



DEPARTMENT OF LABOR AND ECONOMIC OPPORTUNITY
CONSTRUCTION STANDARD

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(as amended December 16, 2004) **(as amended June 11, 2021)**

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(By authority conferred on the director of the department of labor and economic opportunity by sections 14 and 24 of the Michigan occupational safety and health act, 1974 PA 154, MCL 408.1014 and 408.1024, and Executive Reorganization Order Nos. 1996-1, 1996-2, 2003-1, 2008-4, 2011-4, and 2019-3, MCL 330.3101, 445.2001, 445.2011, 445.2025, 445.2030, and 125.1998)

R 325.62991, R 325.62992, R 325.62994, R 325.62995, and R 325.62996 of the Michigan Administrative Code are amended, as follows:

**PART 665. UNDERGROUND CONSTRUCTION, CAISSONS,
COFFERDAMS, AND COMPRESSED AIR**

Table of Contents:

R 325.62991 Underground construction; adoption of regulations by reference; exceptions.	2	(s) Electrical safety.	9
R 325.62992 Caissons; adoption of regulations by reference.....	2	(t) Hoisting unique to underground construction.	9
R 325.62994 Compressed air; adoption of regulations by reference.	3	(u) Definitions.....	10
R 325.62995 Definitions applicable to underground construction, caisson, cofferdams, and compressed air; adoption by reference.	3	1926.801 CAISSONS.....	11
R 325.62996 Availability of documents.....	3	1926.802 COFFERDAMS*.....	11
1926.800 UNDERGROUND CONSTRUCTION.....	4	1926.803 COMPRESSED AIR.....	11
(a) Scope and application.....	4	(a) General provisions.	11
(b) Access and egress.*	4	(b) Medical attendance, examination, and regulations.	11
(c) Check-in/check-out.*	4	(c) Telephone and signal communication.....	12
(d) Safety instruction.*	4	(d) Signs and records.	13
(e) Notification.	4	(e) Compression.	13
(f) Communications.*	4	(f) Decompression.....	13
(g) Emergency provisions.*	4	(g) Man locks and special decompression chambers.....	13
(h) Hazardous classifications.	4	(h) Compressor plant and air supply.....	15
(i) Gassy operations-additional requirements.	4	(i) Ventilation and air quality.	15
(j) Air quality and monitoring.	5	(j) Electricity.	15
(k) Ventilation.	6	(k) Sanitation.....	16
(l) Illumination.	7	(l) Fire prevention and protection.....	16
(m) Fire prevention and control.	7	(m) Bulkheads and safety screens.	17
(n) Welding, cutting, and other hot work.	7	1926.804 DEFINITIONS Applicable to this Subpart	17
(o) Ground support.	8	
(p) Blasting.*	8	APPENDIX A - Decompression Tables.....	18
(q) Drilling.*	8		
(r) Haulage.*	8		

**These issues are covered by the Construction Safety Standard Part 14. Tunnels, Shafts, Caissons, and Cofferdams*

R 325.62991 Underground construction; adoption of regulations by reference; exceptions.

Rule 1. (1) The federal Occupational Safety and Health Administration's regulations on underground construction promulgated by the United States Department of Labor and codified at 29 CFR 1926.800, "Underground Construction," are adopted by reference in these rules as of, May 14, 2019, except for the following regulations and except as provided in subrule (2) of this rule:

- (a) Section 1926.800(b)(1) to (3).
- (b) Section 1926.800(c).
- (c) Section 1926.800(d).
- (d) Section 1926.800(e)(2).
- (e) Section 1926.800(f)(1) to (5).
- (f) Section 1926.800(g)(1) to (5).
- (g) Section 1926.800(i)(4) and (5).
- (h) Section 1926.800(j)(1)(viii) and (2)(iv) and (v).
- (i) Section 1926.800(m)(1) to (8) and (10) to (12).
- (j) Section 1926.800(n)(2).
- (k) Section 1926.800(o)(1) and (2), (3)(i) to (iv), and (4)(i) and (ii).
- (l) Section 1926.800(p).
- (m) Section 1926.800(q).
- (n) Section 1926.800(r)(1) to (3), (5), (6)(i)(A) and (C), (7) to (13)(i), and (14) to (17).
- (o) Section 1926.800(s)(1) to (2).
- (p) Section 1926.800(t)(1)(ii), (iv)(A) and (B), (vi), (2), (3)(i), (ii), (viii), (ix), (xi), (xviii) to (xxiii), and (4)(ii) to (iv) and (vii).

(2) The following references in 29 CFR 1926.800, "Underground Construction," have the following meanings:

- (a) A reference to 29 CFR 1926.650 to 1926.652, subpart P, "Excavations," means Construction Safety Standard Part 9. "Excavation, Trenching, and Shoring," R 408.40901 to R 408.40953.
- (b) A reference to 29 CFR 1926.950 to 1926.960, subpart V, "Electric Power Transmission and Distribution," means Construction Safety Standard Part 16. "Power Transmission and Distribution," R 408.41601 to R 408.41658.
- (c) A reference to 29 CFR 1926.55, subpart D, "Gases, vapors, fumes, dusts, and mists," means Construction Safety and Health Standard Part 601. "Air Contaminants for Construction," R 325.60151 to R 325.60161.
- (d) A reference to 29 CFR 1910.1020, "Access to employee exposure and medical records," means General Industry and Construction Safety and Health Standard Part 470. "Employee Medical Records and Trade Secrets," R 325.3451 to R 325.3476.
- (e) A reference to 29 CFR 1926.65, "Hazardous waste operations and emergency response," means Construction Safety and Health Standard Part 632. "Hazardous Waste Operations and Emergency Response in Construction," R 325.63201.
- (f) A reference to 29 CFR 1926.56, "Illumination," means Construction Safety and Health

Standard Part 1. "General Rules," R 408.40101 to R 408.40134.

(g) A reference to 29 CFR 1926.150 to 1926.159, subpart F, "Fire Protection and Prevention," means Construction Safety Standard Part 18. "Fire Protection and Prevention," R 408.41801 to R 408.41884.

(h) A reference to 29 CFR 1926.350 to 1926.354, subpart J, "Welding and Cutting," means Construction Safety Standard Part 7. "Welding and Cutting," R 408.40701 to R 408.40762.

(i) A reference to 29 CFR 1926.400 to 449, subpart K, "Electrical," means Construction Safety Standard Part 17. "Electrical Installations," R 408.41701 to R 408.41734.

(j) A reference to 29 CFR 1926.550 to 1926.556, subpart N, "Helicopters, Hoists, Elevators, and Conveyors," means Construction Safety and Health Standard Part 10. "Cranes and Derricks," R 408.41001 to R 408.41099a.

(3) The adopted federal regulations have the same force and effect as a rule promulgated under the Michigan occupational safety and health act, 1974 PA 154, MCL 408.1001 to 408.1094.

R 325.62992 Caissons; adoption of regulations by reference.

Rule 2. (1) The federal Occupational Safety and Health Administration's regulations on caissons that have been promulgated by the United States Department of Labor and codified at 29 CFR 1926.801 are adopted by reference in these rules as of the effective date of these rules, except for the following sections:

- (a) 1926.801(b).
- (b) 1926.801(c).

(2) The adopted federal regulations have the same force and effect as a rule promulgated under the Michigan occupational safety and health act, 1974 PA 154, MCL 408.1001 to 408.1094.

R 325.62994 Compressed air; adoption of regulations by reference.

Rule 4. (1) The federal Occupational Safety and Health Administration's regulations on compressed air that have been promulgated by the United States Department of Labor and codified at 29 CFR 1926.803 are adopted by reference in these rules as of the effective date of these rules.

(2) The following references in 29 CFR 1926.803 have the following meanings:

(a) A reference to 29 CFR 1926.50 to 1926.66, subpart D, "Occupational Health and Environmental Controls," means occupational health construction standards.

(b) A reference to 29 CFR 1926.400 to 449, subpart K, "Electrical," means Construction Safety Standard Part 17. "Electrical Installations," R 408.41701 to R 408.41734.

(c) A reference to 29 CFR 1926.900 to 1926.914, subpart U, "Blasting and the Use of Explosives," means Construction Safety Standard Part 27. "Blasting and Use of Explosives," R 408.42701 to R 408.42799.

(d) A reference to 29 CFR 1926.500 to 1926.503, subpart M, "Fall Protection," means Construction Safety Standard Part 45. "Fall Protection," R 408.44501 to 408.44502.

(e) A reference to 29 CFR 1926.800 to 804, subpart S, "Underground Construction, Caissons, Cofferdams, and Compressed Air," means Construction Safety and Health Standard Part 14. "Tunnels, Shafts, Caissons, and Cofferdams," R 408.41401 to R 408.41483 and Construction Safety and Health Standard Part 665. "Underground Construction, Caissons, Cofferdams, and Compressed Air," R 325.62991 to R 325.62996.

(3) The adopted federal regulations have the same force and effect as a rule promulgated under the Michigan occupational safety and health act, 1974 PA 154, MCL 408.1001 to 408.1094.

R 325.62995 Definitions applicable to underground construction, caissons, cofferdams, and compressed air; adoption by reference.

Rule 5. (1) The federal Occupational Safety and Health Administration's definitions applicable to underground construction, caissons, cofferdams, and compressed air that have been promulgated by the United States department of labor and codified at 29 CFR 1926.804 are adopted by reference in these rules as of the effective date of these rules.

(2) The adopted federal regulations have the same force and effect as a rule promulgated under the Michigan occupational safety and health act, 1974 PA 154, MCL 408.1001 to 408.1094.

R 325.62996 Availability of documents.

Rule 6. (1) The federal regulations adopted by reference in these rules are available without cost as of the time of adoption of these rules from the United States Department of Labor, OSHA, via the internet at website: www.osha.gov, or from the Michigan Department of Labor and Economic Opportunity, MIOSHA Standards and FOIA Section, 530 W. Allegan Street, P.O. Box 30643, Lansing, Michigan 48909.

(2) The following Michigan occupational safety and health standards are referenced in these rules. Up to 5 copies of these standards may be obtained at no charge from the Michigan Department of Labor and Economic Opportunity, MIOSHA, Standards and FOIA Section, 530 W. Allegan Street, P.O. Box 30643, Lansing, Michigan, 48909-8143 or via the internet at website: www.michigan.gov/mioshastandards. For quantities greater than 5, the cost, as of the time of adoption of these rules, is 4 cents per page.

(a) Construction Safety and Health Standard Part 1. "General Rules," R 408.40101 to R 408.40134.

(b) Construction Safety Standard Part 7. "Welding and Cutting," R 408.40701 to R 408.40762.

(c) Construction Safety Standard Part 9. "Excavation, Trenching, and Shoring," R 408.40901 to R 408.40953.

(d) Construction Safety and Health Standard Part 10. "Cranes and Derricks," R 408.41001 to R 408.41099a.

(e) Construction Safety and Health Standard Part 14. Tunnels, Shafts, Caissons, and Cofferdams, R 408.41401 to R 408.41483.

(f) Construction Safety Standard Part 16. "Power Transmission and Distribution," R 408.41601 to R 408.41658.

(g) Construction Safety Standard Part 17. "Electrical Installations," R 408.41701 to R 408.41734.

(h) Construction Safety Standard Part 18. "Fire Protection and Prevention," R 408.41801 to R 408.41884.

(i) Construction Safety Standard Part 27. "Blasting and Use of Explosives," R 408.42701 to R 408.42799.

(j) Construction Safety Standard Part 45. "Fall Protection," R 408.44501 to 408.44502.

(k) Construction Safety and Health Standard Part 632. "Hazardous Waste Operations and Emergency Response," R 325.63201.

(l) General Industry and Construction Safety and Health Standard Part 470. "Employee Medical Records and Trade Secrets," R 325.3451 to R 325.3476.

(m) Construction Safety and Health Standard Part 601. "Air Contaminants for Construction," R 325.60151 to R 325.60161.

1926.800 UNDERGROUND CONSTRUCTION.

(a) Scope and application.

(1) This section applies to the construction of underground tunnels, shafts, chambers, and passageways. This section also applies to cut-and-cover excavations which are both physically connected to ongoing underground construction operations within the scope of this section, and covered in such a manner as to create conditions characteristic of underground construction.

(2) This section does not apply to the following:

(i) Excavation and trenching operations covered by Subpart P of this part, such as foundation operations for above-ground structures that are not physical connected to underground construction operations, and surface excavation: nor

(ii) Underground electrical transmission and distribution lines, as addressed in Subpart V of this part.

(b) Access and egress.*

(c) Check-in/check-out.*

(d) Safety instruction.*

(e) Notification.

(1) Oncoming shifts shall be informed of any hazardous occurrences or conditions that have affected or might affect employee safety, including liberation of gas, equipment failures, earth or rock slides, cave-ins, floodings, fires or explosions.

(2)*

(f) Communications.*

(g) Emergency provisions.*

(h) Hazardous classifications.

(1) Potentially gassy operations. Underground construction operations shall be classified as potentially gassy if either:

(i) Air monitoring discloses 10 percent or more of the lower explosive limit for methane or other flammable gases measured at 12 inches (304.8 mm) to + or - 0.25 inch (6.35 mm) from the roof, face, floor or walls in any underground work area for more than a 24-hour period: or

(ii) The history of the geographical area or geological formation indicates that 10 percent or more of the lower explosive limit for methane or other flammable gases is likely to be encountered in such underground operations.

(2) Gassy operations. Underground construction operations shall be classified as gassy if:

(i) Air monitoring discloses 10 percent or more of the lower explosive limit for methane or other flammable gases measured at 12 inches (304.8 mm) + or - inch (6.35 mm) from the roof, face, floor or walls in any underground work area for three consecutive days: or

(ii) There has been an ignition of methane or of other flammable gases emanating from the strata that indicates the presence of such gases: or

(iii) The underground construction operation is both connected to an underground work area which is currently classified as gassy and is also subject to a continuous course of air containing the flammable gas concentration.

(3) Declassification to potentially gassy operations. Underground construction gassy operations may be declassified to Potentially Gassy when air monitoring results remain under 10 percent of the lower explosive limit for methane or other flammable gases for three consecutive days.

(i) Gassy operations-additional requirements.

(1) Only acceptable equipment, maintained in suitable condition, shall be used in gassy operations.

(2) Mobile diesel-powered equipment used in gassy operation shall be either approved in accordance with the requirement of 30 C.F.R. Part 36 (formerly Schedule 31) by MSHA, or shall be demonstrated by the employer to be fully equivalent to such MSHA-approved equipment, and shall be operated in accordance with that part.

(3) Each entrance to a gassy operation shall be prominently posted with signs notifying all entrants of the gassy classification.

(4)*

(5)*

*These issues are covered by the Construction Safety Standard Part 14. Tunnels, Shafts, Caissons, and Cofferdams

(6) Once an operation has met the criteria in paragraph (h)(2) warranting classification as gassy, all operations in the affected area, except the following shall be discontinued until the operation either is in compliance with all of the gassy operation requirements or has been declassified in accordance with paragraph (h)(3) of this section:

- (i) Operations related to the control of the gas concentration.
- (ii) Installation of new equipment, or conversion of existing equipment to comply with this paragraph (i): and
- (iii) Installation of above-ground controls for reversing the air flow.

(j) Air quality and monitoring.

(1) General. Air quality limits and control requirements for construction are found in 1926.55, except as modified by this section.

(i)

(A) The employer shall assign a competent person who shall perform all air monitoring required by this section.

(B) Where this paragraph requires monitoring of airborne contaminants “as often as necessary,” the competent person shall make a reasonable determination as to which substances to monitor and how frequently to monitor, considering at least the following factors:

(1) Location of jobsite: proximity to fuel tanks, sewers, gas lines, old landfills, coal deposits, and swamps;

(2) Geology: geological studies of the jobsite, particularly involving the soil type and its permeability;

(3) History: presence of air contaminants in nearby jobsites, changes in levels of substances monitored on the prior shift; and

(4) Work practices and job site conditions: the use of diesel engines, use of explosives, use of fuel gas, volume and flow of ventilation, visible atmospheric conditions, decompression of the atmosphere, welding, cutting and hot work, and employees’ physical reactions to working underground.

(ii)

(A) The atmosphere in an underground work areas shall be tested as often as necessary to assure that the atmosphere at normal atmospheric pressure contains at least 19.5 percent oxygen and no more than 22 percent oxygen.

(B) Tests of oxygen content shall be made before tests for air contaminants.

(iii)

(A) The atmosphere in all underground work areas shall be tested quantitatively for carbon monoxide, nitrogen dioxide, hydrogen sulfide, and other toxic gases, dusts, vapors, mists, and fumes as often as necessary to ensure that the permissible exposure limits prescribed in 1926.55 are not exceeded.

(B) The atmosphere in all underground work areas shall be tested quantitatively for methane and other flammable gases as often as necessary to determine:

(1) Whether action is to be taken under paragraphs (j)(1)(vii), (viii), and (ix) of this section; and

(2) Whether an operation is to be classified potentially gassy or gassy under paragraph (h) of this section.

(C) If diesel-engine or gasoline-engine driven ventilating fans or compressors are used, an initial test shall be made of the inlet air of the fan or compressor, with the engines operating, to ensure that the air supply is not contaminated by engine exhaust.

(D) Testing shall be performed as often as necessary to ensure that the ventilation requirements of paragraph (k) of this section are met.

(iv) When rapid excavation machines are used, a continuous flammable gas monitor shall be operated at the face with the sensor(s) placed as high and close to the front of the machine’s cutter head as practicable.

(v)

(A) Whenever air monitoring indicates the presence of 5 ppm or more of hydrogen sulfide, a test shall be conducted in the affected underground work area(s), at least at the beginning and midpoint of each shift, until the concentration of hydrogen sulfide has been less than 5 ppm or 3 consecutive days.

(B) Whenever hydrogen sulfide is detected in an amount exceeding 10 ppm, a continuous sampling and indicating hydrogen sulfide monitor shall be used to monitor the affected work area.

(C) Employees shall be informed when a concentration of 10 ppm hydrogen sulfide is exceeded.

(D) The continuous sampling and indicating hydrogen sulfide monitor shall be designed, installed, and maintained to provide a visual and aural alarm when the hydrogen sulfide concentration reaches 20 ppm to signal that additional measures, such as respirator use, increased ventilation, or evacuation, might be necessary to maintain hydrogen sulfide exposure below the permissible exposure limit.

(vi) When the competent person determines, on the basis of air monitoring results or other information, that air contaminants may be present in sufficient quantity to be dangerous to life, the employer shall:

(A) Prominently post a notice at all entrances to the underground jobsite to inform all entrants of the hazardous condition; and

(B) Ensure that the necessary precautions are taken.

(vii) Whenever five percent or more of the lower explosive limit for methane or other flammable gases is detected in any underground work area(s) or in the air return, steps shall be taken to increase ventilation air volume or otherwise control the gas concentration, unless the employer is operating in accordance with the potentially gassy or gassy operation requirements. Such additional ventilation controls may be discontinued when gas concentrations are reduced below five percent of the lower explosive limit, but shall be reinstated whenever the five percent level is exceeded.

(viii)*

(ix) Whenever 20 percent or more of the lower explosive limit for methane or other flammable gases is detected in any underground work area(s) or in the air return:

(A) All employees, except those necessary to eliminate the hazard, shall be immediately withdrawn to a safe location above ground; and

(B) Electrical power, except for acceptable pumping and ventilation equipment, shall be cut off to the area endangered by the flammable gas until the concentration of such gas is reduced to less than 20 percent of the lower explosive limit.

(2) Additional monitoring for potentially gassy and gassy operation. Operations which meet the criteria for potentially gassy and gassy operations set forth in paragraph (h) of this section shall be subject to the additional monitoring requirements of this paragraph.

(i) A test for oxygen content shall be conducted in the affected underground work areas and work areas immediately adjacent to such areas at least at the beginning and midpoint of each shift.

(ii) When using rapid excavation machines, continuous automatic flammable gas monitoring equipment shall be used to monitor the air at the heading, on the rib, and in the return air duct. The continuous monitor shall signal the heading, and shut down electric power in the affected underground work area, except for acceptable pumping and ventilation equipment, when 20 percent or more of the lower explosive limit for methane or other flammable gases encountered.

(iii) A manual flammable gas monitor shall be used as needed, but at least at the beginning and midpoint of each shift, to ensure that the limits prescribed in paragraphs (h) and (j) are not exceeded. In addition a manual electrical shut down control shall be provided near the heading.

(iv)*

(v)*

(3) Recordkeeping. A record of all air quality tests shall be maintained above ground at the worksite and be made available to the Secretary of Labor upon request. The record shall include the location, date, time, substance and amount monitored. Records of exposures to toxic substances shall be retained in accordance with 1910.20 of this chapter. All other air quality test records shall be retained until completion of the project.

(k) Ventilation.

(1)

(i) Fresh air shall be supplied to all underground work areas in sufficient quantities to prevent dangerous or harmful accumulation of dusts, fumes, mists, vapors or gases.

(ii) Mechanical ventilation shall be provided in all underground work areas except when the employer can demonstrate that natural ventilation provides the necessary air quality through sufficient air volume and air flow.

(2) A minimum of 200 cubic feet (5.7 m³) of fresh air per minute shall be supplied for each employee underground.

(3) The linear velocity of air flow in the tunnel bore, in shafts, and in all other underground work areas shall be at least 30 feet (9.15 m) per minute where blasting or rock drilling is conducted, or where other conditions likely to produce dust, fumes, mists, vapors, or gases in harmful or explosive quantities are present.

(4) The direction of mechanical air flow shall be reversible.

(5) Following blasting, ventilation systems shall exhaust smoke and fumes to the outside atmosphere before work is resumed in affected areas.

(6) Ventilation doors shall be designed and installed so that they remain closed when in use, regardless of the direction of the air flow.

(7) When ventilation has been reduced to the extent that hazardous levels of methane or flammable gas may have accumulated, a competent person shall test all affected areas after ventilation has been restored and shall determine whether the atmosphere is within flammable limits before any power, other than for acceptable equipment, is restored or work is resumed.

**These issues are covered by the Construction Safety Standard Part 14. Tunnels, Shafts, Caissons, and Cofferdams*

(8) Whenever the ventilation system has been shut down with all employees out of the underground area, only competent persons authorized to test for air contaminants shall be allowed underground until the ventilation has been restored and all affected areas have been tested for air contaminants and declared safe.

(9) When drilling rock or concrete, appropriate dust control measures shall be taken to maintain dust levels within limits set in 1926.65. Such measures may include, but are not limited to, wet drilling, the use of vacuum collectors, and water mix spray systems.

(10)

(i) Internal combustion engines, except diesel-powered engines on mobile equipment, are prohibited underground.

(ii) Mobile diesel-powered equipment used underground in atmospheres other than gassy operations:

(A) Shall comply with MSHA provisions in 30 CFR 57.5067; or

(B) If purchased on or before July 15, 2019, may alternatively comply with MSHA provisions under 30 CFR part 32 (revised as of July 1, 1996) (formerly Schedule 24), or be demonstrated by the employer to be fully equivalent to such MSHA-approved equipment, and be operated in accordance with that part.

(iii) For purposes of this paragraph (k)(10), when an applicable MSHA provision uses the term "mine," use the phrase "underground construction site." (Each brake horsepower of a diesel engine requires at least 100 cubic feet (2.832 m³) of air per minute for suitable operation in addition to the air requirements for personnel. Some engines may require a greater amount of air to ensure that the allowable levels of carbon monoxide, nitric oxide, and nitrogen dioxide are not exceeded.)

(11) Potentially gassy or gassy operations shall have ventilation systems installed which shall:

(i) Be constructed of fire-resistant materials; and

(ii) Have acceptable electrical systems, including fan motors.

(12) Gassy operations shall be provided with controls located above ground for reversing the air flow of ventilation systems.

(13) In potentially gassy or gassy operations, wherever mine-type ventilation systems using an offset main fan installed on the surface are used, they shall be equipped with explosion-doors or a weak-wall having an area at least equivalent in the cross-sectional area of the airway.

(l) Illumination.

(1) Illumination requirements applicable to underground construction operations are found in Table D-3 of 1926.56 of this part.

(2) Only acceptable portable lighting equipment shall be used within 50 feet (15.24 m) of any underground heading during explosives handling.

(m) Fire prevention and control.

Fire prevention and protection requirements applicable to underground construction operations are found in Subpart F of this part, except as modified by the following additional standards.

(1)*

(2)*

(3)*

(4)*

(5)*

(6)*

(7)*

(8)*

(9)

(i) Electrical installations in underground areas where oil, grease, or diesel fuel are stored shall be used only for lighting fixtures.

(ii) Lighting fixtures in storage areas, or within 25 feet (7.62 m) of underground areas where oil, grease, or diesel fuel are stored, shall be approved for Class I, Division 2 locations, in accordance with Subpart K of this part.

(10)*

(11)*

(12)*

(n) Welding, cutting, and other hot work.

In addition to the requirements of Subpart J of this part, the following requirements shall apply to underground welding, cutting, and other hot work.

(1) No more than the amount of fuel gas and oxygen cylinders necessary to perform welding, cutting, or other hot work during the next 24-hour period shall be permitted underground.

(2)*

**These issues are covered by the Construction Safety Standard Part 14. Tunnels, Shafts, Caissons, and Cofferdams*

(o) Ground support.

(1)*

(2)*

(3) Underground areas.

(3)

(i-iv)*

(v) Suitable protection shall be provided for employees exposed to the hazard of loose ground while installing ground support systems.

(vi) Support sets shall be installed so that the bottoms have sufficient anchorage to prevent ground pressures from dislodging the support base of the sets. Lateral bracing (collar bracing, tie rods, or spreaders) shall be provided between immediately adjacent sets to ensure added stability.

(vii) Damaged or dislodged ground supports that create a hazardous condition shall be promptly repaired or replaced. When replacing supports, the new supports shall be installed before the damaged supports are removed.

(viii) A shield or other type of support shall be used to maintain a safe travelway for employees working in dead-end areas ahead of any support replacement operation.

(4) Shafts.

(i)*

(ii)(A)*

(ii)(B)*

(iii) After blasting operations in shafts, a competent person shall determine if the walls, ladders, timbers, blocking, or wedges have loosened. If so, necessary repairs shall be made before employees other than those assigned to make the repairs are allowed in or below the affected areas.

(p) Blasting.*

(q) Drilling.*

(r) Haulage.*

(1)*

(2)*

(3)*

(4) In those cabs where glazing is used, the glass shall be safety glass, or its equivalent, and shall be maintained and cleaned so that vision is not obstructed.

(5)*

(6)(i)(A)*

(B) Endless belt type manlifts are prohibited in underground construction.

(C)*

(ii) No employee shall ride haulage equipment unless it is equipped with seating for each passenger and protects passengers from being struck, crushed, or caught between other equipment or surfaces. Members of train crews may ride on a locomotive if it is equipped with handholds and nonslip steps or footboards. Requirements applicable to Underground Construction for motor vehicle transportation of employees are found in 1926.601 of this part.

(7)*

(8)*

(9)*

(10)*

(11)*

(12)*

(13)(i)*

(ii) When the grade exceeds one percent and there is a potential for runaway cars, safety chains or other connections shall be used in addition to couplers to connect haulage cars or, as an alternative, the locomotive must be downhill of the train.

(iii) Such safety chains or other connections shall be capable of maintaining connection between cars in the event of either coupler disconnect, failure or breakage.

(14)*

(15)*

(16)*

(17)*

**These issues are covered by the Construction Safety Standard Part 14. Tunnels, Shafts, Caissons, and Cofferdams*

(18)(i) Where switching facilities are available, occupied personnel-cars shall be pulled, not pushed. If personnel-cars must be pushed and visibility of the track ahead is hampered, then a qualified person shall be stationed in the lead car to give signals to the locomotive operator.

(ii) Crew trips shall consist of personnel-loads only.

(s) Electrical safety.

Electrical safety. This paragraph applied in addition to the general requirements for electrical safety which are found in Subpart K of this part.

(1)*

(2)*

(3) Oil-filled transformers shall not be used underground unless they are located in a fire-resistant enclosure suitably vented to the outside and surrounded by a dike to retain the contents of the transformers in the event of rupture.

(t) Hoisting unique to underground construction.

Except as modified by this paragraph (t), the following provisions of Subpart N of this part apply: Requirements for cranes are found in 1926.550 of this part. Paragraph (g) of 1926.550 applies to crane-hoisting of personnel, except that the limitation in paragraph (g)(2) does not apply to the routine access of employees to the underground via a shaft. Requirements for material hoists are found in 1926.552(a) and (b) of this part. Requirements for personnel hoists are found in the personnel hoist requirements of 1926.552(a) and (c) of this part and in the elevator requirements of 1926.552(a) and (d) of this part.

(1) General requirements for cranes and hoists.

(i) Materials, tools, and supplies being raised or lowered, whether within a cage or otherwise, shall be secured or stacked in a manner to prevent the load from shifting, snagging or falling into the shaft.

(ii)*

(iii) Whenever a hoistway is not fully enclosed and employees are at the shaft bottom, conveyances or equipment shall be stopped at least 15 feet (4.57 m) above the bottom of the shaft and held there until the signalman at the bottom of the shaft directs the operator to continue lowering the load, except that the load may be lowered without stopping if the load or conveyance is within full view of a bottom signalman who is in constant voice communication with the operator.

(iv)*

(v) Any connection between the hoisting rope and the cage or skip shall be compatible with the type of wire rope used for hoisting.

(vi)*

(vii) Cage, skip, and load connections to the hoist rope shall be made so that the force of the hoist pull, vibration, misalignment, release of lift force, or impact will not disengage the connection. Moused or latched open-throat hooks do not meet this requirement.

(viii) When using wire rope wedge sockets, means shall be provided to prevent wedge escapement and to ensure that the wedge is properly seated.

(2)*

(3)*

(i)*

(ii)*

(iii) When a hoist is used for both personnel hoisting and material hoisting, load and speed ratings for personnel and for materials shall be assigned to the equipment.

(iv) Material hoisting may be performed at speeds higher than the rated speed for personnel hoisting if the hoist and components have been designed for such higher speeds and if shaft conditions permit.

(v) Employees shall not ride on top of any cage, skip or bucket except when necessary to perform inspection or maintenance of the hoisting system, in which case they shall be protected by a body belt/harness system to prevent falling.

(vi) Personnel and materials (other than small tools and supplies secured in a manner that will not create a hazard to employees) shall not be hoisted together in the same conveyance. However, if the operator is protected from the shifting of materials, then the operator may ride with materials in cages or skips which are designed to be controlled by an operator within the cage or skip.

(vii) Line speed shall not exceed the design limitations of the systems.

(viii)*

(ix)*

**These issues are covered by the Construction Safety Standard Part 14. Tunnels, Shafts, Caissons, and Cofferdams*

(x) A fire extinguisher that is rated at least 2A:10B:C (multipurpose, dry chemical) shall be mounted in each hoist house.

(xi)*

(xii) Hoists shall be equipped with limit switches to prevent overtravel at the top and bottom of the hoistway.

(xiii) Limit switches are to be used only to limit travel of loads when operational controls malfunction and shall not be used as a substitute for other operational controls.

(xiv) Hoist operators shall be provided with a closed-circuit voice communication system to each landing station, with speaker microphones so located that the operator can communicate with individual landing stations during hoist use.

(xv) When sinking shafts 75 feet (22.86 m) or less in depth, cages, skips, and buckets that may swing, bump, or snag against shaft sides or other structural protrusions shall be guided by fenders, rails, ropes, or a combination of those means.

(xvi) When sinking shafts more than 75 feet (22.86 m) in depth, all cages, skips, and buckets shall be rope or rail guided to within a rail length from the sinking operation.

(xvii) Cages, skips, and buckets in all completed shafts, or in all shafts being used as completed shafts, shall be rope or rail-guided for the full length of their travel.

(xviii)*

(xix)*

(xx)*

(xxi) *

(xxii)*

(xxiii) *

(4) Additional requirements for personnel hoists.

(i) Hoist drum systems shall be equipped with at least two means of stopping the load, each of which shall be capable of stopping and holding 150 percent of the hoist's rated line pull. A broken-rope safety, safety catch, or arrestment device is not a permissible means of stopping under this paragraph.

(ii) *

(iii)*

(iv)*

(v) All personnel cages shall be provided with a protective canopy. The canopy shall be made of steel plate, at least 8/16-inch (4.763 mm) in thickness, or material of equivalent strength and impact resistance. The canopy shall be sloped to the outside, and so designed that a section may be readily pushed upward to afford emergency egress. The canopy shall cover the top in such a manner as to protect those inside from objects falling in the shaft.

(vi) Personnel platforms operating on guide rails or guide ropes shall be equipped with broken-rope safety devices, safety catches or arrestment devices that will stop and hold 150 percent of the weight of the personnel platform and its maximum rated load.

(vii)*

(viii) The personnel platform may travel over the controlled length of the hoistway at rated speeds up to 600 feet (182.86 m) per minute during sinking operations in shafts where guides and safeties are used.

(ix) The personnel platform may travel at rated speeds greater than 600 feet (182.86 m) per minute in completed shafts.

(u) Definitions.

"Accept" - Any device, equipment, or appliance that is either approved by MSHA and maintained in permissible condition, or is listed or labeled for the class and location under Subpart K of this part.

"Rapid Excavation Machine" - Tunnel boring machines, shields, roadheaders, or any other similar excavation machine.

**These issues are covered by the Construction Safety Standard Part 14. Tunnels, Shafts, Caissons, and Cofferdams*

1926.801 CAISSONS

(a) Wherever, in caisson work in which compressed air is used, and the working chamber is less than 11 feet in length, and when such caissons are at any time suspended or hung while work is in progress so that the bottom of the excavation is more than 9 feet below the deck of the working chamber, a shield shall be erected therein for the protection of the employees.

(b)*

(c)*

(d) All caissons having a diameter or side greater than 10 feet shall be provided with a man lock and shaft for the exclusive use of employees.

(e) In addition to the gauge in the locks, an accurate gauge shall be maintained on the outer and inner side of each bulkhead. These gauges shall be accessible at all times and kept in accurate working order.

(f) In caisson operations where employees are exposed to compressed air working environments, the requirements contained in 1926.803 shall be complied with.

1926.802 COFFERDAMS*

(a)*

(b)*

(c)*

(d)*

1926.803 COMPRESSED AIR

(a) General provisions.

(1) There shall be present, at all times, at least one competent person designated by and representing the employer, who shall be familiar with this subpart in all respects, and responsible for full compliance with these and other applicable subparts.

(2) Every employee shall be instructed in the rules and regulation which concern his safety or the safety of others.

(b) Medical attendance, examination, and regulations.

(1) There shall be retained one or more licensed physicians familiar with and experienced in the physical requirements and the medical aspects of compressed air work and the treatment of decompression illness. He shall be available at all times while work is in progress in order to provide medical supervision of employees employed in compressed air work. He shall himself be physically qualified and be willing to enter a pressurized environment.

(2) No employee shall be permitted to enter a compressed air environment until he has been examined by the physician and reported by him to be physically qualified to engage in such work.

(3) In the event an employees absent from work for 10 days, or is absent due to sickness or injury, he shall not resume work until he is reexamined by the physician, and his physical condition reported, as provided in this paragraph, to be such as to permit him to work in compressed air.

(4) After an employee has been employed continuously in compressed air for a period designated by the physician, but not to exceed 1 year, he shall be reexamined by the physician to determine if he is still physically qualified to engage in compressed air work.

(5) Such physician shall at all times keep a complete and full record of examinations made by him. The physician shall also keep an accurate record of any decompression illness or other illness or injury incapacitating any employee for work, and of all loss of life that occurs in the operation of a tunnel, caisson, or other compartment in which compressed air is used.

(6) Records shall be available for the inspection by the Secretary or his representatives, and a copy thereof shall be forwarded to OSHA within 48 hours following the occurrence of the accident, death, injury, or decompression illness. It shall state as fully as possible the cause of said death or decompression illness, and the place where the injured or sick employee was taken, and such other relative information as may be required by the Secretary.

**These issues are covered by the Construction Safety Standard Part 14. Tunnels, Shafts, Caissons, and Cofferdams*

(7) A fully equipped first aid station shall be provided at each tunnel project regardless of the number of persons employed. An ambulance or transportation suitable for a litter case shall be at each project.

(8) Where tunnels are being excavated from portals more than 5 road miles apart, a first aid station and transportation facilities shall be provided at each portal.

(9) A medical lock shall be established and maintained in immediate working order whenever air pressure in the working chamber is increased above the normal atmosphere.

(10) The medical lock shall:

(i) Have at least 6 feet of clear headroom at the center, and be subdivided into not less than two compartments;

(ii) Be readily accessible to employees working under compressed air;

(iii) Be kept ready for immediate use for at least 5 hours subsequent to the emergence of any employee from the working chamber;

(iv) Be properly heated, lighted and ventilated;

(v) Be maintained in a sanitary condition;

(vi) Have a nonshatterable port through which the occupant(s) may be kept under constant observation;

(vii) Be designed for a working pressure of 75 p.s.i.g.

(viii) Be equipped with internal controls which may be overridden by external controls;

(ix) Be provided with air pressure gauges to show the air pressure within each compartment to observers inside and outside the medical lock.

(x) Be equipped with a manual type sprinkler system that can be activated inside the lock or by the outside lock tender.

(xi) Be provided with oxygen lines and fittings leading into external tanks. The lines shall be fitted with check valves to prevent reverse flow. The oxygen system inside the chamber shall be of a closed circuit design and be so designed as to automatically shut off the oxygen supply whenever the fire system is activated.

(xii) Be in constant charge of an attendant under the direct control of the retained physician. The attendant shall be trained in the use of the lock and suitably instructed regarding steps to be taken in the treatment of employee exhibiting symptoms compatible with a diagnosis of decompression illness;

(xiii) Be adjacent to an adequate emergency medical facility;

(xiv) The medical facility shall be equipped with demand-type oxygen inhalation equipment approved by the U.S. Bureau of Mines.

(xv) Be capable of being maintained at a temperature, in use, not to exceed 90 degrees Fahrenheit nor be less than 70 degrees Fahrenheit; and

(xvi) Be provided with sources of air, free of oil and carbon monoxide, for normal and emergency use, which are capable of raising the air pressure in the lock from 0 to 75 p.s.i.g. in 5 minutes.

(11) Identification badges shall be furnished to all employees, indicating that the wearer is a compressed air worker. A permanent record shall be kept of all identification badges issued. The badge shall give the employee's name, address of the medical lock, the telephone number of the licensed physician for the compressed air project, and contain instructions that in case of emergency of unknown or doubtful cause or illness, the wearer shall be rushed to the medical lock. The badge shall be worn at all times--off the job, as well as on the job.

(c) Telephone and signal communication.

(1) Effective and reliable means of communication, such as bells, whistles, or telephones, shall be maintained, at all times between all of the following locations:

(i) The working chamber face;

(ii) The working chamber side of the man lock near the door;

(iii) The interior of the man lock;

(iv) Lock attendant's station;

(v) The compressor plant;

(vi) The first-aid station;

(vii) The emergency lock (if one is required); and

(viii) The special decompression chamber (if one is required).

*These issues are covered by the Construction Safety Standard Part 14. Tunnels, Shafts, Caissons, and Cofferdams

(d) Signs and records.

- (1) The time of decompression shall be posted in each man lock as follows:

<p style="margin: 0;">Time of Decompression for This Lock</p> <p style="margin: 5px 0 5px 40px;">_____pounds to _____pounds in _____minutes.</p> <p style="margin: 5px 0 5px 40px;">_____pounds to _____pounds in _____minutes.</p> <p style="margin: 5px 0 5px 20px;">(Signed by) _____</p> <p style="margin: 5px 0 5px 40px;">(Superintendent)</p> <p style="margin: 10px 0 10px 30px;">This form shall be posted in the Man Lock at all times.</p>

(2) Any code of signals used shall be conspicuously posted near workplace entrances and such other locations as may be necessary to bring them to the attention of all employees concerned.

(3) For each 8-hour shift, a record of employees employed under air pressure shall be kept by an employee who shall remain outside the lock near the entrance. This record shall show the period each employee spends in the air chamber and the time taken from decompression. A copy shall be submitted to the appointed physician after each shift.

(e) Compression.

(1) Every employee going under air pressure for the first time shall be instructed on how to avoid excessive discomfort.

(2) During the compression of employees, the pressure shall not be increased to more than 3 p.s.i.g. within the first minute. The pressure shall be held at 3 p.s.i.g. and again at 7 p.s.i.g. sufficiently long to determine if any employees are experiencing discomfort.

(3) After the first minute the pressure shall be raised uniformly and at a rate not to exceed 10 p.s.i. per minute.

(4) If any employee complains of discomfort, the pressure shall be held to determine if the symptoms are relieved. If, after 5 minutes the discomfort does not disappear, the lock attendant shall gradually reduce the pressure until the employee signals that the discomfort has ceased. If he does not indicate that the discomfort has disappeared, the lock attendant shall reduce the pressure to atmospheric and the employee shall be released from the lock.

(5) No employee shall be subjected to pressure exceeding 50 pounds per square inch except in emergency.

(f) Decompression.

(1) Decompression to normal condition shall be in accordance with the Decompression Tables in Appendix A of this subpart.

(2) In the event it is necessary for an employee to be in compressed air more than once in a 24-hour period, the appointed physician shall be responsible for the establishment of methods and procedures of decompression applicable to repetitive exposures.

(3) If decanting is necessary, the appointed physician shall establish procedures before any employee is permitted to be decompressed by decanting methods. The period of time that the employees spend at atmospheric pressure between the decompression following the shift and recompression shall not exceed 5 minutes.

(g) Man locks and special decompression chambers.

(1) Man locks.

(i) Except in emergency, no employees employed in compressed air shall be permitted to pass from the working chamber to atmospheric pressure until after decompression, in accordance with the procedures in this subpart.

(ii) The lock attendant in charge of a man lock shall be under the direct supervision of the appointed physician. He shall be stationed at the lock controls on the free air side during the period of compression and decompression and shall remain at the lock control station whenever there are men in the working chamber or in the man lock.

(iii) Except where air pressure in the working chamber is below 12 p.s.i.g., each man lock shall be equipped with automatic controls which, through taped programs, cams, or similar apparatus, shall automatically regulate

decompressions. It shall also be equipped with manual controls to permit the lock attendant to override the automatic mechanism in the event of an emergency, as provided in paragraph (g)(1)(viii) of this section.

(iv) A manual control, which can be used in the event of an emergency, shall be placed inside the man lock.

(v) A clock, thermometer, and continuous recording pressure gauge with a 4-hour graph shall be installed outside of each man lock and shall be changed prior to each shift's decompression. The chart shall be of sufficient size to register a legible record of variations in pressure within the man lock and shall be visible to the lock attendant. A copy of each graph shall be submitted to the appointed physician after each shift. In addition, a pressure gauge clock, and thermometer shall also be installed in each man lock. Additional fittings shall be provided so that test gauges may be attached whenever necessary.

(vi) Except where air pressure is below 12 p.s.i.g. and there is no danger of rapid flooding, all caissons having a working area greater than 150 square feet, and each bulkhead in tunnels of 14 feet or more in diameter, or equivalent area, shall have at least two locks in perfect working condition, one of which shall be used exclusively as a man lock, the other, as a materials lock.

(vii) Where only a combination man-and-materials lock is required, this signal lock shall be of sufficient capacity to hold the employees constituting two successive shifts.

(viii) Emergency locks shall be large enough to hold an entire heading shift and a limit maintained of 12 p.s.i.g. There shall be a chamber available for oxygen decompression therapy to 28 p.s.i.g.

(ix) The man lock shall be large enough so that those using it are not compelled to be in a cramped position, and shall not have less than 5 feet clear head room at the center and a minimum of 30 cubic feet of air space per occupant.

(x) Locks on caissons shall be so located that the bottom door shall be not less than 3 feet above the water level surrounding the caisson on the outside. (The water level, where it is affected by tides, is construed to mean high tide.)

(xi) In addition to the pressure gauge in the locks, an accurate pressure gauge shall be maintained on the outer and inner side of each bulkhead. These gauges shall be accessible at all times and shall be kept in accurate working order.

(xii) Man locks shall have an observation port at least 4 inches in diameter located in such a position that all occupants of the man lock may be observed from the working chamber and from the free air side of the lock.

(xiii) Adequate ventilation in the lock shall be provided.

(xiv) Man locks shall be maintained at a minimum temperature of 70 degrees Fahrenheit.

(xv) When locks are not in use and employees are in the working chamber, lock doors shall be kept open to the working chamber, where practicable.

(xvi) Provision shall be made to allow for rescue parties to enter the tunnel if the working force is disabled.

(xvii) A special decompression chamber of sufficient size to accommodate the entire force of employees being decompressed at the end of a shift shall be provided whenever the regularly established working period requires a total time of decompression exceeding 75 minutes.

(2) Special decompression chamber.

(i) The headroom in the special decompression chamber shall be not less than a minimum 7 feet and the cubical content shall provide at least 50 cubic feet of airspace for each employee. For each occupant, there shall be provided 4 square feet of free walking area and 3 square feet of seating space, exclusive of area required for lavatory and toilet facilities. The rated capacity shall be based on the stated minimum space per employee and shall be posted at the chamber entrance. The posted capacity shall not be exceeded, except in case of emergency.

(ii) Each special decompression chamber shall be equipped with the following:

(a) A clock or clocks suitably placed so that the attendant and the chamber occupants can readily ascertain the time;

(b) Pressure gauges which will indicate to the attendants and to the chamber occupants the pressure in the chamber;

(c) Valves to enable the attendant to control the supply and discharge of compressed air into and from the chamber;

(d) Valves and pipes, in connection with the air supply and exhaust, arranged so that the chamber pressure can be controlled from within and without;

(e) Effective means of oral intercommunication between the attendant, occupants of the chamber, and the air compressor plant; and

(f) An observation port at the entrance to permit observation of the chamber occupants.

(iii) Seating facilities in special decompression chambers shall be so arranged as to permit a normal sitting posture without cramping. Seating space, not less than 18 inches by 24 inches wide, shall be provided per occupant.

(iv) Adequate toilet and washing facilities, in a screened or enclosed recess, shall be provided. Toilet bowls shall have a built-in protector on the rim so that an air space is created when the seat lid is closed.

(v) Fresh and pure drinking water shall be available. This may be accomplished by either piping water into the special decompression chamber and providing drinking fountains, or by providing individual canteens, or by some other sanitary means. Community drinking vessels are prohibited.

(vi) No refuse or discarded material of any kind shall be permitted to accumulate, and the chamber shall be kept clean.

(vii) Unless the special decompression chamber is serving as the man lock to atmospheric pressure, the special decompression chamber shall be situated, where practicable, adjacent to the man lock on the atmospheric pressure side of the bulkhead. A passageway shall be provided, connecting the special chamber with the man lock, to permit employees in the process of decompression to move from the man lock to the special chamber without a reduction in the ambient pressure from that designated for the next stage of decompression. The passageway shall be so arranged as to not interfere with the normal operation of the man lock, nor with the release of the occupants of the special chamber to atmospheric pressure upon the completion of the decompression procedure.

(h) Compressor plant and air supply.

(1) At all times there shall be a thoroughly experienced, competent, and reliable person on duty at the air control valves as a gauge tender who shall regulate the pressure in the working areas. During tunneling operations, one gauge tender may regulate the pressure in not more than two headings; provided, that the gauge and controls are all in one location. In caisson work, there shall be a gauge tender for each caisson.

(2) The low air compressor plant shall be of sufficient capacity to not only permit the work to be done safely, but shall also provide a margin to meet emergencies and repairs.

(3) Low air compressor units shall have at least two independent and separate sources of power supply and each shall be capable of operating the entire low air plant and its accessory systems.

(4) The capacity, arrangement, and number of compressors shall be sufficient to maintain the necessary pressure without overloading the equipment and to assure maintenance of such pressure in the working chamber during periods of breakdown, repair, or emergency.

(5) Switching from one independent source of power supply to the other shall be done periodically to ensure the workability of the apparatus in an emergency.

(6) Duplicate low-pressure air feedlines and regulating valves shall be provided between the source of air supply and a point beyond the locks with one of the lines extending to within 100 feet of the working face.

(7) All high- and low-pressure air supply lines shall be equipped with check valves.

(8) Low-pressure air shall be regulated automatically. In addition manually operated valves shall be provided for emergency conditions.

(9) The air intakes for all air compressors shall be located at a place where fumes, exhaust, gases, and other air contaminants will be at a minimum.

(10) Gauges indicating the pressure in the working chamber shall be installed in the compressor building, the lock attendant's station, and at the employer's field office.

(i) Ventilation and air quality.

(1) Exhaust valves and exhaust pipes shall be provided and operated so that the working chamber shall be well ventilated, and there shall be no pockets of dead air. Outlets may be required at intermediate points along the main low-pressure air supply line to the heading to eliminate such pockets of dead air. Ventilating air shall be not less than 30 cubic feet per minute.

(2) The air in the workplace shall be analyzed by the employer not less than once each shift, and records of such tests shall be kept on file at the place where the work is in progress. The test results shall be within the threshold limit values specified in Subpart D of this part, for hazardous gases, and within 10 percent of the lower explosive limit of flammable gases. If these limits are not met, immediate action to correct the situation shall be taken by the employer.

(3) The temperature of all working chambers which are subjected to air pressure shall, by means of after-coolers or other suitable devices, be maintained at a temperature not to exceed 85 degrees Fahrenheit.

(4) Forced ventilation shall be provided during decompression. During the entire decompression period, forced ventilation through chemical or mechanical air purifying devices that will ensure a source of fresh air shall be provided.

(5) Whenever heat-producing machines (moles, shields) are used in compressed air tunnel operations, a positive means of removing the heat build-up at the heading shall be provided.

(j) Electricity.

(1) All lighting in compressed-air chambers shall be by electricity exclusively, and two independent electric-lighting systems with independent sources of supply shall be used. The emergency source shall be arranged to become automatically operative in the event of failure of the regularly used source.

(2) The minimum intensity of light on any walkway, ladder, stairway, or working level shall be not less than 10 foot-candles, and in all workplaces the lighting shall at all times be such as to enable employees to see clearly.

(3) All electrical equipment and wiring for light and power circuits shall comply with the requirements of Subpart K of this part for use in damp, hazardous, high temperature, and compressed air environments.

(4) External parts of lighting fixtures and all other electrical equipment, when within 8 feet of the floor, shall be constructed of noncombustible, nonabsorptive, insulating materials, except that metal may be used if it is effectively grounded.

(5) Portable lamps shall be equipped with noncombustible, nonabsorptive, insulating sockets, approved handles, basket guards, and approved cords.

(6) The use of worn or defective portable and pendant conductors is prohibited.

(k) Sanitation.

(1) Sanitary, heated, lighted, and ventilated dressing rooms and drying rooms shall be provided for all employees engaged in compressed air work. Such rooms shall contain suitable benches and lockers. Bathing accommodations (showers at the ratio of one to 10 employees per shift), equipped with running hot and cold water, and suitable and adequate toilet accommodations, shall be provided. One toilet for each 15 employees, or fractional part thereof, shall be provided.

(2) When the toilet bowl is shut by a cover, there should be an air space so that the bowl or bucket does not implode when pressure is increased.

(3) All parts of caissons and other working compartments shall be kept in a sanitary condition.

(l) Fire prevention and protection.

(1) Firefighting equipment shall be available at all times and shall be maintained in working condition.

(2) While welding or flame-cutting is being done in compressed air a firewatch with a fire hose or approved extinguisher shall stand by until such operation is completed.

(3) Shafts and caissons containing flammable material of any kind, either above or below ground, shall be provided with a waterline and a fire hose connected thereto, so arranged that all points of the shaft or caisson are within reach of the hose stream.

(4) Fire hose shall be at least 1 1/2 inches in nominal diameter; the water pressure shall at all times be adequate for efficient operation of the type of nozzle used; and the water supply shall be such as to ensure an uninterrupted flow. Fire hose, when not in use shall be located or guarded to prevent injury thereto.

(5) The power house, compressor house, and all buildings housing ventilating equipment, shall be provided with at least one hose connection in the water line, with a fire hose connected thereto. A fire hose shall be maintained within reach of structures of wood over or near shafts.

(6) Tunnels shall be provided with a 2-inch minimum diameter water line extending into the working chamber and to within 100 feet of the working face. Such line shall have hose outlets with 100 feet of fire hose attached and maintained as follows: One at the working face; one immediately inside of the bulkhead of the working chamber and one immediately outside such bulkhead. In addition, hose outlets shall be provided at 200-foot intervals throughout the length of the tunnel, and 100 feet of fire hose shall be attached to the outlet nearest to any location where flammable material is being kept or stored or where any flame is being used.

(7) In addition to fire hose protection required by this subpart, on every floor of every building not under compressed air, but used in connection with the compressed air work, there shall be provided at least one approved fire extinguisher of the proper type for the hazard involved. At least two approved fire extinguishers shall be provided in the working chamber as follows: One at the working face and one immediately inside the bulkhead (pressure side). Extinguishers in the working chamber shall use water as the primary extinguishing agent and shall not use any extinguishing agent which could be harmful to the employees in the working chamber. The fire extinguisher shall be protected from damage.

(8) Highly combustible materials shall not be used or stored in the working chamber. Wood, paper, and similar combustible material shall not be used in the working chamber in quantities which could cause a fire hazard. The compressor building shall be constructed of non-combustible material.

(9) Man locks shall be equipped with a manual type fire extinguisher system that can be activated inside the man lock and also by the outside lock attendant. In addition, a fire hose and portable fire extinguisher shall be provided inside and outside the man lock. The portable fire extinguisher shall be the dry chemical type.

(10) Equipment, fixtures, and furniture in man locks and special decompression chambers shall be constructed of noncombustible materials. Bedding, etc., shall be chemically treated so as to be fire resistant.

(11) Head frames shall be constructed of structural steel or open frame-work fireproofed timber. Head houses and other temporary surface buildings or structures within 100 feet of the shaft, caisson, or tunnel opening shall be built of fire-resistant materials.

(12) No oil, gasoline, or other combustible material shall be stored within 100 feet of any shaft, caisson, or tunnel opening, except that oils may be stored in suitable tanks in isolated fireproof buildings, provided such buildings are not less than 50 feet from any shaft, caisson, or tunnel opening, or any building directly connected thereto.

(13) Positive means shall be taken to prevent leaking flammable liquids from flowing into the areas specifically mentioned in the preceding paragraph.

(14) All explosives used in connection with compressed air work shall be selected, stored, transported, and used as specified in Subpart U of this part.

(m) Bulkheads and safety screens.

(1) Intermediate bulkheads with locks, or intermediate safety screens or both, are required where there is a danger of rapid flooding.

(2) In tunnels 16 feet or more in diameter, hanging walkways shall be provided from the face to the man lock as high in the tunnel as practicable, with at least 6 feet of head room. Walkways shall be constructed of noncombustible material. Standard railings shall be securely installed throughout the length of all walkways on open sides in accordance with Subpart M of this part. Where walkways are ramped under safety screens, the walkway surface shall be skidproofed by cleats or by equivalent means.

(3) Bulkheads used to contain compressed air shall be tested, where practicable, to prove their ability to resist the highest air pressure which may be expected to be used.

1926.804 DEFINITIONS
Applicable to this Subpart

(a) "Bulkhead" - An airtight structure separating the working chamber from free air or from another chamber under a lesser pressure than the working pressure.

(b) "Caisson" - A wood, steel, concrete or reinforced concrete, air- and water-tight chamber in which it is possible for men to work under air pressure greater than atmospheric pressure to excavate material below water level.

(c) "Decanting" - A method used for decompressing under emergency circumstances. In this procedure, the employees are brought to atmospheric pressure with a very high gas tension in the tissues and then immediately recompressed in a second and separate chamber or lock.

(d) "Emergency locks" - A lock designed to hold and permit the quick passage of an entire shift of employees.

(e) "High air" - Air pressure used to supply power to pneumatic tools and devices.

(f) "Low air" - Air supplied to pressurize working chambers and locks.

(g) "Man lock" - A chamber through which men pass from one air pressure environment into another.

(h) "Materials lock" - A chamber through which materials and equipment pass from one air pressure environment into another.

(i) "Medical lock" - A special chamber in which employees are treated for decompression illness. It may also be used in preemployment physical examinations to determine the adaptability of the prospective employee to changes in pressure.

(j) "Normal condition" - One during which exposure to compressed air is limited to a single continuous working period followed by a single decompression in any given 24- hour period; the total time of exposure to compressed air during the single continuous working period is not interrupted by exposure to normal atmospheric pressure, and a second exposure to compressed air does not occur until at least 12 consecutive hours of exposure to normal atmospheric pressure has elapsed since the employee has been under pressure.

(k) "Pressure" - A force acting on a unit area. Usually shown as pounds per square inch (p.s.i.).

(l) "Absolute pressure" (p.s.i.a.) - The sum of the atmospheric pressure and gauge pressure (p.s.i.g.).

(m) "Atmospheric pressure" - The pressure of air at sea level, usually 14.7 p.s.i.a. (1 atmosphere), or 0 p.s.i.g.

(n) "Gauge pressure" (p.s.i.g.) - Pressure measured by a gauge and indicating the pressure exceeding atmospheric.

(o) "Safety screen" - An air- and water-tight diaphragm placed across the upper part of a compressed air tunnel between the face and bulkhead, in order to prevent flooding the crown of the tunnel between the safety screen and the bulkhead, thus providing a safe means of refuge and exit from a flooding or flooded tunnel.

(p) "Special decompression chamber" - A chamber to provide greater comfort of employees when the total decompression time exceeds 75 minutes.

(q) "Working chamber" - The space or compartment under air pressure in which the work is being done.

**APPENDIX A
DECOMPRESSION TABLES**

1. Explanation. The decompression tables are computed for working chamber pressures from 0 to 14 pounds, and from 14 to 50 pounds per square inch gauge inclusive by 2-pound increments and for exposure times for each pressure extending from one-half to over 8 hours inclusive. Decompressions will be conducted by two or more stages with a maximum of four stages, the latter for a working chamber pressure of 40 pounds per square inch gauge or over.

Stage 1 consists of a reduction in ambient pressure ranging from 10 to a maximum of 16 pounds per square inch, but in no instance will the pressure be reduced below 4 pounds at the end of stage 1. This reduction in pressure in stage 1 will always take place at a rate not greater than 5 pounds per minute.

Further reduction in pressure will take place during stage 2 and subsequent stages as required at a slower rate, but in no event at a rate greater than 1 pound per minute.

Decompression Table No. 1 indicates in the body of the table the total decompression time in minutes for various combinations of working chamber pressure and exposure time.

Decompression Table No. 2 indicates for the same various combinations of working chamber pressure and exposure time the following:

- a. The number of stages required;
- b. The reduction in pressure and the terminal pressure for each required stage;
- c. The time in minutes through which the reduction in pressure is accomplished for each required state.
- d. The pressure reduction rate in minutes per pound for each required stage;

IMPORTANT NOTE: The pressure reduction in each stage is accomplished at a uniform rate. Do not interpolate between values shown on the tables. Use the next higher value of working chamber pressure or exposure time should the actual working chamber pressure or the actual exposure time, respectively, fall between those for which calculated values are shown in the body of the tables.

EXAMPLES	MINUTES
Example No. 1: 4 hours working period at 20 pounds gauge. Decompression Table No. 1: 20 pounds for 4 hours, total decompression time.	43
Decompression Table No. 2: Stage 1: Reduce pressure from 20 pounds to 4 pounds at the uniform rate of 5 pounds per minute. Elapsed time stage 1: 16/5.	3
Stage 2 (final stage): Reduce pressure at a uniform rate from 4 pounds to 0-pound gage over a period of 40 minutes. Rate – 0.10 pound per minute or 10 minutes per pound. Stage 2 (final) elapsed time.	40
Total time.	43
<hr/>	
Example No. 2: 5-hour working period at 24 pounds gage. Decompression Table No. 1: 24 pounds for 5 hours, total decompression time.	117
Decompression Table No. 2: Stage 1: Reduce pressure from 24 pounds to 8 pounds at the uniform rate of 5 pounds per minute. Elapsed time, stage 1: 16/5	3
Stage 2: Reduce pressure at a uniform rate from 8 pounds to 4 pounds over a period of 4 minutes. Rate, 1 pound per minute. Elapsed time, stage 2.	4
Transfer men to special decompression chamber maintaining the 4-pound pressure during the transfer operation. Stage 3 (final stage): In the special decompression chamber, reduce the pressure at a uniform rate from 4 pounds to 0-pound gage over a period of 110 minutes. Rate, 0.037 pound per minute or 27.5 minutes per pound. Stage 3 (final) elapsed time.	110
Total time.	117

**DECOMPRESSION TABLE NO. 1
TOTAL DECOMPRESSION TIME**

Work Pressure p.s.i.g.	Working Period Hours										
	1/2	1	1 1/2	2	3	4	5	6	7	8	Over 8
9 to 12	3	3	3	3	3	3	3	3	3	3	3
14	6	6	6	6	6	6	6	6	16	16	33
16	7	7	7	7	7	7	17	33	48	48	62
18	7	7	7	8	11	17	48	63	63	73	87
20	7	7	8	15	15	43	63	73	83	103	113
22	9	9	16	24	38	68	93	103	113	128	133
24	11	12	23	27	52	92	117	122	127	137	151
26	13	14	29	34	69	104	126	141	142	142	163
28	15	23	31	41	98	127	143	153	153	165	183
30	17	28	38	62	105	143	165	168	178	188	204
32	19	35	43	85	126	163	178	193	203	213	226
34	21	39	58	98	151	178	195	218	223	233	248
36	24	44	63	113	170	198	223	233	243	253	273
38	28	49	73	128	178	203	223	238	253	263	278
40	31	49	84	143	183	213	233	248	258	278	288
42	37	56	102	144	189	215	245	260	263	268	293
44	43	64	118	154	199	234	254	264	269	269	293
46	44	74	139	171	214	244	269	274	289	299	318
48	51	89	144	189	229	269	299	309	319	319	-----
50	58	94	164	209	249	279	309	329	-----	-----	-----

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data					
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes
			From	To			
14	1/2	1	14	4	2	0.20	6
		2	4	0	4	1.00	6
	1	1	14	4	2	0.20	6
		2	4	0	4	1.00	6
	1 1/2	1	14	4	2	0.20	6
		2	4	0	4	1.00	6
	2	1	14	4	2	0.20	6
		2	4	0	4	1.00	6
	3	1	14	4	2	0.20	6
		2	4	0	4	1.00	6
	4	1	14	0	2	0.20	6
		2	4	0	4	1.00	6
	5	1	14	4	2	0.20	6
		2	4	0	4	1.00	6
	6	1	14	4	2	0.20	-----
		2	4	0	4	1.00	6
	7	1	14	4	2	0.20	-----
		2	4	0	14	3.50	16
	8	1	14	4	2	0.20	-----
		2	4	0	14	3.50	16
Over 8	1	14	4	2	0.20	-----	
	2	4	0	30	7.50	32	
16	1/2	1	16	4	3	0.20	-----
		2	4	0	4	1.00	7
	1	1	16	4	3	0.20	7
		2	4	0	4	1.00	7
	1 1/2	1	16	4	3	0.20	-----
		2	4	0	4	1.00	7
	2	1	16	4	3	0.20	-----
		2	4	0	4	1.00	7
	3	1	16	4	3	0.20	-----
		2	4	0	4	1.00	7
	4	1	14	4	3	0.20	-----
		2	4	0	4	1.00	7
	5	1	14	4	3	0.20	7
		2	4	0	4	3.50	17
	6	1	14	4	3	0.20	-----
		2	4	0	30	7.50	33
	7	1	14	4	3	0.20	-----
		2	4	0	45	11.25	48

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data						
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes	
			From	To				
16	8	1	14	4	3	0.20	-----	
		2	4	0	45	11.25	48	
	Over 8	1	14	4	3	0.20	-----	
		2	4	0	60	15.00	63	
18	1/2	1	18	4	3	0.20	-----	
		2	4	0	4	1.00	7	
	1	1	18	4	3	0.20	-----	
		2	4	0	4	1.00	7	
	1 1/2	1	18	4	3	0.20	-----	
		2	4	0	4	1.00	7	
	2	1	18	4	3	0.20	-----	
		2	4	0	5	1.25	8	
	3	1	18	4	3	0.20	-----	
		2	4	0	8	2.00	11	
	4	1	18	4	3	0.20	-----	
		2	4	0	14	3.50	17	
	5	1	18	4	3	0.20	-----	
		2	4	0	45	11.25	48	
	6	1	18	4	3	0.20	-----	
		2	4	0	60	15.00	63	
	7	1	18	4	3	0.20	-----	
		2	4	0	60	15.00	63	
	8	1	18	4	3	0.20	-----	
		2	4	0	70	17.50	73	
	Over 8	1	18	4	3	0.20	-----	
		2	4	0	84	21.00	87	
	20	1/2	1	20	4	3	0.20	-----
			2	4	0	4	1.00	7
1		1	20	4	3	0.20	-----	
		2	4	0	4	1.00	7	
1 1/2		1	20	4	3	0.20	-----	
		2	4	0	5	1.25	8	
2		1	20	4	3	0.20	-----	
		2	4	0	12	3.00	15	
3		1	20	4	3	0.20	-----	
		2	4	0	12	3.00	15	
4		1	20	4	3	0.20	-----	
		2	4	0	40	10.00	43	
5		1	20	4	3	0.20	-----	
		2	4	0	60	15.00	63	

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data						
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes	
			From	To				
20	6	1	20	4	3	0.20	-----	
		2	4	0	70	17.50	73	
	7	1	20	4	3	0.20	-----	
		2	4	0	80	20.00	83	
	8	1	20	4	3	0.20	-----	
		2	4	0	100	25.00	103	
	Over 8	1	20	4	3	0.20	-----	
		2	4	0	110	27.50	113	
	22	1/2	1	22	6	3	0.20	-----
			2	6	0	6	1.00	9
1		1	22	6	3	0.20	-----	
		2	6	0	6	1.00	9	
1 1/2		1	22	6	3	0.20	-----	
		2	6	0	13	2.20	16	
2		1	22	6	3	0.20	-----	
		2	6	0	21	3.50	24	
3		1	22	6	3	0.20	-----	
		2	6	0	35	5.85	38	
4		1	22	6	3	0.20	-----	
		2	6	0	65	10.83	68	
5		1	22	6	3	0.20	-----	
		2	6	0	90	15.00	93	
6		1	22	6	3	0.20	-----	
		2	6	0	100	16.67	103	
7		1	22	6	3	0.20	-----	
		2	6	0	110	18.35	113	
8		1	22	6	3	0.20	-----	
		2	6	0	125	20.80	128	
Over 8		1	22	6	3	0.20	-----	
		2	6	0	130	21.70	133	
24		1/2	1	24	8	3	0.20	-----
			2	8	4	4	1.00	-----
			3	4	0	4	1.00	11
		1	1	24	8	3	0.20	-----
			2	8	4	4	1.00	-----
			3	4	0	5	1.25	12
	1 1/2	1	24	8	3	0.20	-----	
		2	8	4	4	1.00	-----	
		3	4	0	16	4.00	23	

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data					
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes
			From	To			
24	2	1	24	8	3	0.20	-----
		2	8	4	4	1.00	-----
		3	4	0	20	5.00	27
	3	1	24	8	3	0.20	-----
		2	8	4	4	1.00	-----
		3	4	0	45	11.25	52
	4	1	24	8	3	0.20	-----
		2	8	4	4	1.00	-----
		3	4	0	85	21.25	92
	5	1	24	8	3	0.20	-----
		2	8	4	4	1.00	-----
		3	4	0	110	27.50	117
	6	1	24	8	3	0.20	-----
		2	8	4	4	1.00	-----
		3	4	0	115	28.80	122
	7	1	24	8	3	0.20	-----
		2	8	4	4	1.00	-----
		3	4	0	120	30.00	127
	8	1	24	8	3	0.20	-----
		2	8	4	4	1.00	-----
		3	4	0	130	32.50	137
	Over 8	1	24	8	3	0.20	-----
		2	8	4	8	2.00	-----
		3	4	0	140	35.00	151
26	1/2	1	26	10	3	0.20	-----
		2	10	4	6	1.00	-----
		3	4	0	4	1.00	13
	1	1	26	10	3	0.20	-----
		2	10	4	6	1.00	-----
		3	4	0	5	1.25	14
	1 1/2	1	26	10	3	0.20	-----
		2	10	4	6	1.00	-----
		3	4	0	20	5.00	29
	2	1	26	10	3	0.20	-----
		2	10	4	6	1.00	-----
		3	4	0	25	6.25	34
	3	1	26	10	3	0.20	-----
		2	10	4	6	1.00	-----
		3	4	0	60	15.00	69

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data						
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes	
			From	To				
26	4	1	26	10	3	0.20	-----	
		2	10	4	6	1.00	-----	
		3	4	0	95	23.75	104	
	5	1	26	10	3	0.20	-----	
		2	10	4	8	1.33	-----	
		3	4	0	115	28.80	126	
	6	1	26	10	3	0.20	-----	
		2	10	4	8	1.33	-----	
		3	4	0	130	32.50	141	
	7	1	26	10	3	2.20	-----	
		2	10	4	9	1.50	-----	
		3	4	0	130	32.50	142	
	8	1	26	10	3	0.20	-----	
		2	10	4	9	1.50	-----	
		3	4	0	130	32.50	142	
	Over 8	1	26	10	3	0.20	-----	
		2	10	4	30	5.00	-----	
		3	4	0	30	32.50	163	
	28	1/2	1	28	12	3	0.20	-----
			2	12	4	8	1.00	-----
			3	4	0	4	1.00	15
		1	1	28	12	3	0.20	-----
			2	12	4	8	1.00	-----
			3	4	0	12	3.00	23
1 1/2		1	28	12	3	0.20	-----	
		2	12	4	8	1.00	-----	
		3	4	0	20	5.00	31	
2		1	28	12	3	0.20	-----	
		2	12	4	8	1.00	-----	
		3	4	0	30	7.50	41	
3		1	28	12	3	0.20	-----	
		2	12	4	10	1.25	-----	
		3	4	0	85	21.20	98	
4		1	28	12	3	0.20	-----	
		2	12	4	14	1.75	-----	
		3	4	0	110	27.50	127	
5		1	28	12	3	0.20	-----	
		2	12	4	20	2.50	-----	
		3	4	0	120	30.00	143	

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data					
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes
			From	To			
28	6	1	28	12	3	0.20	-----
		2	12	4	20	2.50	-----
		3	4	0	130	32.50	153
	7	1	28	12	3	0.20	-----
		2	12	4	20	2.50	-----
		3	4	0	120	32.50	153
	8	1	28	12	3	0.20	-----
		2	12	4	32	4.00	-----
		3	4	0	130	32.50	165
	Over 8	1	28	12	3	0.20	-----
		2	12	4	50	6.25	-----
		3	4	0	130	32.50	183
30	1/2	1	30	14	3	0.20	-----
		2	14	4	10	1.00	-----
		3	4	0	4	1.00	17
	1	1	30	14	3	0.20	-----
		2	14	4	10	1.00	-----
		3	4	0	15	3.75	28
	1 1/2	1	30	14	3	0.20	-----
		2	14	4	10	1.00	-----
		3	4	0	25	6.25	38
	2	1	30	14	3	0.20	-----
		2	14	4	14	1.40	-----
		3	4	0	45	11.25	62
	3	1	30	14	3	0.20	-----
		2	14	4	17	1.70	-----
		3	4	0	85	21.20	105
	4	1	30	14	3	0.20	-----
		2	14	4	30	3.00	-----
		3	4	0	110	27.50	143
	5	1	30	14	3	0.20	-----
		2	14	4	35	3.50	-----
		3	4	0	130	32.50	165
	6	1	30	14	3	0.20	-----
		2	14	4	35	3.50	-----
		3	4	0	130	32.50	168
	7	1	30	14	3	0.20	-----
		2	14	4	45	4.50	-----
		3	4	0	130	32.50	178

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data					
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes
			From	To			
30	8	1	30	14	3	0.20	-----
		2	14	4	55	5.50	-----
		3	4	0	130	32.50	188
	Over 8	1	30	14	3	0.20	-----
		2	14	4	71	7.10	-----
		3	4	0	130	32.50	204
32	1/2	1	32	16	3	0.20	-----
		2	16	4	12	1.00	-----
		3	4	0	4	1.00	19
	1	1	32	16	3	0.20	-----
		2	16	4	12	1.00	-----
		3	4	0	20	5.00	35
	1 1/2	1	32	16	3	0.20	-----
		2	16	4	15	1.25	-----
		3	4	0	25	6.25	43
	2	1	32	16	3	0.20	-----
		2	16	4	22	1.83	-----
		3	4	0	60	15.00	85
	3	1	32	16	3	0.20	-----
		2	16	4	28	2.33	-----
		3	4	0	95	23.75	126
	4	1	32	16	3	0.20	-----
		2	16	4	40	3.33	-----
		3	4	0	120	30.00	163
	5	1	32	16	3	0.20	-----
		2	16	4	45	3.75	-----
		3	4	0	130	32.50	178
	6	1	32	16	3	0.20	-----
		2	16	4	60	5.00	-----
		3	4	0	130	32.50	193
	7	1	32	16	3	0.20	-----
		2	16	4	70	5.83	-----
		3	4	0	130	32.50	203
	8	1	32	16	3	0.20	-----
		2	16	4	80	6.67	-----
		3	4	0	130	32.50	213
	Over 8	1	32	16	3	0.20	-----
		2	16	4	93	7.75	-----
		3	4	0	130	32.50	226

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data					
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes
			From	To			
34	1/2	1	34	18	3	0.20	-----
		2	18	4	14	1.00	-----
		3	4	0	4	1.00	21
	1	1	34	18	3	0.20	-----
		2	18	4	14	1.00	-----
		3	4	0	22	5.50	39
	1 1/2	1	34	18	3	0.20	-----
		2	18	4	25	1.80	-----
		3	4	0	30	7.50	58
	2	1	34	18	3	0.20	-----
		2	18	4	35	2.50	-----
		3	4	0	60	15.00	98
	3	1	34	18	3	0.20	-----
		2	18	4	43	3.10	-----
		3	4	0	105	26.25	151
	4	1	34	18	3	0.20	-----
		2	18	4	55	3.93	-----
		3	4	0	120	30.00	178
	5	1	34	18	3	0.20	-----
		2	18	4	62	4.43	-----
		3	4	0	130	32.50	195
	6	1	34	18	3	0.20	-----
		2	18	4	85	6.07	-----
		3	4	0	130	32.50	218
	7	1	34	18	3	0.20	-----
		2	18	4	90	6.43	-----
		3	4	0	130	32.50	223
	8	1	34	18	3	0.20	-----
		2	18	4	100	7.15	-----
		3	4	0	130	32.50	233
Over 8	1	34	18	3	0.20	-----	
	2	18	4	115	8.23	-----	
	3	4	0	130	32.50	248	
36	1/2	1	36	20	3	0.20	-----
		2	20	4	16	1.00	-----
		3	4	0	5	1.25	24
	1	1	36	20	3	0.20	-----
		2	20	4	16	1.00	-----
		3	4	0	25	6.25	44

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data					
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes
			From	To			
36	1 1/2	1	36	20	3	0.20	-----
		2	20	4	30	1.88	-----
		3	4	0	30	7.50	63
	2	1	36	20	3	0.20	-----
		2	20	4	40	2.50	-----
		3	4	0	70	17.50	113
	3	1	36	20	3	0.20	-----
		2	20	4	52	3.25	-----
		3	4	0	115	28.75	170
	4	1	36	20	3	0.20	-----
		2	20	4	65	4.06	-----
		3	4	0	130	32.50	198
	5	1	36	20	3	0.20	-----
		2	20	4	90	5.63	-----
		3	4	0	130	32.50	223
	6	1	36	20	3	0.20	-----
		2	20	4	100	6.25	-----
		3	4	0	130	32.50	233
	7	1	36	20	3	0.20	-----
		2	20	4	110	6.88	-----
		3	4	0	130	32.50	243
	8	1	36	20	3	0.20	-----
		2	20	4	120	7.50	-----
		3	4	0	130	32.50	253
	Over 8	1	36	20	3	0.20	-----
		2	20	4	140	8.75	-----
		3	4	0	130	32.50	273
38	1/2	1	38	22	3	0.20	-----
		2	22	6	16	1.00	-----
		3	6	0	9	1.50	28
	1	1	38	22	3	0.20	-----
		2	22	6	16	1.00	-----
		3	6	0	30	5.00	49
	1 1/2	1	38	22	3	0.20	-----
		2	22	6	20	1.25	-----
		3	6	0	50	8.34	73
	2	1	38	22	3	0.20	-----
		2	22	6	30	1.88	-----
		3	6	0	95	15.83	128

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data						
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes	
			From	To				
38	3	1	38	22	3	0.20	-----	
		2	22	6	35	2.19	-----	
		3	6	0	140	23.35	178	
	4	1	38	22	3	0.20	-----	
		2	22	6	50	3.12	-----	
		3	6	0	150	25.00	203	
	5	1	38	22	3	0.20	-----	
		2	22	6	55	3.44	-----	
		3	6	0	165	27.50	223	
	6	1	38	22	3	0.20	-----	
		2	22	6	70	4.38	-----	
		3	6	0	165	27.50	238	
	7	1	38	22	3	0.20	-----	
		2	22	6	85	5.32	-----	
		3	6	0	165	27.50	253	
	8	1	38	22	3	0.20	-----	
		2	22	6	95	5.93	-----	
		3	6	0	165	27.50	263	
	Over 8	1	38	22	3	0.20	-----	
		2	22	6	110	6.88	-----	
		3	6	0	165	27.50	278	
	40	1/2	1	40	24	3	0.20	-----
			2	24	8	16	1.00	-----
			3	8	4	4	1.00	-----
4			4	0	8	2.00	31	
1		1	40	24	3	0.20	-----	
		2	24	8	16	1.00	-----	
		3	8	4	5	1.25	-----	
		4	4	0	25	6.25	49	
1 1/2		1	40	24	3	0.20	-----	
		2	24	8	16	1.00	-----	
		3	8	4	20	5.00	-----	
		4	4	0	45	11.25	84	
2		1	40	24	3	0.20	-----	
		2	24	8	25	1.56	-----	
		3	8	4	20	5.00	-----	
		4	4	0	95	23.75	143	

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data					
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes
			From	To			
40	3	1	40	24	3	0.20	-----
		2	24	8	30	1.88	-----
		3	8	4	30	7.50	-----
		4	4	0	120	30.00	183
	4	1	40	24	3	0.20	-----
		2	24	8	45	2.81	-----
		3	8	4	35	8.75	-----
		4	4	0	130	32.50	213
	5	1	40	24	3	0.20	-----
		2	24	8	47	2.94	-----
		3	8	4	53	13.25	-----
		4	4	0	130	32.50	233
	6	1	40	24	3	0.20	-----
		2	24	8	55	3.44	-----
		3	8	4	60	15.00	-----
		4	4	0	130	32.50	248
	7	1	40	24	3	0.20	-----
		2	24	8	65	4.06	-----
		3	8	4	60	15.00	-----
		4	4	0	130	32.50	258
	8	1	40	24	3	0.20	-----
		2	24	8	75	4.70	-----
		3	8	4	60	15.00	-----
		4	4	0	130	32.50	268
	Over 8	1	40	24	3	0.20	-----
		2	24	8	95	5.93	-----
		3	8	4	60	15.00	-----
		4	4	0	130	32.50	288
42	1/2	1	42	26	3	0.20	-----
		2	26	10	16	1.00	-----
		3	10	4	6	1.00	-----
		4	4	0	12	3.00	37
	1	1	42	26	3	0.20	-----
		2	26	10	16	1.00	-----
		3	10	4	12	2.00	-----
		4	4	0	25	6.25	56
	1 1/2	1	42	26	3	0.20	-----
		2	26	10	16	1.00	-----
		3	10	4	23	3.83	-----
		4	4	0	60	15.00	102

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data					
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes
			From	To			
42	2	1	42	26	3	0.20	-----
		2	26	10	16	1.00	-----
		3	10	4	30	5.00	-----
		4	4	0	95	23.75	144
	3	1	42	26	3	0.20	-----
		2	26	10	16	1.00	-----
		3	10	4	50	8.34	-----
		4	4	0	120	30.00	189
	4	1	42	26	3	0.20	-----
		2	26	10	17	1.06	-----
		3	10	4	65	10.83	-----
		4	4	0	130	32.50	215
	5	1	42	26	3	0.20	-----
		2	26	10	27	1.69	-----
		3	10	4	85	14.18	-----
		4	4	0	130	32.50	245
	6	1	42	26	3	0.20	-----
		2	26	10	27	1.69	-----
		3	10	4	100	16.67	-----
		4	4	0	130	32.50	260
	7	1	42	26	3	0.20	-----
		2	26	10	30	1.88	-----
		3	10	4	100	16.67	-----
		4	4	0	130	32.50	263
	8	1	42	26	3	0.20	-----
		2	26	10	35	2.19	-----
		3	10	4	100	16.67	-----
		4	4	0	130	32.50	268
Over 8	1	42	26	3	0.20	-----	
	2	26	10	60	3.75	-----	
	3	10	4	100	16.67	-----	
	4	4	0	130	32.50	293	
44	1/2	1	44	28	3	0.20	-----
		2	28	12	16	1.00	-----
		3	12	4	8	1.00	-----
		4	4	0	16	4.00	43
	1	1	44	28	3	0.20	-----
		2	28	12	16	1.00	-----
		3	12	4	20	2.50	-----
		4	4	0	25	6.25	64

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data					
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes
			From	To			
44	1 1/2	1	44	28	3	0.20	-----
		2	28	12	16	1.00	-----
		3	12	4	27	3.38	-----
		4	4	0	72	18.00	118
	2	1	44	28	3	0.20	-----
		2	28	12	16	1.00	-----
		3	12	4	40	5.00	-----
		4	4	0	95	23.75	154
	3	1	44	28	3	0.20	-----
		2	28	12	16	1.00	-----
		3	12	4	60	7.50	-----
		4	4	0	120	30.00	199
	4	1	44	28	3	0.20	-----
		2	28	12	16	1.00	-----
		3	12	4	85	10.62	-----
		4	4	0	130	32.50	234
	5	1	44	28	3	0.20	-----
		2	28	12	16	1.00	-----
		3	12	4	105	13.13	-----
		4	4	0	130	32.50	254
	6	1	44	28	3	0.20	-----
		2	28	12	16	1.00	-----
		3	12	4	115	14.38	-----
		4	4	0	130	32.50	264
	7	1	44	28	3	0.20	-----
		2	28	12	16	1.00	-----
		3	12	4	120	15.00	-----
		4	4	0	130	32.50	269
	8	1	44	28	3	0.20	-----
		2	28	12	16	1.00	-----
		3	12	4	120	15.00	-----
		4	4	0	130	32.50	269
Over 8	1	44	28	3	0.20	-----	
	2	28	12	40	2.50	-----	
	3	12	4	120	15.00	-----	
	4	4	0	130	32.50	293	
46	1/2	1	46	30	3	0.20	-----
		2	30	14	16	1.00	-----
		3	14	4	10	1.00	-----
		4	4	0	15	3.75	44

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data					
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes
			From	To			
46	1	1	46	30	3	0.20	-----
		2	30	14	16	1.00	-----
		3	14	4	25	2.50	-----
		4	4	0	30	7.50	74
	1 1/2	1	46	30	3	0.20	-----
		2	30	14	16	1.00	-----
		3	14	4	35	3.50	-----
		4	4	0	85	21.20	139
	2	1	46	30	3	0.20	-----
		2	30	14	16	1.00	-----
		3	14	4	47	4.70	-----
		4	4	0	105	26.25	171
	3	1	46	30	3	0.20	-----
		2	30	14	16	1.00	-----
		3	14	4	65	6.50	-----
		4	4	0	130	32.50	214
	4	1	46	30	3	0.20	-----
		2	30	14	16	1.00	-----
		3	14	4	95	9.50	-----
		4	4	0	130	32.50	244
	5	1	46	30	3	0.20	-----
		2	30	14	16	1.00	-----
		3	14	4	120	12.00	-----
		4	4	0	130	32.50	269
	6	1	46	30	3	0.20	-----
		2	30	14	16	1.00	-----
		3	14	4	125	12.50	-----
		4	4	0	130	32.50	274
	7	1	46	30	3	0.20	-----
		2	34	14	16	1.00	-----
		3	10	4	140	14.00	-----
		4	4	0	130	32.50	289
8	1	46	30	3	0.20	-----	
	2	30	14	16	1.00	-----	
	3	14	4	150	15.00	-----	
	4	4	0	130	32.50	299	
Over 8	1	46	30	3	0.20	-----	
	2	30	14	25	1.56	-----	
	3	14	4	160	16.00	-----	
	4	4	0	130	32.50	318	

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data					
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes
			From	To			
48	1/2	1	48	32	3	0.20	-----
		2	32	16	16	1.00	-----
		3	16	4	12	1.00	-----
		4	4	0	20	5.00	51
	1	1	48	32	3	0.20	-----
		2	32	16	16	1.00	-----
		3	16	4	35	2.92	-----
		4	4	0	35	8.75	89
	1 1/2	1	48	32	3	0.20	-----
		2	32	16	16	1.00	-----
		3	16	4	45	3.75	-----
		4	4	0	80	20.00	144
	2	1	48	32	3	0.20	-----
		2	32	16	16	1.00	-----
		3	16	4	60	5.00	-----
		4	4	0	110	27.50	189
	3	1	48	32	3	0.20	-----
		2	32	16	16	1.00	-----
		3	16	4	90	7.50	-----
		4	4	0	120	30.00	229
	4	1	48	32	3	0.20	-----
		2	32	16	16	1.00	-----
		3	16	4	120	10.00	-----
		4	4	0	130	32.50	269
	5	1	48	32	3	0.20	-----
		2	32	16	16	1.00	-----
		3	16	4	140	11.67	-----
		4	4	0	130	32.50	209
	6	1	48	32	3	0.20	-----
		2	32	16	16	1.00	-----
		3	16	4	160	13.33	-----
		4	4	0	130	32.50	309
7	1	48	32	3	0.20	-----	
	2	32	16	16	1.00	-----	
	3	16	4	170	14.17	-----	
	4	4	0	130	32.50	-----	
8	1	48	32	3	0.20	-----	
	2	32	16	16	1.00	-----	
	3	16	4	170	14.17	-----	
	4	4	0	130	32.50	-----	

DECOMPRESSION TABLE NO. 2

(Do not interpolate, use next higher value for conditions not computed)

Working chamber pressure p.s.i.g.	Working period hours	Decompression data					
		Stage No.	Pressure reduc. p.s.i.g.		Time in stage minutes	Pressure reduc. rate min/pound	Total time decompress minutes
			From	To			
50	1/2	1	50	34	3	0.20	-----
		2	34	18	16	1.00	-----
		3	18	4	14	1.00	-----
		4	4	0	25	6.25	58
	1	1	50	34	3	0.20	-----
		2	34	18	16	1.00	-----
		3	18	4	40	2.86	-----
		4	4	0	35	8.75	94
	1 1/2	1	50	34	3	0.20	-----
		2	34	18	16	1.00	-----
		3	18	4	55	3.93	-----
		4	4	0	90	22.50	164
	2	1	50	34	3	0.20	-----
		2	34	18	16	1.00	-----
		3	18	4	70	5.00	-----
		4	4	0	120	30.00	209
	3	1	50	34	3	0.20	-----
		2	34	18	16	1.00	-----
		3	18	4	100	7.15	-----
		4	4	0	130	32.50	249
	4	1	50	34	3	0.20	-----
		2	34	18	16	1.00	-----
		3	18	4	130	8.58	-----
		4	4	0	130	32.50	279
	5	1	50	34	3	0.20	-----
		2	34	18	16	1.00	-----
		3	18	4	160	11.42	-----
		4	4	0	130	32.50	309
6	1	50	34	3	0.20	-----	
	2	34	18	16	1.00	-----	
	3	18	4	180	12.85	-----	
	4	4	0	130	32.50	329	



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