experience to thoroughly investigate and analyze the incident.

(4) A report shall be prepared at the conclusion of the investigation which includes at a minimum:

(i) Date of incident;

(ii) Date investigation began;

(iii) A description of the incident;

(iv) The factors that contributed to the incident; and

(v) Any recommendations resulting from the investigation.

(5) The employer shall establish a system to promptly address and resolve the incident report findings and recommendations. Resolutions and corrective actions shall be documented.

(6) The report shall be reviewed with all affected personnel whose job tasks are relevant to the incident findings including contract employees where applicable.

(7) Incident investigation reports shall be retained for 5 years.

(n) Emergency planning and response. The employer shall establish and implement an emergency action plan for the entire plant in accordance with the provisions of 29 CFR 1910.38(a). In addition, the emergency action plan shall include procedures for handling small releases. Employers covered under this standard may also be subject to the hazardous waste and emergency response provisions contained in 29 CFR 1910.120(a), (p) and (q).

Note: 1910.38 is now OAR 437-002-0042.

(o) Compliance Audits.

(1) Employers shall certify that they have evaluated compliance with the provisions of this section at least every 3 years to verify that the procedures and practices developed under the standard are adequate and are being followed.

(2) The compliance audit shall be conducted by at least one person knowledgeable in the process.

(3) A report of the findings of the audit shall be developed.

(4) The employer shall promptly determine and document an appropriate response to each of the findings of the compliance audit, and document that deficiencies have been corrected.

(5) Employers shall retain the two most recent compliance audit reports.

(p) Trade secrets.

(1) Employers shall make all information necessary to comply with the section available to those persons responsible for compiling the process safety information (required by paragraph (d) of this section), those assisting in the development of the process hazard analysis (required by paragraph (e) of this section), those responsible for developing the operating procedures (required by paragraph (f) of this section), and those involved in incident investigations (required by paragraph (m) of this section), emergency planning and response (paragraph (n) of this section) and compliance audits (paragraph (o) of this section) without regard to possible trade secret status of such information.

(2) Nothing in this paragraph shall preclude the employer from requiring the persons to whom the information is made available under paragraph (p)(1) of this section to enter into confidentiality agreements not to disclose the information as set forth in 29 CFR 1910.1200.

(3) Subject to the rules and procedures set forth in 29 CFR 1910.1200(i)(1) through 1910.1200(i)(12), employees and their designated representatives shall have access to trade secret information contained within the process hazard analysis and other documents required to be developed by this standard.

[57 FR 6403, Feb. 24, 1992; 57 FR 7847, Mar. 4, 1992, as amended at 61 FR 9238, Mar. 7, 1996; 67 FR 67964, Nov. 7, 2002; 76 FR 80738, Dec. 27, 2011; 77 FR 17776, Mar. 26, 2012; 78 FR 9313, Feb. 8, 2013; 84 FR 15102, Apr. 15, 2019]

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: OR-OSHA Admin. Order 8-1992, f. 8/13/92, ef. 11/24/92.
OR-OSHA Admin. Order 3-1993, f. 2/23/93, ef. 2/23/93.
OR-OSHA Admin. Order 6-1994, f. 9/30/94, ef. 9/30/94.
OR-OSHA Admin. Order 4-1997, f. 4/2/97, ef. 4/2/97.
OR-OSHA Admin. Order 12-2001, f. 10/26/01, ef. 10/26/01.
OR-OSHA Admin. Order 1-2012, f. 4/10/12, ef. 4/10/12.
OR-OSHA Admin. Order 5-2012, f. 9/25/12, ef. 9/25/12.
OR-OSHA Admin. Order 4-2013, f. 7/19/13, ef. 7/19/13.

Appendix A to 1910.119 - List of Highly Hazardous Chemicals, Toxics and Reactives (Mandatory)

This Appendix contains a listing of toxic and reactive highly hazardous chemicals which present a potential for a catastrophic event at or above the threshold quantity.

Chemical Name	CAS*	TQ**
Acetaldehyde	75-07-0	2500
Acrolein (2-Propenal)	107-02-8	150
Acrylyl Chloride	814-68-6	250
Allyl Chloride	107-05-1	1000
Allylamine	107-11-9	1000
Alkylaluminums	Varies	5000
Ammonia, Anhydrous	7664-41-7	10000
Ammonia solutions (> 44% ammonia by weight)	7664-41-7	15000
Ammonium Perchlorate	7790-98-9	7500
Ammonium Permanganate	7787-36-2	7500
Arsine (also called Arsenic Hydride)	7784-42-1	100
Bis(Chloromethyl) Ether	542-88-1	100
Boron Trichloride	10294-34-5	2500
Boron Trifluoride	7637-07-2	250
Bromine	7726-95-6	1500
Bromine Chloride	13863-41-7	1500
Bromine Pentafluoride	7789-30-2	2500
Bromine Trifluoride	7787-71-5	15000
3-Bromopropyne (also called Propargyl Bromide)	106-96-7	100
Butyl Hydroperoxide (Tertiary)	75-91-2	5000
Butyl Perbenzoate (Tertiary)	614-45-9	7500
Carbonyl Chloride (see Phosgene)	75-44-5	100
Carbonyl Fluoride	353-50-4	2500
Cellulose Nitrate (concentration > 12.6% nitrogen)	9004-70-0	2500
Chlorine	7782-50-5	1500
Chlorine Dioxide	10049-04-4	1000
Chlorine Pentrafluoride	13637-63-3	1000
Chlorine Trifluoride	7790-91-2	1000
Chlorodiethylaluminum (also called Diethylaluminum Chloride)	96-10-6	5000
1-Chloro-2,4-Dinitrobenzene	97-00-7	5000

Chemical Name	CAS*	TQ**
Chloromethyl Methyl Ether	107-30-2	500
Chloropicrin	76-06-2	500
Chloropicrin and Methyl Bromide mixture	None	1500
Chloropicrin and Methyl Chloride mixture	None	1500
Cumene Hydroperoxide	80-15-9	5000
Cyanogen	460-19-5	2500
Cyanogen Chloride	506-77-4	500
Cyanuric Fluoride	675-14-9	100
Diacetyl Peroxide (concentration > 70%)	110-22-5	5000
Diazomethane	334-88-3	500
Dibenzoyl Peroxide	94-36-0	7500
Diborane	19287-45-7	100
Dibutyl Peroxide (Tertiary)	110-05-4	5000
Dichloro Acetylene	7572-29-4	250
Dichlorosilane	4109-96-0	2500
Diethylzinc	557-20-0	10000
Diisopropyl Peroxydicarbonate	105-64-6	7500
Dilaluroyl Peroxide	105-74-8	7500
Dimethyldichlorosilane	75-78-5	1000
Dimethylhydrazine, 1,1-	57-14-7	1000
Dimethylamine, Anhydrous	124-40-3	2500
2,4-Dinitroaniline	97-02-9	5000
Ethyl Methyl Ketone Peroxide (also Methyl Ethyl Ketone Peroxide; concentration > 60%)	1338-23-4	5000
Ethyl Nitrite	109-95-5	5000
Ethylamine	75-04-7	7500
Ethylene Fluorohydrin	371-62-0	100
Ethylene Oxide	75-21-8	5000
Ethyleneimine	151-56-4	1000
Fluorine	7782-41-4	1000
Formaldehyde (Formalin)	50-00-0	1000
Furan	110-00-9	500
Hexafluoroacetone	684-16-2	5000
Hydrochloric Acid, Anhydrous	7647-01-0	5000
Hydrofluoric Acid, Anhydrous	7664-39-3	1000
Hydrogen Bromide	10035-10-6	5000
Hydrogen Chloride	7647-01-0	5000

Chemical Name	CAS*	TQ**
Hydrogen Cyanide, Anhydrous	74-90-8	1000
Hydrogen Fluoride	7664-39-3	1000
Hydrogen Peroxide (52% by weight or greater)	7722-84-1	7500
Hydrogen Selenide	7783-07-5	150
Hydrogen Sulfide	7783-06-4	1500
Hydroxylamine	7803-49-8	2500
Iron, Pentacarbonyl	13463-40-6	250
Isopropylamine	75-31-0	5000
Ketene	463-51-4	100
Methacrylaldehyde	78-85-3	1000
Methacryloyl Chloride	920-46-7	150
Methacryloyloxyethyl Isocyanate	30674-80-7	100
Methyl Acrylonitrile	126-98-7	250
Methylamine, Anhydrous	74-89-5	1000
Methyl Bromide	74-83-9	2500
Methyl Chloride	74-87-3	15000
Methyl Chloroformate	79-22-1	500
Methyl Ethyl Ketone Peroxide (concentration > 60%)	1338-23-4	5000
Methyl Fluoroacetate	453-18-9	100
Methyl Fluorosulfate	421-20-5	100
Methyl Hydrazine	60-34-4	100
Methyl Iodide	74-88-4	7500
Methyl Isocyanate	624-83-9	250
Methyl Mercaptan	74-93-1	5000
Methyl Vinyl Ketone	79-94-4	100
Methyltrichlorosilane	75-79-6	500
Nickel Carbonyl (Nickel Tetracarbonyl)	13463-39-3	150
Nitric Acid (94.5% by weight or greater)	7697-37-2	500
Nitric Oxide	10102-43-9	250
Nitroaniline (para Nitroaniline)	100-01-6	5000
Nitromethane	75-52-5	2500
Nitrogen Dioxide	10102-44-0	250
Nitrogen Oxides (NO; NO2; N2O4; N2O3)	10102-44-0	250
Nitrogen Tetroxide (also called Nitrogen Peroxide)	10544-72-6	250
Nitrogen Trifluoride	7783-54-2	5000
Nitrogen Trioxide	10544-73-7	250

Chemical Name	CAS*	TQ**
Oleum (65% to 80% by weight; also called Fuming Sulfuric Acid)	8014-95-7	1000
Osmium Tetroxide	20816-12-0	100
Oxygen Difluoride (Fluorine Monoxide)	7783-41-7	100
Ozone	10028-15-6	100
Pentaborane	19624-22-7	100
Peracetic Acid (concentration > 60% Acetic Acid; also called Peroxyacetic Acid)	79-21-0	1000
Perchloric Acid (concentration > 60% by weight)	7601-90-3	5000
Perchloromethyl Mercaptan	594-42-3	150
Perchloryl Fluoride	7616-94-6	5000
Peroxyacetic Acid (concentration > 60% Acetic Acid; also called Peracetic Acid)	79-21-0	1000
Phosgene (also called Carbonyl Chloride)	75-44-5	100
Phosphine (Hydrogen Phosphide)	7803-51-2	100
Phosphorus Oxychloride (also called Phosphoryl Chloride)	10025-87-3	1000
Phosphorus Trichloride	7719-12-2	1000
Phosphoryl Chloride (also called Phosphorus Oxychloride)	10025-87-3	1000
Propargyl Bromide	106-96-7	100
Propyl Nitrate	627-3-4	2500
Sarin	107-44-8	100
Selenium Hexafluoride	7783-79-1	1000
Stibine (Antimony Hydride)	7803-52-3	500
Sulfur Dioxide (liquid)	7446-09-5	1000
Sulfur Pentafluoride	5714-22-7	250
Sulfur Tetrafluoride	7783-60-0	250
Sulfur Trioxide (also called Sulfuric Anhydride)	7446-11-9	1000
Sulfuric Anhydride (also called Sulfur Trioxide)	7446-11-9	1000
Tellurium Hexafluoride	7783-80-4	250
Tetrafluoroethylene	116-14-3	5000
Tetrafluorohydrazine	10036-47-2	5000
Tetramethyl Lead	75-74-1	1000
Thionyl Chloride	7719-09-7	250
Trichloro (chloromethyl) Silane	1558-25-4	100
Trichloro (dichlorophenyl) Silane	27137-85-5	2500
Trichlorosilane	10025-78-2	5000
Trifluorochloroethylene	79-38-9	10000
Trimethyoxysilane	2487-90-3	1500

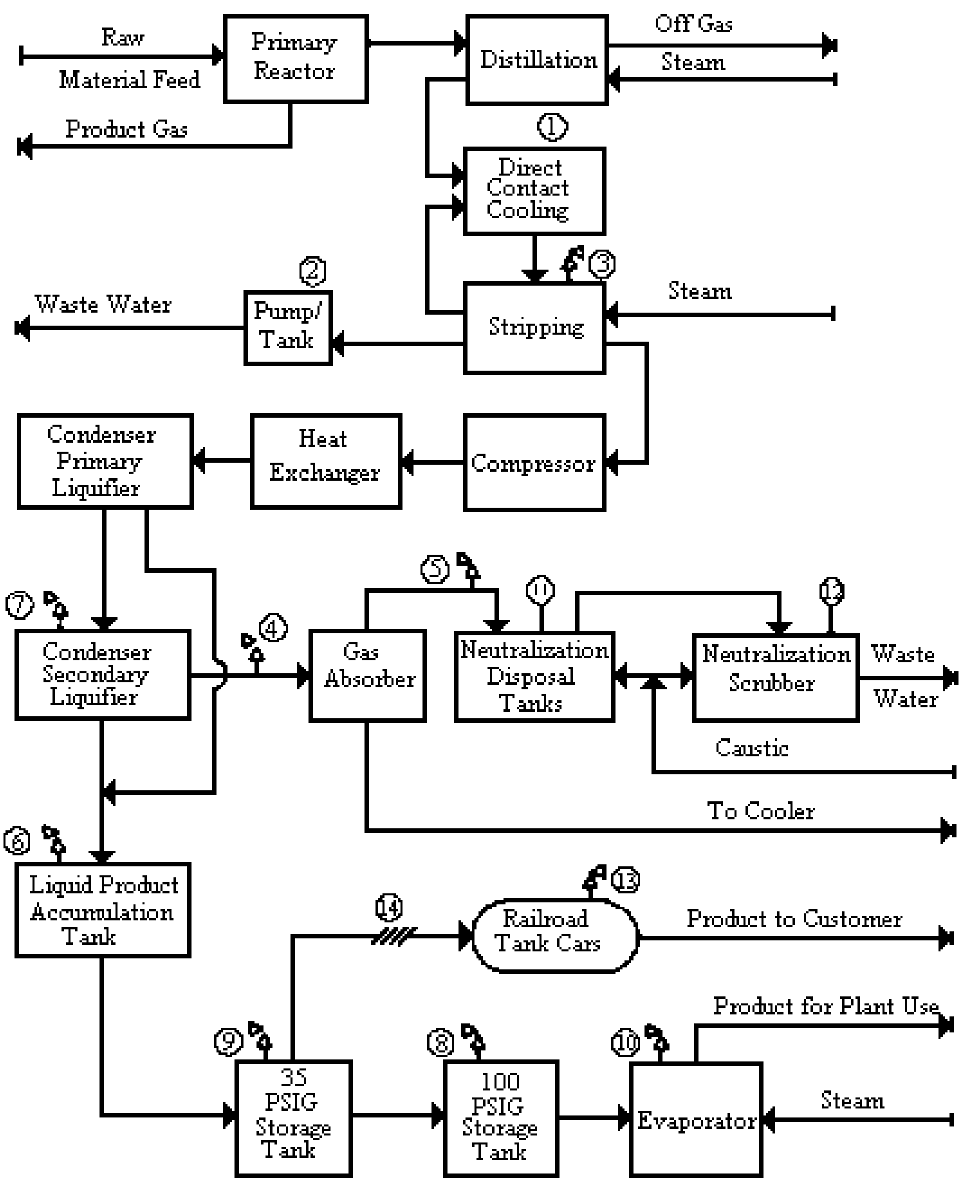
* Chemical Abstract Service Number.

** Threshold Quantity in Pounds (Amount necessary to be covered by this standard).

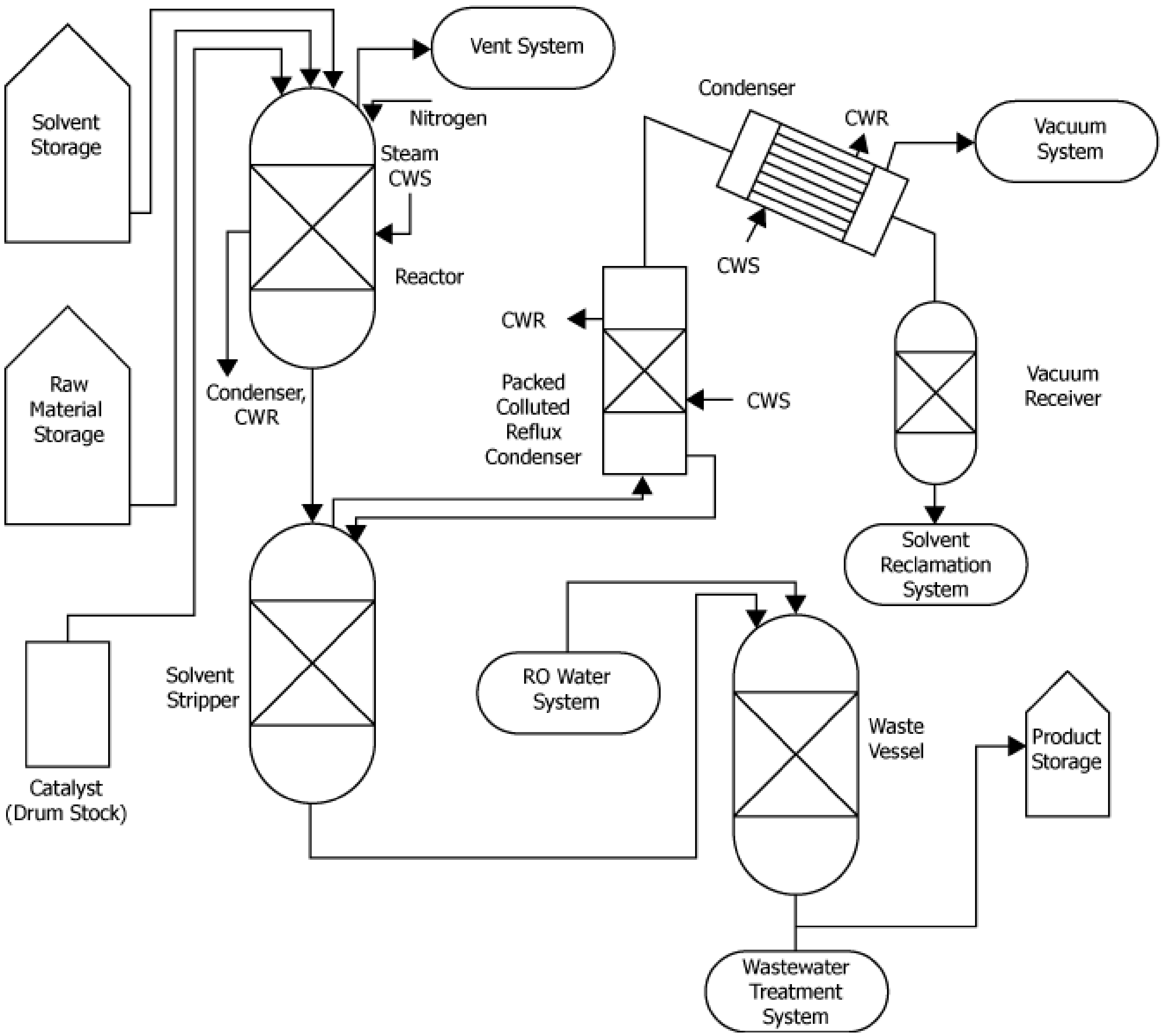
Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats Implemented: ORS 654.001 through 654.295.
Hist: OR-OSHA Admin. Order 8-1992, f. 8/13/92, ef. 11/24/92.
OR-OSHA Admin. Order 1-2012, f. 4/10/12, ef. 4/10/12.
OR-OSHA Admin. Order 5-2012, f. 9/25/12, ef. 9/25/12.
OR-OSHA Admin. Order 3-2019, f. 10/29/19, ef. 10/29/19.

Appendix B to 1910.119 - Block Flow Diagram and Simplified Process Flow Diagram (Nonmandatory)

Example of a Block Flow Diagram



Example of a Process Flow Diagram



Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: OR-OSHA Admin. Order 8-1992, f. 8/13/92, ef. 11/24/92.

Appendix C to 1910.119 - Compliance Guidelines and Recommendations for Process Safety Management (Nonmandatory)

This appendix serves as a nonmandatory guideline to assist employers and employees in complying with the requirements of this section, as well as provides other helpful recommendations and information. Examples presented in this appendix are not the only means of achieving the performance goals in the standard. This appendix neither adds nor detracts from the requirements of the standard.

1. Introduction to Process Safety Management. The major objective of process safety management of highly hazardous chemicals is to prevent unwanted releases of hazardous chemicals especially into locations which could expose employees and others to serious hazards. An effective process safety management program requires a systematic approach to evaluating the whole process. Using this approach the process design, process technology, operational and maintenance activities and procedures, nonroutine activities and procedures, emergency preparedness plans and procedures, training programs, and other elements which impact the process are all considered in the evaluation. The various lines of defense that have been incorporated into the design and operation of the process to prevent or mitigate the release of hazardous chemicals need to be evaluated and strengthened to assure their effectiveness at each level. Process safety management is the proactive identification, evaluation and mitigation or prevention of chemical releases that could occur as a result of failures in process, procedures or equipment.

   The process safety management standard targets highly hazardous chemicals that have the potential to cause a catastrophic incident. This standard as a whole is to aid employers in their efforts to prevent or mitigate episodic chemical releases that could lead to a catastrophe in the workplace and possibly to the surrounding community. To control these types of hazards, employers need to develop the necessary expertise, experiences, judgement and proactive initiative within their workforce to properly implement and maintain an effective process safety management program as envisioned in the OSHA standard. This OSHA standard is required by the Clean Air Act Amendments as is the Environmental Protection Agency's Risk Management Plan. Employers, who merge the two sets of requirements into their process safety management program, will better assure full compliance with each as well as enhancing their relationship with the local community.

While OSHA believes process safety management will have a positive effect on the safety of employees in workplaces and also offers other potential benefits to employers (increased productivity), smaller businesses which may have limited resources available to them at this time, might consider alternative avenues of decreasing the risks associated with highly hazardous chemicals at their workplaces. One method which might be considered is the reduction in the inventory of the highly hazardous chemical. This reduction in inventory will result in a reduction of the risk or potential for a catastrophic incident. Also, employers including small employers may be able to establish more efficient inventory control by reducing the quantities of highly hazardous chemicals on site below the established threshold quantities. This reduction can be accomplished by ordering smaller shipments and maintaining the minimum inventory necessary for efficient and safe operation. When reduced inventory is not feasible, then the employer might consider dispersing inventory to several locations on site. Dispersing storage into locations where a release in one location will not cause a release in another location is a practical method to also reduce the risk or potential for catastrophic incidents.

2. Employee Involvement in Process Safety Management. Section 304 of the Clean Air Act Amendments states that employers are to consult with their employees and their representatives regarding the employers efforts in the development and implementation of the process safety management program elements and hazard assessments. Section 304 also requires employers to train and educate their employees and to inform affected employees of the findings from incident investigations required by the process safety management program. Many employers, under their safety and health programs, have already established means and methods to keep employees and their representatives informed about relevant safety and health issues and employers may be able to adapt these practices and procedures to meet their obligations under this standard. Employers who have not implemented an occupational safety and health program may wish to form a safety and health committee of employees and management representatives to help the employer meet the obligations specified by this standard. These committees can become a significant ally in helping the employer to implement and maintain an effective process safety management program for all employees.

3. Process Safety Information. Complete and accurate written information concerning process chemicals, process technology, and process equipment is essential to an effective process safety management program and to a process hazards analysis. The compiled information will be a necessary resource to a variety of users including the team that will perform the process hazards analysis as required under paragraph (e); those developing the training programs and the operating procedures; contractors whose employees will be working with the process; those conducting the pre-startup reviews; local emergency preparedness planners; and insurance and enforcement officials.

   The information to be compiled about the chemicals, including process intermediates, needs to be comprehensive enough for an accurate assessment of the fire and explosion characteristics, reactivity hazards, the safety and health hazards to workers, and the corrosion and erosion effects on the process equipment and monitoring tools. Current safety data sheet (SDS) information can be used to help meet this requirement which must be supplemented with process chemistry information including runaway reaction and over pressure hazards if applicable.

   Process technology information will be a part of the process safety information package and it is expected that it will include diagrams of the type shown in Appendix B of this section as well as employer established criteria for maximum inventory levels for process chemicals; limits beyond which would be considered upset conditions; and a qualitative estimate of the consequences or results of deviation that could occur if operating beyond the established process limits. Employers are encouraged to use diagrams which will help users understand the process.

   A block flow diagram is used to show the major process equipment and interconnecting process flow lines and show flow rates, stream composition, temperatures, and pressures when necessary for clarity. The block flow diagram is a simplified diagram.

   Process flow diagrams are more complex and will show all main flow streams including valves to enhance the understanding of the process, as well as pressures and temperatures on all feed and product lines within all major vessels, in and out of headers and heat exchangers, and points of pressure and temperature control. Also, materials of construction information, pump capacities and pressure heads, compressor horsepower and vessel design pressures and temperatures are shown when necessary for clarity. In addition, major components of control loops are usually shown along with key utilities on process flow diagrams.

Piping and instrument diagrams (P&IDs) may be the more appropriate type of diagrams to show some of the above details and to display the information for the piping designer and engineering staff. The P&IDs are to be used to describe the relationships between equipment and instrumentation as well as other relevant information that will enhance clarity. Computer software programs which do P&IDs or other diagrams useful to the information package, may be used to help meet this requirement.

The information pertaining to process equipment design must be documented. In other words, what were the codes and standards relied on to establish good engineering practice. These codes and standards are published by such organizations as the American Society of Mechanical Engineers, American Petroleum Institute, American National Standards Institute, National Fire Protection Association, American Society for Testing and Materials, National Board of Boiler and Pressure Vessel Inspectors, National Association of Corrosion Engineers, American Society of Exchange Manufacturers Association, and model building code groups.

In addition, various engineering societies issue technical reports which impact process design. For example, the American Institute of Chemical Engineers has published technical reports on topics such as two phase flow for venting devices. This type of technically recognized report would constitute good engineering practice.

For existing equipment designed and constructed many years ago in accordance with the codes and standards available at that time and no longer in general use today, the employer must document which codes and standards were used and that the design and construction along with the testing, inspection and operation are still suitable for the intended use. Where the process technology requires a design which departs from the applicable codes and standards, the employer must document that the design and construction is suitable for the intended purpose.

4. Process Hazard Analysis. A process hazard analysis (PHA), sometimes called a process hazard evaluation, is one of the most important elements of the process safety management program. A PHA is an organized and systematic effort to identify and analyze the significance of potential hazards associated with the processing or handling of highly hazardous chemicals. A PHA provides information which will assist employers and employees in making decisions for improving safety and reducing the consequences of unwanted or unplanned releases of hazardous chemicals. A PHA is directed toward analyzing potential causes and consequences of fires, explosions, releases of toxic or flammable chemicals and major spills of hazardous chemicals. The PHA focuses on equipment, instrumentation, utilities, human actions (routine and nonroutine), and external factors that might impact the process. These considerations assist in determining the hazards and potential failure points or failure modes in a process.

   The selection of a PHA methodology or technique will be influenced by many factors including the amount of existing knowledge about the process. Is it a process that has been operated for a long period of time with little or no innovation and extensive experience has been generated with its use? Or, is it a new process or one which has been changed frequently by the inclusion of innovative features? Also, the size and complexity of the process will influence the decision as to the appropriate PHA methodology to use. All PHA methodologies are subject to certain limitations. For example, the checklist methodology works well when the process is very stable and no changes are made, but it is not as effective when the process has undergone extensive change. The checklist may miss the most recent changes and consequently the changes would not be evaluated. Another limitation to be considered concerns the assumptions made by the team or analyst. The PHA is dependent on good judgment and the assumptions made during the study need to be documented and understood by the team and reviewer and kept for a future PHA.

The team conducting the PHA need to understand the methodology that is going to be used. A PHA team can vary in size from two people to a number of people with varied operational and technical backgrounds. Some team members may only be a part of the team for a limited time. The team leader needs to be fully knowledgeable in the proper implementation of the PHA methodology that is to be used and should be impartial in the evaluation. The other full- or part-time team members need to provide the team with expertise in areas such as process technology, process design, operating procedures and practices, including how the work is actually performed, alarms, emergency procedures, instrumentation, maintenance procedures, both routine and nonroutine tasks, including how the tasks are authorized, procurement of parts and supplies, safety and health, and any other relevant subject as the need dictates. At least one team member must be familiar with the process.

The ideal team will have an intimate knowledge of the standards, codes, specifications and regulations applicable to the process being studied. The selected team members need to be compatible and the team leader needs to be able to manage the team and the PHA study. The team needs to be able to work together while benefiting from the expertise of others on the team or outside the team, to resolve issues, and to forge a consensus on the findings of the study and the recommendations.

The application of a PHA to a process may involve the use of different methodologies for various parts of the process. For example, a process involving a series of unit operations of varying sizes, complexities, and ages may use different methodologies and team members for each operation. Then the conclusions can be integrated into one final study and evaluation. A more specific example is the use of a checklist PHA for a standard boiler or heat exchanger and the use of a Hazard and Operability PHA for the overall process. Also, for batch type processes like custom batch operations, a generic PHA of a representative batch may be used where there are only small changes of monomer or other ingredient ratios and the chemistry is documented for the full range and ratio of batch ingredients. Another process that might consider using a generic type of PHA is a gas plant. Often these plants are simply moved from site to site and therefore, a generic PHA may be used for these movable plants. Also, when an employer has several similar size gas plants and no sour gas is being processed at the site, then a generic PHA is feasible as long as the variations of the individual sites are accounted for in the PHA. Finally, when an employer has a large continuous process which has several control rooms for different portions of the process such as for a distillation tower and a blending operation, the employer may wish to do each segment separately and then integrate the final results.

Additionally, small businesses which are covered by this rule, will often have processes that have less storage volume, less capacity, and less complicated than processes at a large facility. Therefore, OSHA would anticipate that the less complex methodologies would be used to meet the process hazard analysis criteria in the standard. These process hazard analyses can be done in less time and with a few people being involved. A less complex process generally means that less data, P&IDs, and process information is needed to perform a process hazard analysis.

Many small businesses have processes that are not unique, such as cold storage lockers or water treatment facilities. Where employer associations have a number of members with such facilities, a generic PHA, evolved from a checklist or what-if questions, could be developed and used by each employer effectively to reflect his/her particular process; this would simplify compliance for them.

When the employer has a number of processes which require a PHA, the employer must set up a priority system of which PHAs to conduct first. A preliminary or gross hazard analysis may be useful in prioritizing the processes that the employer has determined are subject to coverage by the process safety management standard. Consideration should first be given to those processes with the potential of adversely affecting the largest number of employees. This prioritizing should consider the potential severity of a chemical release, the number of potentially affected employees, the operating history of the process such as the frequency of chemical releases, the age of the process and any other relevant factors. These factors would suggest a ranking order and would suggest either using a weighing factor system or a systematic ranking method. The use of a preliminary hazard analysis would assist an employer in determining which process should be of the highest priority and thereby the employer would obtain the greatest improvement in safety at the facility.

Detailed guidance on the content and application of process hazard analysis methodologies is available from the American Institute of Chemical Engineers' Center for Chemical Process Safety (see Appendix D).

5. Operating Procedures and Practices. Operating procedures describe tasks to be performed, data to be recorded, operating conditions to be maintained, samples to be collected, and safety and health precautions to be taken. The procedures need to be technically accurate, understandable to employees, and revised periodically to ensure that they reflect current operations. The process safety information package is to be used as a resource to better assure that the operating procedures and practices are consistent with the known hazards of the chemicals in the process and that the operating parameters are accurate. Operating procedures should be reviewed by engineering staff and operating personnel to ensure that they are accurate and provide practical instructions on how to actually carry out job duties safely.

   Operating procedures will include specific instructions or details on what steps are to be taken or followed in carrying out the stated procedures. These operating instructions for each procedure should include the applicable safety precautions and should contain appropriate information on safety implications. For example, the operating procedures addressing operating parameters will contain operating instructions about pressure limits, temperature ranges, flow rates, what to do when an upset condition occurs, what alarms and instruments are pertinent if an upset condition occurs, and other subjects. Another example of using operating instructions to properly implement operating procedures is in starting up or shutting down the process. In these cases, different parameters will be required from those of normal operation. These operating instructions need to clearly indicate the distinctions between startup and normal operations such as the appropriate allowances for heating up a unit to reach the normal operating parameters. Also the operating instructions need to describe the proper method for increasing the temperature of the unit until the normal operating temperature parameters are achieved.

   Computerized process control systems add complexity to operating instructions. These operating instructions need to describe the logic of the software as well as the relationship between the equipment and the control system; otherwise, it may not be apparent to the operator.

Operating procedures and instructions are important for training operating personnel. The operating procedures are often viewed as the standard operating practices (SOPs) for operations. Control room personnel and operating staff, in general, need to have a full understanding of operating procedures. If workers are not fluent in English then procedures and instructions need to be prepared in a second language understood by the workers. In addition, operating procedures need to be changed when there is a change in the process as a result of the management of change procedures. The consequences of operating procedure changes need to be fully evaluated and the information conveyed to the personnel. For example, mechanical changes to the process made by the maintenance department (like changing a valve from steel to brass or other subtle changes) need to be evaluated to determine if operating procedures and practices also need to be changed. All management of change actions must be coordinated and integrated with current operating procedures and operating personnel must be oriented to the changes in procedures before the change is made. When the process is shutdown in order to make a change, then the operating procedures must be updated before startup of the process.

Training in how to handle upset conditions must be accomplished as well as what operating personnel are to do in emergencies such as when a pump seal fails or a pipeline ruptures. Communication between operating personnel and workers performing work within the process area, such as nonroutine tasks, also must be maintained. The hazards of the tasks are to be conveyed to operating personnel in accordance with established procedures and to those performing the actual tasks. When the work is completed, operating personnel should be informed to provide closure on the job.

6. Employee Training. All employees, including maintenance and contractor employees, involved with highly hazardous chemicals need to fully understand the safety and health hazards of the chemicals and processes they work with for the protection of themselves, their fellow employees and the citizens of nearby communities. Training conducted in compliance with 1910.1200, the Hazard Communication standard, will help employees to be more knowledgeable about the chemicals they work with as well as familiarize them with reading and understanding SDS. However, additional training in subjects such as operating procedures and safety work practices, emergency evacuation and response, safety procedures, routine and nonroutine work authorization activities, and other areas pertinent to process safety and health will need to be covered by an employer's training program.

In establishing their training programs, employers must clearly define the employees to be trained and what subjects are to be covered in their training. Employers in setting up their training program will need to clearly establish the goals and objectives they wish to achieve with the training that they provide to their employees. The learning goals or objectives should be written in clear measurable terms before the training begins. These goals and objectives need to be tailored to each of the specific training modules or segments. Employers should describe the important actions and conditions under which the employee will demonstrate competence or knowledge as well as what is acceptable performance.

Hands-on-training where employees are able to use their senses beyond listening, will enhance learning. For example, operating personnel, who will work in a control room or at control panels, would benefit by being trained at a simulated control panel or panels. Upset conditions of various types could be displayed on the simulator, and then the employee could go through the proper operating procedures to bring the simulator panel back to the normal operating parameters. A training environment could be created to help the trainee feel the full reality of the situation but, of course, under controlled conditions. This realistic type of training can be very effective in teaching employees correct procedures while allowing them to also see the consequences of what might happens if they do not follow established operating procedures. Other training techniques using videos or on-the-job training can also be very effective for teaching other job tasks, duties, or other important information. An effective training program will allow the employee to fully participate in the training process and to practice their skill or knowledge.

Employers need to periodically evaluate their training programs to see if the necessary skills, knowledge, and routines are being properly understood and implemented by their trained employees. The means or methods for evaluating the training should be developed along with the training program goals and objectives. Training program evaluation will help employers to determine the amount of training their employees understood, and whether the desired results were obtained. If, after the evaluation, it appears that the trained employees are not at the level of knowledge and skill that was expected, the employer will need to revise the training program, provide retraining, or provide more frequent refresher training sessions until the deficiency is resolved. Those who conducted the training and those who received the training should also be consulted as to how best to improve the training process. If there is a language barrier, the language known to the trainees should be used to reinforce the training messages and information.

Careful consideration must be given to assure that employees including maintenance and contract employees receive current and updated training. For example, if changes are made to a process, impacted employees must be trained in the changes and understand the effects of the changes on their job tasks (e.g., any new operating procedures pertinent to their tasks). Additionally, as already discussed the evaluation of the employee's absorption of training will certainly influence the need for training.

7. Contractors. Employers who use contractors to perform work in and around processes that involve highly hazardous chemicals, will need to establish a screening process so that they hire and use contractors who accomplish the desired job tasks without compromising the safety and health of employees at a facility. For contractors, whose safety performance on the job is not known to the hiring employer, the employer will need to obtain information on injury and illness rates and experience and should obtain contractor references. Additionally, the employer must assure that the contractor has the appropriate job skills, knowledge and certifications (such as for pressure vessel welders). Contractor work methods and experiences should be evaluated. For example, does the contractor conducting demolition work swing loads over operating processes or does the contractor avoid such hazards?

Maintaining a site injury and illness log for contractors is another method employers must use to track and maintain current knowledge of work activities involving contract employees working on or adjacent to covered processes. Injury and illness logs of both the employer's employees and contract employees allow an employer to have full knowledge of process injury and illness experience. This log will also contain information which will be of use to those auditing process safety management compliance and those involved in incident investigations.

Contract employees must perform their work safely. Considering that contractors often perform very specialized and potentially hazardous tasks such as confined space entry activities and nonroutine repair activities it is quite important that their activities be controlled while they are working on or near a covered process. A permit system or work authorization system for these activities would also be helpful to all affected employers. The use of a work authorization system keeps an employer informed of contract employee activities, and as a benefit the employer will have better coordination and more management control over the work being performed in the process area. A well run and well maintained process where employee safety is fully recognized will benefit all of those who work in the facility whether they be contract employees or employees of the owner.

8. Pre-Startup Safety. For new processes, the employer will find a PHA helpful in improving the design and construction of the process from a reliability and quality point of view. The safe operation of the new process will be enhanced by making use of the PHA recommendations before final installations are completed. P&IDs are to be completed along with having the operating procedures in place and the operating staff trained to run the process before startup. The initial startup procedures and normal operating procedures need to be fully evaluated as part of the pre-startup review to assure a safe transfer into the normal operating mode for meeting the process parameters.

   For existing processes that have been shutdown for turnaround, or modification, etc., the employer must assure that any changes other than "replacement in kind" made to the process during shutdown go through the management of change procedures. P&IDs will need to be updated as necessary, as well as operating procedures and instructions. If the changes made to the process during shutdown are significant and impact the training program, then operating personnel as well as employees engaged in routine and nonroutine work in the process area may need some refresher or additional training in light of the changes. Any incident investigation recommendations, compliance audits or PHA recommendations need to be reviewed as well to see what impacts they may have on the process before beginning the startup.

9. Mechanical Integrity. Employers will need to review their maintenance programs and schedules to see if there are areas where "breakdown" maintenance is used rather than an on-going mechanical integrity program. Equipment used to process, store, or handle highly hazardous chemicals needs to be designed, constructed, installed and maintained to minimize the risk of releases of such chemicals. This requires that a mechanical integrity program be in place to assure the continued integrity of process equipment. Elements of a mechanical integrity program include the identification and categorization of equipment and instrumentation, inspections and tests, testing and inspection frequencies, development of maintenance procedures, training of maintenance personnel, the establishment of criteria for acceptable test results, documentation of test and inspection results, and documentation of manufacturer recommendations as to meantime to failure for equipment and instrumentation.

The first line of defense an employer has available is to operate and maintain the process as designed, and to keep the chemicals contained. This line of defense is backed up by the next line of defense which is the controlled release of chemicals through venting to scrubbers or flares, or to surge or overflow tanks which are designed to receive such chemicals, etc. These lines of defense are the primary lines of defense or means to prevent unwanted releases. The secondary lines of defense would include fixed fire protection systems like sprinklers, water spray, or deluge systems, monitor guns, etc., dikes, designed drainage systems, and other systems which would control or mitigate hazardous chemicals once an unwanted release occurs. These primary and secondary lines of defense are what the mechanical integrity program needs to protect and strengthen these primary and secondary lines of defenses where appropriate.

The first step of an effective mechanical integrity program is to compile and categorize a list of process equipment and instrumentation for inclusion in the program. This list would include pressure vessels, storage tanks, process piping, relief and vent systems, fire protection system components, emergency shutdown systems and alarms and interlocks and pumps. For the categorization of instrumentation and the listed equipment the employer would prioritize which pieces of equipment require closer scrutiny than others. Meantime to failure of various instrumentation and equipment parts would be known from the manufacturers data or the employer’s experience with the parts, which would then influence the inspection and testing frequency and associated procedures. Also, applicable codes and standards such as the National Board Inspection Code, or those from the American Society for Testing and Material, American Petroleum Institute, National Fire Protection Association, American National Standards Institute, American Society of Mechanical Engineers, and other groups, provide information to help establish an effective testing and inspection frequency, as well as appropriate methodologies.

The applicable codes and standards provide criteria for external inspections for such items as foundation and supports, anchor bolts, concrete or steel supports, guy wires, nozzles and sprinklers, pipe hangers, grounding connections, protective coatings and insulation, and external metal surfaces of piping and vessels, etc. These codes and standards also provide information on methodologies for internal inspection, and a frequency formula based on the corrosion rate of the materials of construction. Also, erosion both internal and external needs to be considered along with corrosion effects for piping and valves. Where the corrosion rate is not known, a maximum inspection frequency is recommended, and methods of developing the corrosion rate are available in the codes. Internal inspections need to cover items such as vessel shell, bottom and head; metallic linings; nonmetallic linings; thickness measurements for vessels and piping; inspection for erosion, corrosion, cracking and bulges; internal equipment like trays, baffles, sensors and screens for erosion, corrosion or cracking and other deficiencies. Some of these inspections may be performed by state or local government inspectors under state and local statutes. However, each employer needs to develop procedures to ensure that tests and inspections are conducted properly and that consistency is maintained even where different employees may be involved. Appropriate training is to be provided to maintenance personnel to ensure that they understand the preventive maintenance program procedures, safe practices, and the proper use and application of special equipment or unique tools that may be required. This training is part of the overall training program called for in the standard.

A quality assurance system is needed to help ensure that the proper materials of construction are used, that fabrication and inspection procedures are proper, and that installation procedures recognize field installation concerns. The quality assurance program is an essential part of the mechanical integrity program and will help to maintain the primary and secondary lines of defense that have been designed into the process to prevent unwanted chemical releases or those which control or mitigate a release. “As built” drawings, together with certifications of coded vessels and other equipment, and materials of construction need to be verified and retained in the quality assurance documentation. Equipment installation jobs need to be properly inspected in the field for use of proper materials and procedures and to assure that qualified craftsmen are used to do the job. The use of appropriate gaskets, packing, bolts, valves, lubricants and welding rods need to be verified in the field. Also, procedures for installation of safety devices need to be verified, such as the torque on the bolts on ruptured disc installations, uniform torque on flange bolts, proper installation of pump seals, etc. If the quality of parts is a problem, it may be appropriate to conduct audits of the equipment supplier’s facilities to better assure proper purchases of required equipment which is suitable for its intended service. Any changes in equipment that may become necessary will need to go through the management of change procedures.

10. Nonroutine Work Authorizations. Nonroutine work which is conducted in process areas needs to be controlled by the employer in a consistent manner. The hazards identified involving the work that is to be accomplished must be communicated to those doing the work, but also to those operating personnel whose work could affect the safety of the process. A work authorization notice or permit must have a procedure that describes the steps the maintenance supervisor, contractor representative or other person needs to follow to obtain the necessary clearance to get the job started. The work authorization procedures need to reference and coordinate, as applicable, lockout/tagout procedures, line breaking procedures, confined space entry procedures and hot work authorizations. This procedure also needs to provide clear steps to follow once the job is completed in order to provide closure for those that need to know the job is now completed and equipment can be returned to normal.

11. Managing Change. To properly manage changes to process chemicals, technology, equipment and facilities, one must define what is meant by change. In this process safety management standard, change includes all modifications to equipment, procedures, raw materials and processing conditions other than “replacement in kind.” These changes need to be properly managed by identifying and reviewing them prior to implementation of the change. For example, the operating procedures contain the operating parameters (pressure limits, temperature ranges, flow rates, etc.) and the importance of operating within these limits. While the operator must have the flexibility to maintain safe operation within the established parameters, any operation outside of these parameters requires review and approval by a written management of change procedure.

Management of change covers such as changes in process technology and changes to equipment and instrumentation. Changes in process technology can result from changes in production rates, raw materials, experimentation, equipment unavailability, new equipment, new product development, change in catalyst and changes in operating conditions to improve yield or quality. Equipment changes include among others change in materials of construction, equipment specifications, piping pre-arrangements, experimental equipment, computer program revisions and changes in alarms and interlocks. Employers need to establish means and methods to detect both technical changes and mechanical changes.

Temporary changes have caused a number of catastrophes over the years, and employers need to establish ways to detect temporary changes as well as those that are permanent. It is important that a time limit for temporary changes be established and monitored since, without control, these changes may tend to become permanent. Temporary changes are subject to the management of change provisions. In addition, the management of change procedures are used to insure that the equipment and procedures are returned to their original or designed conditions at the end of the temporary change. Proper documentation and review of these changes is invaluable in assuring that the safety and health considerations are being incorporated into the operating procedures and the process.

Employers may wish to develop a form or clearance sheet to facilitate the processing of changes through the management of change procedures. A typical change form may include a description and the purpose of the change, the technical basis for the change, safety and health considerations, documentation of changes for the operating procedures, maintenance procedures, inspection and testing, P&IDs, electrical classification, training and communications, pre-startup inspection, duration if a temporary change, approvals and authorization. Where the impact of the change is minor and well understood, a check list reviewed by an authorized person with proper communication to others who are affected may be sufficient. However, for a more complex or significant design change, a hazard evaluation procedure with approvals by operations, maintenance, and safety departments may be appropriate. Changes in documents such as P&IDs, raw materials, operating procedures, mechanical integrity programs, electrical classifications, etc., need to be noted so that these revisions can be made permanent when the drawings and procedure manuals are updated. Copies of process changes need to be kept in an accessible location to ensure that design changes are available to operating personnel as well as to PHA team members when a PHA is being done or one is being updated.

12. Investigation of Incidents. Incident investigation is the process of identifying the underlying causes of incidents and implementing steps to prevent similar events from occurring. The intent of an incident investigation is for employers to learn from past experiences and thus avoid repeating past mistakes. The incidents for which OSHA expects employers to become aware and to investigate are the types of events which result in or could reasonably have resulted in a catastrophic release. Some of the events are sometimes referred to as “near misses,” meaning that a serious consequence did not occur, but could have.

Employers need to develop in-house capability to investigate incidents that occur in their facilities. A team needs to be assembled by the employer and trained in the techniques of investigation including how to conduct interviews of witnesses, needed documentation and report writing. A multidisciplinary team is better able to gather the facts of the event and to analyze them and develop plausible scenarios as to what happened, and why. Team members should be selected on the basis of their training, knowledge and ability to contribute to a team effort to fully investigate the incident. Employees in the process area where the incident occurred should be consulted, interviewed or made a member of the team. Their knowledge of the events form a significant set of facts about the incident which occurred. The report, its findings and recommendations are to be shared with those who can benefit from the information. The cooperation of employees is essential to an effective incident investigation. The focus of the investigation should be to obtain facts, and not to place blame. The team and the investigation process should clearly deal with all involved individuals in a fair, open and consistent manner.

13. Emergency Preparedness. Each employer must address what actions employees are to take when there is an unwanted release of highly hazardous chemicals. Emergency preparedness or the employer's tertiary (third) lines of defense are those that will be relied on along with the secondary lines of defense when the primary lines of defense which are used to prevent an unwanted release fail to stop the release. Employers will need to decide if they want employees to handle and stop small or minor incidental releases. Whether they wish to mobilize the available resources at the plant and have them brought to bear on a more significant release. Or whether employers want their employees to evacuate the danger area and promptly escape to a preplanned safe zone area, and allow the local community emergency response organizations to handle the release. Or whether the employer wants to use some combination of these actions. Employers will need to select how many different emergency preparedness or tertiary lines of defense they plan to have and then develop the necessary plans and procedures, and appropriately train employees in their emergency duties and responsibilities and then implement these lines of defense.

Employers at a minimum must have an emergency action plan which will facilitate the prompt evacuation of employees when an unwanted release of highly hazardous chemical. This means that the employer will have a plan that will be activated by an alarm system to alert employees when to evacuate and, that employees who are physically impaired, will have the necessary support and assistance to get them to the safe zone as well. The intent of these requirements is to alert and move employees to a safe zone quickly. Delaying alarms or confusing alarms are to be avoided. The use of process control centers or similar process buildings in the process area as safe areas is discouraged. Recent catastrophes have shown that a large life loss has occurred in these structures because of where they have been sited and because they are not necessarily designed to withstand overpressures from shock waves resulting from explosions in the process area.

Unwanted incidental releases of highly hazardous chemicals in the process area must be addressed by the employer as to what actions employees are to take. If the employer wants employees to evacuate the area, then the emergency action plan will be activated. For outdoor processes where wind direction is important for selecting the safe route to a refuge area, the employer should place a wind direction indicator such as a wind sock or pennant at the highest point that can be seen throughout the process area. Employees can move in the direction of cross wind to upwind to gain safe access to the refuge area by knowing the wind direction.

If the employer wants specific employees in the release area to control or stop the minor emergency or incidental release, these actions must be planned for in advance and procedures developed and implemented. Preplanning for handling incidental releases for minor emergencies in the process area needs to be done, appropriate equipment for the hazards must be provided, and training conducted for those employees who will perform the emergency work before they respond to handle an actual release. The employer’s training program, including the Hazard Communication standard training is to address the training needs for employees who are expected to handle incidental or minor releases.

Preplanning for releases that are more serious than incidental releases is another important line of defense to be used by the employer. When a serious release of a highly hazardous chemical occurs, the employer through pre-planning will have determined in advance what actions employees are to take. The evacuation of the immediate release area and other areas as necessary would be accomplished under the emergency action plan. If the employer wishes to use plant personnel such as a fire brigade, spill control team, a hazardous materials team, or use employees to render aid to those in the immediate release area and control or mitigate the incident, these actions are covered by 1910.120, the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard. If outside assistance is necessary, such as through mutual aid agreements between employers or local government emergency response organizations, these emergency responders are also covered by HAZWOPER. The safety and health protections required for emergency responders are the responsibility of their employers and of the on-scene incident commander.

Responders may be working under very hazardous conditions and therefore the objective is to have them competently led by an on-scene incident commander and the commander's staff, properly equipped to do their assigned work safely, and fully trained to carry out their duties safely before they respond to an emergency. Drills, training exercises, or simulations with the local community emergency response planners and responder organizations is one means to obtain better preparedness. This close cooperation and coordination between plant and local community emergency preparedness managers will also aid the employer in complying with the Environmental Protection Agency's Risk Management Plan criteria.

One effective way for medium to large facilities to enhance coordination and communication during emergencies for on plant operations and with local community organizations is for employers to establish and equip an emergency control center. The emergency control center would be sited in a safe zone area so that it could be occupied throughout the duration of an emergency. The center would serve as the major communication link between the on-scene incident commander and plant or corporate management as well as with the local community officials. The communication equipment in the emergency control center should include a network to receive and transmit information by telephone, radio or other means. It is important to have a backup communication network in case of power failure or one communication means fails. The center should also be equipped with the plant layout and community maps, utility drawings including fire water, emergency lighting, appropriate reference materials such as a government agency notification list, company personnel phone list, SARA Title III reports and safety data sheets, emergency plans and procedures manual, a listing with the location of emergency response equipment, mutual aid information, and access to meteorological or weather condition data and any dispersion modeling data.

14. Compliance Audits. Employers need to select a trained individual or assemble a trained team of people to audit the process safety management system and program. A small process or plant may need only one knowledgeable person to conduct an audit. The audit is to include an evaluation of the design and effectiveness of the process safety management system and a field inspection of the safety and health conditions and practices to verify that the employer's systems are effectively implemented. The audit should be conducted or lead by a person knowledgeable in audit techniques and who is impartial towards the facility or area being audited. The essential elements of an audit program include planning, staffing, conducting the audit, evaluation and corrective action, follow-up and documentation.

Planning in advance is essential to the success of the auditing process. Each employer needs to establish the format, staffing, scheduling and verification methods prior to conducting the audit. The format should be designed to provide the lead auditor with a procedure or checklist which details the requirements of each section of the standard. The names of the audit team members should be listed as part of the format as well. The checklist, if properly designed, could serve as the verification sheet which provides the auditor with the necessary information to expedite the review and assure that no requirements of the standard are omitted. This verification sheet format could also identify those elements that will require evaluation or a response to correct deficiencies. This sheet could also be used for developing the follow-up and documentation requirements.

The selection of effective audit team members is critical to the success of the program. Team members should be chosen for their experience, knowledge, and training and should be familiar with the processes and with auditing techniques, practices and procedures. The size of the team will vary depending on the size and complexity of the process under consideration. For a large, complex, highly instrumented plant, it may be desirable to have team members with expertise in process engineering and design, process chemistry, instrumentation and computer controls, electrical hazards and classifications, safety and health disciplines, maintenance, emergency preparedness, warehousing or shipping, and process safety auditing. The team may use part-time members to provide for the depth of expertise required as well as for what is actually done or followed, compared to what is written.

An effective audit includes a review of the relevant documentation and process safety information, inspection of the physical facilities, and interviews with all levels of plant personnel. Utilizing the audit procedure and checklist developed in the preplanning stage, the audit team can systematically analyze compliance with the provisions of the standard and any other corporate policies that are relevant. For example, the audit team will review all aspects of the training program as part of the overall audit. The team will review the written training program for adequacy of content, frequency of training, effectiveness of training in terms of its goals and objectives as well as to how it fits into meeting the standard's requirements, documentation, etc. Through interviews, the team can determine the employee's knowledge and awareness of the safety procedures, duties, rules, emergency response assignments, etc. During the inspection, the team can observe actual practices such as safety and health policies, procedures, and work authorization practices. This approach enables the team to identify deficiencies and determine where corrective actions or improvements are necessary.

An audit is a technique used to gather sufficient facts and information, including statistical information, to verify compliance with standards. Auditors should select as part of their preplanning a sample size sufficient to give a degree of confidence that the audit reflects the level of compliance with the standard. The audit team, through this systematic analysis, should document areas which require corrective action as well as those areas where the process safety management system is effective and working in an effective manner. This provides a record of the audit procedures and findings, and serves as a baseline of operation data for future audits. It will assist future auditors in determining changes or trends from previous audits.

Corrective action is one of the most important parts of the audit. It includes not only addressing the identified deficiencies, but also planning, follow-up, and documentation. The corrective action process normally begins with a management review of the audit findings. The purpose of this review is to determine what actions are appropriate, and to establish priorities, timetables, resource allocations and requirements and responsibilities. In some cases, corrective action may involve a simple change in procedure or minor maintenance effort to remedy the concern. Management of change procedures need to be used, as appropriate, even for what may seem to be a minor change. Many of the deficiencies can be acted on promptly, while some may require engineering studies or in-depth review of actual procedures and practices. There may be instances where no action is necessary and this is a valid response to an audit finding. All actions taken, including an explanation where no action is taken on a finding, needs to be documented as to what was done and why.

It is important to assure that each deficiency identified is addressed, the corrective action to be taken noted, and the audit person or team responsible be properly documented by the employer. To control the corrective action process, the employer should consider the use of a tracking system. This tracking system might include periodic status reports shared with affected levels of management, specific reports such as completion of an engineering study, and a final implementation report to provide closure for audit findings that have been through management of change, if appropriate, and then shared with affected employees and management. This type of tracking system provides the employer with the status of the corrective action. It also provides the documentation required to verify that appropriate corrective actions were taken on deficiencies identified in the audit.

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: OR-OSHA Admin. Order 8-1992, f. 8/13/92, ef. 11/24/92.
OR-OSHA Admin. Order 4-2013, f. 7/19/13, ef. 7/19/13.

Appendix D to 1910.119 - Sources of Further Information (Nonmandatory)

1. Center for Chemical Process Safety, American Institute of Chemical Engineers, 345 East 47th Street, New York, NY 10017, (212) 705-7319.
2. "Guidelines for Hazard Evaluation Procedures," American Institute of Chemical Engineers; 345 East 47th Street, New York, NY 10017.
3. "Guidelines for Technical Management of Chemical Process Safety," Center for Chemical Process Safety of the American Institute of Chemical Engineers; 345 East 47th Street, New York, NY 10017.
4. "Evaluating Process Safety in the Chemical Industry," Chemical Manufacturers Association; 2501 M Street NW, Washington, DC 20037.
5. "Safe Warehousing of Chemicals," Chemical Manufacturers Association; 2501 M Street NW, Washington, DC 20037.
6. "Management of Process Hazards," American Petroleum Institute (API Recommended Practice 750); 1220 L Street NW, Washington, DC 20005.
7. "Improving Owner and Contractor Safety Performance," American Petroleum Institute (API Recommended Practice 2220); API, 1220 L Street NW, Washington, DC 20005.
8. Chemical Manufacturers Association (CMA's Manager Guide), First Edition, September 1991; CMA, 2501 M Street NW, Washington, DC 20037.
9. "Improving Construction Safety Performance," Report A-3, The Business Roundtable; The Business Roundtable, 200 Park Avenue, New York, NY 10166. (Report includes criteria to evaluate contractor safety performance and criteria to enhance contractor safety performance.)
10. "Recommended Guidelines for Contractor Safety and Health," Texas Chemical Council; Texas Chemical Council, 1402 Nueces Street, Austin, TX 78701-1534.
11. "Loss Prevention in the Process Industries," Volumes I and II; Frank P. Lees, Butterworth; London 1983.
12. "Safety and Health Program Management Guidelines," 1989; U.S. Department of Labor, Occupational Safety and Health Administration.
13. "Safety and Health Guide for the Chemical Industry," 1986, (OSHA 3091); U.S. Department of Labor, Occupational Safety and Health Administration; 200 Constitution Avenue NW, Washington, DC 20210.

14. "Review of Emergency Systems," June 1988; U.S. Environmental Protection Agency (EPA), Office of Solid Waste and Emergency Response, Washington, DC 20460.

15. "Technical Guidance for Hazards Analysis, Emergency Planning for Extremely Hazardous Substances," December 1987; U.S. Environmental Protection Agency (EPA), Federal Emergency Management Administration (FEMA) and U.S. Department of Transportation (DOT), Washington, DC 20460.

16. "Accident Investigation * * * A New Approach," 1983, National Safety Council; 444 North Michigan Avenue, Chicago, IL 60611-3991.

17. "Fire & Explosion Index Hazard Classification Guide," 6th Edition, May 1987, Dow Chemical Company; Midland, Michigan 48674.

18. "Chemical Exposure Index," May 1988, Dow Chemical Company; Midland, Michigan 48674.

[57 FR 6403, Feb. 24, 1992; 57 FR 7847, Mar. 4, 1992 as amended at 61 FR 9238, Mar. 7, 1996]

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: OR-OSHA Admin. Order 8-1992, f. 8/13/92, ef. 11/24/92.

1910.120 Hazardous Waste Operations and Emergency Response

437-002-0101 Oregon Start-Up Date

29 CFR 1910.120, Hazardous Waste Operations and Emergency Response – Final Rules, is effective on July 14, 1990.

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: APD Admin. Order 19-1988, f. 11/17/88, ef. 11/17/88 (Hazwaste – Interim).
APD Admin. Order 12-1989, f. 7/14/89, ef. 7/14/90 (Hazwaste – Final).
OR-OSHA Admin. Order 22-1990, f. 9/28/90, ef. 10/1/90.

1910.120 (a) Scope, application, and definitions.

(1) Scope. This section covers the following operations, unless the employer can demonstrate that the operation does not involve employee exposure or the reasonable possibility for employee exposure to safety or health hazards:

(i) Clean-up operations required by a governmental body, whether Federal, state, local or other involving hazardous substances that are conducted at uncontrolled hazardous waste sites (including, but not limited to, the EPA's National Priority Site List (NPL), state priority site lists, sites recommended for the EPA NPL, and initial investigations of government identified sites which are conducted before the presence or absence of hazardous substances has been ascertained);

(ii) Corrective actions involving clean-up operations at sites covered by the Resource Conservation and Recovery Act of 1976 (RCRA) as amended (42 U.S.C. 6901 et seq.);

(iii) Voluntary clean-up operations at sites recognized by Federal, state, local or other governmental bodies as uncontrolled hazardous waste sites;

(iv) Operations involving hazardous wastes that are conducted at treatment, storage, and disposal (TSD) facilities regulated by 40 CFR Parts 264 and 265 pursuant to RCRA; or by agencies under agreement with U.S.E.P.A. to implement RCRA regulations; and

(v) Emergency response operations for releases of, or substantial threats of releases of, hazardous substances without regard to the location of the hazard.

(2) Application.

(i) All requirements of Part 1910 and Part 1926 of Title 29 of the Code of Federal Regulations apply pursuant to their terms to hazardous waste and emergency response operations whether covered by this section or not. If there is a conflict or overlap, the provision more protective of employee safety and health shall apply without regard to 29 CFR 1910.5(c)(1).

(ii) Hazardous substance clean-up operations within the scope of paragraphs (a)(1)(i) through (a)(1)(iii) of this section must comply with all paragraphs of this section except paragraphs (p) and (q).

(iii) Operations within the scope of paragraph (a)(1)(iv) of this section must comply only with the requirements of paragraph (p) of this section.

Notes and Exceptions:

(A) All provisions of paragraph (p) of this section cover any treatment, storage or disposal (TSD) operation regulated by 40 CFR Parts 264 and 265 or by state law authorized under RCRA, and required to have a permit or interim status from EPA pursuant to 40 CFR 270.1 or from a state agency pursuant to RCRA.

(B) Employers who are not required to have a permit or interim status because they are conditionally exempt small quantity generators under 40 CFR 261.5 or are generators who qualify under 40 CFR 262.34 for exemptions from regulation under 40 CFR Parts 264, 265 and 270 (“excepted employers”) are not covered by paragraphs (p)(1) through (p)(7) of this section. Excepted employers who are required by the EPA or state agency to have their employees engage in emergency response, or who direct their employees to engage in emergency response, are covered by paragraph (p)(8) of this section, and cannot be exempted by (p)(8)(i) of this section. Excepted employers who are not required to have employees engage in emergency response, who direct their employees to evacuate in the case of such emergencies and who meet the requirements of paragraph (p)(8)(i) of this section, are exempt from the balance of paragraph (p)(8) of this section.

(C) If an area is used primarily for treatment, storage or disposal, any emergency response operations in that area shall comply with paragraph (p)(8) of this section. In other areas not used primarily for treatment, storage or disposal, any emergency response operations shall comply with paragraph (q) of this section. Compliance with the requirements of paragraph (q) of this section shall be deemed to be in compliance with the requirements of paragraph (p)(8) of this section.

(iv) Emergency response operations for releases of, or substantial threats of releases of, hazardous substances which are not covered by paragraphs (a)(1)(i) through (a)(1)(iv) of this section must only comply with the requirements of paragraph (q) of this section.

(3) Definitions.

Buddy system means a system of organizing employees into work groups in such a manner that each employee of the work group is designated to be observed by at least one other employee in the work group. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.

Clean-up operation means an operation where hazardous substances are removed, contained, incinerated, neutralized, stabilized, cleared-up, or in any other manner processed or handled with the ultimate goal of making the site safer for people or the environment.

Decontamination means the removal of hazardous substances from employees and their equipment to the extent necessary to preclude the occurrence of foreseeable adverse health affects.

Emergency response or responding to emergencies means a response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual-aid groups, local fire departments, etc.) to an occurrence which results, or is likely to result, in an uncontrolled release of a hazardous substance. Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area, or by maintenance personnel are not considered to be emergency responses within the scope of this standard. Responses to releases of hazardous substances where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency responses.

Facility means (A) any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, storage container, motor vehicle, rolling stock, or aircraft, or (B) any site or area where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located; but does not include any consumer product in consumer use or any water-borne vessel.

Hazardous materials response (HAZMAT) team means an organized group of employees, designated by the employer, who are expected to perform work to handle and control actual or potential leaks or spills of hazardous substances requiring possible close approach to the substance. The team members perform responses to releases or potential releases of hazardous substances for the purpose of control or stabilization of the incident. A HAZMAT team is not a fire brigade nor is a typical fire brigade a HAZMAT team. A HAZMAT team, however, may be a separate component of a fire brigade or fire department.

Hazardous substance means any substance designated or listed under paragraphs (A) through (D) of this definition, exposure to which results or may result in adverse affects on the health or safety of employees:

(A) Any substance defined under section 103(14) of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (42 U.S.C. 9601).

(B) Any biological agent and other disease-causing agent which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any person, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations in such persons or their offspring.

(C) Any substance listed by the U.S. Department of Transportation as hazardous materials under 49 CFR 172.101 and appendices; and

(D) Hazardous waste as herein defined.

Hazardous waste means:

(A) A waste or combination of wastes as defined in 40 CFR 261.3, or

(B) Those substances defined as hazardous wastes in 49 CFR 171.8.

Hazardous waste operation means any operation conducted within the scope of this standard.

Hazardous waste site or **Site** means any facility or location within the scope of this standard at which hazardous waste operations take place.

Health hazard means a chemical or a pathogen where acute or chronic health effects may occur in exposed employees. It also includes stress due to temperature extremes. The term health hazard includes chemicals that are classified in accordance with the Hazard Communication Standard, 29 CFR 1910.1200, as posing one of the following hazardous effects: Acute toxicity (any route of exposure); skin corrosion or irritation; serious eye damage or eye irritation; respiratory or skin sensitization; germ cell mutagenicity; carcinogenicity; reproductive toxicity; specific target organ toxicity (single or repeated exposure); aspiration toxicity or simple asphyxiant. (See Appendix A to 1910.1200 - Health Hazard Criteria (Mandatory) for the criteria for determining whether a chemical is classified as a health hazard.)

IDLH or **Immediately dangerous to life or health** means an atmospheric concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere.

Oxygen deficiency means that concentration of oxygen by volume below which atmosphere supplying respiratory protection must be provided. It exists in atmospheres where the percentage of oxygen by volume is less than 19.5 percent oxygen.

Permissible exposure limit means the exposure, inhalation or dermal permissible exposure limit specified in 29 CFR Part 1910, Subparts G and Z.

Post emergency response means that portion of an emergency response performed after the immediate threat of a release has been stabilized or eliminated and clean-up of the site has begun. If post emergency response is performed by an employer's own employees who were part of the initial emergency response, it is considered to be part of the initial response and not post emergency response. However, if a group of an employer's own employees, separate from the group providing initial response, performs the clean-up operation, then the separate group of employees would be considered to be performing post-emergency response and subject to paragraph (q)(11) of this section.

Published exposure level means the exposure limits published in "NIOSH Recommendations for Occupational Health Standards" dated 1986, which is incorporated by reference as specified in 1910.6, or if none is specified, the exposure limits published in the standards specified by the American Conference of Governmental Industrial Hygienists in their publication "Threshold Limit Values and Biological Exposure Indices for 1987-88" dated 1987, which is incorporated by reference as specified in 1910.6.

Qualified person means a person with specific training, knowledge and experience in the area for which the person has the responsibility and the authority to control.

Site safety and health supervisor (or official) means the individual located on a hazardous waste site who is responsible to the employer and has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with applicable safety and health requirements.

Small quantity generator means a generator of hazardous wastes who in any calendar month generates no more than 1,000 kilograms (2,205 pounds) of hazardous waste in that month.

Uncontrolled hazardous waste site means an area identified as an uncontrolled hazardous waste site by a governmental body, whether Federal, state, local or other, where an accumulation of hazardous substances creates a threat to the health and safety of individuals or the environment or both. Some sites are found on public lands, such as those created by former municipal, county or state landfills where illegal or poorly managed waste disposal has taken place. Other sites are found on private property, often belonging to generators or former generators of hazardous substance wastes. Examples of such sites include, but are not limited to, surface impoundments, landfills, dumps, and tank or drum farms. Normal operations at TSD sites are not covered by this definition.

(b) Safety and health program.

Note to (b): Safety and health programs developed and implemented to meet other Federal, state, or local regulations are considered acceptable in meeting this requirement if they cover or are modified to cover the topics required in this paragraph. An additional or separate safety and health program is not required by this paragraph.

(1) General.

(i) Employers shall develop and implement a written safety and health program for their employees involved in hazardous waste operations. The program shall be designed to identify, evaluate, and control safety and health hazards, and provide for emergency response for hazardous waste operations.

(ii) The written safety and health program shall incorporate the following:

(A) An organizational structure;

(B) A comprehensive workplan;

(C) A site-specific safety and health plan which need not repeat the employer's standard operating procedures required in paragraph (b)(1)(ii)(F) of this section;

(D) The safety and health training program;

(E) The medical surveillance program;

(F) The employer's standard operating procedures for safety and health; and

(G) Any necessary interface between general program and site specific activities.

(iii) Site excavation. Site excavations created during initial site preparation or during hazardous waste operations shall be shored or sloped as appropriate to prevent accidental collapse in accordance with Subpart P of 29 CFR Part 1926.

(iv) Contractors and subcontractors. An employer who retains contractor or subcontractor services for work in hazardous waste operations shall inform those contractors, subcontractors, or their representatives of the site emergency response procedures and any potential fire, explosion, health, safety or other hazards of the hazardous waste operation that have been identified by the employer, including those identified in the employer's information program.

(v) Program availability. The written safety and health program shall be made available to any contractor or subcontractor or their representative who will be involved with the hazardous waste operation; to employees; to employee designated representatives; to OSHA personnel, and to personnel of other Federal, state, or local agencies with regulatory authority over the site.

(2) Organizational structure part of the site program.

(i) The organizational structure part of the program shall establish the specific chain of command and specify the overall responsibilities of supervisors and employees. It shall include, at a minimum, the following elements:

(A) A general supervisor who has the responsibility and authority to direct all hazardous waste operations.

(B) A site safety and health supervisor who has the responsibility and authority to develop and implement the site safety and health plan and verify compliance.

(C) All other personnel needed for hazardous waste site operations and emergency response and their general functions and responsibilities.

(D) The lines of authority, responsibility, and communication.

(ii) The organizational structure shall be reviewed and updated as necessary to reflect the current status of waste site operations.

(3) Comprehensive workplan part of the site program. The comprehensive workplan part of the program shall address the tasks and objectives of the site operations and the logistics and resources required to reach those tasks and objectives.

(i) The comprehensive workplan shall address anticipated clean-up activities as well as normal operating procedures which need not repeat the employer's procedures available elsewhere.

(ii) The comprehensive workplan shall define work tasks and objectives and identify the methods for accomplishing those tasks and objectives.

(iii) The comprehensive workplan shall establish personnel requirements for implementing the plan.

(iv) The comprehensive workplan shall provide for the implementation of the training required in paragraph (e) of this section.

(v) The comprehensive workplan shall provide for the implementation of the required informational programs required in paragraph (i) of this section.

(vi) The comprehensive workplan shall provide for the implementation of the medical surveillance program described in paragraph (f) of this section.

(4) Site-specific safety and health plan part of the program.

(i) General. The site safety and health plan, which must be kept on site, shall address the safety and health hazards of each phase of site operation and include the requirements and procedures for employee protection.

(ii) Elements. The site safety and health plan, as a minimum, shall address the following:

(A) A safety and health risk or hazard analysis for each site task and operation found in the workplan.

(B) Employee training assignments to assure compliance with paragraph (e) of this section.

(C) Personal protective equipment to be used by employees for each of the site tasks and operations being conducted as required by the personal protective equipment program in paragraph (g)(5) of this section.

(D) Medical surveillance requirements in accordance with the program in paragraph (f) of this section.

(E) Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.

(F) Site control measures in accordance with the site control program required in paragraph (d) of this section.

(G) Decontamination procedures in accordance with paragraph (k) of this section.

(H) An emergency response plan meeting the requirements of paragraph (l) of this section for safe and effective responses to emergencies, including the necessary PPE and other equipment.

(I) Confined space entry procedures.

(J) A spill containment program meeting the requirements of paragraph (j) of this section.

(iii) Pre-entry briefing. The site specific safety and health plan shall provide for pre-entry briefings to be held prior to initiating any site activity, and at such other times as necessary to ensure that employees are apprised of the site safety and health plan and that this plan is being followed. The information and data obtained from site characterization and analysis work required in paragraph (c) of this section shall be used to prepare and update the site safety and health plan.

(iv) Effectiveness of site safety and health plan. Inspections shall be conducted by the site safety and health supervisor or, in the absence of that individual, another individual who is knowledgeable in occupational safety and health, acting on behalf of the employer as necessary to determine the effectiveness of the site safety and health plan. Any deficiencies in the effectiveness of the site safety and health plan shall be corrected by the employer.

(c) Site characterization and analysis.

(1) General. Hazardous waste sites shall be evaluated in accordance with this paragraph to identify specific site hazards and to determine the appropriate safety and health control procedures needed to protect employees from the identified hazards.

(2) Preliminary evaluation. A preliminary evaluation of a site's characteristics shall be performed prior to site entry by a qualified person in order to aid in the selection of appropriate employee protection methods prior to site entry. Immediately after initial site entry, a more detailed evaluation of the site's specific characteristics shall be performed by a qualified person in order to further identify existing site hazards and to further aid in the selection of the appropriate engineering controls and personal protective equipment for the tasks to be performed.

(3) Hazard identification. All suspected conditions that may pose inhalation or skin absorption hazards that are immediately dangerous to life or health (IDLH), or other conditions that may cause death or serious harm, shall be identified during the preliminary survey and evaluated during the detailed survey. Examples of such hazards include, but are not limited to, confined space entry, potentially explosive or flammable situations, visible vapor clouds, or areas where biological indicators such as dead animals or vegetation are located.

(4) Required information. The following information to the extent available shall be obtained by the employer prior to allowing employees to enter a site:

(i) Location and approximate size of the site.

(ii) Description of the response activity and/or the job task to be performed.

(iii) Duration of the planned employee activity.

(iv) Site topography and accessibility by air and roads.

(v) Safety and health hazards expected at the site.

(vi) Pathways for hazardous substance dispersion.

(vii) Present status and capabilities of emergency response teams that would provide assistance to hazardous waste clean-up site employees at the time of an emergency.

(viii) Hazardous substances and health hazards involved or expected at the site, and their chemical and physical properties.

(5) Personal protective equipment. Personal protective equipment (PPE) shall be provided and used during initial site entry in accordance with the following requirements:

(i) Based upon the results of the preliminary site evaluation, an ensemble of PPE shall be selected and used during initial site entry which will provide protection to a level of exposure below permissible exposure limits and published exposure levels for known or suspected hazardous substances and health hazards, and which will provide protection against other known and suspected hazards identified during the preliminary site evaluation. If there is no permissible exposure limit or published exposure level, the employer may use other published studies and information as a guide to appropriate personal protective equipment.

(ii) If positive-pressure self-contained breathing apparatus is not used as part of the entry ensemble, and if respiratory protection is warranted by the potential hazards identified during the preliminary site evaluation, an escape self-contained breathing apparatus of at least 5 minute's duration shall be carried by employees during initial site entry.

(iii) If the preliminary site evaluation does not produce sufficient information to identify the hazards or suspected hazards of the site, an ensemble providing protection equivalent to Level B PPE shall be provided as minimum protection, and direct reading instruments shall be used as appropriate for identifying IDLH conditions. (See Appendix B for a description of Level B hazards and the recommendations for Level B protective equipment.)

(iv) Once the hazards of the site have been identified, the appropriate PPE shall be selected and used in accordance with paragraph (g) of this section.

(6) Monitoring. The following monitoring shall be conducted during initial site entry when the site evaluation produces information that shows the potential for ionizing radiation or IDLH conditions, or when the site information is not sufficient reasonably to eliminate these possible conditions:

(i) Monitoring with direct reading instruments for hazardous levels of ionizing radiation.

(ii) Monitoring the air with appropriate direct reading test equipment (i.e., combustible gas meters, detector tubes) for IDLH and other conditions that may cause death or serious harm (combustible or explosive atmospheres, oxygen deficiency, toxic substances).

(iii) Visually observing for signs of actual or potential IDLH or other dangerous conditions.

(iv) An ongoing air monitoring program in accordance with paragraph (h) of this section shall be implemented after site characterization has determined the site is safe for the start-up of operations.

(7) Risk identification. Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances shall be identified. Employees who will be working on the site shall be informed of any risks that have been identified. In situations covered by the Hazard Communication Standard, 29 CFR 1910.1200, training required by that standard need not be duplicated.

Note to (c)(7). Risks to consider include, but are not limited to:

(a) Exposures exceeding the permissible exposure limits and published exposure levels.

(b) IDLH concentrations.

(c) Potential skin absorption and irritation sources.

(d) Potential eye irritation sources.

(e) Explosion sensitivity and flammability ranges.

(f) Oxygen deficiency.

(8) Employee notification. Any information concerning the chemical, physical, and toxicologic properties of each substance known or expected to be present on site that is available to the employer and relevant to the duties an employee is expected to perform shall be made available to the affected employees prior to the commencement of their work activities. The employer may utilize information developed for the hazard communication standard for this purpose.

(d) Site control.

(1) General. Appropriate site control procedures shall be implemented to control employee exposure to hazardous substances before clean-up work begins.

(2) Site control program. A site control program for protecting employees which is part of the employer's site safety and health program required in paragraph (b) of this section shall be developed during the planning stages of a hazardous waste clean-up operation and modified as necessary as new information becomes available.

(3) Elements of the site control program. The site control program shall, as a minimum, include: A site map; site work zones; the use of a "buddy system"; site communications including alerting means for emergencies; the standard operating procedures or safe work practices; and, identification of the nearest medical assistance. Where these requirements are covered elsewhere they need not be repeated.

(e) Training.

(1) General.

(i) All employees working on site (such as but not limited to equipment operators, general laborers and others) exposed to hazardous substances, health hazards, or safety hazards and their supervisors and management responsible for the site shall receive training meeting the requirements of this paragraph before they are permitted to engage in hazardous waste operations that could expose them to hazardous substances, safety, or health hazards, and they shall receive review training as specified in this paragraph.

(ii) Employees shall not be permitted to participate in or supervise field activities until they have been trained to a level required by their job function and responsibility.

(2) Elements to be covered. The training shall thoroughly cover the following:

(i) Names of personnel and alternates responsible for site safety and health;

(ii) Safety, health and other hazards present on the site;

(iii) Use of personal protective equipment;

(iv) Work practices by which the employee can minimize risks from hazards;

(v) Safe use of engineering controls and equipment on the site;

(vi) Medical surveillance requirements, including recognition of symptoms and signs which might indicate overexposure to hazards; and

(vii) The contents of paragraphs (G) through (J) of the site safety and health plan set forth in paragraph (b)(4)(ii) of this section.

(3) Initial training.

(i) General site workers (such as equipment operators, general laborers and supervisory personnel) engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of 3 days actual field experience under the direct supervision of a trained, experienced supervisor.

(ii) Workers on site only occasionally for a specific limited task (such as, but not limited to, ground water monitoring, land surveying, or geophysical surveying) and who are unlikely to be exposed over permissible exposure limits and published exposure limits shall receive a minimum of 24 hours of instruction off the site, and the minimum of 1-day actual field experience under the direct supervision of a trained, experienced supervisor.

(iii) Workers regularly on site who work in areas which have been monitored and fully characterized indicating that exposures are under permissible exposure limits and published exposure limits where respirators are not necessary, and the characterization indicates that there are no health hazards or the possibility of an emergency developing, shall receive a minimum of 24 hours of instruction off the site and the minimum of 1-day actual field experience under the direct supervision of a trained, experienced supervisor.

(iv) Workers with 24 hours of training who are covered by paragraphs (e)(3)(ii) and (e)(3)(iii) of this section, and who become general site workers or who are required to wear respirators, shall have the additional 16 hours and 2 days of training necessary to total the training specified in paragraph (e)(3)(i).

(4) Management and supervisor training. On-site management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations shall receive 40 hours initial training, and 3 days of supervised field experience (the training may be reduced to 24 hours and 1-day if the only area of their responsibility is employees covered by paragraphs (e)(3)(ii) and (e)(3)(iii)) and at least 8 additional hours of specialized training at the time of job assignment on such topics as, but not limited to, the employer’s safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedure and techniques.

(5) Qualifications for trainers. Trainers shall be qualified to instruct employees about the subject matter that is being presented in training. Such trainers shall have satisfactorily completed a training program for teaching the subjects they are expected to teach, or they shall have the academic credentials and instructional experience necessary for teaching the subjects. Instructors shall demonstrate competent instructional skills and knowledge of the applicable subject matter.

(6) Training certification. Employees and supervisors that have received and successfully completed the training and field experience specified in paragraphs (e)(1) through (e)(4) of this section shall be certified by their instructor or the head instructor and trained supervisor as having successfully completed the necessary training. A written certificate shall be given to each person so certified. Any person who has not been so certified or who does not meet the requirements of paragraph (e)(9) of this section shall be prohibited from engaging in hazardous waste operations.

(7) Emergency response. Employees who are engaged in responding to hazardous emergency situations at hazardous waste clean-up sites that may expose them to hazardous substances shall be trained in how to respond to such expected emergencies.

(8) Refresher training. Employees specified in paragraph (e)(1) of this section, and managers and supervisors specified in paragraph (e)(4) of this section, shall receive 8 hours of refresher training annually on the items specified in paragraph (e)(2) and/or (e)(4) of this section, any critique of incidents that have occurred in the past year that can serve as training examples of related work, and other relevant topics.

(9) Equivalent training. Employers who can show by documentation or certification that an employee's work experience and/or training has resulted in training equivalent to that training required in paragraphs (e)(1) through (e)(4) of this section shall not be required to provide the initial training requirements of those paragraphs to such employees and shall provide a copy of the certification or documentation to the employee upon request. However, certified employees or employees with equivalent training new to a site shall receive appropriate, site specific training before site entry and have appropriate supervised field experience at the new site. Equivalent training includes any academic training or the training that existing employees might have already received from actual hazardous waste site work experience.

(f) Medical surveillance.

(1) General. Employers engaged in operations specified in paragraphs (a)(1)(i) through (a)(1)(iv) of this section and not covered by (a)(2)(iii) exceptions and employers of employees specified in paragraph (q)(9) shall institute a medical surveillance program in accordance with this paragraph.

(2) Employees covered. The medical surveillance program shall be instituted by the employer for the following employees:

(i) All employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year;

(ii) All employees who wear a respirator for 30 days or more a year or as required by 1910.134;

(iii) All employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation; and

(iv) Members of HAZMAT teams.

(3) Frequency of medical examinations and consultations. Medical examinations and consultations shall be made available by the employer to each employee covered under paragraph (f)(2) of this section on the following schedules:

(i) For employees covered under paragraphs (f)(2)(i), (f)(2)(ii), and (f)(2)(iv):

(A) Prior to assignment;

(B) At least once every 12 months for each employee covered unless the attending physician believes a longer interval (not greater than biennially) is appropriate;

(C) At termination of employment or reassignment to an area where the employee would not be covered if the employee has not had an examination within the last 6 months;

(D) As soon as possible upon notification by an employee that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or that the employee has been injured or exposed above the permissible exposure limits or published exposure levels in an emergency situation;

(E) At more frequent times, if the examining physician determines that an increased frequency of examination is medically necessary.

(ii) For employees covered under paragraph (f)(2)(iii) and for all employees including those of employers covered by paragraph (a)(1)(v) who may have been injured, received a health impairment, developed signs or symptoms which may have resulted from exposure to hazardous substances resulting from an emergency incident, or exposed during an emergency incident to hazardous substances at concentrations above the permissible exposure limits or the published exposure levels without the necessary personal protective equipment being used:

(A) As soon as possible following the emergency incident or development of signs or symptoms;

(B) At additional times, if the examining physician determines that follow-up examinations or consultations are medically necessary.

(4) Content of medical examinations and consultations.

(i) Medical examinations required by paragraph (f)(3) of this section shall include a medical and work history (or updated history if one is in the employee's file) with special emphasis on symptoms related to the handling of hazardous substances and health hazards, and to fitness for duty including the ability to wear any required PPE under conditions (i.e., temperature extremes) that may be expected at the work site.

(ii) The content of medical examinations or consultations made available to employees pursuant to paragraph (f) shall be determined by the attending physician. The guidelines in the Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (See Appendix D, Reference #10) should be consulted.

(5) Examination by a physician and costs. All medical examinations and procedures shall be performed by or under the supervision of a licensed physician, preferably one knowledgeable in occupational medicine, and shall be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

(6) Information provided to the physician. The employer shall provide one copy of this standard and its appendices to the attending physician, and in addition the following for each employee:

(i) A description of the employee's duties as they relate to the employee's exposures.

(ii) The employee's exposure levels or anticipated exposure levels.

(iii) A description of any personal protective equipment used or to be used.

(iv) Information from previous medical examinations of the employee which is not readily available to the examining physician.

(v) Information required by 1910.134.

(7) Physician's written opinion.

(i) The employer shall obtain and furnish the employee with a copy of a written opinion from the attending physician containing the following:

(A) The physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response, or from respirator use.

(B) The physician's recommended limitations upon the employee's assigned work.

(C) The results of the medical examination and tests if requested by the employee.

(D) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

(ii) The written opinion obtained by the employer shall not reveal specific findings or diagnoses unrelated to occupational exposures.

(8) Recordkeeping.

(i) An accurate record of the medical surveillance required by paragraph (f) of this section shall be retained. This record shall be retained for the period specified and meet the criteria of 29 CFR 1910.1020.

(ii) The record required in paragraph (f)(8)(i) of this section shall include at least the following information:

(A) The name of the employee;

(B) Physician's written opinions, recommended limitations, and results of examinations and tests;

(C) Any employee medical complaints related to exposure to hazardous substances;

(D) A copy of the information provided to the examining physician by the employer, with the exception of the standard and its appendices.

(g) Engineering controls, work practices, and personal protective equipment for employee protection. Engineering controls, work practices, personal protective equipment, or a combination of these shall be implemented in accordance with this paragraph to protect employees from exposure to hazardous substances and safety and health hazards.

(1) Engineering controls, work practices and PPE for substances regulated in Subparts G and Z.

(i) Engineering controls and work practices shall be instituted to reduce and maintain employee exposure to or below the permissible exposure limits for substances regulated by 29 CFR Part 1910, to the extent required by Subpart Z, except to the extent that such controls and practices are not feasible.

Note to (g)(1)(i): Engineering controls which may be feasible include the use of pressurized cabs or control booths on equipment, and/or the use of remotely operated material handling equipment. Work practices which may be feasible are removing all nonessential employees from potential exposure during opening of drums, wetting down dusty operations and locating employees upwind of possible hazards.

(ii) Whenever engineering controls and work practices are not feasible or not required, any reasonable combination of engineering controls, work practices and PPE shall be used to reduce and maintain employee exposures to or below the permissible exposure limits or dose limits for substances regulated by 29 CFR Part 1910, Subpart Z.

(iii) The employer shall not implement a schedule of employee rotation as a means of compliance with permissible exposure limits or dose limits except when there is no other feasible way of complying with the airborne or dermal dose limits for ionizing radiation.

(iv) The provisions of 29 CFR 1910, Subpart G, shall be followed.

(2) Engineering controls, work practices, and PPE for substances not regulated in Subparts G and Z. An appropriate combination of engineering controls, work practices and personal protective equipment shall be used to reduce and maintain employee exposure to or below published exposure levels for hazardous substances and health hazards not regulated by 29 CFR Part 1910, Subparts G and Z. The employer may use the published literature and SDS as a guide in making the employer's determination as to what level of protection the employer believes is appropriate for hazardous substances and health hazards for which there is no permissible exposure limit or published exposure limit.

(3) Personal protective equipment selection.

(i) Personal protective equipment (PPE) shall be selected and used which will protect employees from the hazards and potential hazards they are likely to encounter as identified during the site characterization and analysis.

(ii) Personal protective equipment selection shall be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, the task-specific conditions and duration, and the hazards and potential hazards identified at the site.

(iii) Positive pressure self-contained breathing apparatus, or positive pressure air-line respirators equipped with an escape air supply, shall be used when chemical exposure levels present will create a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

(iv) Totally-encapsulating chemical protective suits (protection equivalent to Level A protection as recommended in Appendix B) shall be used in conditions where skin absorption of a hazardous substance may result in a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

(v) The level of protection provided by PPE selection shall be increased when additional information on site conditions indicates that increased protection is necessary to reduce employee exposures below permissible exposure limits and published exposure levels for hazardous substances and health hazards. (See Appendix B for guidance on selecting PPE ensembles.)

Note to (g)(3): The level of employee protection provided may be decreased when additional information or site conditions show that decreased protection will not result in hazardous exposures to employees.

(vi) Personal protective equipment shall be selected and used to meet the requirements of 29 CFR Part 1910, Subpart I, and additional requirements specified in this section.

(4) Totally-encapsulating chemical protective suits.

(i) Totally-encapsulating suits shall protect employees from the particular hazards which are identified during site characterization and analysis.

(ii) Totally-encapsulating suits shall be capable of maintaining positive air pressure. (See Appendix A for a test method which may be used to evaluate this requirement.)

(iii) Totally-encapsulating suits shall be capable of preventing inward test gas leakage of more than 0.5 percent. (See Appendix A for a test method which may be used to evaluate this requirement.)

(5) Personal protective equipment (PPE) program. A written personal protective equipment program, which is part of the employer's safety and health program required in paragraph (b) of this section or required in paragraph (p)(1) of this section and which is also a part of the site-specific safety and health plan shall be established. The PPE program shall address the elements listed below. When elements, such as donning and doffing procedures, are provided by the manufacturer of a piece of equipment and are attached to the plan, they need not be rewritten into the plan as long as they adequately address the procedure or element.

(i) PPE selection based upon site hazards,

(ii) PPE use and limitations of the equipment,

(iii) Work mission duration,

(iv) PPE maintenance and storage,

(v) PPE decontamination and disposal,

(vi) PPE training and proper fitting,

(vii) PPE donning and doffing procedures,

(viii) PPE inspection procedures prior to, during, and after use,

(ix) Evaluation of the effectiveness of the PPE program, and

(x) Limitations during temperature extremes, heat stress, and other appropriate medical considerations.

(h) Monitoring.

(1) General.

(i) Monitoring shall be performed in accordance with this paragraph where there may be a question of employee exposure to hazardous concentrations of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment so that employees are not exposed to levels which exceed permissible exposure limits, or published exposure levels if there are no permissible exposure limits, for hazardous substances.

(ii) Air monitoring shall be used to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine the appropriate level of employee protection needed on site.

(2) Initial entry. Upon initial entry, representative air monitoring shall be conducted to identify any IDLH condition, exposure over permissible exposure limits or published exposure levels, exposure over a radioactive material's dose limits or other dangerous condition such as the presence of flammable atmospheres or oxygen-deficient environments.

(3) Periodic monitoring. Periodic monitoring shall be conducted when the possibility of an IDLH condition or flammable atmosphere has developed or when there is indication that exposures may have risen over permissible exposure limits or published exposure levels since prior monitoring. Situations where it shall be considered whether the possibility that exposures have risen are as follows:

(i) When work begins on a different portion of the site.

(ii) When contaminants other than those previously identified are being handled.

(iii) When a different type of operation is initiated (e.g., drum opening as opposed to exploratory well drilling).

(iv) When employees are handling leaking drums or containers or working in areas with obvious liquid contamination (e.g., a spill or lagoon).

(4) Monitoring of high-risk employees. After the actual clean-up phase of any hazardous waste operation commences; for example, when soil, surface water or containers are moved or disturbed; the employer shall monitor those employees likely to have the highest exposures to hazardous substances and health hazards likely to be present above permissible exposure limits or published exposure levels by using personal sampling frequently enough to characterize employee exposures. If the employees likely to have the highest exposure are over permissible exposure limits or published exposure limits, then monitoring shall continue to determine all employees likely to be above those limits. The employer may utilize a representative sampling approach by documenting that the employees and chemicals chosen for monitoring are based on the criteria stated above.

Note to (h): It is not required to monitor employees engaged in site characterization operations covered by paragraph (c) of this section.

(i) Informational programs. Employers shall develop and implement a program, which is part of the employer's safety and health program required in paragraph (b) of this section, to inform employees, contractors, and subcontractors (or their representative) actually engaged in hazardous waste operations of the nature, level and degree of exposure likely as a result of participation in such hazardous waste operations. Employees, contractors and subcontractors working outside of the operations part of a site are not covered by this standard.

(j) Handling drums and containers.

(1) General.

(i) Hazardous substances and contaminated soils, liquids, and other residues shall be handled, transported, labeled, and disposed of in accordance with this paragraph.

(ii) Drums and containers used during the clean-up shall meet the appropriate DOT, OSHA, and EPA regulations for the wastes that they contain.

(iii) When practical, drums and containers shall be inspected and their integrity shall be assured prior to being moved. Drums or containers that cannot be inspected before being moved because of storage conditions (i.e., buried beneath the earth, stacked behind other drums, stacked several tiers high in a pile, etc.) shall be moved to an accessible location and inspected prior to further handling.

(iv) Unlabelled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled.

(v) Site operations shall be organized to minimize the amount of drum or container movement.

(vi) Prior to movement of drums or containers, all employees exposed to the transfer operation shall be warned of the potential hazards associated with the contents of the drums or containers.

(vii) U.S. Department of Transportation specified salvage drums or containers and suitable quantities of proper absorbent shall be kept available and used in areas where spills, leaks, or ruptures may occur.

(viii) Where major spills may occur, a spill containment program, which is part of the employer's safety and health program required in paragraph (b) of this section, shall be implemented to contain and isolate the entire volume of the hazardous substance being transferred.

(ix) Drums and containers that cannot be moved without rupture, leakage, or spillage shall be emptied into a sound container using a device classified for the material being transferred.

(x) A ground-penetrating system or other type of detection system or device shall be used to estimate the location and depth of buried drums or containers.

(xi) Soil or covering material shall be removed with caution to prevent drum or container rupture.

(xii) Fire extinguishing equipment meeting the requirements of 29 CFR Part 1910, Subpart L, shall be on hand and ready for use to control incipient fires.

(2) Opening drums and containers. The following procedures shall be followed in areas where drums or containers are being opened:

(i) Where an airline respirator system is used, connections to the source of air supply shall be protected from contamination and the entire system shall be protected from physical damage.

(ii) Employees not actually involved in opening drums or containers shall be kept a safe distance from the drums or containers being opened.

(iii) If employees must work near or adjacent to drums or containers being opened, a suitable shield that does not interfere with the work operation shall be placed between the employee and the drums or containers being opened to protect the employee in case of accidental explosion.

(iv) Controls for drum or container opening equipment, monitoring equipment, and fire suppression equipment shall be located behind the explosion-resistant barrier.

(v) When there is a reasonable possibility of flammable atmospheres being present, material handling equipment and hand tools shall be of the type to prevent sources of ignition.

(vi) Drums and containers shall be opened in such a manner that excess interior pressure will be safely relieved. If pressure can not be relieved from a remote location, appropriate shielding shall be placed between the employee and the drums or containers to reduce the risk of employee injury.

(vii) Employees shall not stand upon or work from drums or containers.

(3) Material handling equipment. Material handling equipment used to transfer drums and containers shall be selected, positioned and operated to minimize sources of ignition related to the equipment from igniting vapors released from ruptured drums or containers.

(4) Radioactive wastes. Drums and containers containing radioactive wastes shall not be handled until such time as their hazard to employees is properly assessed.

(5) Shock sensitive wastes. As a minimum, the following special precautions shall be taken when drums and containers containing or suspected of containing shock-sensitive wastes are handled:

(i) All nonessential employees shall be evacuated from the area of transfer.

(ii) Material handling equipment shall be provided with explosive containment devices or protective shields to protect equipment operators from exploding containers.

(iii) An employee alarm system capable of being perceived above surrounding light and noise conditions shall be used to signal the commencement and completion of explosive waste handling activities.

(iv) Continuous communications (i.e., portable radios, hand signals, telephones, as appropriate) shall be maintained between the employee-in-charge of the immediate handling area and both the site safety and health supervisor and the command post until such time as the handling operation is completed. Communication equipment or methods that could cause shock sensitive materials to explode shall not be used.

(v) Drums and containers under pressure, as evidenced by bulging or swelling, shall not be moved until such time as the cause for excess pressure is determined and appropriate containment procedures have been implemented to protect employees from explosive relief of the drum.

(vi) Drums and containers containing packaged laboratory wastes shall be condsidered to contain shock-sensitive or explosive materials until they have been characterized.

Caution: Shipping of shock sensitive wastes may be prohibited under U.S. Department of Transportation regulations. Employers and their shippers should refer to 49 CFR 173.21 and 173.50.

(6) Laboratory waste packs. In addition to the requirements of paragraph (j)(5) of this section, the following precautions shall be taken, as a minimum, in handling laboratory waste packs (lab packs):

(i) Lab packs shall be opened only when necessary and then only by an individual knowledgeable in the inspection, classification, and segregation of the containers within the pack according to the hazards of the wastes.

(ii) If crystalline material is noted on any container, the contents shall be handled as a shock-sensitive waste until the contents are identified.

(7) Sampling of drum and container contents. Sampling of containers and drums shall be done in accordance with a sampling procedure which is part of the site safety and health plan developed for and available to employees and others at the specific worksite.

(8) Shipping and transport.

(i) Drums and containers shall be identified and classified prior to packaging for shipment.

(ii) Drum or container staging areas shall be kept to the minimum number necessary to identify and classify materials safely and prepare them for transport.

(iii) Staging areas shall be provided with adequate access and egress routes.

(iv) Bulking of hazardous wastes shall be permitted only after a thorough characterization of the materials has been completed.

(9) Tank and vault procedures.

(i) Tanks and vaults containing hazardous substances shall be handled in a manner similar to that for drums and containers, taking into consideration the size of the tank or vault.

(ii) Appropriate tank or vault entry procedures as described in the employer's safety and health plan shall be followed whenever employees must enter a tank or vault.

(k) Decontamination.

(1) General. Procedures for all phases of decontamination shall be developed and implemented in accordance with this paragraph.

(2) Decontamination procedures.

(i) A decontamination procedure shall be developed, communicated to employees and implemented before any employees or equipment may enter areas on site where potential for exposure to hazardous substances exists.

(ii) Standard operating procedures shall be developed to minimize employee contact with hazardous substances or with equipment that has contacted hazardous substances.

(iii) All employees leaving a contaminated area shall be appropriately decontaminated; all contaminated clothing and equipment leaving a contaminated area shall be appropriately disposed of or decontaminated.

(iv) Decontamination procedures shall be monitored by the site safety and health supervisor to determine their effectiveness. When such procedures are found to be ineffective, appropriate steps shall be taken to correct any deficiencies.

(3) Location. Decontamination shall be performed in geographical areas that will minimize the exposure of uncontaminated employees or equipment to contaminated employees or equipment.

(4) Equipment and solvents. All equipment and solvents used for decontamination shall be decontaminated or disposed of properly.

(5) Personal protective clothing and equipment.

(i) Protective clothing and equipment shall be decontaminated, cleaned, laundered, maintained or replaced as needed to maintain their effectiveness.

(ii) Employees whose nonimpermeable clothing becomes wetted with hazardous substances shall immediately remove that clothing and proceed to shower. The clothing shall be disposed of or decontaminated before it is removed from the work zone.

(6) Unauthorized employees. Unauthorized employees shall not remove protective clothing or equipment from change rooms.

(7) Commercial laundries or cleaning establishments. Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment shall be informed of the potentially harmful effects of exposures to hazardous substances.

(8) Showers and change rooms. Where the decontamination procedure indicates a need for regular showers and change rooms outside of a contaminated area, they shall be provided and meet the requirements of 29 CFR 1910.141. If temperature conditions prevent the effective use of water, then other effective means for cleansing shall be provided and used.

(l) Emergency response by employees at uncontrolled hazardous waste sites.

(1) Emergency response plan.

(i) An emergency response plan shall be developed and implemented by all employers within the scope of paragraphs (a)(1)(i) and (ii) of this section to handle anticipated emergencies prior to the commencement of hazardous waste operations. The plan shall be in writing and available for inspection and copying by employees, their representatives, OSHA personnel and other governmental agencies with relevant responsibilities.

(ii) Employers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph if they provide an emergency action plan complying with section 1910.38(a) of this part.

Note: 1910.38 is now OAR 437-002-0042.

(2) Elements of an emergency response plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following:

(i) Pre-emergency planning.

(ii) Personnel roles, lines of authority, and communication.

(iii) Emergency recognition and prevention.

(iv) Safe distances and places of refuge.

(v) Site security and control.

(vi) Evacuation routes and procedures.

(vii) Decontamination procedures which are not covered by the site safety and health plan.

(viii) Emergency medical treatment and first aid.

(ix) Emergency alerting and response procedures.

(x) Critique of response and follow-up.

(xi) PPE and emergency equipment.

(3) Procedures for handling emergency incidents.

(i) In addition to the elements for the emergency response plan required in paragraph (l)(2) of this section, the following elements shall be included for emergency response plans:

(A) Site topography, layout, and prevailing weather conditions.

(B) Procedures for reporting incidents to local, state, and federal governmental agencies.

(ii) The emergency response plan shall be a separate section of the Site Safety and Health Plan.

(iii) The emergency response plan shall be compatible and integrated with the disaster, fire and/or emergency response plans of local, state, and federal agencies.

(iv) The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.

(v) The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(vi) An employee alarm system shall be installed in accordance with 29 CFR 1910.165 to notify employees of an emergency situation; to stop work activities if necessary; to lower background noise in order to speed communication; and to begin emergency procedures.

(vii) Based upon the information available at time of the emergency, the employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.

(m) Illumination. Areas accessible to employees shall be lighted to not less than the minimum illumination intensities listed in the following Table H-120.1 while any work is in progress:

Table H-36 – Minimum Illumination Intensities in Foot-Candles

Foot-candles	Area or operations
5	General site areas.
3	Excavation and waste areas, accessways, active storage areas, loading platforms, refueling, and field maintenance areas.
5	Indoors: Warehouses, corridors, hallways, and exitways.
5	Tunnels, shafts, and general underground work areas. (Exception: Minimum of 10 footcandles is required at tunnel and shaft heading during drilling, mucking, and scaling. Mine Safety and Health Administration approved cap lights shall be acceptable for use in the tunnel heading.)
10	General shops (e.g., mechanical and electrical equipment rooms, active storerooms, barracks or living quarters, locker or dressing rooms, dining areas, and indoor toilets and workrooms.)
30	First aid stations, infirmaries, and offices.

(n) Sanitation at temporary workplaces.

(1) Potable water.

(i) An adequate supply of potable water shall be provided on the site.

(ii) Portable containers used to dispense drinking water shall be capable of being tightly closed, and equipped with a tap. Water shall not be dipped from containers.

(iii) Any container used to distribute drinking water shall be clearly marked as to the nature of its contents and not used for any other purpose.

(iv) Where single service cups (to be used but once) are supplied, both a sanitary container for the unused cups and a receptacle for disposing of the used cups shall be provided.

(2) Nonpotable water.

(i) Outlets for nonpotable water, such as water for firefighting purposes, shall be identified to indicate clearly that the water is unsafe and is not to be used for drinking, washing, or cooking purposes.

(ii) There shall be no cross-connection, open or potential, between a system furnishing potable water and a system furnishing nonpotable water.

(3) Toilet facilities.

(i) Toilets shall be provided for employees according to the following Table H-120.2.

Table 120.2 – Toilet Facilities'

Number of employees	Minimum number of facilities
20 or fewer	One.
More than 20, fewer than 200	One toilet seat and one urinal per 40 employees.
More than 200	One toilet seat and one urinal per 50 employees.

(ii) Under temporary field conditions, provisions shall be made to assure that at least one toilet facility is available.

(iii) Hazardous waste sites not provided with a sanitary sewer shall be provided with the following toilet facilities unless prohibited by local codes:

(A) Chemical toilets;

(B) Recirculating toilets;

(C) Combustion toilets; or

(D) Flush toilets.

(iv) The requirements of this paragraph for sanitation facilities shall not apply to mobile crews having transportation readily available to nearby toilet facilities.

(v) Doors entering toilet facilities shall be provided with entrance locks controlled from inside the facility.

(4) Food handling. All food service facilities and operations for employees shall meet the applicable laws, ordinances, and regulations of the jurisdictions in which they are located.

(5) Temporary sleeping quarters. When temporary sleeping quarters are provided, they shall be heated, ventilated, and lighted.

(6) Washing facilities. The employer shall provide adequate washing facilities for employees engaged in operations where hazardous substances may be harmful to employees. Such facilities shall be in near proximity to the worksite; in areas where exposures are below permissible exposure limits and published exposure levels and which are under the controls of the employer; and shall be so equipped as to enable employees to remove hazardous substances from themselves.

(7) Showers and change rooms. When hazardous waste clean-up or removal operations commence on a site and the duration of the work will require 6 months or greater time to complete, the employer shall provide showers and change rooms for all employees exposed to hazardous substances and health hazards involved in hazardous waste clean-up or removal operations.

(i) Showers shall be provided and shall meet the requirements of 29 CFR 1910.141(d)(3).

(ii) Change rooms shall be provided and shall meet the requirements of 29 CFR 1910.141(e). Change rooms shall consist of two separate change areas separated by the shower area required in paragraph (n)(7)(i) of this section. One change area, with an exit leading off the worksite, shall provide employees with a clean area where they can remove, store, and put on street clothing. The second area, with an exit to the worksite, shall provide employees with an area where they can put on, remove and store work clothing and personal protective equipment.

(iii) Showers and change rooms shall be located in areas where exposures are below the permissible exposure limits and published exposure levels. If this cannot be accomplished, then a ventilation system shall be provided that will supply air that is below the permissible exposure limits and published exposure levels.

(iv) Employers shall assure that employees shower at the end of their work shift and when leaving the hazardous waste site.

(o) New technology programs.

(1) The employer shall develop and implement procedures for the introduction of effective new technologies and equipment developed for the improved protection of employees working with hazardous waste clean-up operations, and the same shall be implemented as part of the site safety and health program to assure that employee protection is being maintained.

(2) New technologies, equipment or control measures available to the industry, such as the use of foams, absorbents, adsorbents, neutralizers, or other means to suppress the level of air contaminates while excavating the site or for spill control, shall be evaluated by employers or their representatives. Such an evaluation shall be done to determine the effectiveness of the new methods, materials, or equipment before implementing their use on a large scale for enhancing employee protection. Information and data from manufacturers or suppliers may be used as part of the employer's evaluation effort. Such evaluations shall be made available to OSHA upon request.

(p) Certain Operations Conducted Under the Resource Conservation and Recovery Act of 1976 (RCRA). Employers conducting operations at treatment, storage, and disposal (TSD) facilities specified in paragraph (a)(1)(iv) of this section shall provide and implement the programs specified in this paragraph. See the "Notes and Exceptions" to paragraph (a)(2)(iii) of this section for employers not covered.

(1) Safety and health program. The employer shall develop and implement a written safety and health program for employees involved in hazardous waste operations that shall be available for inspection by employees, their representatives and OSHA personnel. The program shall be designed to identify, evaluate and control safety and health hazards in their facilities for the purpose of employee protection, to provide for emergency response meeting the requirements of paragraph (p)(8) of this section and to address as appropriate site analysis, engineering controls, maximum exposure limits, hazardous waste handling procedures and uses of new technologies.

(2) Hazard communication program. The employer shall implement a hazard communication program meeting the requirements of 29 CFR 1910.1200 as part of the employer's safety and health program.

Note to 1910.120: The exemption for hazardous waste provided in 1910.1200 is applicable to this section.

(3) Medical surveillance program. The employer shall develop and implement a medical surveillance program meeting the requirements of paragraph (f) of this section.

(4) Decontamination program. The employer shall develop and implement a decontamination procedure meeting the requirements of paragraph (k) of this section.

(5) New technology program. The employer shall develop and implement procedures meeting the requirements of paragraph (o) of this section for introducing new and innovative equipment into the workplace.

(6) Material handling program. Where employees will be handling drums or containers, the employer shall develop and implement procedures meeting the requirements of paragraphs (j)(1)(ii) through (viii) and (xi) of this section, as well as (j)(3) and (j)(8) of this section prior to starting such work.

(7) Training program.

(i) New employees. The employer shall develop and implement a training program, which is part of the employer's safety and health program, for employees exposed to health hazards or hazardous substances at TSD operations to enable the employees to perform their assigned duties and functions in a safe and healthful manner so as not endanger themselves or other employees. The initial training shall be for 24 hours and refresher training shall be for 8 hours annually. Employees who have received the initial training required by this paragraph shall be given a written certificate attesting that they have successfully completed the necessary training.

(ii) Current employees. Employers who can show by an employee's previous work experience and/or training that the employee has had training equivalent to the initial training required by this paragraph, shall be considered as meeting the initial training requirements of this paragraph as to that employee. Equivalent training includes the training that existing employees might have already received from actual site work experience. Current employees shall receive 8 hours of refresher training annually.

(iii) Trainers. Trainers who teach initial training shall have satisfactorily completed a training course for teaching the subjects they are expected to teach or they shall have the academic credentials and instruction experience necessary to demonstrate a good command of the subject matter of the courses and competent instructional skills.

(8) Emergency response program.

(i) Emergency response plan. An emergency response plan shall be developed and implemented by all employers. Such plans need not duplicate any of the subjects fully addressed in the employer's contingency planning required by permits, such as those issued by the U.S. Environmental Protection Agency, provided that the contingency plan is made part of the emergency response plan.

The emergency response plan shall be a written portion of the employers safety and health program required in paragraph (p)(1) of this section. Employers who will evacuate their employees from the worksite location when an emergency occurs and who do not permit any of their employees to assist in handling the emergency are exempt from the requirements of paragraph (p)(8) if they provide an emergency action plan complying with 1910.38(a) of this part.

Note: 1910.38 is now OAR 437-002-0042.

(ii) Elements of an emergency response plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following areas to the extent that they are not addressed in any specific program required in this paragraph:

(A) Pre-emergency planning and coordination with outside parties.

(B) Personnel roles, lines of authority, and communication.

(C) Emergency recognition and prevention.

(D) Safe distances and places of refuge.

(E) Site security and control.

(F) Evacuation routes and procedures.

(G) Decontamination procedures.

(H) Emergency medical treatment and first aid.

(I) Emergency alerting and response procedures.

(J) Critique of response and follow-up.

(K) PPE and emergency equipment.

(iii) Training.

(A) Training for emergency response employees shall be completed before they are called upon to perform in real emergencies. Such training shall include the elements of the emergency response plan, standard operating procedures the employer has established for the job, the personal protective equipment to be worn and procedures for handling emergency incidents.

Exception #1: An employer need not train all employees to the degree specified if the employer divides the work force in a manner such that a sufficient number of employees who have responsibility to control emergencies have the training specified, and all other employees, who may first respond to an emergency incident, have sufficient awareness training to recognize that an emergency response situation exists and that they are instructed in that case to summon the fully trained employees and not attempt control activities for which they are not trained.

Exception #2: An employer need not train all employees to the degree specified if arrangements have been made in advance for an outside fully-trained emergency response team to respond in a reasonable period and all employees, who may come to the incident first, have sufficient awareness training to recognize that an emergency response situation exists and they have been instructed to call the designated outside fully-trained emergency response team for assistance.

(B) Employee members of TSD facility emergency response organizations shall be trained to a level of competence in the recognition of health and safety hazards to protect themselves and other employees. This would include training in the methods used to minimize the risk from safety and health hazards; in the safe use of control equipment; in the selection and use of appropriate personal protective equipment; in the safe operating procedures to be used at the incident scene; in the techniques of coordination with other employees to minimize risks; in the appropriate response to over exposure from health hazards or injury to themselves and other employees; and in the recognition of subsequent symptoms which may result from over exposures.

(C) The employer shall certify that each covered employee has attended and successfully completed the training required in paragraph (p)(8)(iii) of this section, or shall certify the employee's competency at least yearly. The method used to demonstrate competency for certification of training shall be recorded and maintained by the employer.

(iv) Procedures for handling emergency incidents.

(A) In addition to the elements for the emergency response plan required in paragraph (p)(8)(ii) of this section, the following elements shall be included for emergency response plans to the extent that they do not repeat any information already contained in the emergency response plan:

(1) Site topography, layout, and prevailing weather conditions.

(2) Procedures for reporting incidents to local, state, and federal governmental agencies.

(B) The emergency response plan shall be compatible and integrated with the disaster, fire and/or emergency response plans of local, state, and federal agencies.

(C) The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.

(D) The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(E) An employee alarm system shall be installed in accordance with 29 CFR 1910.165 to notify employees of an emergency situation; to stop work activities if necessary; to lower background noise in order to speed communication; and to begin emergency procedures.

(F) Based upon the information available at time of the emergency, the employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.

(q) Emergency response to hazardous substance releases. This paragraph covers employers whose employees are engaged in emergency response no matter where it occurs except that it does not cover employees engaged in operations specified in paragraphs (a)(1)(i) through (a)(1)(iv) of this section. Those emergency response organizations who have developed and implemented programs equivalent to this paragraph for handling releases of hazardous substances pursuant to section 303 of the Superfund Amendments and Reauthorization Act of 1986 (Emergency Planning and Community Right-to-Know Act of 1986, 42 U.S.C. 11003) shall be deemed to have met the requirements of this paragraph.

(1) Emergency response plan. An emergency response plan shall be developed and implemented to handle anticipated emergencies prior to the commencement of emergency response operations. The plan shall be in writing and available for inspection and copying by employees, their representatives and OSHA personnel. Employers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph if they provide an emergency action plan in accordance with 1910.38(a) of this part.

Note: 1910.38 is now OAR 437-002-0042.

(2) Elements of an emergency response plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following to the extent that they are not addressed elsewhere:

(i) Pre-emergency planning and coordination with outside parties.

(ii) Personnel roles, lines of authority, training, and communication.

(iii) Emergency recognition and prevention.

(iv) Safe distances and places of refuge.

(v) Site security and control.

(vi) Evacuation routes and procedures.

(vii) Decontamination.

(viii) Emergency medical treatment and first aid.

(ix) Emergency alerting and response procedures.

(x) Critique of response and follow-up.

(xi) PPE and emergency equipment.

(xii) Emergency response organizations may use the local emergency response plan or the state emergency response plan or both, as part of their emergency response plan to avoid duplication. Those items of the emergency response plan that are being properly addressed by the SARA Title III plans may be substituted into their emergency plan or otherwise kept together for the employer and employee's use.

(3) Procedures for handling emergency response.

(i) The senior emergency response official responding to an emergency shall become the individual in charge of a site-specific Incident Command System (ICS). All emergency responders and their communications shall be coordinated and controlled through the individual in charge of the ICS assisted by the senior official present for each employer.

Note to (q)(3)(i): The "senior official" at an emergency response is the most senior official on the site who has the responsibility for controlling the operations at the site. Initially it is the senior officer on the first-due piece of responding emergency apparatus to arrive on the incident scene. As more senior officers arrive (i.e., battalion chief, fire chief, state law enforcement official, site coordinator, etc.) the position is passed up the line of authority which has been previously established.

(ii) The individual in charge of the ICS shall identify, to the extent possible, all hazardous substances or conditions present and shall address as appropriate site analysis, use of engineering controls, maximum exposure limits, hazardous substance handling procedures, and use of any new technologies.

(iii) Based on the hazardous substances and/or conditions present, the individual in charge of the ICS shall implement appropriate emergency operations, and assure that the personal protective equipment worn is appropriate for the hazards to be encountered. However, personal protective equipment shall meet, at a minimum, the criteria contained in 29 CFR 1910.156(e) when worn while performing fire fighting operations beyond the incipient stage for any incident.

(iv) Employees engaged in emergency response and exposed to hazardous substances presenting an inhalation hazard or potential inhalation hazard shall wear positive pressure self-contained breathing apparatus while engaged in emergency response, until such time that the individual in charge of the ICS determines through the use of air monitoring that a decreased level of respiratory protection will not result in hazardous exposures to employees.

(v) The individual in charge of the ICS shall limit the number of emergency response personnel at the emergency site, in those areas of potential or actual exposure to incident or site hazards, to those who are actively performing emergency operations. However, operations in hazardous areas shall be performed using the buddy system in groups of two or more.

(vi) Back-up personnel shall stand by with equipment ready to provide assistance or rescue. Advance first aid support personnel, as a minimum, shall also stand by with medical equipment and transportation capability.

(vii) The individual in charge of the ICS shall designate a safety official, who is knowledgeable in the operations being implemented at the emergency response site, with specific responsibility to identify and evaluate hazards and to provide direction with respect to the safety of operations for the emergency at hand.

(viii) When activities are judged by the safety official to be an IDLH condition and/or to involve an imminent danger condition, the safety official shall have the authority to alter, suspend, or terminate those activities. The safety official shall immediately inform the individual in charge of the ICS of any actions needed to be taken to correct these hazards at the emergency scene.

(ix) After emergency operations have terminated, the individual in charge of the ICS shall implement appropriate decontamination procedures.

(x) When deemed necessary for meeting the tasks at hand, approved self-contained compressed air breathing apparatus may be used with approved cylinders from other approved self-contained compressed air breathing apparatus provided that such cylinders are of the same capacity and pressure rating. All compressed air cylinders used with self-contained breathing apparatus shall meet U.S. Department of Transportation and National Institute for Occupational Safety and Health criteria.

(4) Skilled support personnel. Personnel, not necessarily an employer’s own employees, who are skilled in the operation of certain equipment, such as mechanized earth moving or digging equipment or crane and hoisting equipment, and who are needed temporarily to perform immediate emergency support work that cannot reasonably be performed in a timely fashion by an employer’s own employees, and who will be or may be exposed to the hazards at an emergency response scene, are not required to meet the training required in this paragraph for the employer’s regular employees. However, these personnel shall be given an initial briefing at the site prior to their participation in any emergency response. The initial briefing shall include instruction in the wearing of appropriate personal protective equipment, what chemical hazards are involved, and what duties are to be performed. All other appropriate safety and health precautions provided to the employer’s own employees shall be used to assure the safety and health of these personnel.

(5) Specialist employees. Employees who, in the course of their regular job duties, work with and are trained in the hazards of specific hazardous substances, and who will be called upon to provide technical advice or assistance at a hazardous substance release incident to the individual in charge, shall receive training or demonstrate competency in the area of their specialization annually.

(6) Training. Training shall be based on the duties and function to be performed by each responder of an emergency response organization. The skill and knowledge levels required for all new responders, those hired after the effective date of this standard, shall be conveyed to them through training before they are permitted to take part in actual emergency operations on an incident. Employees who participate, or are expected to participate, in emergency response, shall be given training in accordance with the following paragraphs:

(i) First responder awareness level. First responders at the awareness level are individuals who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond notifying the authorities of the release. First responders at the awareness level shall have sufficient training or have had sufficient experience to objectively demonstrate competency in the following areas:

(A) An understanding of what hazardous substances are, and the risks associated with them in an incident.

(B) An understanding of the potential outcomes associated with an emergency created when hazardous substances are present.

(C) The ability to recognize the presence of hazardous substances in an emergency.

(D) The ability to identify the hazardous substances, if possible.

(E) An understanding of the role of the first responder awareness individual in the employer's emergency response plan including site security and control and the U.S. Department of Transportation's Emergency Response Guidebook.

(F) The ability to realize the need for additional resources, and to make appropriate notifications to the communication center.

(ii) First responder operations level. First responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures. First responders at the operational level shall have received at least 8 hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level and the employer shall so certify:

(A) Knowledge of the basic hazard and risk assessment techniques.

(B) Know how to select and use proper personal protective equipment provided to the first responder operational level.

(C) An understanding of basic hazardous materials terms.

(D) Know how to perform basic control, containment and/or confinement operations within the capabilities of the resources and personal protective equipment available with their unit.

(E) Know how to implement basic decontamination procedures.

(F) An understanding of the relevant standard operating procedures and termination procedures.

(iii) Hazardous materials technician. Hazardous materials technicians are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder at the operations level in that they will approach the point of release in order to plug, patch or otherwise stop the release of a hazardous substance. Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

(A) Know how to implement the employer's emergency response plan.

(B) Know the classification, identification and verification of known and unknown materials by using field survey instruments and equipment.

(C) Be able to function within an assigned role in the Incident Command System.

(D) Know how to select and use proper specialized chemical personal protective equipment provided to the hazardous materials technician.

(E) Understand hazard and risk assessment techniques.

(F) Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with the unit.

(G) Understand and implement decontamination procedures.

(H) Understand and termination procedures.

(I) Understand basic chemical and toxicological terminology and behavior.

(iv) Hazardous materials specialist. Hazardous materials specialists are individuals who respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician, however, those duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with Federal, state, local and other government authorities in regards to site activities. Hazardous materials specialists shall have received at least 24 hours of training equal to the technician level and in addition have competency in the following areas and the employer shall so certify:

(A) Know how to implement the local emergency response plan.

(B) Understand classification, identification and verification of known and unknown materials by using advanced survey instruments and equipment.

(C) Know of the state emergency response plan.

(D) Be able to select and use proper specialized chemical personal protective equipment provided to the hazardous materials specialist.

(E) Understand in-depth hazard and risk techniques.

(F) Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available.

(G) Be able to determine and implement decontamination procedures.

(H) Have the ability to develop a site safety and control plan.

(I) Understand chemical, radiological and toxicological terminology and behavior.

(v) On scene incident commander. Incident commanders, who will assume control of the incident scene beyond the first responder awareness level, shall receive at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

(A) Know and be able to implement the employer's incident command system.

(B) Know how to implement the employer's emergency response plan.

(C) Know and understand the hazards and risks associated with employees working in chemical protective clothing.

(D) Know how to implement the local emergency response plan.

(E) Know of the state emergency response plan and of the Federal Regional Response Team.

(F) Know and understand the importance of decontamination procedures.

(7) Trainers. Trainers who teach any of the above training subjects shall have satisfactorily completed a training course for teaching the subjects they are expected to teach, such as the courses offered by the U.S. National Fire Academy, or they shall have the training and/or academic credentials and instructional experience necessary to demonstrate competent instructional skills and a good command of the subject matter of the courses they are to teach.

(8) Refresher training.

(i) Those employees who are trained in accordance with paragraph (q)(6) of this section shall receive annual refresher training of sufficient content and duration to maintain their competencies, or shall demonstrate competency in those areas at least yearly.

(ii) A statement shall be made of the training or competency, and if a statement of competency is made, the employer shall keep a record of the methodology used to demonstrate competency.

(9) Medical surveillance and consultation.

(i) Members of an organized and designated HAZMAT team and hazardous materials specialists shall receive a baseline physical examination and be provided with medical surveillance as required in paragraph (f) of this section.

(ii) Any emergency response employees who exhibits signs or symptoms which may have resulted from exposure to hazardous substances during the course of an emergency incident, either immediately or subsequently, shall be provided with medical consultation as required in paragraph (f)(3)(ii) of this section.

(10) Chemical protective clothing. Chemical protective clothing and equipment to be used by organized and designated HAZMAT team members, or to be used by hazardous materials specialists, shall meet the requirements of paragraphs (g)(3) through (5) of this section.

(11) Post-emergency response operations. Upon completion of the emergency response, if it is determined that it is necessary to remove hazardous substances, health hazards, and materials contaminated with them (such as contaminated soil or other elements of the natural environment) from the site of the incident, the employer conducting the clean-up shall comply with one of the following:

(i) Meet all of the requirements of paragraphs (b) through (o) of this section; or

(ii) Where the clean-up is done on plant property using plant or workplace employees, such employees shall have completed the training requirements of the following: 29 CFR 1910.38(a); 1910.134; 1910.1200, and other appropriate safety and health training made necessary by the tasks that they are expected to be performed such as personal protective equipment and decontamination procedures. All equipment to be used in the performance of the clean-up work shall be in serviceable condition and shall have been inspected prior to use.

Note: 1910.38 is now OAR 437-002-0042.

[54 FR 9317, Mar. 6, 1989, as amended at 55 FR 14073, Apr. 13, 1990; 56 FR 15832, Apr. 18, 1991; 59 FR 43270, Aug. 22, 1994; 61 FR 9238, Mar. 7, 1996; 67 FR 67964, Nov. 7, 2002; 71 FR 16672, Apr. 3, 2006; 76 FR 80738, Dec. 27, 2011; 77 FR 17776, Mar. 26, 2012; 78 FR 9313, Feb. 8, 2013; 84 FR 21597, May 14, 2019]

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: APD Admin. Order 12-1989, f. 7/14/89, ef. 7/14/90 (Hazardous Wastes – Final).
OR-OSHA Admin. Order 22-1990, f. 9/28/90, ef. 10/1/90.
OR-OSHA Admin. Order 3-1992, f. 2/6/92, ef. 2/6/92.
OR-OSHA Admin. Order 4-1997, f. 4/2/97, ef. 4/2/97.
OR-OSHA Admin. Order 12-2001, f. 10/26/01, ef. 10/26/01.
OR-OSHA Admin. Order 4-2006, f. 7/24/06, ef. 7/24/06.
OR-OSHA Admin. Order 1-2012, f. 4/10/12, ef. 4/10/12.
OR-OSHA Admin. Order 5-2012, f. 9/25/12, ef. 9/25/12.
OR-OSHA Admin. Order 4-2013, f. 7/19/13, ef. 7/19/13.
OR-OSHA Admin. Order 3-2019, f. 10/29/19, ef. 10/29/19.

Appendices to 1910.120

Hazardous Waste Operations And Emergency Response

Note: The following appendices serve as nonmandatory guidelines to assist employees and employers in complying with the appropriate requirements of this section. However, paragraph 1910.120(g) makes mandatory in certain circumstances the use of Level A and Level B PPE protection.

Appendix A – Personal Protective Equipment Test Methods

This appendix sets forth the nonmandatory examples of tests which may be used to evaluate compliance with 1910.120(g)(4)(ii) and (iii). Other tests and other challenge agents may be used to evaluate compliance.

A. Totally-encapsulating chemical protective suit pressure test

1.0 – Scope

1.1 This practice measures the ability of a gas-tight totally-encapsulating chemical protective suit material, seams, and closures to maintain a fixed positive pressure. The results of this practice allow the gas-tight integrity of a totally encapsulating chemical protective suit to be evaluated.

1.2 Resistance of the suit materials to permeation, penetration, and degradation by specific hazardous substances is not determined by this test method.

2.0 – Definition of terms

2.1 **Totally-encapsulated chemical protective suit (TECP suit)** means a full body garment which is constructed of protective clothing materials; covers the wearer's torso, head, arms, legs and respirator; may cover the wearer's hands and feet with tightly attached gloves and boots; completely encloses the wearer and respirator by itself or in combination with the wearer's gloves and boots.

2.2 **Protective clothing material** means any material or combination of materials used in an item of clothing for the purpose of isolating parts of the body from direct contact with a potentially hazardous liquid or gaseous chemicals.

2.3 **Gas-tight** means, for the purpose of this test method, the limited flow of a gas under pressure from the inside of a TECP suit to atmosphere at a prescribed pressure and time interval.

3.0 – Summary of test method

3.1 The TECP suit is visually inspected and modified for the test. The test apparatus is attached to the suit to permit inflation to the pre-test suit expansion pressure for removal of suit wrinkles and creases. The pressure is lowered to the test pressure and monitored for 3 minutes. If the pressure drop is excessive, the TECP suit fails the test and is removed from service. The test is repeated after leak location and repair.

4.0 – Required Supplies

4.1 Source of compressed air.

4.2 Test apparatus for suit testing, including a pressure measurement device with a sensitivity of at least 1/4-inch water gauge.

4.3 Vent valve closure plugs or sealing tape.

4.4 Soapy water solution and soft brush.

4.5 Stop watch or appropriate timing device.

5.0 – Safety Precautions

5.1 Care shall be taken to provide the correct pressure safety devices required for the source of compressed air used.

6.0 – Test Procedure

6.1 Prior to each test, the tester shall perform a visual inspection of the suit. Check the suit for seam integrity by visually examining the seams and gently pulling on the seams. Ensure that all air supply lines, fittings, visor, zippers, and valves are secure and show no signs of deterioration.

6.1.1 Seal off the vent valves along with any other normal inlet or exhaust points (such as umbilical air line fittings or face piece opening) with tape or other appropriate means (caps, plugs, fixture, etc.). Care should be exercised in the sealing process not to damage any of the suit components.

6.1.2 Close all closure assemblies.

6.1.3 Prepare the suit for inflation by providing an improvised connection point on the suit for connecting an airline. Attach the pressure test apparatus to the suit to permit suit inflation from a compressed air source equipped with a pressure indicating regulator. The leak tightness of the pressure test apparatus should be tested before and after each test by closing off the end of the tubing attached to the suit and assuring a pressure of 3 inches water gauge for 3 minutes can be maintained. If a component is removed for the test, that component shall be replaced and a second test conducted with another component removed to permit a complete test of the ensemble.

6.1.4 The pre-test expansion pressure (A) and the suit test pressure (B) shall be supplied by the suit manufacturer, but in no case shall they be less than: (A)=3 inches water gauge; and (B)=2 inches water gauge. The ending suit pressure (C) shall be no less than 80 percent of the test pressure (B); i.e., the pressure drop shall not exceed 20 percent of the test pressure (B).

6.1.5 Inflate the suit until the pressure inside is equal to pressure (A), the pre- test expansion suit pressure. Allow at least 1-minute to fill out the wrinkles in the suit. Release sufficient air to reduce the suit pressure to pressure (B), the suit test pressure. Begin timing. At the end of 3 minutes, record the suit pressure as pressure (C), the ending suit pressure. The difference between the suit test pressure and the ending suit test pressure (B-C) shall be defined as the suit pressure drop.

6.1.6 If the suit pressure drop is more than 20 percent of the suit test pressure (B) during the 3-minute test period, the suit fails the test and shall be removed from service.

7.0 – Retest Procedure

7.1 If the suit fails the test check for leaks by inflating the suit to pressure (A) and brushing or wiping the entire suit (including seams, closures, lens gaskets, glove-to-sleeve joints, etc.) with a mild soap and water solution. Observe the suit for the formation of soap bubbles, which is an indication of a leak. Repair all identified leaks.

7.2 Retest the TECP suit as outlined in Test procedure 6.0.

8.0 – Report

8.1 Each TECP suit tested by this practice shall have the following information recorded:

8.1.1 Unique identification number, identifying brand name, date of purchase, material of construction, and unique fit features, e.g., special breathing apparatus.

8.1.2 The actual values for test pressures (A), (B), and (C) shall be recorded along with the specific observation times. If the ending pressure (C) is less than 80 percent of the test pressure (B), the suit shall be identified as failing the test. When possible, the specific leak location shall be identified in the test records. Retest pressure data shall be recorded as an additional test.

8.1.3 The source of the test apparatus used shall be identified and the sensitivity of the pressure gauge shall be recorded.

8.1.4 Records shall be kept for each pressure test even if repairs are being made at the test location.

Caution

Visually inspect all parts of the suit to be sure they are positioned correctly and secured tightly before putting the suit back into service. Special care should be taken to examine each exhaust valve to make sure it is not blocked.

Care should also be exercised to assure that the inside and outside of the suit is completely dry before it is put into storage.

B. Totally-encapsulating chemical protective suit qualitative leak test

1.0 – Scope

1.1 This practice semi-qualitatively tests gas-tight totally-encapsulating chemical protective suit integrity by detecting inward leakage of ammonia vapor. Since no modifications are made to the suit to carry out this test, the results from this practice provide a realistic test for the integrity of the entire suit.

1.2 Resistance of the suit materials to permeation, penetration, and degradation is not determined by this test method. ASTM test methods are available to test suit materials for these characteristics and the tests are usually conducted by the manufacturers of the suits.

2.0 – Definition of terms

2.1 Totally-encapsulated chemical protective suit (TECP suit) means a full body garment which is constructed of protective clothing materials; covers the wearer's torso, head, arms, legs and respirator; may cover the wearer's hands and feet with tightly attached gloves and boots; completely encloses the wearer and respirator by itself or in combination with the wearer's gloves, and boots.

2.2 Protective clothing material means any material or combination of materials used in an item of clothing for the purpose of isolating parts of the body from direct contact with a potentially hazardous liquid or gaseous chemicals.

2.3 Gas-tight means, for the purpose of this test method, the limited flow of a gas under pressure from the inside of a TECP suit to atmosphere at a prescribed pressure and time interval.

2.4 Intrusion Coefficient means a number expressing the level of protection provided by a gas-tight totally-encapsulating chemical protective suit. The intrusion coefficient is calculated by dividing the test room challenge agent concentration by the concentration of challenge agent found inside the suit. The accuracy of the intrusion coefficient is dependent on the challenge agent monitoring methods. The larger the intrusion coefficient the greater the protection provided by the TECP suit.

3.0 – Summary of recommended practice

3.1 The volume of concentrated aqueous ammonia solution (ammonia hydroxide NH_4OH) required to generate the test atmosphere is determined using the directions outlined in 6.1. The suit is donned by a person wearing the appropriate respiratory equipment (either a positive pressure self-contained breathing apparatus or a positive pressure supplied air respirator) and worn inside the enclosed test room. The concentrated aqueous ammonia solution is taken by the suited individual into the test room and poured into an open plastic pan. A 2-minute evaporation period is observed before the test room concentration is measured, using a high range ammonia length of stain detector tube. When the ammonia vapor reaches a concentration of between 1000 and 1200 ppm, the suited individual starts a standardized exercise protocol to stress and flex the suit. After this protocol is completed, the test room concentration is measured again. The suited individual exits the test room and his stand-by person measures the ammonia concentration inside the suit using a low range ammonia length of stain detector tube or other more sensitive ammonia detector. A stand-by person is required to observe the test individual during the test procedure; aid the person in donning and doffing the TECP suit; and monitor the suit interior. The intrusion coefficient of the suit can be calculated by dividing the average test area concentration by the interior suit concentration. A colorimetric ammonia indicator strip of bromophenol blue or equivalent is placed on the inside of the suit face piece lens so that the suited individual is able to detect a color change and know if the suit has a significant leak. If a color change is observed the individual shall leave the test room immediately.

4.0 – Required supplies

4.1 A supply of concentrated aqueous ammonium hydroxide (58 percent by weight).

4.2 A supply of bromophenol/blue indicating paper or equivalent, sensitive to 5 10 ppm ammonia or greater over a 2-minute period of exposure. (pH 3.0 (yellow) to pH 4.6 (blue))

4.3 A supply of high range (0.5-10 volume percent) and low range (5-700 ppm) detector tubes for ammonia and the corresponding sampling pump. More sensitive ammonia detectors can be substituted for the low range detector tubes to improve the sensitivity of this practice.

4.4 A shallow plastic pan (PVC) at least 12”:14”:1” and 1/2-pint plastic container (PVC) with tightly closing lid.

4.5 A graduated cylinder or other volumetric measuring device of at least 50 milliliters in volume with an accuracy of at least ±1 milliliters.

5.0 – Safety precautions

5.1 Concentrated aqueous ammonium hydroxide, NH_4OH, is a corrosive volatile liquid requiring eye, skin, and respiratory protection. The person conducting the test shall review the MSDS for aqueous ammonia.

5.2 Since the established permissible exposure limit for ammonia is 35 ppm as a 15 minute STEL, only persons wearing a positive pressure self-contained breathing apparatus or a positive pressure supplied air respirator shall be in the chamber. Normally only the person wearing the totally-encapsulating suit will be inside the chamber. A stand-by person shall have a positive pressure self-contained breathing apparatus, or a positive pressure supplied air respirator available to enter the test area should the suited individual need assistance.

5.3 A method to monitor the suited individual must be used during this test. Visual contact is the simplest but other methods using communication devices are acceptable.

5.4 The test room shall be large enough to allow the exercise protocol to be carried out and then to be ventilated to allow for easy exhaust of the ammonia test atmosphere after the test(s) are completed.

5.5 Individuals shall be medically screened for the use of respiratory protection and checked for allergies to ammonia before participating in this test procedure.

6.0 – Test procedure

6.1.1 Measure the test area to the nearest foot and calculate its volume in cubic feet. Multiply the test area volume by 0.2 milliliters of concentrated aqueous ammonia solution per cubic foot of test area volume to determine the approximate volume of concentrated aqueous ammonia required to generate 1000 ppm in the test area.

6.1.2 Measure this volume from the supply of concentrated aqueous ammonia and place it into a closed plastic container.

6.1.3 Place the container, several high range ammonia detector tubes, and the pump in the clean test pan and locate it near the test area entry door so that the suited individual has easy access to these supplies.

6.2.1 In a noncontaminated atmosphere, open a pre-sealed ammonia indicator strip and fasten one end of the strip to the inside of the suit face shield lens where it can be seen by the wearer. Moisten the indicator strip with distilled water. Care shall be taken not to contaminate the detector part of the indicator paper by touching it. A small piece of masking tape or equivalent should be used to attach the indicator strip to the interior of the suit face shield.

6.2.2 If problems are encountered with this method of attachment, the indicator strip can be attached to the outside of the respirator face piece lens being used during the test.

6.3 Don the respiratory protective device normally used with the suit, and then don the TECP suit to be tested. Check to be sure all openings which are intended to be sealed (zippers, gloves, etc.) are completely sealed. DO NOT, however, plug off any venting valves.

6.4 Step into the enclosed test room such as a closet, bathroom, or test booth, equipped with an exhaust fan. No air should be exhausted from the chamber during the test because this will dilute the ammonia challenge concentrations.

6.5 Open the container with the pre-measured volume of concentrated aqueous ammonia within the enclosed test room, and pour the liquid into the empty plastic test pan. Wait 2 minutes to allow for adequate volatilization of the concentrated aqueous ammonia. A small mixing fan can be used near the evaporation pan to increase the evaporation rate of the ammonia solution.

6.6 After 2 minutes a determination of the ammonia concentration within the chamber should be made using the high range colorimetric detector tube. A concentration of 1000 ppm ammonia or greater shall be generated before the exercises are started.

6.7 To test the integrity of the suit the following 4-minute exercise protocol should be followed:

6.7.1 Raising the arms above the head with at least 15 raising motions completed in 1-minute.

6.7.2 Walking in place for 1-minute with at least 15 raising motions of each leg in a 1-minute period.

6.7.3 Touching the toes with a least 10 complete motions of the arms from above the head to touching of the toes in a 1-minute period.

6.7.4 Knee bends with at least 10 complete standing and squatting motions in a 1-minute period.

6.8 If at any time during the test the colorimetric indicating paper should change colors, the test should be stopped and section 6.10 and 6.12 initiated (See paragraph 4.2).

6.9 After completion of the test exercise, the test area concentration should be measured again using the high range colorimetric detector tube.

6.10 Exit the test area.

6.11 The opening created by the suit zipper or other appropriate suit penetration should be used to determine the ammonia concentration in the suit with the low range length of stain detector tube or other ammonia monitor. The internal TECP suit air should be sampled far enough from the enclosed test area to prevent a false ammonia reading.

6.12 After completion of the measurement of the suit interior ammonia concentration the test is concluded and the suit is doffed and the respirator removed.

6.13 The ventilating fan for the test room should be turned on and allowed to run for enough time to remove the ammonia gas. The fan shall be vented to the outside of the building.

6.14 Any detectable ammonia in the suit interior (5 ppm ammonia (NH_3) or more for the length of stain detector tube) indicates that the suit has failed the test. When other ammonia detectors are used a lower level of detection is possible, and it should be specified as the pass/fail criteria.

6.15 By following this test method, an intrusion coefficient of approximately 200 or more can be measured with the suit in a completely operational condition. If the intrusion coefficient is 200 or more, then the suit is suitable for emergency response and field use.

7.0 – Retest procedures

7.1 If the suit fails this test, check for leaks by following the pressure test in test A above.

7.2 Retest the TECP suit as outlined in the test procedure 6.0.

8.0 – Report

8.1 Each gas-tight totally-encapsulating chemical protective suit tested by this practice shall have the following information recorded.

8.1.1 Unique identification number, identifying brand name, date of purchase, material of construction, and unique suit features; e.g., special breathing apparatus.

8.1.2 General description of test room used for test.

8.1.3 Brand name and purchase date of ammonia detector strips and color change data.

8.1.4 Brand name, sampling range, and expiration date of the length of stain ammonia detector tubes. The brand name and model of the sampling pump should also be recorded. If another type of ammonia detector is used, it should be identified along with its minimum detection limit for ammonia.

8.1.5 Actual test results shall list the two test area concentrations, their average, the interior suit concentration, and the calculated intrusion coefficient. Retest data shall be recorded as an additional test.

8.2 The evaluation of the data shall be specified as “suit passed” or “suit failed,” and the date of the test. Any detectable ammonia (five ppm or greater for the length of stain detector tube) in the suit interior indicates the suit has failed this test. When other ammonia detectors are used, a lower level of detection is possible and it should be specified as the pass fail criteria.

Caution

Visually inspect all parts of the suit to be sure they are positioned correctly and secured tightly before putting the suit back into service. Special care should be taken to examine each exhaust valve to make sure it is not blocked.

Care should also be exercised to assure that the inside and outside of the suit is completely dry before it is put into storage.

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: APD Admin. Order 12-1989, f. 7/14/89, ef. 7/14/90 (Hazardous Wastes – Final).
OR-OSHA Admin. Order 22-1990, f. 9/28/90, ef. 10/1/90.

Appendix B – General Description and Discussion of the Levels of Protection and Protective Gear

This appendix sets forth information about personal protective equipment (PPE) protection levels which may be used to assist employers in complying with the PPE requirements of this section.

As required by the standard, PPE must be selected which will protect employees from the specific hazards which they are likely to encounter during their work on-site.

Selection of the appropriate PPE is a complex process which should take into consideration a variety of factors. Key factors involved in this process are identification of the hazards, or suspected hazards; their routes of potential hazard to employees (inhalation, skin absorption, ingestion, and eye or skin contact); and the performance of the PPE materials (and seams) in providing a barrier to these hazards. The amount of protection provided by PPE is material-hazard specific. That is, protective equipment materials will protect well against some hazardous substances and poorly, or not at all, against others. In many instances, protective equipment materials cannot be found which will provide continuous protection from the particular hazardous substance. In these cases the breakthrough time of the protective material should exceed the work durations.

Other factors in this selection process to be considered are matching the PPE to the employee's work requirements and task-specific conditions. The durability of PPE materials, such as tear strength and seam strength, should be considered in relation to the employee's tasks. The effects of PPE in relation to heat stress and task duration are a factor in selecting and using PPE. In some cases layers of PPE may be necessary to provide sufficient protection, or to protect expensive PPE inner garments, suits or equipment.

The more that is known about the hazards at the site, the easier the job of PPE selection becomes. As more information about the hazards and conditions at the site becomes available, the site supervisor can make decisions to upgrade or downgrade the level of PPE protection to match the tasks at hand.

The following are guidelines which an employer can use to begin the selection of the appropriate PPE. As noted above, the site information may suggest the use of combinations of PPE selected from the different protection levels (i.e., A, B, C, or D) as being more suitable to the hazards of the work. It should be cautioned that the listing below does not fully address the performance of the specific PPE material in relation to the specific hazards at the job site, and that PPE selection, evaluation and reselection is an ongoing process until sufficient information about the hazards and PPE performance is obtained.

Part A. Personal protective equipment is divided into four categories based on the degree of protection afforded. (See Part B of this appendix for further explanation of Levels A, B, C, and D hazards.)

I. Level A – To be selected when the greatest level of skin, respiratory, and eye protection is required. The following constitute Level A equipment; it may be used as appropriate;

1. Positive pressure, full facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA, approved by the National Institute for Occupational Safety and Health (NIOSH).
2. Totally-encapsulating chemical-protective suit.
3. Coveralls.[1]
4. Long underwear.[1]
5. Gloves, outer, chemical-resistant.
6. Gloves, inner, chemical-resistant.
7. Boots, chemical-resistant, steel toe and shank.
8. Hard hat (under suit).[1]
9. Disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit).

II. Level B – The highest level of respiratory protection is necessary but a lesser level of skin protection is needed.

The following constitute Level B equipment; it may be used as appropriate.

1. Positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA (NIOSH approved).
2. Hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls).
3. Coveralls.[1]
4. Gloves, outer, chemical-resistant.
5. Gloves, inner, chemical-resistant.

[1]Optional, as applicable

6. Boots, outer, chemical-resistant steel toe and shank.
7. Boot-covers, outer, chemical-resistant (disposable).[1]
8. Hard hat.[1]
9. (Reserved)
10. Face shield.[1]

III. Level C – The concentration(s) and type(s) of airborne substance(s) is known and the criteria for using air purifying respirators are met.

The following constitute Level C equipment; it may be used as appropriate.

1. Full-face or half-mask, air-purifying respirators (NIOSH approved).
2. Hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls).
3. Coveralls.[1]
4. Gloves, outer, chemical-resistant.
5. Gloves, inner, chemical-resistant.
6. Boots (outer), chemical-resistant steel toe and shank.[1]
7. Boot-covers, outer, chemical-resistant (disposable).[1]
8. Hard hat.[1]
9. Escape mask.[1]
10. Face shield.[1]

IV. Level D – A work uniform affording minimal protection, used for nuisance contamination only.

The following constitute Level D equipment; it may be used as appropriate:

1. Coveralls.
2. Gloves.[1]
3. Boots/shoes, chemical-resistant steel toe and shank.
4. Boots, outer, chemical-resistant (disposable).[1]

[1]Optional, as applicable

5. Safety glasses or chemical splash goggles.[1]
6. Hard hat.[1]
7. Escape mask.[1]
8. Face shield.[1]

Part B. The types of hazards for which levels A, B, C, and D protection are appropriate are described below:

I. Level A – Level A protection should be used when:

1. The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either the measured (or potential for) high concentration of atmospheric vapors, gases, or particulates; or the site operations and work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the skin;
2. Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible; or
3. Operations are being conducted in confined, poorly ventilated areas, and the absence of conditions requiring Level A have not yet been determined.

II. Level B – Level B protection should be used when:

1. The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection;
2. The atmosphere contains less than 19.5 percent oxygen; or
3. The presence of incompletely identified vapors or gases is indicated by a direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the skin.

Note: This involves atmospheres with IDLH concentrations of specific substances that present severe inhalation hazards and that do not represent a severe skin hazard; or that do not meet the criteria for use of air-purifying respirators.

III. Level C – Level C protection should be used when:

[1]Optional, as applicable

1. The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin;

2. The types of air contaminants have been identified, concentrations measured, and an air-purifying respirator is available that can remove the contaminants; and

3. All criteria for the use of air-purifying respirators are met.

IV. Level D – Level D protection should be used when:

1. The atmosphere contains no known hazard; and

2. Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

Note: As stated before, combinations of personal protective equipment other than those described for Levels A, B, C, and D protection may be more appropriate and may be used to provide the proper level of protection.

As an aid in selecting suitable chemical protective clothing, it should be noted that the National Fire Protection Association (NFPA) has developed standards on chemical protective clothing. The standards that have been adopted by include:

NFPA 1991 – Standard on Vapor-Protective Suits for Hazardous Chemical Emergencies (EPA Level A Protective Clothing)

NFPA 1992 – Standard on Liquid Splash-Protective Suits for Hazardous Chemical Emergencies (EPA Level B Protective Clothing)

NFPA 1993 – Standard on Liquid Splash-Protective Suits for Nonemergency, Nonflammable Hazardous Chemical Situations (EPA Level B Protective Clothing)

These standards apply documentation and performance requirements to the manufacture of chemical protective suits. Chemical protective suits meeting these requirements are labelled as compliant with the appropriate standard. It is recommended that chemical protective suits that meet these standards be used.

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: APD Admin. Order 12-1989, f. 7/14/89, ef. 7/14/90 (Hazardous Wastes – Final).
OR-OSHA Admin. Order 22-1990, f. 9/28/90, ef. 10/1/90.
OR-OSHA Admin. Order 3-1995, f. 2/22/95, ef. 2/22/95 (Haz Wst/Emg Rsp).

Appendix C – Compliance Guidelines

1. Occupational Safety and Health Program. Each hazardous waste site clean-up effort will require an occupational safety and health program headed by the site coordinator or the employer's representative. The purpose of the program will be the protection of employees at the site and will be an extension of the employer's overall safety and health program. The program will need to be developed before work begins on the site and implemented as work proceeds as stated in paragraph (b). The program is to facilitate coordination and communication of safety and health issues among personnel responsible for the various activities which will take place at the site. It will provide the overall means for planning and implementing the needed safety and health training and job orientation of employees who will be working at the site. The program will provide the means for identifying and controlling worksite hazards and the means for monitoring program effectiveness. The program will need to cover the responsibilities and authority of the site coordinator or the employer's manager on the site for the safety and health of employees at the site, and the relationships with contractors or support services as to what each employer's safety and health responsibilities are for their employees on the site. Each contractor on the site needs to have its own safety and health program so structured that it will smoothly interface with the program of the site coordinator or principal contractor.

   Also those employers involved with treating, storing or disposal of hazardous waste as covered in paragraph (p) must have implemented a safety and health program for their employees. This program is to include the hazard communication program required in paragraph (p)(1) and the training required in paragraphs (p)(7) and (p)(8) as parts of the employers comprehensive overall safety and health program. This program is to be in writing.

Each site or workplace safety and health program will need to include the following: (1) Policy statements of the line of authority and accountability for implementing the program, the objectives of the program and the role of the site safety and health supervisor or manager and staff; (2) means or methods for the development of procedures for identifying and controlling workplace hazards at the site; (3) means or methods for the development and communication to employees of the various plans, work rules, standard operating procedures and practices that pertain to individual employees and supervisors; (4) means for the training of supervisors and employees to develop the needed skills and knowledge to perform their work in a safe and healthful manner; (5) means to anticipate and prepare for emergency situations; and (6) means for obtaining information feedback to aid in evaluating the program and for improving the effectiveness of the program. The management and employees should be trying continually to improve the effectiveness of the program thereby enhancing the protection being afforded those working on the site.

Accidents on the site or workplace should be investigated to provide information on how such occurrences can be avoided in the future. When injuries or illnesses occur on the site or workplace, they will need to be investigated to determine what needs to be done to prevent this incident from occurring again. Such information will need to be used as feedback on the effectiveness of the program and the information turned into positive steps to prevent any reoccurrence. Receipt of employee suggestions or complaints relating to safety and health issues involved with site or workplace activities is also a feedback mechanism that can be used effectively to improve the program and may serve in part as an evaluative tool(s).

For the development and implementation of the program to be the most effective, professional safety and health personnel should be used. Certified Safety Professionals, Board Certified Industrial Hygienists or Registered Professional Safety Engineers are good examples of professional stature for safety and health managers who will administer the employer’s program.

2. Training. The training programs for employees subject to the requirements of paragraph (e) of this standard should address: the safety and health hazards employees should expect to find on hazardous waste clean-up sites; what control measures or techniques are effective for those hazards; what monitoring procedures are effective in characterizing exposure levels; what makes an effective employer's safety and health program; what a site safety and health plan should include; hands on training with personal protective equipment and clothing they may be expected to use; the contents of the OSHA standard relevant to the employee's duties and function; and, employee's responsibilities under OSHA and other regulations. Supervisors will need training in their responsibilities under the safety and health program and its subject areas such as the spill containment program, the personal protective equipment program, the medical surveillance program, the emergency response plan and other areas.

The training programs for employees subject to the requirements of paragraph (p) of this standard should address: the employers safety and health program elements impacting employees; the hazard communication program; the medical surveillance program; the hazards and the controls for such hazards that employees need to know for their job duties and functions. All require annual refresher training.

The training programs for employees covered by the requirements of paragraph (q) of this standard should address those competencies required for the various levels of response such as: the hazards associated with hazardous substances; hazard identification and awareness; notification of appropriate persons; the need for and use of personal protective equipment including respirators; the decontamination procedures to be used; preplanning activities for hazardous substance incidents including the emergency response plan; company standard operating procedures for hazardous substance emergency responses; the use of the incident command system and other subjects. Hands-on training should be stressed whenever possible. Critiques done after an incident which include an evaluation of what worked and what did not and how could the incident be better handled the next time may be counted as training time.

For hazardous materials specialists (usually members of hazardous materials teams), the training should address the care, use and/or testing of chemical protective clothing including totally encapsulating suits, the medical surveillance program, the standard operating procedures for the hazardous materials team including the use of plugging and patching equipment and other subject areas.

Officers and leaders who may be expected to be in charge at an incident should be fully knowledgeable of their company's incident command system. They should know where and how to obtain additional assistance and be familiar with the local district's emergency response plan and the state emergency response plan.

Specialist employees such as technical experts, medical experts or environmental experts that work with hazardous materials in their regular jobs, who may be sent to the incident scene by the shipper, manufacturer or governmental agency to advise and assist the person in charge of the incident should have training on an annual basis. Their training should include the care and use of personal protective equipment including respirators; knowledge of the incident command system and how they are to relate to it; and those areas needed to keep them current in their respective field as it relates to safety and health involving specific hazardous substances.

Those skilled support personnel, such as employees who work for public works departments or equipment operators who operate bulldozers, sand trucks, backhoes, etc., who may be called to the incident scene to provide emergency support assistance, should have at least a safety and health briefing before entering the area of potential or actual exposure. These skilled support personnel, who have not been a part of the emergency response plan and do not meet the training requirements, should be made aware of the hazards they face and should be provided all necessary protective clothing and equipment required for their tasks.

There are two National Fire Protection Association standards, NFPA 472 – "Standard for Professional Competence of Responders to Hazardous Material Incidents" and NFPA 471 – "Recommended Practice for Responding to Hazardous Material Incidents," which are excellent resource documents to aid fire departments and other emergency response organizations in developing their training program materials. NFPA 472 provides guidance on the skills and knowledge needed for first responder awareness level, first responder operations level, hazmat technicians, and hazmat specialist. It also offers guidance for the officer corps who will be in charge of hazardous substance incidents.

3. Decontamination. Decontamination procedures should be tailored to the specific hazards of the site, and may vary in complexity and number of steps, depending on the level of hazard and the employee's exposure to the hazard. Decontamination procedures and PPE decontamination methods will vary depending upon the specific substance, since one procedure or method may not work for all substances. Evaluation of decontamination methods and procedures should be performed, as necessary, to assure that employees are not exposed to hazards by reusing PPE. References in Appendix D may be used for guidance in establishing an effective decontamination program. In addition, the U.S. Coast Guard's Manual, "Policy Guidance for Response to Hazardous Chemical Releases," U.S. Department of Transportation, Washington, DC (COMD TINST M16465.30) is a good reference for establishing an effective decontamination program.

4. Emergency response plans. States, along with designated districts within the states, will be developing or have developed local emergency response plans. These state and district plans should be utilized in the emergency response plans called for in the standard. Each employer should assure that its emergency response plan is compatible with the local plan. The major reference being used to aid in developing the state and local district plans is the Hazardous Materials Emergency Planning Guide, NRT-1. The current Emergency Response Guidebook from the U.S. Department of Transportation, CMA's CHEMTREC and the Fire Service Emergency Management Handbook may also be used as resources.

   Employers involved with treatment, storage, and disposal facilities for hazardous waste, which have the required contingency plan called for by their permit, would not need to duplicate the same planning elements. Those items of the emergency response plan that are properly addressed in the contingency plan may be substituted into the emergency response plan required in 1910.120 or otherwise kept together for employer and employee use.

5. Personal protective equipment programs. The purpose of personal protective clothing and equipment (PPE) is to shield or isolate individuals from the chemical, physical, and biologic hazards that may be encountered at a hazardous substance site.

   As discussed in Appendix B, no single combination of protective equipment and clothing is capable of protecting against all hazards. Thus PPE should be used in conjunction with other protective methods and its effectiveness evaluated periodically.

The use of PPE can itself create significant worker hazards, such as heat stress, physical and psychological stress, and impaired vision, mobility, and communication. For any given situation, equipment and clothing should be selected that provide an adequate level of protection. However, over-protection, as well as under-protection, can be hazardous and should be avoided where possible.

Two basic objectives of any PPE program should be to protect the wearer from safety and health hazards, and to prevent injury to the wearer from incorrect use and/or malfunction of the PPE. To accomplish these goals, a comprehensive PPE program should include hazard identification, medical monitoring, environmental surveillance, selection, use, maintenance, and decontamination of PPE and its associated training.

The written PPE program should include policy statements, procedures, and guidelines. Copies should be made available to all employees, and a reference copy should be made available at the worksite. Technical data on equipment, maintenance manuals, relevant regulations, and other essential information should also be collected and maintained.

6. Incident command system (ICS). Paragraph 1910.120(q)(3)(ii) requires the implementation of an ICS. The ICS is an organized approach to effectively control and manage operations at an emergency incident. The individual in charge of the ICS is the senior official responding to the incident. The ICS is not much different than the “command post” approach used for many years by the fire service. During large complex fires involving several companies and many pieces of apparatus, a command post would be established. This enabled one individual to be in charge of managing the incident, rather than having several officers from different companies making separate, and sometimes conflicting, decisions. The individual in charge of the command post would delegate responsibility for performing various tasks to subordinate officers. Additionally, all communications were routed through the command post to reduce the number of radio transmissions and eliminate confusion. However, strategy, tactics, and all decisions were made by one individual.

The ICS is a very similar system, except it is implemented for emergency response to all incidents, both large and small, that involve hazardous substances.

For a small incident, the individual in charge of the ICS may perform many tasks of the ICS. There may not be any, or little, delegation of tasks to subordinates. For example, in response to a small incident, the individual in charge of the ICS, in addition to normal command activities, may become the safety officer and may designate only one employee (with proper equipment) as a backup to provide assistance if needed. OSHA does recommend, however, that at least two employees be designated as back-up personnel since the assistance needed may include rescue.

To illustrate the operation of the ICS, the following scenario might develop during a small incident, such as an overturned tank truck with a small leak of flammable liquid.

The first responding senior officer would implement and take command of the ICS. That person would size-up the incident and determine if additional personnel and apparatus were necessary; would determine what actions to take to control the leak; and, determine the proper level of personal protective equipment. If additional assistance is not needed, the individual in charge of the ICS would implement actions to stop and control the leak using the fewest number of personnel that can effectively accomplish the tasks. The individual in charge of the ICS then would designate himself as the safety officer and two other employees as a back-up in case rescue may become necessary. In this scenario, decontamination procedures would not be necessary.

A large complex incident may require many employees and difficult, time-consuming efforts to control. In these situations, the individual in charge of the ICS will want to delegate different tasks to subordinates in order to maintain a span of control that will keep the number of subordinates, that are reporting, to a manageable level.

Delegation of task at large incidents may be by location, where the incident scene is divided into sectors, and subordinate officers coordinate activities within the sector that they have been assigned.

Delegation of tasks can also be by function. Some of the functions that the individual in charge of the ICS may want to delegate at a large incident are: medical services; evacuation; water supply; resources (equipment, apparatus); media relations; safety; and, site control (integrate activities with police for crowd and traffic control). Also for a large incident, the individual in charge of the ICS will designate several employees as back-up personnel; and a number of safety officers to monitor conditions and recommend safety precautions.

Therefore, no matter what size or complexity an incident may be, by implementing an ICS there will be one individual in charge who makes the decisions and gives directions; and, all actions, and communications are coordinated through one central point of command. Such a system should reduce confusion, improve safety, organize and coordinate actions, and should facilitate effective management of the incident.

7. Site Safety and Control Plans. The safety and security of response personnel and others in the area of an emergency response incident site should be of primary concern to the incident commander. The use of a site safety and control plan could greatly assist those in charge of assuring the safety and health of employees on the site.

A comprehensive site safety and control plan should include the following: summary analysis of hazards on the site and a risk analysis of those hazards; site map or sketch; site work zones (clean zone, transition or decontamination zone, work or hot zone); use of the buddy system; site communications; command post or command center; standard operating procedures and safe work practices; medical assistance and triage area; hazard monitoring plan (air contaminate monitoring, etc.); decontamination procedures and area; and other relevant areas. This plan should be a part of the employer's emergency response plan or an extension of it to the specific site.

8. Medical surveillance programs. Workers handling hazardous substances may be exposed to toxic chemicals, safety hazards, biologic hazards, and radiation. Therefore, a medical surveillance program is essential to assess and monitor workers' health and fitness for employment in hazardous waste operations and during the course of work; to provide emergency and other treatment as needed; and to keep accurate records for future reference.

The Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities developed by the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), the U.S. Coast Guard (USCG), and the Environmental Protection Agency (EPA); October 1985 provides an excellent example of the types of medical testing that should be done as part of a medical surveillance program.

9. New Technology and Spill Containment Programs. Where hazardous substances may be released by spilling from a container that will expose employees to the hazards of the materials, the employer will need to implement a program to contain and control the spilled material. Diking and ditching, as well as use of absorbents like diatomaceous earth, are traditional techniques which have proven to be effective over the years. However, in recent years new products have come into the marketplace, the use of which complement and increase the effectiveness of these traditional methods. These new products also provide emergency responders and others with additional tools or agents to use to reduce the hazards of spilled materials.

   These agents can be rapidly applied over a large area and can be uniformly applied or otherwise can be used to build a small dam, thus improving the workers' ability to control spilled material. These application techniques enhance the intimate contact between the agent and the spilled material allowing for the quickest effect by the agent or quickest control of the spilled material. Agents are available to solidify liquid spilled materials, to suppress vapor generation from spilled materials, and to do both. Some special agents, which when applied as recommended by the manufacturer, will react in a controlled manner with the spilled material to neutralize acids or caustics, or greatly reduce the level of hazard of the spilled material.

   There are several modern methods and devices for use by emergency response personnel or others involved with spill control efforts to safety apply spill control agents to control spilled material hazards. These include portable pressurized applicators similar to hand-held portable fire extinguishing devices, and nozzle and hose systems similar to portable fire fighting foam systems which allow the operator to apply the agent without having to come into contact with the spilled material. The operator is able to apply the agent to the spilled material from a remote position.

   The solidification of liquids provides for rapid containment and isolation of hazardous substance spills. By directing the agent at run-off points or at the edges of the spill, the reactant solid will automatically create a barrier to slow or stop the spread of the material. Clean-up of hazardous substances is greatly improved when solidifying agents, acid or caustic neutralizers, or activated carbon adsorbents are used. Properly applied, these agents can totally solidify liquid hazardous substances or neutralize or absorb them, which results in materials which are less hazardous and easier to handle, transport, and dispose of. The concept of spill treatment, to create less hazardous substances, will improve the safety and level of protection of employees working at spill clean-up operations or emergency response operations to spills of hazardous substances.

The use of vapor suppression agents for volatile hazardous substances, such as flammable liquids and those substances which present an inhalation hazard, is important for protecting workers. The rapid and uniform distribution of the agent over the surface of the spilled material can provide quick vapor knockdown. There are temporary and long-term foam-type agents which are effective on vapors and dusts, and activated carbon adsorption agents which are effective for vapor control and soaking-up of the liquid. The proper use of hose lines or hand-held portable pressurized applicators provides good mobility and permits the worker to deliver the agent from a safe distance without having to step into the untreated spilled material. Some of these systems can be recharged in the field to provide coverage of larger spill areas than the design limits of a single charged applicator unit. Some of the more effective agents can solidify the liquid flammable hazardous substances and at the same time elevate the flashpoint above 140 degrees F so the resulting substance may be handled as a nonhazardous waste material if it meets the U.S. Environmental Protection Agency's 40 CFR Part 261 requirements (See particularly 261.21).

All workers performing hazardous substance spill control work are expected to wear the proper protective clothing and equipment for the materials present and to follow the employer's established standard operating procedures for spill control. All involved workers need to be trained in the established operating procedures; in the use and care of spill control equipment; and in the associated hazards and control of such hazards of spill containment work.

These new tools and agents are the things that employers will want to evaluate as part of their new technology program. The treatment of spills of hazardous substances or wastes at an emergency incident as part of the immediate spill containment and control efforts is sometimes acceptable to EPA and a permit exception is described in 40 CFR 264.1(g)(8) and 265.1(c)(11).

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: APD Admin. Order 12-1989, f. 7/14/89, ef. 7/14/90 (Hazardous Wastes – Final).
OR-OSHA Admin. Order 22-1990, f. 9/28/90, ef. 10/1/90.

Appendix D – References

The following references may be consulted for further information on the subject of this standard:

1. OSHA Instruction DFO CPL 2.70 – January 29, 1986, Special Emphasis Program: Hazardous Waste Sites.

2. OSHA Instruction DFO CPL 2-2.37A – January 29, 1986, Technical Assistance and Guidelines for Superfund and Other Hazardous Waste Site Activities.

3. OSHA Instruction DTS CPL 2.74 – January 29, 1986, Hazardous Waste Activity Form, OSHA 175.

4. Hazardous Waste Inspections Reference Manual, U.S. Department of Labor, Occupational Safety and Health Administration, 1986.

5. Memorandum of Understanding Among the National Institute for Occupational Safety and Health, the Occupational Safety and Health Administration, the United States Coast Guard, and the United States Environmental Protection Agency, Guidance for Worker Protection During Hazardous Waste Site Investigations and Clean-up and Hazardous Substance Emergencies. December 18, 1980.

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9. Standard Operating Safety Guidelines; U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Hazardous Response Support Division, Environmental Response Team; November 1984.

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15. Emergency Response Guidebook, U.S. Department of Transportation, Washington, DC, 1987.

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19. Incident Command System, Fire Protection Publications, Oklahoma State University, Stillwater, OK 74078, 1983.

20. Site Emergency Response Planning, Chemical Manufacturers Association, Washington, DC 20037, 1986.

21. Hazardous Materials Emergency Planning Guide, NRT-1, Environmental Protection Agency, Washington, DC, March 1987.

22. Community Teamwork: Working Together to Promote Hazardous Materials Transportation Safety. U.S. Department of Transportation, Washington, DC, May 1983.

23. Disaster Planning Guide for Business and Industry, Federal Emergency Management Agency, Publication No. FEMA 141, August 1987.

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: APD Admin. Order 12-1989, f. 7/14/89, ef. 7/14/90 (Hazardous Wastes – Final).
OR-OSHA Admin. Order 22-1990, f. 9/28/90, ef. 10/1/90.

Appendix E – Training Curriculum Guidelines

The following nonmandatory general criteria may be used for assistance in developing site-specific training curriculum used to meet the training requirements of 29 CFR 1910.120(e); 29 CFR 1910.120(p)(7), (p)(8)(iii); and 29 CFR 1910.120(q)(6), (q)(7), and (q)(8). These are generic guidelines and they are not presented as a complete training curriculum for any specific employer. Site-specific training programs must be developed on the basis of a needs assessment of the hazardous waste site, RCRA/TSDF, or emergency response operation in accordance with 29 CFR 1910.120.

It is noted that the legal requirements are set forth in the regulatory text of 1910.120. The guidance set forth here presents a highly effective program that in the areas covered would meet or exceed the regulatory requirements. In addition, other approaches could meet the regulatory requirements.

Suggested General Criteria

Definitions:

Competent means possessing the skills, knowledge, experience, and judgment to perform assigned tasks or activities satisfactorily as determined by the employer.

Demonstration means the showing by actual use of equipment or procedures.

Hands-on training means training in a simulated work environment that permits each student to have experience performing tasks, making decisions, or using equipment appropriate to the job assignment for which the training is being conducted.

Initial training means training required prior to beginning work.

Lecture means an interactive discourse with a class lead by an instructor.

Proficient means meeting a stated level of achievement.

Site-specific means individual training directed to the operations of a specific job site.

Training hours means the number of hours devoted to lecture, learning activities, small group work sessions, demonstration, evaluations, or hands-on experience.

Suggested Core Criteria:

1. Training facility. The training facility should have available sufficient resources, equipment, and site locations to perform didactic and hands-on training when appropriate. Training facilities should have sufficient organization, support staff, and services to conduct training in each of the courses offered.
2. Training Director. Each training program should be under the direction of a training director who is responsible for the program. The Training Director should have a minimum of 2 years of employee education experience.
3. Instructors. Instructors should be deemed competent on the basis of previous documented experience in their area of instruction, successful completion of a "train-the-trainer" program specific to the topics they will teach, and an evaluation of instructional competence by the Training Director.

   Instructors should be required to maintain professional competency by participating in continuing education or professional development programs or by completing successfully an annual refresher course and having an annual review by the Training Director.

   The annual review by the Training Director should include observation of an instructor's delivery, a review of those observations with the trainer, and an analysis of any instructor or class evaluations completed by the students during the previous year.
4. Course materials. The Training Director should approve all course materials to be used by the training provider. Course materials should be reviewed and updated at least annually. Materials and equipment should be in good working order and maintained properly.

   All written and audiovisual materials in training curricula should be peer reviewed by technically competent outside reviewers or by a standing advisory committee.

   Reviews should possess expertise in the following disciplines where applicable: occupational health, industrial hygiene and safety, chemical/environmental engineering, employee education, or emergency response. One or more of the peer reviewers should be an employee experienced in the work activities to which the training is directed.
5. Students. The program for accepting students should include:
   a. Assurance that the student is or will be involved in work where chemical exposures are likely and that the student possesses the skills necessary to perform the work;
   b. A policy on the necessary medical clearance.

6. Ratios. Student-instructor ratios should not exceed 30 students per instructor. Hands-on activity requiring the use of personal protective equipment should have the following student-instructor ratios. For Level C or Level D personal protective equipment the ratio should be 10 students per instructor. For Level A or Level B personal protective equipment the ratio should be 5 students per instructor.

7. Proficiency assessment. Proficiency should be evaluated and documented by the use of a written assessment and a skill demonstration selected and developed by the Training Director and training staff. The assessment and demonstration should evaluate the knowledge and individual skills developed in the course of training. The level of minimum achievement necessary for proficiency shall be specified in writing by the Training Director.

   If a written test is used, there should be a minimum of 50 questions. If a written test is used in combination with a skills demonstration, a minimum of 25 questions should be used. If a skills demonstration is used, the tasks chosen and the means to rate successful completion should be fully documented by the Training Director.

   The content of the written test or of the skill demonstration shall be relevant to the objectives of the course. The written test and skill demonstration should be updated as necessary to reflect changes in the curriculum and any update should be approved by the Training Director.

   The proficiency assessment methods, regardless of the approach or combination of approaches used, should be justified, documented and approved by the Training Director.

   The proficiency of those taking the additional courses for supervisors should be evaluated and documented by using proficiency assessment methods acceptable to the Training Director. These proficiency assessment methods must reflect the additional responsibilities borne by supervisory personnel in hazardous waste operations or emergency response.

8. Course certificate. Written documentation should be provided to each student who satisfactorily completes the training course. The documentation should include:

   a. Student’s name.

   b. Course title.

   c. Course date.

   d. Statement that the student has successfully completed the course.

   e. Name and address of the training provider.

f. An individual identification number for the certificate.

g. List of the levels of personal protective equipment used by the student to complete the course.

This documentation may include a certificate and an appropriate wallet-sized laminated card with a photograph of the student and the above information. When such course certificate cards are used, the individual identification number for the training certificate should be shown on the card.

9. Recordkeeping. Training providers should maintain records listing the dates courses were presented, the names of the individual course attenders, the names of those students successfully completing each course, and the number of training certificates issued to each successful student. These records should be maintained for a minimum of 5 years after the date an individual participated in a training program offered by the training provider. These records should be available and provided upon the student's request or as mandated by law.

10. Program quality control. The Training Director should conduct or direct an annual written audit of the training program. Program modifications to address deficiencies, if any, should be documented, approved, and implemented by the training provider. The audit and the program modification documents should be maintained at the training facility.

<u>Suggested Program Quality Control Criteria</u>

Factors listed here are suggested criteria for determining the quality and appropriateness of employee health and safety training for hazardous waste operations and emergency response.

A. Training Plan.

Adequacy and appropriateness of the training program's curriculum development, instructor training, distribution of course materials, and direct student training should be considered, including:

1. The duration of training, course content, and course schedules/agendas;
2. The different training requirements of the various target populations, as specified in the appropriate generic training curriculum;
3. The process for the development of curriculum, which includes appropriate technical input, outside review, evaluation, program pretesting;
4. The adequate and appropriate inclusion of hands-on, demonstration, and instruction methods;

5. Adequate monitoring of student safety, progress, and performance during the training.

B. Program management, Training Director, staff, and consultants.

Adequacy and appropriateness of staff performance and delivering an effective training program should be considered, including:

1. Demonstration of the training director's leadership in assuring quality of health and safety training;
2. Demonstration of the competency of the staff to meet the demands of delivering high quality hazardous waste employee health and safety training;
3. Organization charts establishing clear lines of authority;
4. Clearly defined staff duties including the relationship of the training staff to the overall program;
5. Evidence that the training organizational structure suits the needs of the training program;
6. Appropriateness and adequacy of the training methods used by the instructors;
7. Sufficiency of the time committed by the training director and staff to the training program;
8. Adequacy of the ratio of training staff to students;
9. Availability and commitment of the training program of adequate human and equipment resources in the areas of:
   a. Health effects,
   b. Safety,
   c. Personal protective equipment (PPE),
   d. Operational procedures,
   e. Employee protection practices/procedures.
10. Appropriateness of management controls;
11. Adequacy of the organization and appropriate resources assigned to assure appropriate training;

12. In the case of multiple-site training programs, adequacy of satellite centers management.

C. Training facilities and resources.

Adequacy and appropriateness of the facilities and resources for supporting the training program should be considered, including:

1. Space and equipment to conduct the training;
2. Facilities for representative hands-on training;
3. In the case of multiple-site programs, equipment and facilities at the satellite centers;
4. Adequacy and appropriateness of the quality control and evaluations program to account for instructor performance;
5. Adequacy and appropriateness of the quality control and evaluation program to ensure appropriate course evaluation, feedback, updating, and corrective action;
6. Adequacy and appropriateness of disciplines and expertise being used within the quality control and evaluation program;
7. Adequacy and appropriateness of the role of student evaluations to provide feedback for training program improvement.

D. Quality control and evaluation.

Adequacy and appropriateness of quality control and evaluation plans for training programs should be considered, including:

1. A balanced advisory committee and/or competent outside reviewers to give overall policy guidance;
2. Clear and adequate definition of the composition and active programmatic role of the advisory committee or outside reviewers;
3. Adequacy of the minutes or reports of the advisory committee or outside reviewers' meetings or written communication;
4. Adequacy and appropriateness of the quality control and evaluations program to account for instructor performance;
5. Adequacy and appropriateness of the quality control and evaluation program to ensure appropriate course evaluation, feedback, updating, and corrective action;

6. Adequacy and appropriateness of disciplines and expertise being used within the quality control and evaluation program;

7. Adequacy and appropriateness of the role of student evaluations to provide feedback for training program improvement.

E. Students

Adequacy and appropriateness of the program for accepting students should be considered, including:

1. Assurance that the student already possess the necessary skills for their job, including necessary documentation;

2. Appropriateness of methods the program uses to ensure that recruits are capable of satisfactorily completing training;

3. Review and compliance with any medical clearance policy.

F. Institutional Environment and Administrative Support

The adequacy and appropriateness of the institutional environment and administrative support system for the training program should be considered, including:

1. Adequacy of the institutional commitment to the employee training program;

2. Adequacy and appropriateness of the administrative structure and administrative support.

G. Summary of Evaluation Questions

Key questions for evaluating the quality and appropriateness of an overall training program should include the following:

1. Are the program objectives clearly stated?

2. Is the program accomplishing its objectives?

3. Are appropriate facilities and staff available?

4. Is there an appropriate mix of classroom, demonstration, and hands-on training?

5. Is the program providing quality employee health and safety training that fully meets the intent of regulatory requirements?

6. What are the program's main strengths?

7. What are the program's main weaknesses?

8. What is recommended to improve the program?

9. Are instructors instructing according to their training outlines?

10. Is the evaluation tool current and appropriate for the program content?

11. Is the course material current and relevant to the target group?

Suggested Training Curriculum Guidelines

The following training curriculum guidelines are for those operations specifically identified in 29 CFR 1910.120 as requiring training. Issues such as qualifications of instructors, training certification, and similar criteria appropriate to all categories of operations addressed in 1910.120 have been covered in the preceding section and are not readdressed in each of the generic guidelines. Basic core requirements for training programs that are addressed include:

1. General Hazardous Waste Operations;

2. RCRA operations – Treatment, storage, and disposal facilities;

3. Emergency Response.

A. General Hazardous Waste Operations and Site-specific Training

1. Off-site training. Training course content for hazardous waste operations, required by 29 CFR 1910.120(e), should include the following topics or procedures:

a. Regulatory knowledge.

(1) A review of 29 CFR 1910.120 and the core elements of an occupational safety and health program.

(2) The content of a medical surveillance program as outlined in 29 CFR 1910.120(f).

(3) The content of an effective site safety and health plan consistent with the requirements of 29 CFR 1910.120(b)(4)(ii).

(4) Emergency response plan and procedures as outlined in 29 CFR 1910.38 and 29 CFR 1910.120(l).

(5) Adequate illumination.

(6) Sanitation recommendation and equipment.

(7) Review and explanation of OSHA's hazard-communication standard (29 CFR 1910.1200) and lockout/tagout standard (29 CFR 1910.147).

(8) Review of other applicable standards including but not limited to those in the construction standards (29 CFR Part 1926).

(9) Rights and responsibilities of employers and employees under applicable OSHA and EPA laws.

b. Technical knowledge.

(1) Type of potential exposures to chemical, biological, and radiological hazards; types of human responses to these hazards and recognition of those responses; principles of toxicology and information about acute and chronic hazards; health and safety considerations of new technology.

(2) Fundamentals of chemical hazards including but not limited to vapor pressure, boiling points, flash points, ph, other physical and chemical properties.

(3) Fire and explosion hazards of chemicals.

(4) General safety hazards such as but not limited to electrical hazards, powered equipment hazards, motor vehicle hazards, walking-working surface hazards, excavation hazards, and hazards associated with working in hot and cold temperature extremes.

(5) Review and knowledge of confined space entry procedures in OAR 437-002-0146.

(6) Work practices to minimize employee risk from site hazards.

(7) Safe use of engineering controls, equipment, and any new relevant safety technology or safety procedures.

(8) Review and demonstration of competency with air sampling and monitoring equipment that may be used in a site monitoring program.

(9) Container sampling procedures and safeguarding; general drum and container handling procedures including special requirement for laboratory waste packs, shock-sensitive wastes, and radioactive wastes.

(10) The elements of a spill control program.

(11) Proper use and limitations of material handling equipment.

(12) Procedures for safe and healthful preparation of containers for shipping and transport.

(13) Methods of communication including those used while wearing respiratory protection.

c. Technical skills.

(1) Selection, use, maintenance, and limitations of personal protective equipment including the components and procedures for carrying out a respirator program to comply with 29 CFR 1910.134.

(2) Instruction in decontamination programs including personnel, equipment, and hardware; hands-on training including level A, B, and C ensembles and appropriate decontamination lines; field activities including the donning and doffing of protective equipment to a level commensurate with the employee's anticipated job function and responsibility and to the degree required by potential hazards.

(3) Sources for additional hazard information; exercises using relevant manuals and hazard coding systems.

d. Additional suggested items.

(1) A laminated, dated card or certificate with photo, denoting limitations and level of protection for which the employee is trained should be issued to those students successfully completing a course.

(2) Attendance should be required at all training modules, with successful completion of exercises and a final written or oral examination with at least 50 questions.

(3) A minimum of one-third of the program should be devoted to hands-on exercises.

(4) A curriculum should be established for the 8-hour refresher training required by 29 CFR 1910.120(e)(8), with delivery of such courses directed toward those areas of previous training that need improvement or reemphasis.

(5) A curriculum should be established for the required 8-hour training for supervisors. Demonstrated competency in the skills and knowledge provided in a 40 hour course should be a prerequisite for supervisor training.

2. Refresher training.

The 8-hour annual refresher training required in 29 CFR 1910.120(e)(8) should be conducted by qualified training providers. Refresher training should include at a minimum the following topics and procedures:

a. Review of and retraining on relevant topics covered in the 40-hour program, as appropriate, using reports by the students on their work experiences.

b. Update on developments with respect to material covered in the 40-hour course.

c. Review of changes to pertinent provisions of EPA or OSHA standards or laws.

d. Introduction of additional subject areas as appropriate.

e. Hands-on review of new or altered PPE or decontamination equipment or procedures. Review of new developments in personal protective equipment.

f. Review of newly developed air and contaminant monitoring equipment.

3. On-site training.

a. The employer should provide employees engaged in hazardous waste site activities with information and training prior to initial assignment into their work area, as follows:

(1) The requirements of the hazard communication program including the location and availability of the written program, required lists of hazardous chemicals, and safety data sheets.

(2) Activities and locations in their work area where hazardous substance may be present.

(3) Methods and observations that may be used to detect the present or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearances, or other evidence (sight, sound or smell) of hazardous chemicals being released, and applicable alarms from monitoring devices that record chemical releases.

(4) The physical and health hazards of substances known or potentially present in the work area.

(5) The measures employees can take to help protect themselves from worksite hazards, including specific procedures the employer has implemented.

(6) An explanation of the labeling system and safety data sheets and how employees can obtain and use appropriate hazard information.

(7) The elements of the confined space program including special PPE, permits, monitoring requirements, communication procedures, emergency response, and applicable lockout procedures.

b. The employer should provide hazardous waste employees information and training and should provide a review and access to the site safety and plan as follows:

(1) Names of personnel and alternate responsible for site safety and health.

(2) Safety and health hazards present on the site.

(3) Selection, use, maintenance, and limitations of personal protective equipment specific to the site.

(4) Work practices by which the employee can minimize risks from hazards.

(5) Safe use of engineering controls and equipment available on site.

(6) Safe decontamination procedures established to minimize employee contact with hazardous substances, including:

(A) Employee decontamination,

(B) Clothing decontamination, and

(C) Equipment decontamination.

(7) Elements of the site emergency response plan, including:

(A) Pre-emergency planning.

(B) Personnel roles and lines of authority and communication.

(C) Emergency recognition and prevention.

(D) Safe distances and places of refuge.

(E) Site security and control.

(F) Evacuation routes and procedures.

(G) Decontamination procedures not covered by the site safety and health plan.

(H) Emergency medical treatment and first aid.

(I) Emergency equipment and procedures for handling emergency incidents.

c. The employer should provide hazardous waste employees information and training on personal protective equipment used at the site, such as the following:

(1) PPE to be used based upon known or anticipated site hazards.

(2) PPE limitations of materials and construction; limitations during temperature extremes, heat stress, and other appropriate medical considerations; use and limitations of respirator equipment as well as documentation procedures as outlined in 29 CFR 1910.134.

(3) PPE inspection procedures prior to, during, and after use.

(4) PPE donning and doffing procedures.

(5) PPE decontamination and disposal procedures.

(6) PPE maintenance and storage.

(7) Task duration as related to PPE limitations.

d. The employer should instruct the employee about the site medical surveillance program relative to the particular site, including:

(1) Specific medical surveillance programs that have been adapted for the site.

(2) Specific signs and symptoms related to exposure to hazardous materials on the site.

(3) The frequency and extent of periodic medical examinations that will be used on the site.

(4) Maintenance and availability of records.

(5) Personnel to be contacted and procedures to be followed when signs and symptoms of exposures are recognized.

e. The employees will review and discuss the site safety plan as part of the training program. The location of the site safety plan and all written programs should be discussed with employees including a discussion of the mechanisms for access, review, and references described.

B. RCRA Operations Training for Treatment, Storage and Disposal Facilities.

1. As a minimum, the training course required in 29 CFR 1910.120(p) should include the following topics:

a. Review of the applicable paragraphs of 29 CFR 1910.120 and the elements of the employer's occupational safety and health plan.

b. Review of relevant hazards such as, but not limited to, chemical, biological, and radiological exposures; fire and explosion hazards; thermal extremes; and physical hazards.

c. General safety hazards including those associated with electrical hazards, powered equipment hazards, lockout/tagout procedures, motor vehicle hazards and walking-working surface hazards.

d. Confined-space hazards and procedures.

e. Work practices to minimize employee risk from workplace hazards.

f. Emergency response plan and procedures including first aid meeting the requirements of paragraph (p)(8).

g. A review of procedures to minimize exposure to hazardous waste and various type of waste streams, including the materials handling program and spill containment program.

h. A review of hazard communication programs meeting the requirements of 29 CFR 1910.1200.

i. A review of medical surveillance programs meeting the requirements of 29 CFR 1910.120(p)(3) including the recognition of signs and symptoms of overexposure to hazardous substance including known synergistic interactions.

j. A review of decontamination programs and procedures meeting the requirements of 29 CFR 1910.120(p)(4).

k. A review of an employer's requirements to implement a training program and its elements.

l. A review of the criteria and programs for proper selection and use of personal protective equipment, including respirators.

m. A review of the applicable appendices to 29 CFR 1910.120.

n. Principles of toxicology and biological monitoring as they pertain to occupational health.

o. Rights and responsibilities of employees and employers under applicable OSHA and EPA laws.

p. Hands-on exercises and demonstrations of competency with equipment to illustrate the basic equipment principles that may be used during the performance of work duties, including the donning and doffing of PPE.

q. Sources of reference, efficient use of relevant manuals, and knowledge of hazard coding systems to include information contained in hazardous waste manifests.

r. At least 8 hours of hands-on training.

s. Training in the job skills required for an employee's job function and responsibility before they are permitted to participate in or supervise field activities.

2. The individual employer should provide hazardous waste employees with information and training prior to an employee's initial assignment into a work area. The training and information should cover the following topics:

a. The Emergency response plan and procedures including first aid.

b. A review of the employer's hazardous waste handling procedures including the materials handling program and elements of the spill containment program, location of spill response kits or equipment, and the names of those trained to respond to releases.

c. The hazardous communication program meeting the requirements of 29 CFR 1910.1200.

d. A review of the employer's medical surveillance program including the recognition of signs and symptoms of exposure to relevant hazardous substance including known synergistic interactions.

e. A review of the employer's decontamination program and procedures.

f. A review of the employer's training program and the parties responsible for that program.

g. A review of the employer's personal protective equipment program including the proper selection and use of PPE based upon specific site hazards.

h. All relevant site-specific procedures addressing potential safety and health hazards. This may include, as appropriate, biological and radiological exposures, fire and explosion hazards, thermal hazards, and physical hazards such as electrical hazards, powered equipment hazards, lockout/tagout hazards, motor vehicle hazards, and walking-working surface hazards.

i. Safe use engineering controls and equipment on site.

j. Names of personnel and alternates responsible for safety and health.

C. Emergency response training.

Federal OSHA standards in 29 CFR 1910.120(q) are directed toward private sector emergency responders. Therefore, the guidelines provided in this portion of the appendix are directed toward that employee population. However, they also impact indirectly through State OSHA or USEPA regulations some public sector emergency responders. Therefore, the guidelines provided in this portion of the appendix may be applied to both employee populations.

States with OSHA state plans must cover their employees with regulations at least as effective as the Federal OSHA standards. Public employees in states without approved state OSHA programs covering hazardous waste operations and emergency response are covered by the U.S. EPA under 40 CFR 311, a regulation virtually identical to 1910.120.

Since this is a nonmandatory appendix and therefore not an enforceable standard, OSHA recommends that those employers, employees or volunteers in public sector emergency response organizations outside Federal OSHA jurisdiction consider the following criteria in developing their own training programs. A unified approach to training at the community level between emergency response organizations covered by Federal OSHA and those not covered directly by Federal OSHA can help ensure an effective community response to the release or potential release of hazardous substances in the community.

a. General considerations.

Emergency response organizations are required to consider the topics listed in 1910.120(q)(6). Emergency response organizations may use some or all of the following topics to supplement those mandatory topics when developing their response training programs. Many of the topics would require an interaction between the response provider and the individuals responsible for the site where the response would be expected.

(1) Hazard recognition, including:

(A) Nature of hazardous substances present,

(B) Practical applications of hazard recognition, including presentations on biology, chemistry, and physics.

(2) Principles of toxicology, biological monitoring, and risk assessment.

(3) Safe work practices and general site safety.

(4) Engineering controls and hazardous waste operations.

(5) Site safety plans and standard operating procedures.

(6) Decontamination procedures and practices.

(7) Emergency procedures, first aid, and self-rescue.

(8) Safe use of field equipment.

(9) Storage, handling, use and transportation of hazardous substances.

(10) Use, care, and limitations of personal protective equipment.

(11) Safe sampling techniques.

(12) Rights and responsibilities of employees under OSHA and other related laws concerning right-to-know, safety and health, compensations and liability.

(13) Medical monitoring requirements.

(14) Community relations.

b. Suggested criteria for specific courses.

(1) First responder awareness level.

(A) Review of and demonstration of competency in performing the applicable skills of 29 CFR 1910.120(q).

(B) Hands-on experience with the U.S. Department of Transportation’s Emergency Response Guidebook (ERG) and familiarization with OSHA standard 29 CFR 1910.1201.

(C) Review of the principles and practices for analyzing an incident to determine both the hazardous substances present and the basic hazard and response information for each hazardous substance present.

(D) Review of procedures for implementing actions consistent with the local emergency response plan, the organization's standard operating procedures, and the current edition of DOT's ERG including emergency notification procedures and follow-up communications.

(E) Review of the expected hazards including fire and explosions hazards, confined space hazards, electrical hazards, powered equipment hazards, motor vehicle hazards, and walking-working surface hazards.

(F) Awareness and knowledge of the competencies for the First Responder at the Awareness Level covered in the National Fire Protection Association's Standard No. 472, Professional Competence of Responders to Hazardous Materials Incidents.

(2) First responder operations level.

(A) Review of and demonstration of competency in performing the applicable skills of 29 CFR 1910.120(q).

(B) Hands-on experience with the U.S. Department of Transportation's Emergency Response Guidebook (ERG), manufacturer safety data sheets, CHEMTREC/CANUTEC, shipper or manufacturer contacts, and other relevant sources of information addressing hazardous substance releases. Familiarization with OSHA standard 29 CFR 1910.1201.

(C) Review of the principles and practices for analyzing an incident to determine the hazardous substances present, the likely behavior of the hazardous substance and its container, the types of hazardous substance transportation containers and vehicles, the types and selection of the appropriate defensive strategy for containing the release.

(D) Review of procedures for implementing continuing response actions consistent with the local emergency response plan, the organization's standard operating procedures, and the current edition of DOT's ERG including extended emergency notification procedures and follow-up communications.

(E) Review of the principles and practice for proper selection and use of personal protective equipment.

(F) Review of the principles and practice of personnel and equipment decontamination.

(G) Review of the expected hazards including fire and explosions hazards, confined space hazards, electrical hazards, powered equipment hazards, motor vehicle hazards, and walking-working surface hazards.

(H) Awareness and knowledge of the competencies for the First Responder at the Operations Level covered in the National Fire Protection Association's Standard No. 472, Professional Competence of Responders to Hazardous Materials Incidents.

(3) Hazardous materials technician.

(A) Review of and demonstration of competency in performing the applicable skills of 29 CFR 1910.120(q).

(B) Hands-on experience with written and electronic information relative to response decision making including but not limited to the U.S. Department of Transportation's Emergency Response Guidebook (ERG), manufacturer safety data sheets, CHEMTREC/CANUTEC, shipper or manufacturer contacts, computer data bases and response models, and other relevant sources of information addressing hazardous substance releases. Familiarization with OSHA standard 29 CFR 1910.1201.

(C) Review of the principles and practices for analyzing an incident to determine the hazardous substances present, their physical and chemical properties, the likely behavior of the hazardous substance and its container, the types of hazardous substance transportation containers and vehicles involved in the release, the appropriate strategy for approaching release sites and containing the release.

(D) Review of procedures for implementing continuing response actions consistent with the local emergency response plan, the organization's standard operating procedures, and the current edition of DOT's ERG including extended emergency notification procedures and follow-up communications.

(E) Review of the principles and practice for proper selection and use of personal protective equipment.

(F) Review of the principles and practices of establishing exposure zones, proper decontamination and medical surveillance stations and procedures.

(G) Review of the expected hazards including fire and explosions hazards, confined space hazards, electrical hazards, powered equipment hazards, motor vehicle hazards, and walking-working surface hazards.

(H) Awareness and knowledge of the competencies for the Hazardous Materials Technician covered in the National Fire Protection Association's Standard No. 472, Professional Competence of Responders to Hazardous Materials Incidents.

(4) Hazardous materials specialist.

(A) Review of and demonstration of competency in performing the applicable skills of 29 CFR 1910.120(q).

(B) Hands-on experience with retrieval and use of written and electronic information relative to response decision making including but not limited to the U.S. Department of Transportation's Emergency Response Guidebook (ERG), manufacturer safety data sheets, CHEMTREC/CANUTEC, shipper or manufacturer contacts, computer data bases and response models, and other relevant sources of information addressing hazardous substance releases. Familiarization with OSHA standard 29 CFR 1910.1201.

(C) Review of the principles and practices for analyzing an incident to determine the hazardous substances present, their physical and chemical properties, and the likely behavior of the hazardous substance and its container, vessel, or vehicle.

(D) Review of the principles and practices for identification of the types of hazardous substance transportation containers, vessels and vehicles involved in the release; selecting and using the various types of equipment available for plugging or patching transportation containers, vessels or vehicles; organizing and directing the use of multiple teams of hazardous material technicians and selecting the appropriate strategy for approaching release sites and containing or stopping the release.

(E) Review of procedures for implementing continuing response actions consistent with the local emergency response plan, the organization's standard operating procedures, including knowledge of the available public and private response resources, establishment of an incident command post, direction of hazardous material technician teams, and extended emergency notification procedures and follow-up communications.

(F) Review of the principles and practice for proper selection and use of personal protective equipment.

(G) Review of the principles and practices of establishing exposure zones and proper decontamination, monitoring and medical surveillance stations and procedures.

(H) Review of the expected hazards including fire and explosions hazards, confined space hazards, electrical hazards, powered equipment hazards, motor vehicle hazards, and walking-working surface hazards.

(I) Awareness and knowledge of the competencies for the Off-site Specialist Employee covered in the National Fire Protection Association's Standard No. 472, Professional Competence of Responders to Hazardous Materials Incidents.

(5) Incident commander.

The incident commander is the individual who, at any one time, is responsible for and in control of the response effort. This individual is the person responsible for the direction and coordination of the response effort. An incident commander's position should be occupied by the most senior, appropriately trained individual present at the response site. Yet, as necessary and appropriate by the level of response provided, the position may be occupied by many individuals during a particular response as the need for greater authority, responsibility, or training increases. It is possible for the first responder at the awareness level to assume the duties of incident commander until a more senior and appropriately trained individual arrives at the response site.

Therefore, any emergency responder expected to perform as an incident commander should be trained to fulfill the obligations of the position at the level of response they will be providing including the following:

(A) Ability to analyze a hazardous substance incident to determine the magnitude of the response problem.

(B) Ability to plan and implement an appropriate response plan within the capabilities of available personnel and equipment.

(C) Ability to implement a response to favorably change the outcome of the incident in a manner consistent with the local emergency response plan and the organization's standard operating procedures.

(D) Ability to evaluate the progress of the emergency response to ensure that the response objectives are being met safely, effectively, and efficiently.

(E) Ability to adjust the response plan to the conditions of the response and to notify higher levels of response when required by the changes to the response plan.

[54 FR 9317, Mar. 6, 1989, as amended at 55 FR 14073, Apr. 13, 1990; 56 FR 15832, Apr. 18, 1991; 59 FR 43270, Aug. 22, 1994; 61 FR 9238, Mar. 7, 1996]

Stat. Auth.: ORS 654.025(2) and ORS 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: OR-OSHA Admin. Order 3-1995, f. 2/22/95, ef. 2/22/95.
OR-OSHA Admin. Order 6-2012, f. 9/28/12, ef. 4/1/13.
OR-OSHA Admin. Order 4-2013, f. 7/19/13, ef. 7/19/13.

1910.121 (Reserved)

437-002-0122 Dipping and Coating

(1) Scope.

(a) This rule applies to all operations where an object is partially or fully immersed in a liquid, or the vapors of a liquid. Such operations include, but are not limited to, cleaning, coating, altering the surface of an object, or changing the character of an object. Examples of covered operations are paint dipping, electroplating, pickling, quenching, tanning, degreasing, stripping, cleaning, roll coating, flow coating, and curtain coating. This rule also applies to draining or drying an object that has been dipped or coated.

(b) This rule does not apply to tanks that contain only water or a molten material.

(2) Definitions.

***Adjacent area:** Any area within 20 feet (6.1 m) of a vapor area that is not separated from the vapor area by tight partitions.*

***Approved:** The equipment is listed or approved by a nationally recognized testing laboratory.*

***Autoignition temperature:** The minimum temperature required to cause self-sustained combustion, independent of any other source of heat.*

***Dip tank:** A container holding a liquid other than water and is used for dipping or coating. An object may be immersed (or partially immersed) in a dip tank or it may be suspended in a vapor coming from the tank.*

***Flammable liquid:** A liquid having a flashpoint at or below 199.4º F (93º C).*

***Flashpoint:** The minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite if tested in accordance with the test methods in Appendix B to 1910.1200 – Physical Hazard Criteria.*

***Lower flammable limit (LFL):** The lowest concentration of a material that will propagate a flame. The LFL is usually expressed as a percent by volume of the material in air (or other oxidant).*

***Vapor area:** Any space containing a dip tank, including its drain boards, associated drying or conveying equipment, and any surrounding area where the vapor concentration exceeds 25% of the LFL of the liquid in the tank.*

(3) Any container used as a dip tank must be strong enough to withstand any expected load.

(4) Ventilation.

(a) Ensure airborne concentrations of materials in any vapor area do not exceed 25% of its LFL.

(b) A tank cover or material that floats on the surface of the liquid in a dip tank to replace or supplement ventilation is acceptable, as long as the airborne concentrations do not exceed 25% of the LFL or any limit established by Division 2, Subdivision Z.

(c) When mechanical ventilation is used, it must conform to design standards based on national consensus standards that meet the following:

(A) The standard specifies the safety requirements for the particular equipment;

(B) The standard is recognized in the United States as providing specifications that result in an adequate level of safety;

(C) The standard was developed by a standards development organization under a method providing for input and consideration of views of industry groups, experts, users, governmental authorities, and others having broad experience and expertise in issues related to the design and construction of the particular equipment.

(d) Nonmandatory appendix A of this section contains examples of consensus standards that meet the requirements of paragraph (4)(c) of this section.

(e) When mechanical ventilation is used, each dip tank must have an independent exhaust system unless the combination of substances being removed will not cause a fire, explosion, or chemical reaction.

(f) When mechanical ventilation is used, it must draw the flow of air into a hood or exhaust duct.

(A) Ensure each room with exhaust hoods has make-up airflow that is at least 90% of the volume of air exhausted.

(B) Ensure that make-up air does not damage exhaust hoods.

(C) When air is recirculated, it must meet the requirements of OAR 437-002-0081, "Oregon Ventilation Regulations."

(g) Inspect hoods and ventilation ductwork for corrosion or damage at least quarterly and prior to operation after a prolonged shutdown.

(h) Ensure the ventilation airflow is adequate at least quarterly and prior to operation after a prolonged shutdown.

(5) Periodically inspect all dipping and coating equipment, including covers, drains, overflow piping, and electrical and fire-extinguishing systems, and promptly correct any deficiencies.

(6) Thoroughly clean dip tanks of solvents and vapors before permitting welding, burning, or open-flame work.

(7) Provide mechanical ventilation or respirators (selected and used as specified in 1910.134, Respiratory Protection) to protect employees in the vapor area from exposure to toxic substances released during welding, burning, or open-flame work.

(8) Medical, first aid, and hygiene facilities.

(a) All employees working with or around dip tanks must know the first-aid procedures appropriate to the dipping and coating hazards to which they are exposed.

(b) When employees work with liquids that may burn, irritate, or otherwise harm their skin:

(A) Obtain a physician's approval before an employee with a sore, burn, or other skin lesion that requires medical attention can return to work in a vapor area.

(B) Only a properly designated person can provide treatment for any skin abrasion, cut, rash, or open sore.

(C) Keep appropriate first-aid supplies near dipping or coating operations.

(D) Provide employees who work with chromic acid periodic examinations, at least annually, of their exposed body parts, especially their nostrils.

(E) Provide locker space or other storage space to prevent contamination of employee's street clothes.

(F) Provide at least one basin with hot water for every 10 employees who work with such liquids.

(G) Follow the emergency eyewash and shower facilities requirements of OAR 437-002-0161, "Medical & First Aid."

(9) Before cleaning a dip tank:

(a) Drain the tank and open the cleanout doors ; and

(b) Ventilate and clear any pockets where hazardous vapors may have accumulated.

(10) Use of flammable or combustible liquids.

(a) Use only dip tanks constructed from non-combustible materials. When drainboards are used, use only drainboards constructed from non-combustible materials.

(b) Overflow piping.

(A) Provide properly trapped overflow piping for dip tanks that have a capacity greater than 150 gallons (568 liters) or a surface area greater than 10 square feet (0.95 square meters).

(B) Overflow piping must discharge to a safe location.

(C) Overflow piping must be at least 3 inches (7.6 cm) diameter and must have sufficient capacity to prevent the tank from overflowing.

(D) The bottom of the overflow connector must be at least 6 inches (15.2 cm) below the top of the dip tank.

(c) Bottom Drains.

(A) Dip tanks containing more than 500 gallons (1893 L) of liquid must have a bottom drain.

(i) A bottom drain is not required if an automatic cover that meets the requirements of paragraph (10)(d)(C) is used.

(ii) A bottom drain is not required if the viscosity of the liquid at normal atmospheric temperature makes this impractical.

(B) Ensure the bottom drain will empty the dip tank in the event of a fire.

(C) Properly trap the bottom drain.

(D) Ensure the bottom drain has pipes that will empty the dip tank within 5 minutes.

(E) Bottom drains must discharge to a safe location.

(F) Bottom drains must be capable of manual and automatic operation. Manual operation must be from a safe and accessible location.

(G) When gravity flow from the bottom drain is impractical, use automatic pumps.

(d) Fire Protection.

(A) Provide portable fire extinguishers that meet the requirements of OAR 437-002-0187 in every vapor area.

(B) Provide an automatic fire extinguishing system:

(i) When the capacity of the dip tank is at least 150 gallons (568 L) or the liquid surface area is 4 square feet (0.38 square meters) or more; or

(ii) When the capacity of a hardening or tempering tank is at least 500 gallons (1893 L) or a liquid surface area of 25 square feet (2.37 square meters) or more.

(C) A cover that is closed by an approved automatic device for the automatic fire-extinguishing system may be used instead of the fire extinguishing system if the cover:

(i) Can also be activated manually;

(ii) Is noncombustible or tin-clad, with the enclosing metal applied with locked joints; and

(iii) Is kept closed when the dip tank is not in use.

(D) In each vapor area and any adjacent area, ensure that:

(i) All electrical wiring and equipment conform to OAR 437, Division 2, Subdivision S (except as specifically permitted in paragraph (15)); and

(ii) There are no flames, spark-producing devices, or other surfaces that are hot enough to ignite vapors.

(E) Electrically bond and ground portable containers used to add liquids to dip tanks to prevent static electrical sparks or arcs.

(F) All vapor areas must be free of combustible debris and as free as practicable of combustible stock.

(G) Deposit all rags or waste impregnated with dipping or coating material in a tightly-closing metal waste can immediately after use. Use only waste cans that are approved or acceptable to the local fire authority.

(H) Empty all waste containers at the end of each shift.

(I) Prohibit smoking in all vapor areas. Post a readily visible "No Smoking" sign near each dip tank or designate the entire area as "No Smoking."

(e) If a conveyor system is used with a dip tank, it must automatically shut down in the event of a fire. If a ventilation system is used to meet the ventilation requirements of paragraph (4), the conveyor system must automatically shut down if the ventilation system fails.

(f) If a liquid is heated in a dip tank, it must be maintained below the liquid's boiling point, and it must be maintained at least 100º F (37.8º C) below the liquid's autoignition temperature.

(g) Ensure that a heating system that is used in a drying operation and could cause ignition:

(A) Is installed in accordance with NFPA 86A-1969, Standard for Ovens and Furnaces (which is incorporated by reference in 1910.6 of this part); and

(B) Has adequate mechanical ventilation that operates before and during the drying operation; and

(C) Shuts down automatically if any ventilating fan fails to maintain adequate ventilation.

(11) Hardening or Tempering Tanks.

(a) Ensure that hardening or tempering tanks:

(A) Are located as far as practicable from furnaces;

(B) Are on noncombustible flooring;

(C) Have noncombustible hoods and vents (or equivalent devices) for venting to the outside. For this purpose, treat vent ducts as flues and keep them away from combustible materials, particularly roofs.

(b) Equip each tank with an alarm that will sound if the temperature of the liquid comes within 50º F (10º C) of its flashpoint (the alarm set point).

(c) When practicable, provide each tank with a limit switch to shut down the conveyor supplying work to the tank.

(d) If the temperature of the liquid can exceed the alarm set point, equip the tank with a circulating cooling system.

(e) If the tank has a bottom drain, the bottom drain may be combined with the oil-circulating system.

(f) Do not use air under pressure when filling the dip tank or agitating the liquid in the dip tank.

(12) Flow Coating.

(a) Use a direct low-pressure pumping system or a 10-gallon (38 L) or smaller gravity tank to supply the paint for flow coating. In case of fire, an approved heat-actuated device must shut down the pumping system.

(b) Ensure that the piping is substantial and rigidly supported.

(13) When roll coating, roll spreading, or roll impregnating operations use a flammable or combustible liquid that has a flashpoint below 140º F (60º C), prevent sparking of static electricity by:

(a) Bonding and grounding all metallic parts (including rotating parts) and installing static collectors; or

(b) Maintaining a conductive atmosphere (for example, one with a high relative humidity) in the vapor area.

(14) Vapor degreasing tanks.

(a) Ensure that the condenser or vapor-level thermostat keeps the vapor level at least 36 inches (91 cm) or one-half the tank width, whichever is less, below the top of the vapor degreasing tank.

(b) When using gas as a fuel to heat the tank liquid, the combustion chamber must be airtight (except for the flue opening) to prevent solvent vapors from entering the air-fuel mixture.

(c) The flue must be made of corrosion-resistant material, and it must extend to the outside. Install a draft diverter if mechanical exhaust is used on the flue.

(d) Do not allow the temperature of the heating element to cause a solvent or mixture to decompose or to generate an excessive amount of vapor.

(15) Ensure that cyanide tanks have a dike or other safeguard to prevent cyanide from mixing with an acid if a dip tank fails.

(16) If a liquid is sprayed in the air over an open-surface cleaning or degreasing tank, control the spraying to the extent feasible by:

(a) Enclosing the spraying operation; and

(b) Using mechanical ventilation to provide enough inward air velocity to prevent the spray from leaving the vapor area.

(17) Electrostatic paint detearing.

(a) Use only approved electrostatic equipment in paint-detearing operations. Electrodes in such equipment must be substantial, rigidly supported, permanently located, and effectively insulated from ground by nonporous, noncombustible, clean, dry insulators.

(b) Use conveyors to support any goods being paint deteared.

(c) Do not manually handle goods being electrostatically deteared.

(d) Maintain a minimum distance of twice the sparking distance between goods being electrostatically deteared and the electrodes or conductors of the electrostatic equipment.

This minimum distance must be displayed conspicuously on a sign located near the equipment.

(e) Ensure that the electrostatic equipment has automatic controls that immediately disconnect the power supply to the high-voltage transformer and signal the operator if:

(A) Ventilation or the conveyors fail to operate;

(B) A ground (or imminent ground) occurs anywhere in the high-voltage system; or

(C) Goods being electrostatically deteared come within twice the sparking distance of the electrodes or conductors of the equipment.

(f) Use fences, rails, or guards, made of conducting material and adequately grounded, to separate paint-detearing operations from storage areas and from personnel.

(g) To protect paint-detearing operations from fire, use automatic sprinklers or an automatic fire-extinguishing system conforming to the requirements of OAR 437, Division 2, Subdivision F.

(h) To collect paint deposits, provide drip plates and screens and clean these plates and screens in a safe location.

Stat. Authority: ORS 654.025(2) and 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: OR-OSHA Admin. Order 9-2007, f. 12/3/07, ef. 12/3/07.
OR-OSHA Admin. Order 5-2012, f. 9/25/12, ef. 9/25/12.

Appendix A: Criteria for Ventilation Consensus Standards (Nonmandatory)

This appendix lists ventilation design consensus standards that meet OAR 437-002-0122(4)(c).

ANSI Z9.1-2006, Ventilation and Control of Airborne Contaminants During Open-Surface Tank Operations

ANSI Z9.2-2001, Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems

NFPA 34-2007, Dipping and Coating Processes Using Flammable or Combustible Liquids

ACGIH's “Industrial Ventilation: A Manual of Recommended Practice” (25th ed., 2004)

Stat. Authority: ORS 654.025(2) and 656.726(4).
Stats. Implemented: ORS 654.001 through 654.295.
Hist: OR-OSHA Admin. Order 9-2007, f. 12/3/07, ef. 12/3/07.

Historical Notes for Subdivision H

Note: The following federal rules were adopted by reference by OR-OSHA Admin. Order 2-1992, filed 2/6/92, EFFECTIVE 5/1/92. OAR 437, Division 2, Subdivision H, Hazardous Materials (29 CFR 1910.101 through 1910.116). (See NOTE 2 below for historical note on 1910.120, Hazwaste.) (See NOTE 3 below for historical note on 1910.119, Process Safety Management.)

OAR 437-002-0100 is the rule which adopts by reference the federal standards.

Oregon-initiated rules were also adopted pertaining to Spray Finishing Operations (437-002-0107), and Explosives and Blasting Agents (437-002-0109). All Oregon-initiated rules are printed in italics and located with related federal rules.

The Oregon Code on Reinforced Plastics Manufacturing (formerly Division 152) was amended and is now included in 2/H as OAR 437-002-0118. This code follows 1910.107, Spray Finishing Operations, in this codebook.

The following Oregon Codes were replaced by rules in Division 2/H effective 5/1/92:

OAR 437, Div. 45, Handling and Use of Explosives & Blasting Agents

" " " 119, Spray Finishing Operations

" " " 122, Compressed Gases

" " " 123, Flammable & Combustible Liquids

" " " 124, Dip Tanks Containing Flam. & Combust. Liquids

" " " 125, Liquefied Petroleum Gases

" " " 126, Storage & Handling of Anhydrous Ammonia

" " " 142, Acetylene

" " " 143, Hydrogen

" " " 144, Oxygen

" " " 145, Nitrous Oxide

" " " 150, Reinforced Plastics Manufacturing

Note: OR-OSHA adopted by reference 29 CFR 1910.120, Final Rules on Hazardous Waste Operations and Emergency Response, which replaced Interim Final Rules EFFECTIVE 7/14/90 (APD Admin. Order 12-1989, filed 7/14/89).

OAR 437-002-0100(17) is the rule which adopts by reference the federal standard 29 CFR 1910.120.

Amended by OR-OSHA Admin. Order 22-1990, f. 9/28/90, ef. 10/1/90.

Amended by OR-OSHA Admin. Order 3-1992, f. 2/6/92, ef. 2/6/92.

Amended by OR-OSHA Admin. Order 3-1995, f. 2/22/95, ef. 2/22/95.

Note: OR-OSHA adopted by reference 29 CFR 1910.119, Process Safety Management of Highly Hazardous Chemicals, a new federal standard, EFFECTIVE 11/24/92 (OR-OSHA Admin. Order 8-1992, filed 8/13/92).

Editorial corrections were made to 1910.119 and OAR 437-002-0119 by OR-OSHA Admin. Order 3 1993, filed 2/23/93, effective 2/23/93.

Amended by OR-OSHA Admin. Order 14-1993, filed 8/27/93, effective 11/1/93.

Note: Excepted rules in 1910.119 were adopted by reference by OR-OSHA and amendments were also made to Table OR-118-1, adopted by Admin. Order 6-1994, filed 9/30/94, EFFECTIVE 9/30/94.

Note: OR-OSHA adopted by reference corrections and technical amendments issued by Federal OSHA. OR-OSHA Admin. Order 4-1997, filed and effective 4/2/97, made simple corrections and reference changes in Division 2/H, as well as other subdivisions in General Industry, Construction, and Maritime Activities.

Note: Federal OSHA published in the Federal Register the new Respiratory Protection Standard. The new standard replaces respiratory protection standards that were adopted in 1971 by OSHA. The new respiratory protection text is in general industry, 29 CFR 1910.134. The text previously in 1910.134 has been redesignated as 1910.139, Respiratory Protection for M. Tuberculosis. Four subdivisions in the Construction standard have also been amended. OR-OSHA Admin. Order 3-1998, filed 7/7/98, effective 7/7/98.

Note: Federal OSHA made amendments in general industry and construction in both safety and health standards that will revise or eliminate duplicative, inconsistent, or unnecessary regulatory requirements without diminishing employee protections. Changes being made to health standards include reducing the frequency of required chest x-rays and eliminating sputum-cytology examinations for workers covered by the coke oven and inorganic arsenic standards, and changing the emergency-response provisions of the vinyl chloride standard. Changes being made to OSHA safety standards, eliminating the public safety provisions of the temporary labor camp standard, eliminating unnecessary cross-references in the textile industry standards, and others. OR-OSHA Admin. Order 4-1999, filed 4/30/99, effective 4/30/99.

Note: Federal OSHA published in the March 23, 1999, Federal Register changes to the standards for dipping and coating operations in general industry.

Based on comments received during the national review of these rules, and other considerations, federal OSHA developed the final standard to accomplish several goals: To rewrite the former standards in plain language; to consolidate the former requirements in sequential sections (sections 1910.122 through 1910.126 in Subdivision H of 1910 (general industry)); and to update the former standards to increase the compliance options available to employers. In addition to achieving these goals, OSHA concludes that the final rule will enhance employee protection by making it more understandable and useful to employers and employees and more flexible and performance-oriented than the former rules. The final rule accomplishes these goals without increasing the regulatory burden of employers or reducing employee protection. OR-OSHA adopted the federal amendments by reference into its Divisions 2/A, 2/G, and 2/H in OR-OSHA Administrative Order 8-1999, filed and effective August 6, 1999.

Note: OR-OSHA Admin. Order 12-2001, filed and effective October 26, 2001. These changes just update invalid references to obsolete publications or other parts of our standards.

Note: OR-OSHA Admin. Order 4-2002, filed and effective May 30, 2002. Oregon OSHA repealed OAR 437-002-1910.124(g)(2). This paragraph was in Division 2/H, in the dipping and coating operations standard. Replacing this paragraph is a note directing the reader to Division 2/K, 437-002-0161(5), which is the paragraph for emergency eyewash and shower facilities. This rulemaking is intended to eliminate any confusion about which standard to use to ensure worker safety in this area.

Note: OAR 437-002-0107, Spray Finishing, replaces 1910.94(c) and 1910.107. Written in clear language with all requirements in one location, language was added to 437-002-0107 to allow for alternatives to certain requirements when the local fire authority allows an alternative in writing. Language was added to clarify requirements for paint mixing rooms from 437-002-1910.106, Article 80 of the Uniform Fire Code and NFPA 86-1999. OR-OSHA Admin. Order 3-2003, filed and effective 4/21/03.

Note: Federal OSHA published, in the June 8, 2004 Federal Register, error corrections (typographical and reference) to four standards. Oregon OSHA's standards must be at least as effective as federal OSHA, therefore, we are adopting the corrections.

The first correction deletes two references to a nonexistent table in the Mechanical Power-Transmission Apparatus Standard. The second is a correction of typographical errors in the Mechanical Power Presses Standard. The third correction is to a cross-reference in the Telecommunications Standard. The fourth correction is to a reference to a table contained in the Hazardous Materials Standard for Hydrogen.

These changes are in Oregon OSHA's Divisions 2/H, 2/O, and 2/R. Federal OSHA amended CFR 1926.307 in the June 8, 2004 Federal Register. Oregon OSHA did not adopt 1926.307, therefore, it is not included in this rulemaking.

This is OR-OSHA Administrative Order 4-2004, adopted and effective September 15, 2004.

Note: Federal OSHA published in the September 13, 2005 Federal Register a final rule to delete from its standards three references to national consensus standards and two references to industry standards that are outdated. Deleting these references does not reduce employee protections. By eliminating the outdated references OSHA clarifies employer obligations under the applicable OSHA standards and reduces administrative burdens on employers and OSHA.

This final rule updates standards on hazardous materials, flammable and combustible liquids; general environmental controls, temporary labor camps; hand and portable powered tools and other hand held equipment, guarding of portable powered tools; welding, cutting, and brazing, arc welding and cutting; and special industries, sawmills. All in general industries standards.

Oregon OSHA adopts all these changes to remain at least as effective as Federal OSHA standards, with the exception of amending 1910.142 Temporary Labor Camps, which Oregon did not adopt. OAR 437-002-0142 Labor Camps, applies in Oregon.

This is OR-OSHA Administrative Order 4-2005, adopted and effective December 14, 2005.

Note: Oregon OSHA adopted Federal OSHA changes as they appear in the April 3, 2006 Federal Register. These revisions include updating references and removing obsolete effective dates and startup dates from existing rules in General Industry, Construction, and Maritime Activities. Two changes Federal OSHA made that we do not include in this rulemaking are to remove effective dates in 1910.266 and 1926.1092, neither of which OR-OSHA had adopted before. OR-OSHA Admin. Order 4-2006, filed and effective 7/24/06.

Note: Oregon OSHA adopts a new Dipping and Coating standard in General Industry. This rule combines the requirements of the current standards in 1910.122 through 1910.126. This is also part of our initiative to convert our rules into clear language. The standards in 1910.122 through 1910.126 are removed and a new rule OAR 437-002-0122, Dipping and Coating is adopted into Division 2/H.

This is OR-OSHA Administrative Order 9-2007, adopted and effective December 3, 2007.

Note: This rule making is to keep Oregon OSHA in harmony with recent changes to Federal OSHA's standards. We are removing several references to consensus standards that have requirements that duplicate, or are comparable to, other OR-OSHA rules; this action includes correcting a paragraph citation in one of these rules. We are also removing a reference to American Welding Society standard A3.0-1969 ("Terms and Definitions") in our general industry welding standards. This rulemaking is part of a continuing effort to update references to consensus and industry standards used throughout our rules.

OR-OSHA adopts the changes in general industry as published in the December 14, 2007 Federal Register. A reference to American National Standard Safety Requirements for Explosive-Actuated Fastening Tools, ANSI A10.3-1995 is removed in Division 4/P, Agriculture/Small Tools.

This is OR-OSHA Administrative Order 7-2008, adopted and effective May 30, 2008.

Note: On August 11, 2009, Federal OSHA published in the Federal Register a direct final rule to revise 1910.102, Acetylene, by updating references to standards developing organizations (SDO standards). Federal OSHA also revised 1910.6, Incorporation by reference, to reflect updated documents.

Oregon OSHA formed an advisory committee with representatives from organized labor, employers, distributors, and manufacturers to review and discuss the existing rules and the requirement to adopt the Federal OSHA direct final rule for Acetylene. It was determined through examining 1910.102 Acetylene, and the SDO standards, that Oregon OSHA would develop an Oregon-initiated rule to replace the federal standard.

New Oregon rule 437-002-2102 Acetylene, includes general requirements for work practices and definitions used in paragraph (1), Cylinders. Piped systems and generators and filling cylinders retains language from 1910.102 for those topics.

Oregon OSHA revised Division 2/H, General Industry/Hazardous Materials, rules which will:

- Repeal the current Acetylene rule, 1910.102, that is based on the Compressed Gas Association (CGA) Pamphlets; G-1-1966, G1.3-1959, G1.4-1966
- Adopt new rule, OAR 437-002-2102, Acetylene, that updates references to standards developing organizations (SDO standards) making them consistent with current industry practices which will improve employee safety by clarifying employer obligations, and eliminate confusing requirements.

Based on comments received at the public hearing and during the open comment period, the following are added to the new acetylene rule:

- Compliance with Compressed Gas Association (CGA) Pamphlet G-1-2009 (“Acetylene”) (Compressed Gas Association, Inc., 12th ed., 2009.)
- Clarification to store and use cylinders valve end up.
- Note to allow minimal movement by hand of cylinders to get them on and off carts or pallets.
- Install reverse flow check valves and flashback arrester according to manufacturer recommendations.

Oregon OSHA will adopt the federal changes to 1910.6 Incorporation by reference, as they appear in the August 11, 2009 Federal Register with the exception of 1910.6(k)(3). This references the CGA Pamphlet G-1 Acetylene. In Oregon, the 12th edition 2009 applies.

Oregon OSHA standards must be at least as effective as Federal OSHA standards. With the creation of the new Oregon-initiated rule for acetylene, Oregon has all the protective measures referenced in the Federal OSHA standard, as well as expanded work practices language and definitions used in 437-002-2102(1) Cylinders.

This is Oregon OSHA Administrative Order 1-2010, adopted and effective February 19, 2010.

Note: This rulemaking is to keep Oregon OSHA in harmony with recent changes to Federal OSHA’s standards.

Federal OSHA published in the December 27, 2011 Federal Register corrections of typographical errors and non-substantive technical amendments to a number of standards in general industry, construction, and shipyard employment. The technical amendments include updating or revising cross-references. These revisions do not affect the substantive requirements or coverage of those standards, do not modify or revoke existing rights or obligations, and do not establish new rights or obligations.

Oregon OSHA adopts these corrections and amendments to the standards Oregon has adopted previously to reflect federal OSHA's changes. We are also making rule reference changes in a number of standards to reflect the newly adopted OAR 437-002-0134 Personal Protective Equipment.

This is Oregon OSHA Administrative Order 1-2012, adopted and effective April 10, 2012.

Note: Federal OSHA modified its Hazard Communication Standard (HCS) to conform to the United Nations' Globally Harmonized System of Classification and Labelling of Chemicals (GHS). OSHA determined that the modifications will significantly reduce costs and burdens while also improving the quality and consistency of information provided to employers and employees regarding chemical hazards and associated protective measures. OSHA concluded this improved information will enhance the effectiveness of the HCS in ensuring that employees are apprised of the chemical hazards to which they may be exposed, and in reducing the incidence of chemical-related occupational illnesses and injuries.

The modifications to the standard include revised criteria for classification of chemical hazards; revised labeling provisions that include requirements for use of standardized signal words, pictograms, hazard statements, and precautionary statements; a specified format for safety data sheets; and related revisions to definitions of terms used in the standard, and requirements for employee training on labels and safety data sheets. OSHA and Oregon OSHA are also modifying provisions of other standards, including standards for flammable and combustible liquids, spray finishing, reinforced plastics, dipping and coating, welding, cutting, and brazing, hazardous waste operations and emergency response, process safety management, pipe labeling, and most substance specific health standards, to ensure consistency with the modified HCS requirements. The consequences of these modifications will be to improve safety, to facilitate global harmonization of standards, and to produce hundreds of millions of dollars in annual savings nationally.

This rulemaking also repeals three Oregon-initiated rules: OAR 437-002-0289 Precautionary Labels, general requirements in Division 2/Q; 437-002-0361, regarding certain compliance dates for the Ethylene Oxide rule in Division 2/Z; and 437-003-0035 additional rules in hazard communication in Division 3/D. All three rules repealed are obsolete and unnecessary. The text of 1926.59 Hazard Communication in Division 3/D is repealed and a note added to refer the reader to 1910.1200 Hazard Communication in Division 2/Z (same as federal OSHA).

This is Oregon OSHA Administrative Order 5-2012, adopted and effective September 25, 2012.

Note: Oregon OSHA adopts new rule, OAR 437-002-0146 Confined Spaces, which replaces 1910.146 Permit-Required Confined Spaces, in Division 2/J General Environmental Controls. This expands the scope of the new rule to include the construction industry.

During the 2011 proposal, several issues were discovered that needed to be resolved. We reconvened our stakeholder groups to resolve those issues and addressed any other areas for clarification. The identified issues include: revising and including several definitions, language for closing permits, ensuring employee access to written materials, ensuring all actions required by the permit are followed, and clarifying when alternate entry cannot be used.

Other areas amended for clarification include:

Permit Space Program.

- Changed the requirement to catalog all confined spaces to catalog all permit spaces.
- If the permit program needs to be revised, the language was changed that prohibiting entry into any space; to any space that is affected by that revision until the revision is complete.

Evacuation. Added language on what to do if entrants need to evacuate a permit space.

Decontamination. There was language requiring patient decontamination. The group consensus was to move this language to the appendix on rescue. In its place, language was added requiring MSDSs and providing them to the medical providers.

Rescue.

- For non-entry rescue – modified the language to include a rescue person, as the rescue “team” may only consist of the attendant retrieving the entrant from the space.
- For entry rescue – language change from ensuring the rescue team can proficiently perform rescues to ensuring rescue teams can efficiently perform rescues.
- Added language requiring that, if a third-party rescue service is used, that the agreement is in writing.

Alternate Entry.

- Changed the language in the exception for alternate entry.
- Added language to specify which parts of the rule don’t apply when one uses alternate entry.
- Added a condition on when the space must be evacuated during alternate entry (new hazard or conditions change).

Training. Moved the awareness training piece to the bottom of the training section to avoid confusion and clarified that it is only for employees who work around permit spaces.

Records. Modified the record retention section to refer back to the rule that requires a review of the permit program.

The requirements of this standard are similar to the requirements of the existing general industry standard, but are written to clarify employer obligations and eliminate confusing requirements.

This rulemaking amends Oregon-initiated rules OAR 437-002-0182, 437-002-0256, and 437-002-0312 to update the rule reference to the new Oregon rule 437-002-0146 Confined Spaces. Also amended to reflect the new Confined Spaces rules are 1910.120 Appendix E, and 1910.269 that currently refer the reader to 1910.146. We also repeal 1926.21(b)(6) in Division 3/C, and place a note referring the reader to Division 2/J, 437-002-0146 Confined Spaces.

This is Oregon OSHA Administrative Order 6-2012, adopted September 28, 2012, and effective April 1, 2013.

Note: This rulemaking is to keep Oregon OSHA in harmony with recent changes to federal OSHA's standards.

Federal OSHA has corrected regulations that were amended by the Hazard Communication standard published in the March 26, 2012 Federal Register. The majority of corrections are to references inadvertently missed in the original publication of the final rule. Other corrections include correcting values or notations in tables, and updating references to terms. These corrections appear in the February 8, 2013 Federal Register.

Oregon OSHA adopts these corrections and amendments in general industry, construction, and shipyard employment.

This is Oregon OSHA Administrative Order 4-2013, adopted and effective July 19, 2013.

Note: Oregon OSHA has adopted OAR 437-002-2253, the Oxygen-Fuel Gas Welding and Cutting Standard for General Industry employers and Construction employers when welding, cutting, brazing, soldering, and flame coating is performed using a combination of oxygen and a fuel-gas. This rulemaking combines the existing Division 2 and Division 3 Oxygen-Fuel Gas Welding and Cutting rules. Twelve related Division 2 rules and a single Division 3 rule were either amended or repealed in the creation of OAR 437-002-2253.

OAR 437-002-2253 makes one rule applicable to all disciplines involved in the processes of welding, cutting, brazing, soldering, and thermal coating when using a combination of oxygen and a fuel-gas except for Agriculture, Maritime and Forest Activities. Additionally, it adds a Scope to the rule.

It provides definitions for key words and terms relevant to processes covered by the rule. It creates a user friendly format by taking separate rules that had multiple requirements and consolidating them into a single rule with easy to understand sections, sections that can be used as a template for training.

The rule establishes a requirement for the training of employees to be performed by a competent person prior to allowing them to work independently.

Additionally, the rule prohibits the use of passenger vehicle trunks for transportation of cylinders and establishes requirements to perform leak tests prior to each placement of a cylinder into an enclosed vehicle.

It establishes requirements to perform drop tests on cylinders and associated equipment and explains how to perform a drop test for those instances when it is required.

Cylinders in storage and transportation must not be exposed to temperatures of 125oF or greater.

The rule permits employers to follow manufacturer's recommendations when installing reverse flow check valves (back flow) and flashback arrestors (flashback preventers).

Finally, it updates language in the rule to reflect contemporary American Society of Mechanical Engineers (ASME) requirements, Association for Rubber Product Manufacturers (ARPM) requirements, Compressed Gas Association (CGA) requirements, and National Fire Protection Association (NFPA) requirements.

This is Oregon OSHA Administrative Order 6-2014, adopted October 28, 2014, and effective May 1, 2015.

Note: Oregon OSHA is adopting changes to our administrative (recordkeeping), general industry, and construction standards, and updating references in the maritime activity standards in response to federal OSHA's adoption of final rules published in the May 14, 2019 Federal Register. This is Phase IV of federal OSHA's-Standards Improvement Project (SIP-IV), the fourth in a series of rulemakings to improve and streamline workplace safety and health standards. Oregon's response removes or revises rules or requirements within our corresponding rules that are outdated, duplicative, or inconsistent. This rulemaking is anticipated to reduce regulatory burden and compliance costs while maintaining or enhancing worker safety and health as well as worker privacy protections.

In Division 2H, Oregon OSHA corrected a small error in the CAS number for Methyl Vinyl Ketone in Appendix A to 1910.119.

This is Oregon OSHA Administrative Order 3-2019, adopted October 29, 2019, and effective October 29, 2019.

List of Figures for Subdivision H

List of Tables for Subdivision H