CHAPTER 43. TUNNEL CONSTRUCTION AND COMPRESSED AIR WORK

Authority

The provisions of this chapter 43 issued under act of June 2, 1913 (P. L. 396, No. 267) (71 P. S. § 1442); and act of May 18, 1937 (P. L. 654, No. 174) (43 P. S. §§ 25-1—25-15), unless otherwise noted.

Cross References

This chapter cited in 34 Pa. Code § 11.85 (relating to applicable provisions of other regulations).

Subchapter A. TUNNEL CONSTRUCTION AND WORK IN COMPRESSED AIR

GENERAL PROVISIONS

TUNNEL CONSTRUCTION

WORK IN COMPRESSED AIR—GENERAL

WORK IN COMPRESSED AIR TUNNELS

WORK IN COMPRESSED AIR—CAISSONS AND OTHER PLACES

Source

The provisions of this Subchapter A adopted June 13, 1922, amended through July 15, 1964, unless otherwise noted.

GENERAL PROVISIONS

§ 43.1. Definitions.

The following words and terms, when used in this subchapter, have the following meanings, unless the context clearly indicates otherwise:

Blaster—Any person designated by the superintendent to supervise blasting operations who shall be charged with the responsibility of properly thawing explosives, preparing and fixing charges, firing and approaching misfires.

Bulkhead—A longitudinal or transverse partition separating the tunnel into sections or chambers.

Caisson—A wood, steel, concrete, or reinforced concrete air and watertight chamber in which it is possible for men to work to excavate material.

Carrying capacity—Carrying a capacity of a given wire as prescribed for various insulated wires in Chapter 39, Subchapter B (relating to electric safety).

Constructor—The person, firm, or body corporate in immediate control of the construction of any tunnel or its accessories, and as such responsible for the condition and management thereof.

Difference of potential—The difference of electrical potential, as determined by a voltmeter, existing between any two points of an electrical system or between any point of such a system and the earth.

Employe or *person employed*—Any person receiving compensation for labor or services performed on the works.

Explosive—Any compound or mixture containing any ingredients in such proportions, quantities, or packing that an ignition of any part of the compound or mixture may cause pressures capable of destroying life, limb or contiguous objects.

Flammable—aterial which readily ignites or burns.

Foreman—A person in charge of a subdivision of work or of the entire work and under the instructions of the superintendent.

Grounding—Connecting any part of an electrical system to the earth so that there is no material difference of potential between such part and the earth.

Guarded, encased, or *enclosed*—An object so covered, fenced or surrounded that contact at the point of danger is remote.

High voltage supply—The supply of electricity if the difference of potential between any two points of the circuit may at any time exceed 650 volts.

Lock—A chamber designed to facilitate the passage of men and materials from an air pressure greater than normal, as in a compartment, caisson or tunnel, to the ground or water level or normal air pressure. This term shall include the following:

(i) *Emergency lock*—A lock designed to hold and permit the quick passage of an entire shift.

(ii) *Man lock*—A lock through which only men pass.

(iii) *Medical lock*—A lock to which men suffering from compressed air diseases (bends) may be removed for medical attention.

Low voltage supply—The supply of electricity if the difference of potential between any two points of the circuit does not exceed 300 volts.

Magazine—Any building or other structure or place in which explosives are stored or kept, whether above or below ground.

Medium voltage supply—The supply of electricity if the difference of potential between any two points of the circuit may, at any time, exceed 300 volts, but which shall not exceed 650 volts.

Nuisance—Any horseplay or any offensive or obnoxious practice that endangers the lives, limbs, or health of persons employed.

Person—A firm or corporation as well as natural persons.

Potential or *voltage*—Electrical pressure.

Potential of a circuit—The potential normally existing between the conductors of such circuit or the terminals of such machines or apparatus.

Shaft—An excavation made from the surface of the ground, the longer axis of which is steeper than 45° with the horizontal.

Shafting—An air and watertight shaft built in the roof of the caisson and extended upward until above the normal water level.

Superintendent—The person resident on the work having general supervision and responsibility.

Tunnel—A subterranean passage or chamber.

Tunnel heading—The section of a tunnel where excavation work for driving the tunnel is being carried on.

Underground—Within the limits of any shaft or tunnel.

Underground station—Any place where electrical machinery is permanently installed in the tunnel.

Works—Any or all parts of a tunnel excavated or being excavated as well as shafts and approaches, powerhouses, lumberyards, storage yards and structures of all kinds in the immediate vicinity used in connection with the excavation

or the immediate disposal of excavated material or in connection with the construction of the tunnel lining.

§ 43.2. Scope; applicability.

This Subchapter sets forth rules to safeguard the lives and limbs of workers in tunnel construction and work in compressed air, and places the responsibility for compliance with such rules upon both employer and employe. Unless otherwise stated, the rules shall apply to all installations.

§ 43.3. Health recommendations for compressed air workers.

The following recommendations relating to health are for the guidance of compressed air workers:

(1) Never go on shift with an empty stomach.

(2) Be temperate and avoid all alcoholic liquors.

(3) Eat moderately.

(4) Sleep at least 7 hours a day.

(5) Keep your bowels regular.

(6) Take extra outer clothing into the tunnel when going on shift and wear it during decompression to avoid chilling during that period.

(7) To stimulate circulation, move limbs freely during decompression.

(8) Decompress slowly, for this means safety and freedom from compressed air illness.

(9) Drink hot coffee and take a warm shower bath and a brisk rubdown after each shift.

(10) Report at once to the physician in charge any compressed air illness; do not give men suffering from compressed air illness any intoxicating liquor.

(11) If taken sick away from plant, communicate at once with the physician in charge, whose name and telephone number shall be made available to all employes.

(12) Wear your identification badge at all times so that others will know what to do with you in an emergency.

(13) Stay about the works for at least 1/2 hour after locking out; however, 1 hour is more desirable.

(14) See that you are reexamined as required by the Board; regular employes shall be reexamined after a continuous employment of 2 months or after an absence of 10-consecutive days. Employes not previously employed in compressed air shall be reexamined after the first 1/2 day period.

(15) Do not work more than two periods in any 24 hours.

§ 43.4. Penalty.

Any person who violates any of the provisions of this subchapter or any regulations of the Department, or who interferes with the Department or its duly authorized representative in the enforcement of these provisions or regulations

shall, upon conviction, be penalized under section 15 of act of May 18, 1937 (No. 654, No. 174) (43 P. S. § 25-15).

TUNNEL CONSTRUCTION

§ 43.11. Safety requirements.

(a) *Safety precautions.* The constructor and superintendent of every tunnel shall use every reasonable precaution to insure the safety of all workmen.

(b) *Reporting defects, damage or accidents.* The following shall be promptly reported to the tunnel foreman or superintendent by the person observing them:

(1) All defects in or damage to machinery, timbering, apparatus, or other equipment.

(2) All unsafe or dangerous conditions.

(3) All accidents occurring in the course of tunneling operations, even though there is no personal injury. However, accidents of a purely minor character need not be reported.

(c) *Approval of apparatus.* Upon formal application to the Board, any apparatus, machinery, timbering and safeguards previously installed may be accepted by the Board.

(d) *Intoxicating liquors.* No person shall, while under the influence of intoxicating liquor, be permitted to enter any shaft or tunnel or any of the buildings connected with the operation of any shaft or tunnel nor shall intoxicating liquor be brought into these places. However, the carrying of alcoholic spirits or other stimulants into a shaft, tunnel or building for medical purposes, in accordance with the law, is not prohibited.

§ 43.12. Superintendents.

(a) The constructor of every tunnel shall appoint a superintendent who shall be personally in charge of the works and the performance of the work done. The owner or constructor may himself fill the office of superintendent.

(b) The duties of the superintendent shall include the following:

(1) Inspect, or cause some competent person or persons appointed by him to inspect, all appliances, boilers, engines, magazines, shafts, shaft houses, underground workings, roofs, pillars, timbers, explosives, bell ropes, speaking tubes, telephones, tracks, ladders, dry closets and all parts and appliances of the tunnel in actual use. Any person or persons appointed by the superintendent shall immediately report any defects or hazards to the superintendent.

(2) Take immediate steps to remedy any defects or hazards so as to comply with the provisions of this subchapter.

(3) Notify the constructor of the tunnel of any defects or hazards.

(4) Keep on file a record of all inspections made on each operation.

(5) Notify all foremen of any hazards or dangerous conditions before the foremen assume charge of the shift.

(6) Appoint a competent man to have full charge, under the direction of the superintendent, of every magazine containing explosives situated on the works.

(7) Perform such other duties as are provided for him in this subchapter.

§ 43.13. Hoisting engineer.

(a) *Appointment and qualifications.* Every superintendent of every tunnel having a hoisting engine shall appoint one or more persons as hoisting engineers. Hoisting engineers shall have the following qualifications:

(1) Be able to speak and read the English language readily.

(2) Be at least 18 years of age.

(3) Be familiar with the details and working of a hoisting engine.

(b) *Operation; exceptions.* Only the hoisting engineer shall run the engine or hoisting machinery, with the following exceptions:

(1) In cases of emergency.

(2) At such times and under such restrictions as the superintendent may deem necessary to protect life and limb, specified apprentices may be taught the operation of the hoisting engine.

(c) *Duties.* The hoisting engineer shall have the following duties:

(1) Keep a careful watch over his engine and over all machinery under his charge.

(2) Become familiar with and use the signal code posted in the engineroom.

(3) Run his engine unless it is properly provided with brakes and distance marks on hoisting ropes or cables.

(4) Exclude every person from his engineroom, except any person whose duties require his presence in the room.

(5) Hold no conversation with any one while his engine is in motion or while attending to signals.

(6) Hoist men out of, or lower men into, the tunnel or shaft at a speed not greater than the rate posted in the engineroom.

(7) Inspect all hoisting machinery and any connected safety appliances, and report immediately any defects.

(8) After any repairs, he shall run an unmanned bucket, skip, cage or other conveyance up and down the working part of the shaft at least once, and no person shall ride the bucket, skip, cage or other conveyance until the hoisting machinery and shaft are found to be in safe condition.

(9) Do no hoisting in any compartment of a shaft while repairs are being made in the compartment except such as may be necessary to make the repairs.

(10) Be in immediate charge of his engine and never delegate any of his duties to any other person, except to apprentices duly designated.

(11) Turn over the charge of the engine to his relief at change of shift or any other time only when the bucket, skip, cage or other conveyance is not in motion.

Source

The provisions of this § 43.13 amended June 10, 1977, 7 Pa.B. 1592. Immediately preceding text appears at serial page (9102).

§ 43.14. Hoisting procedure.

(a) *Speed.* The superintendent of the tunnel shall establish for each shaft rates of speed not to be exceeded in the hoisting and lowering of men. He shall post a notice of the rates of speed in a conspicuous place near each hoisting engine. The rates of speed shall not exceed the maximum approved by the Board. In hoisting or lowering men with a bucket, the speed, except in the case of apprehended danger, shall not exceed 100 feet per minute when the bucket is within 50 feet of the top or bottom of the shaft, or 500 feet per minute in any other part of the shaft.

(b) *Number of men.* Each superintendent of the tunnel shall determine the maximum number of men that may safely ride on each cage, skip, bucket or other conveyance used in the tunnel under his supervision, and shall post in a conspicuous place near each shaft a notice stating the maximum number of persons permitted to ride and forbidding the carrying of any greater number. The number of persons permitted to ride shall not exceed the maximum approved by the Board.

(c) *Traversing shafts.* No employe shall walk up or down any incline or shaft while any car, cage or bucket is above.

(d) *Signalmen.* There shall be two signalmen on duty, one at the top and one at the bottom of each shaft, whenever hoisting or lowering is being done. The signalmen shall be at least 21 years of age and shall be appointed and instructed in their duties by the superintendent. The signalmen shall prevent overloading of men on cages, skips, buckets, or other conveyances used in the shaft. Only signalmen shall give signals for starting or stopping such conveyances.

(e) *Riding with materials.* No person shall ride in any car, cage, skip or bucket that is loaded with tools, timber, powder, or other material except to handle such material while in transit and then only after a special signal has been given. When tools, timber or other material are lowered or hoisted in a shaft, means shall be taken to prevent their shifting while the hoist is in motion.

(f) *Overwinding.* Approved means to prevent overwinding shall be provided.

(g) *Signal for overtravel.* There shall be installed in every shaft where men are hoisted a device which shall indicate or give a warning signal in the engineroom whenever the cage, skip or bucket reaches a certain point below or above its limit of travel, such point to be determined by local conditions.

§ 43.15. Hoisting ropes.

(a) When the hoisting or lowering of men is done by any means other than human or animal power, the rope or cable used shall be composed of metal wires. The metal wires may be laid around a hemp center.

(b) All ropes shall have a factor of safety of at least eight. All cables shall have a factor of safety of at least five.

(c) No head or angle sheave of a diameter less than 40 times the diameter of the rope shall be used for hoisting or lowering men.

(d) Ropes or cables with any of the following characteristics shall not be used to hoist or lower men:

(1) If the number of breaks in any consecutive 10 feet of rope exceeds 10% of the total number of wires composing the rope.

(2) If the wires on the crown of the strands are worn down to less than 60% of their original area.

(3) If there are marked signs of corrosion.

(e) All ropes used for hoisting or lowering men shall be thoroughly inspected once a week by some competent person designated by the superintendent. Any rope or cable found to be below the requirements set forth in this subchapter shall not be used to hoist or lower men.

(f) Every rope used for hoisting or lowering men shall be securely fastened at both ends, and when in use shall never be fully unwound; at least two full turns shall remain always on the drum or reel. The end of the rope attached to the conveyance in the shaft shall be securely fastened within a tapered socket or shall be bound around on an oval thimble and then fastened to itself by the use of three or more approved clamps.

§ 43.16. Signals.

(a) Every shaft shall be provided with an efficient means of interchanging distinct and definite signals between the top of the shaft and the lowest level and the intermediate levels from which hoisting is being done. After sinking operations have been completed and before tunneling operations are begun from any shaft, there shall be provided and maintained two separate systems of signaling, which shall be either electrical, pneumatic, or mechanical, or one such system supplemented by a speaking tube or telephone.

(b) No person shall knowingly interfere with or impede a signal, or damage a signal system, or give cause for a wrong signal to be given.

(c) No signal shall be given to the hoisting engineer to raise or lower any car, cage, skip or bucket unless the signalman is at the same level occupied by that car, cage, skip or bucket.

(d) The following code of signals shall be used:

(1) One bell—Stop if in motion, or hoist if not in motion.

(2) Two bells—Lower.

(3) Three bells—Men on, run very carefully.

(e) Additional signals to meet local conditions may be used, if they are easily distinguishable and do not conflict with subsection (d). In shafts where there are intermediate levels, means shall be provided for preventing conflict of signals from the different levels.

(f) An easily legible copy of the requirement in subsection (d) and of any special code adopted in any shaft or tunnel, shall be secureley posted in the engineroom, at the collar of the shaft, and at each level or station. Each copy shall be printed in letters at least 1/2 inch high, on a board or metal plate at least 18 inches by 18 inches.

§ 43.17. Hoisting cages.

(a) In all shafts where men are hoisted or lowered, an iron-bonneted cage shall be used, but this shall not apply to shafts in the process of sinking or during the dismantling of the shaft after work in the tunnel is substantially completed.

(b) Cages shall be provided with bonnets consisting of two steel plates at least 3/16 of an inch in thickness, sloping toward each side and so arranged that they may be readily pushed upward to afford egress to persons inside. The bonnet shall cover the top of the cage so as to protect persons on the cage from falling objects.

(c) Cages shall be entirely enclosed on two sides with solid partitions of wire mesh not less than No. 8 U.S. standard gauge, no opening in which shall exceed two inches.

(d) Cages shall be provided with hanging chains or other similar devices for handholds.

(e) Every cage shall be provided with an approved safety catch of sufficient strength to hold the cage, with its maximum load, at any point in the shaft.

(f) A safety device shall be provided for blocking cars while on cage.

(g) All parts of the hoisting apparatus, cables, brakes, guides, and fastenings shall be of the most substantial design and shall be arranged for convenient inspection. The efficiency of all safety devices shall be established by satisfactory tests before the cages are put into service. The devices shall be similarly tested at least once every 3 months, and a record of the tests shall be kept.

(h) The test of the safety catch shall consist of releasing the cage suddenly in such manner that the safety catches shall have opportunity to grip the guides. The test shall be made with the cage loaded to capacity.

(i) In all vertical shafts in which hoisting is done by a bucket, suitable guides shall be provided when the depth exceeds ten times the diameter or width of the shaft. In no case shall the maximum depth without guides exceed 150 feet. In connection with the bucket, there shall be a crosshead traveling between these guides. The height of the crosshead shall be at least 2/3 of its width, but in no case less than 30 inches, unless otherwise authorized by the Board.

§ 43.18. Stairways and ladders.

(a) In each shaft, except during the period of sinking, there shall be a covered stairway at least 2 1/2 feet wide leading from the bottom of the shaft to the surface. However, in case it is not practicable to construct a stairway, a ladder shall be installed with landings at every 20 feet of sufficient width to permit men

to pass. Stairways and ladders shall be kept clear and in good condition at all times. The distance between the centers of the rungs of a ladder shall be 12 inches. Any ladder having a variation in its step or rung spacing of 1/2 inch or more shall be rebuilt to meet the requirements of this chapter. The length of the ladder rungs, that is, the width of the ladder on the inside of the stringers, shall be at least 12 inches. The rungs of a ladder shall be at least 6 1/2 inches from the wall or other obstruction in the shaft or opening in which the ladder shall be used. Under no circumstances shall any ladder inclining backward from the vertical be installed.

(b) At all landings where it is necessary to cross from one side of the shaft to the other, passageways shall be provided and shall be kept free from all obstructions and properly lighted.

(c) Ladderways and stairways in daily use shall be kept clean.

§ 43.19. Shaft protection.

(a) During shaft sinking operations the tops of all shafts shall be guarded by a standard rail and standard toeboard. The rail and toeboard may be provided with the necessary gates to give access to the shaft, but the gates shall be closed when access to the shaft is not necessary.

(b) If there is danger to persons from material falling into the shaft during shaft sinking operations, shaft doors opening outward or upward shall be installed to prevent any material from falling into the shaft. The doors shall be closed except when opened to permit the passage of a bucket, skip, material or men.

(c) When cages are installed in shafts, automatic gates shall be used at the top landings. All landings shall be provided with a fence and gate, the members of which shall be no more than 4 inches apart and no more than 5 feet high. The gates at such landings shall not be more than 12 inches from the openings, and shall be kept closed at all times except when cages are being loaded or unloaded.

(d) Means for blocking cars shall be provided at all landings.

§ 43.20. Mechanical haulage.

(a) *Locomotives; speed.* Cars shall not be moved except by a locomotive, unless under direct control of an operator. No cars shall be pushed ahead of the locomotive underground if it is practicable to draw, and all locomotives shall be provided with headlights and gongs. In cases when it is necessary to push cars ahead of the locomotive a man shall be stationed on the head end of the train for the purpose of giving warning when the train approaches. Trolley poles shall be trailed wherever it is possible to do so. No locomotive shall be driven by a person under 21 years of age. No gas locomotive shall be used in any tunnel without the written consent of the Department. Approved means shall be provided to prevent runaway of standing cars. When mechanical haulage is used through passageways and approaches to working places, the speed regulations of the Board shall be observed.

(b) *Footpath.* If workmen need to traverse passageways used for mechanical haulage, a footpath along one side of the track shall be provided. The footpath shall be at least 3 feet wide in the clear of all moving cars and locomotives.

§ 43.21. Timbering; sumps.

(a) When necessary, every shaft or tunnel, and any working place in the shaft or tunnel, shall be adequately and securely timbered to prevent injury to any person from falling material. The timbering shall include wood, steel, or concrete.

(b) All sumps shall be securely covered or fenced, except when being cleaned or repaired.

§ 43.22. Storage of explosives.

(a) *Permits.* The constructor shall not store any explosive in any section of this Commonwealth under the jurisidiction of the Department until he obtains a permit from the Department. The permit will be granted upon the sworn application in writing, stating the place or building in which the applicant desires to store explosives, and after the place or building has been inspected by a representative of the Department.

(b) *Posting.* The constructor shall place a copy of the permit on some conspicuous part of the building or premises in which explosives are stored.

(c) *Specifications.* The permit shall specify what explosives may be stored, and the amount of each explosive which the constructor may store in any one place at any one time.

(d) *Expiration.* Each permit shall expire on the first of January of each year.

(e) *Storage.* No explosive shall be stored in any frame or wooden building or in any building within 300 feet of a schoolhouse, church, hospital, theatre or hall licensed for public assemblies or any public building.

(f) *Matches.* No matches, smoking or intoxicated person shall be allowed upon any premises in which explosives are stored.

§ 43.23. Transportation of explosives.

The following provisions shall apply to the transportation of explosives in the streets, avenues, roads or highways of that portion of this Commonwealth under the jurisdiction of the Department:

(1) All packages containing explosives during transportation shall be kept clean.

(2) Layers of blasting cartridges in packages shall be separated by sawdust or other suitable inexplosive absorbent.

(3) No iron or steel shall be used in the construction of any package, unless covered with zinc, tin or similar material.

(4) Each package, except smokeless powder, shall be marked by means of a brand or stencil or a securely attached label, with the words ''Explosive—Dangerous,'' followed by the specific name of the explosive, the name and

(242268) No. 282 May 98

address of both the manufacturer and the forwarder, and a brief statement showing the weight of the package, the percentage of absorbent and the date of manufacture.

(5) Explosives shall not be transported in the streets, avenues, roads or highways, from sunrise to sunset.

(6) No matches, smoking or intoxicated person shall be allowed upon any vehicle engaged in the transportation of high explosives, nor shall any unauthorized person be present during the loading or unloading of the vehicle.

(7) No stops except unavoidable stops shall be made during the journey.

§ 43.24. Conveying of explosives.

(a) *Handling.* Only experienced men who have been selected and regularly designated by the superintendent in charge and whose names have been posted in the field office or at the magazine shall handle, transport or prepare for use dynamite or other high explosives.

(b) *Quantity; detonators.* No greater quantity of explosives than that which is required for immediate use shall be taken into the shaft or tunnel, except for storage in an approved underground magazine. Explosives, when not in the original box, shall be conveyed in a suitable covered wooden box painted red. Detonators shall be conveyed in a separate wooden box painted red with one inch yellow stripe running horizontally entirely around the box. During transportation, explosives and detonators shall be kept at least 25 feet apart, unless transported in separate cars, in which case the distance between the explosives and detonators shall be at least six feet. Explosives and detonators shall not be taken down the shaft on the same cage at the same time. After blasting is completed all explosives and detonators shall be returned at once to the magazine, observing the same rules as when bringing them to the work. Between firing rounds, the explosives and detonators shall be deposited separately on wooden platforms at least 25 feet apart and at least 600 feet from the heading, on the side of the chamber opposite the electric light and power line, under the supervision of a competent man, or in the case of shafts, at least 50 feet from the outside of the opening.

(c) *Tools.* No tools or other articles shall be carried with the explosives or with the detonators.

§ 43.25. Loading of explosives.

(a) Detonators shall be inserted in the explosives only as required for each round of blasting. Detonators shall not be inserted in the explosives without first making a hole in the cartridge with a sharpened stick. No holes shall be loaded except those to be fired at the next round of blasting. All explosives remaining after loading a round shall be removed from the heading before any wires are connected.

(b) If electric devices, such as electric blasting caps, are used, the legs of these devices shall be short-circuited by twisting the naked ends together before taking them into the tunnel. They shall remain twisted until ready to be connected to the firing line.

(c) All lights used when loading shall be an enclosed type. If electric flash lamps are used, they shall be so constructed that it is not possible to obtain a difference of potential between any two points on the outside of the lamp casing.

(d) No naked light shall be used in the vicinity of open chests or magazines containing explosives, or near where a charge is being primed.

(e) Fuses may be kept with detonators. All crimping of caps on fuse shall be done with a crimper at least 25 feet away from explosives.

(f) All drill holes shall be of sufficient bore to permit the free insertion of a cartridge of explosive to the bottom of the hole without the necessity of undue ramming or removing the dynamite from its original wrapper.

§ 43.26. Blasting.

(a) There shall be one blaster in charge of blasting in each section.

(b) No one who has not received a permit from the Department shall be employed as a blaster anywhere within the jurisdiction of the Department.

(c) The explosives used shall be such as to cause the least amount of injurious gases.

(d) No blaster shall attempt to use any frozen dynamite. No quantity greater than is sufficient for daily use shall be artificially thawed at one time. Only approved methods of thawing shall be permitted.

(e) Except in cases of instantaneous blasting by electricity, a blaster shall count the number of shots exploding when he fires a round of holes. If there are any misfires, he shall remain until the misfires have been exploded or holes made safe.

(f) If a fuse is used, misfires shall not be approached, even for purposes of inspection, until three hours have elapsed. If electric blasting caps are used, misfires shall not be approached, even for purposes of inspection, until 15 minutes have elapsed.

(g) Whenever feasible, a charge that has failed to explode shall be exploded by inserting a new primer in the hold on the old charge and detonating the primer.

(h) The blaster shall use only hardwood rods for tamping. He shall not tamp or load any hole with a metal bar, nor shall the wooden rod have any metal parts.

(i) Firing shall be done by safety fuse or approved battery or from an electric current of not over 250 volts, if an approved switch is used. Other methods of firing may be permitted upon approval by the Department.

(j) When firing by electricity from power or lighting wires in any tunnel, an approved switch shall be furnished with the lever down when in the ''off'' position. The switch shall be fixed in a locked box, to which no person shall have access except the blaster. There shall be flexible leads of connecting wires at least

five feet in length with one end attached to the incoming lines and the other end provided with plugs that may be connected to the switch on the inside shot-firing circuit when firing and that shall at all times be connected to an effective ground. After blasting, the switch lever shall be pulled out, the wires disconnected and the box locked before any person shall be allowed to return, and shall remain locked until again ready to blast. Blasting wires shall be laid on the opposite side of the tunnel from the lighting and power wires.

(k) Before the loading of holes, all powerlines and electric light wires shall be disconnected at a point outside the blasting switch. After explosives are taken in, preparatory to blasting, no current by grounding of power or bonded rails shall be allowed beyond the blasting switch. Under no circumstances shall ground current be used for exploding blasts.

(l) The blaster shall cause a sufficient warning to be sounded and shall be responsible to see that all persons retreat to safe shelter before he sets off the blast, and shall also see that no one returns until he reports it safe. He shall report to the tunnel foreman and furnish names of all persons refusing to obey his caution.

(m) No person shall be allowed to deepen holes that have previously contained explosives.

(n) All wires in broken rock shall be carefully traced and a search made for unexploded cartridges.

(o) Whenever blasting is done at points liable to break through to where other men are at work, the foreman or person in charge shall, before any holes are loaded, give warning of danger to all persons working where the blasts may break through, and he shall not allow any holes to be charged until warning is acknowledged and the men are removed.

(p) When testing circuits through charged holes, blasters shall use sufficient leading wires to be at a safe distance and shall use only approved types of galvanometers. No tests of circuits in charged holes shall be made until men are removed to a safe distance.

(q) No blasts shall be fired with fuse in vertical or steep shafts.

(r) In shaft sinking where the electric current is used for firing, a separate switch not controlling any electric lights shall be used for blasting. Proper safeguards similar to those in tunnels shall be followed in order to insure against premature firing.

§ 43.27. Loose rock.

(a) The superintendent of the tunnel shall order a competent person to make a daily inspection of the roof. All loose pieces of rock shall be removed from the roof and sides of the excavation.

(b) After a blast is fired, loosened pieces of rock shall be scaled from the roof and sides of the excavation. After the blasting is completed, the entire locality

shall be thoroughly scaled and all loose rock or ground shall be removed and the excavation made safe before proceeding with the work.

§ 43.28. Lighting.

(a) While work is in progress, tunnels, stairways, ladderways, and all places on the surface where work is being conducted, shall be properly lighted. In shafts more than 100 feet deep the shaft below that point shall be lighted.

(b) All machinery in the area where persons are likely to be working or moving about shall be lighted so that the moving parts of the machinery are clearly distinguished.

(c) The exterior of the sockets of all fixed incandescent lamps, installed after June 13, 1922, shall be entirely nonmetallic.

(d) Lamp cord, when used for temporary lighting connections, shall have extra heavy insulation. Single portable lights shall be protected by a wire cage large enough to enclose both lamp and socket, and shall be provided with a handle to which the light and socket shall be firmly attached and through which the leading-in wires shall be carried.

(e) Incandescent lamps shall be placed so that they do not come in contact with combustible material, and so that an adequate circulation of air may take place on all sides of them.

(f) In all underground stations where a failure of electric light is likely to cause danger, lamps or other proper lights shall be kept ready for use.

§ 43.29. Means of communication.

When tunnels are driven from shafts more than 250 feet deep, a telephone system shall be maintained which communicates with the surface at each shaft. The system shall include a station or stations readily and quickly accessible to the men at the working level.

§ 43.30. Electrical equipment.

(a) *Installation.* No person shall, without authority, install or handle electric wires, lights, conductors or electrical apparatus of any kind, or enter an electrical machine room or underground station.

(b) *Instructions.* No person shall be allowed to work with electrically driven apparatus, unless he is previously instructed by a competent person and duly authorized by the tunnel superintendent or tunnel foreman.

(c) *Shock.* Instructions for the disengaging of persons from contact with live wires and the resuscitation of persons suffering from electric shock shall be posted at the entrance to the tunnel, in every generating station and substation, and in all underground electric stations. All employes working with electrical apparatus shall be required by the tunnel superintendent to familiarize themselves with the instructions of this section.

(d) *Grounding.* The frames and bed plates of generators, transformers, compensators, rheostats and motors installed underground shall be effectively grounded. All metallic coverings, armoring of cables (other than trailing cables), and the neutral wire of three-wire systems shall be grounded.

(e) *Underground voltage.* When electrical systems are installed, no higher voltage than low voltage shall be used underground, except for transmission or for application to transformers, motors, generators or other apparatus in which the whole of the medium or high voltage apparatus is stationary.

(f) *Switchboard construction.* Switchboards shall consist of a substantial framework of iron pipes, angle irons or bar iron, on which shall be mounted a panel or panels of incombustible nonabsorbent material that is mechanically strong and has insulating qualities suitable for the voltage at which it is used.

(g) *Switchboard panels.* The panels of insulating material may be omitted, if each piece of equipment carried on the switchboard is provided with an individual base of insulating material of the character specified for the panels. The material shall be of adequate dimensions, or have its current-carrying parts mounted on similar insulating self-contained in the equipment, which shall be especially designed for mounting on iron, pipe, angle iron or bar iron frameworks.

(h) *Danger signals.* All medium and high voltage machines and apparatus shall be conspicuously marked with the word ''danger'' and shall be properly illuminated when in circuit.

§ 43.31. Underground stations and transformer rooms.

(a) *Mounting.* All switches, circuit breakers, rheostats, fuses and measuring instruments used in connection with underground motor generators, rotary converters, transformers, and motors shall be mounted on standard bases of noncombustible and insulating material, but in no case shall primary instruments be used in circuits of more than 300 volts. This requirement shall not apply to compensators for induction motors. The switches, circuit breakers, rheostats, fuses and instruments may be mounted on a common base, if the base is of noncombustible, insulating material.

(b) *Passageways.* A passageway at least 3 feet in width shall be maintained in front of all switchboards. No one shall be permitted in back of the switchboards while the current is on.

(c) *Switchboards.* Any space over 30 inches wide at the back of switchboards shall be accessible from each end and shall be kept locked up in case of medium and high voltage boards, but no lock shall be used that will not permit the door to be opened from the inside without the use of a key. In no case shall this space be used as a change room, wardrobe, or for the storage of material. Only noncombustible flooring shall be used at the front and back of high voltage boards, and insulating mats or their equivalent shall be provided in front and back of all boards, whatever the voltage.

(d) *Conductors.* No electric conductor shall cross a passageway at the back of a switchboard except below the floor or at a height of not less than seven feet above the level of the floor, unless properly guarded.

(e) *Live metal work.* No live metal work shall be placed on the front of a high voltage switchboard within 7 feet of the floor, unless properly guarded.

(f) *Terminals.* All exposed terminals on underground machines shall be protected with properly designed insulating covers of suitable materials or with metal covers connected to ground.

(g) *Transformer rooms.* Transformer rooms shall be properly lighted and of fireproof construction, and, if of conductive material, shall be effectively grounded.

(h) *Circuits.* Circuits leaving the transformers shall be protected by a switch and an automatic circuit breaker to interrupt current, but fuses may be substituted for the circuit breakers. Primary fuses and disconnecting switches shall be placed in the primary circuit ahead of the transformers.

§ 43.32. Cables and wires.

(a) All high voltage wires installed underground shall be in the form of insulated lead-covered cables, which shall be armored or effectively protected against abrasion. The armor shall be electrically continuous throughout and shall be effectively grounded. The installation of efficiently insulated wires in metal conduit to transmit power underground shall be sufficient to meet this requirement.

(b) All underground cables and wires, unless provided with grounded metallic covering, shall be supported by efficient insulators. The conductors connecting lamps to the power supply shall in all cases be insulated.

(c) Cables and wires not provided with metallic coverings shall not be fixed to walls or timbers by means of uninsulated fastenings.

(d) Overhead transmission lines between the generating station or substations and the tunnel entrance shall be supported upon insulators, which shall be adequate in quality, size, and design for the voltage transmitted. If the line is more than 500 feet in length, lightning arresters shall be installed. The line, except in the case of trolley wires, shall be maintained at least 10 feet above the ground at the lowest point, except at the point of entrance to the tunnel.

(e) Buried cables shall be continuously insulated and protected by a metallic sheath, preferably lead. If they are so located that there is a possibility of danger to the sheath by puncturing, the cables shall be further protected by armor.

(f) When the exposed ends of cables enter any fittings, they shall be so protected and finished off that moisture cannot enter the cable or the insulating material leak out, if of an oily or viscous nature.

(g) When unarmored cables or wires pass through metal frames or into boxes or motor casings, the holes shall be substantially lined with insulated bushings.

§ 43.33. Electrical circuits.

(a) Any completely insulated feeder circuit in excess of 24-kilowatt-capacity leading underground, if the potential does not exceed the limits of a medium voltage potential, shall be provided above ground with a switch and an automatic overload circuit breaker. In the case of ground return direct current circuits, a switch and circuit breaker shall be installed in the underground side of the circuit but may be omitted from the return side. Fuses may be substituted for circuit breakers in circuits.

(b) Any high voltage alternating current feeder circuit leading underground shall be provided above ground with an oil break switch on each phase and every switch shall be equipped with an automatic overload trip.

(c) Any branch shall be provided with a switch of ample carrying capacity on each phase within 50 feet of the point where it leaves the main circuit.

(d) Wires for all lighting circuits shall be covered with an insulation adequate for the voltage of the circuit. Unless encased in pipes or other metallic covering, wires shall be strung on porcelain or glass insulators. Separate encased wires shall be kept at least three inches apart except where they enter the fittings. Metallic casings, if used, shall be efficiently grounded.

§ 43.34. Trolley wires.

(a) Trolley wires shall be installed as far on one side of the tunnel as is practicable and shall be securely supported and the supports insulated.

(b) Suitable protection shall be provided at all places where men are required to work or pass under trolley or other bare power wires which are placed less than eight feet above top of rail. This may consist of channeling the roof or of placing boards along the wire, which shall extend at least three inches below it, or in the use of any other device that will afford ample protection. At all points where timbers or tools have to be unloaded or transferred up a raise, the trolley wires shall be boxed or otherwise protected as provided for in this section. All places where it is required that the trolley wires shall be boxed, shall be well lighted with electric lamps.

§ 43.35. Power wires and cables.

(a) In all shafts where the angle of inclination is above 45° from the horizontal, and in all hoisting shafts or manway compartments, all power wires and cables shall be amply protected by insulation and substantially fixed in position. All shaft cable shall be supported on insulators that do not cause abrasion of the covering or insulation, and shall be spaced so that no part of the cable is under a tension greater than 1/4 its ultimate strength. The cable shall be held in position at points between the insulators by grips or cleats that do not cause abrasion of the covering or insulation. If the cables are not completely boxed in and protected from falling material, space shall be left between them and the side of the shaft

so that they may yield and lessen a blow from falling material. This requirement shall not be construed to prevent the installation of efficiently insulated wires in metal conduit, to transmit power underground.

(b) If it is not possible to keep the cables or feed wires in tunnels at least 12 inches from any part of the tunnel, car or locomotive, they shall be specially protected by proper guards.

§ 43.36. Joints in cables and conductors.

(a) All joints in conductors shall be mechanically and electrically efficient and shall be soldered when necessary. All joints in insulated wire shall, after the joint is complete, be reinsulated to the same extent as the remainder of the wire.

(b) Where cables are joined, suitable junction boxes shall be used or the joints shall be soldered and the insulation, armoring, or lead covering replaced in as good condition as it was originally.

§ 43.37. Fuses, circuit breakers, switches, and motors.

(a) Fuses and automatic circuit breakers shall be constructed so as to effectually interrupt the current when a short circuit occurs or when the current through them exceeds a predetermined value. No open type or link fuses shall be kept.

(b) All points at which a circuit has to be made or broken shall be provided with suitable switches, which shall be installed so that they cannot be closed by gravity.

(c) Fuses shall be stamped or marked, or shall have a label attached indicating the maximum current that they are intended to carry. Fuses shall be adjusted or replaced only by an authorized and competent person.

(d) The capacity of fuses used to protect feeders shall not exceed the current capacity of the feeder by more than 25%.

(e) All circuit breakers and fuses shall have noncombustible bases and shall be properly enclosed.

(f) All switches used for medium and high voltage shall have noncombustible bases and shall be of approved safety types.

(g) Every motor and its starting device shall be protected by a fuse in each phase or in the case of motors of more than 40 horsepower, by a circuit breaking device on at least one phase of direct current motors and on each phase of alternating current motors and by switches arranged to cut off entirely the power from the motor. These devices shall be installed in a convenient position near the motor and in sight of it.

§ 43.38. Fire protection.

(a) In timbered tunnels, if there is any danger of fire, all reasonable precaution against fire shall be taken and adequate fire protection shall be provided in such a manner as may be approved by the Department.

(b) Headframes built of combustible material shall be open framework. At or above the surface landing there may be a headhouse, if built of fire-resisting material.

(c) It shall be the duty of the constructor of every tunnel in which oils and other dangerous flammable materials are used, to store the materials, or cause them to be stored, in a covered building kept solely for this storage. The building shall be at least 100 feet from any shaft, tunnel, or approaches, or any building directly connected with a tunnel opening, and at least 300 feet from any powder magazine except that gasoline, naphtha, distillate and fuel oils may be stored in tanks buried in the ground. The tanks shall be provided with proper vents and shall be at least 50 feet from any shaft, tunnel or approaches, or any building directly connected with a tunnel opening, and at least 300 feet from any powder magazine. Lubricating oils may be stored in a well-constructed covered building, which shall be at least 50 feet from any shaft, tunnel or approaches, or any building directly connected with a tunnel opening. No tank shall be installed from which fuel oil is to be conducted by gravity to the point of combustion, unless such tank is located so that escaping oil cannot run over the surface from the tank to any building within 100 feet of any tunnel opening.

(d) The person in charge of the building or tanks referred to in subsection (c) shall be the superintendent or a person expressly designated by him. He shall permit only sufficient oil or other flammable material to be taken from the building or tanks to meet the requirements of subsection (e). If any oil or gasoline storage is situated so that leakage would permit the oil or gasoline to flow within the distances specified in subsection (c), means to prevent the flow shall be provided.

(e) Oil for illumination or power shall not be taken into or kept in the underground workings of any tunnel in quantities greater than necessary to afford one day's supply.

(f) The storage of gasoline, naphtha and other distillates underground is prohibited. However, a supply sufficient for one day's operation of blow torches, fuel burning engines or locomotives may be kept in the tanks attached to the equipment.

(g) Waste or decayed timber shall not be stored in the tunnel, but shall be promptly removed. Empty boxes, wooden chips, paper and combustible rubbish of all kinds shall not be allowed to accumulate underground.

(h) Smoking or the use of unprotected lights shall be prohibited any place where there is danger of igniting explosives, oils, fumes, dust, gases or other combustible material. Notices shall be posted to this effect.

(i) Any person using a candle or other portable light in any part of a shaft or tunnel shall extinguish it before departing from the shaft or tunnel, and bring it to the outer air.

(j) Buckets filled with clean, dry sand, ready for immediate use in extinguishing fires, shall be kept in all underground electrical stations. An approved fire extinguisher may be kept instead of the sand.

§ 43.39. Sanitation.

(a) It shall be the duty of the constructor of every tunnel, for the purpose of improving sanitation and preserving the health of those employed, to provide dry closets, water closets, chemical closets, or closet cars upon all main working levels for the use of all men employed in the tunnel. At least one closet shall be provided for every 40 men employed within the tunnel. Ready means of access to each closet shall be provided by the constructor. No closet shall be constructed without adequate provision for its effective cleaning. The contents of the closet shall be removed and disposed of at least twice a week. The tunnel foreman shall cause each dry closet to be supplied with some disinfectant or deodorizer to be sprinkled upon its contents. All men employed within the tunnel where such closets are provided shall use the closets exclusively when in the tunnel. This requirement shall not apply to any tunnel where the constructor or superintendent prefers to permit the men to go to the surface and requires the men to do so.

(b) Every stable or other place underground used for the housing of mules, horses or other animals, shall be kept thoroughly clean and the waste contents removed to the surface.

(c) The constructor of every tunnel shall provide a sufficient quantity of good drinking water for the use of all men employed in the tunnel. A supply shall be provided on each main working level. The superintendent shall insure that the drinking water is adequately protected from contamination.

(d) The constructor of every tunnel employing more than 25 men underground shall provide a wash and change house. It shall be adequately heated and lighted and shall contain a sufficient supply of running water, hot and cold showers, washbowls and lockers.

§ 43.40. Ventilation.

The constructor of every shaft or tunnel shall provide and maintain a ventilating system with a capacity of at least 75 cubic feet per man per minute or, if horses and mules are used, at least 175 cubic feet per horse or mule per minute. The ventilating system, immediately after blasting has occurred, shall be capable of removing 4,000 cubic feet per minute and entirely removing the contaminated air in 15 minutes.

§ 43.41. First aid.

(a) *Materials.* The constructor, superintendent, or other person in charge of any tunnel shall keep at places and in numbers so the Department may designate, stretchers, woolen blankets, and waterproof blankets in good condition, for use in carrying out any person who may be injured on the works. On all tunnel works

(242278) No. 282 May 98

an adequate supply of material shall be kept readily accessible for the treatment of any one injured and shall include the following:

(1) First aid outfits consisting of extra long gauze bandages with compress served in the center, triangular bandages with methods of application attached and safety pins.

(2) Large first aid dressings for wounds, assorted bandages, tourniquet and boric acid ointment.

(3) Packages of sterilized gauze, picric acid gauze and absorbent cotton.

(4) Wooden or wire gauge splints.

(5) Scissors and forceps, aromatic spirits of ammonia, peroxide and paper cups.

(6) First aid book of instructions.

(b) *Corps.* On all tunnels where work is in progress a first aid corps shall be maintained. It shall consist of a foreman, shift bosses, timekeepers or other employes designated by the superintendent. The constructor or superintendent of the tunnel shall organize the first aid corps so that at least one member is on the works through each shift. The constructor or superintendent of the tunnel shall procure the services of a competent person to instruct the members of the first aid corps from time to time, but not less than once in every 3 months, in the proper handling and treatment of injured persons before the arrival of a physician.

§ 43.42. Special protective requirements.

(a) All persons employed in tunneling operations shall be provided with and shall wear an approved type of protective hat or cap for protection against falling objects.

(b) Approved types of goggles shall be provided and shall be worn by all persons exposed to the hazard of eye injury from drilling, sledging, chipping, riveting or similar operations and from radiant energy from welding or cutting operations.

(c) The Department may require the use of safety shoes, respirators, gloves or other personal protection devices when necessary to protect employes from health and accident hazards.

§ 43.43. Special protection against dust.

(a) *Special definitions.* The following words and terms, when used in this section, have the following meanings, unless the context clearly indicates otherwise:

(1) *Rock drilling*—Drilling, cutting, chipping, channeling, broaching or crushing by means of machinery or hand hammers.

(2) *Silica-bearing rock*—Any rock formation, natural or synthetic, containing as a component part, free silicon dioxide. This shall include the following classes:

(i) *Class I*—Any rock formation of substantially uniform geological character having free silicon dioxide as a component part which is known from geological studies or otherwise may be shown by the applicant to the satisfaction of the Department to run uniformly less than 10% by weight, of the rock formation.

(ii) *Class II*—All rock formations having free silicon dioxide as a componenet part, 10% or more by weight, and all other formation, natural and synthetic, having a variable and unpredictable content of free silicon dioxide of more than 10%.

(3) *Injurious silica dust concentration*—Dust particles less than ten microns in size produced from drilling silica-bearing rock which is in excess of the following values as determined by an approved dust count method:

(i) *Class I*—100 million particles per cubic foot of air.

(ii) *Class II*—Ten million particles per cubic foot of air.

(b) *Drilling.* All drilling in silica-bearing rock shall be so executed that there is no dissemination of injurious silica dust concentrations in the breathing zone of the worker.

(c) *Ventilation.* In order that the dust concentration shall be kept within specifications, only wet drilling or local collection employing suction or exhaust, with the necessary ventilation is permitted. Ventilation shall consist of general ventilation, exhaust systems or a combination of the two to produce the desired results.

(d) *Vision.* During any and all excavations and construction operations in the tunnel, the atmospheric conditions at the point of the operations shall be maintained so that there is clear vision at all times in order that work may be conducted safely.

§ 43.44. Special protection against gases.

(a) *Amounts.* Each case containing explosives for underground use shall be clearly marked in 1/4 inch or larger type with the designation ''fume class 1,'' ''fume class 2'' or ''fume class 3,'' to indicate the amount of poisonous gases produced. The amount of poisonous gases produced shall be the total volume of carbon monoxide plus hydrogen sulphide emitted in the Bichel gauge by a 1 1/4 by 8 inch cartridge of the explosive as determined by tests according to the standard procedure of the United States Bureau of Mines. The standard procedure is recorded on pages 91 to 94 of the United States Bureau of Mines Bulletin 346 entitled ''Physical Testing of Explosives.'' The gases emitted shall not contain more oxygen than is sufficient to burn the combustible gases to their maximum oxidizable state. The amount of poisonous gases produced per 1 1/4 by 8 inch cartridge shall be less than 0.16 cubic feet for fume class 1, from 0.16 to 0.33 cubic feet for fume class 2, and from 0.33 to 0.67 cubic feet for fume class 3. Explosives in cartridges smaller than 1 1/4 by eight inches shall comply with the limits specified for the fume class of the 1 1/4 by 8 inch cartridge of that explosive.

(242280) No. 282 May 98

(b) *Classes.* No explosive other than those in fume class 1 shall be used underground in any operation, except that if conditions in any operation warrant, the Department may, at its discretion, grant permission for use of explosives in fume class 2, or fume class 3 when proper application has been made by an operator.

(c) *Oxygen.* No explosive shall be used underground in any operation if the gases emitted in the Bichel gauge, in tests, according to the standard procedure of the United States Bureau of Mines, contain more oxygen than is sufficient to burn the combustible gases to their maximum oxidizable state. The standard procedure is recorded on pages 91 to 94 of the United States Bureau of Mines Bulletin 346 entitled ''Physical Testing of Explosives.''

(d) *Packing.* No explosive which is packed in cartridges of less than one inch diameter shall be used underground in any operation.

(e) *Wrapper.* No explosive shall be used underground with its wrapper removed and no additional paper shall be wrapped around the explosive charge.

(f) *Deterioration.* No explosive which has obviously deteriorated due to improper storage, or to any other cause, shall be used underground in any operation.

(g) *Permissible explosives.* Permissible explosives used in underground operations having inflammable gas shall conform to all requirements of the United States Bureau of Mines as to permissibility and are therefore excluded from the requirements of subsections (a) and (b). Periodic tests shall be made for methane or other explosive gases.

(h) *Blasts.* No person shall enter a hazardous area created by a blast involving 25 pounds or more of explosives in any underground operation until at least 15 minutes have elapsed after the blast.

(i) *Ventilation.* The following requirements for ventilation shall be complied with:

(1) No person shall enter or remain in a section containing gases produced by a blast in any underground operation unless the ventilation meets the requirements of this subsection.

(2) Ventilation shall be maintained so that in the breathing zone of the section the concentration of carbon monoxide, as determined by an approved carbon monoxide detector, does not exceed .030% by volume at the time of entrance into the section, and does not exceed .015% at the end of 1 hour after entrance, and .010% at the end of 2 or more hours.

(3) This requirement is not intended to prevent entering into, passing through or remaining in localized sections for a period not exceeding 5 minutes in concentrations of carbon monoxide of .060% to .100% or for a period not exceeding 15 minutes in concentrations of carbon monoxide of .030% to .060%.

(4) When the concentration of carbon monoxide and the conditions of exposure to the gas in a section exceed the limitations stated in this subsection,

adequate respiratory protection shall be provided for and shall be used by any person entering the section. A contractor or operator shall designate a capable inspector who shall have the following duties:

(i) Make the tests and examinations as are necessary to establish conditions with respect to ventilation and poisonous gas concentrations in sections containing the gases.

(ii) Direct and control the entrance into and periods of exposure of all persons within these sections.

(iii) Keep a dated record of all tests and examinations. The record shall be available for examination by inspectors of the Department at all times.

(j) *Fresh air.* The minimum amount of fresh air introduced into the shaft or tunnel heading of any construction project shall be the larger of the two following alternatives:

(1) 100 cubic feet per minute per man occupying the section within 200 feet of the blasted face.

(2) Five cubic feet per minute per cartridge of explosive used in blasting that face.

(k) *Delay electric blasting caps.* In all blasts involving delay electric blasting caps in shafts or tunnels, each shot hole shall be adequately stemmed with noncombustible material or the explosives confined in some other manner approved by the Department.

(l) *Internal combustion engine.* No internal combustion engine may be used in any shaft or tunnel of a construction project unless it has been approved by the Department.

WORK IN COMPRESSED AIR—GENERAL

§ 43.51. Interpretation.

In cases of direct conflict between the specific provisions and the general provisions of this subchapter relating to work in compressed air the requirements of the former shall govern.

§ 43.52. Air pressure and hours of labor.

(a) *Less than 21 pounds.* When the air pressure in any compartment, caisson, tunnel or place in which men are employed is greater than normal and less than 21 pounds per square inch, no employe shall be permitted to work or remain there more than 8 hours in any 24 hours and shall be permitted to work under such air pressure only if he shall, during the 8 hours, return to the open air for an interval of at least 30-consecutive minutes and the employer shall provide for the interval.

(b) *Less than 30 pounds.* When the air pressure in any compartment, caisson, tunnel or place in which men are employed is 21 pounds or more and less than 30 pounds per square inch, no employe shall be permitted to work or remain there

more than 6 hours in any 24 hours, the 6 hours to be divided into two periods of 3 hours each, with an interval of at least 1 hour between the periods.

(c) *Less than 35 pounds.* When the air pressure in any compartment, caisson, tunnel or place is 30 pounds or more and less than 35 pounds per square inch, no employe shall be permitted to work or remain more than 4 hours in any 24 hours, the 4 hours to be divided into two periods of 2 hours each, with an interval of at least 2 hours between the periods.

(d) *Less than 40 pounds.* When the air pressure in any such compartment, caisson, tunnel or place is 35 pounds or more and less than 40 pounds per square inch, no employe shall be permitted to work or remain there more than 3 hours in any 24 hours, the 3 hours to be divided into periods of not more than 1 1/2 hours each, with an interval of at least 3 hours between the periods.

(e) *Less than 45 pounds.* When the air pressure in any compartment, caisson, tunnel or place is 40 pounds or more and less than 45 pounds per square inch no employe shall be permitted to work or remain there more than 2 hours in any 24 hours, the 2 hours to be divided into periods of not more than one hour each, with an interval of at least 4 hours between the periods.

(f) *Less than 50 pounds.* When the air pressure in any compartment, caisson, tunnel or place is 45 pounds or more and less than 50 pounds per square inch, no employe shall be permitted to work or remain there more than 90 minutes in any 24 hours, the 90 minutes to be divided into two periods of 45 minutes each, with an interval of not less than 5 hours between the periods.

(g) *Time limit.* The limits of hours specified in this section shall apply according to the maximum pressure attained at any time during the period when men are working.

§ 43.53. Decompression.

(a) A stage decompression shall be used in which a drop of 1/2 of the maximum gauge pressure shall be at the rate of 5 pounds per minute. The remaining decompression shall be at a uniform rate and the total time of decompression shall equal the time specified for the original maximum pressure.

(b) No person employed in compressed air shall be permitted to pass from the place in which the work is being done to normal air, except after decompression in the intermediate lock as follows:

(1) If the air pressure is greater than normal and less than 15 pounds per square inch, decompression shall be at the maximum rate of 3 pounds per minute.

(2) If the air pressure is 15 pounds or more and less than 20 pounds per square inch, decompression shall be at the maximum rate of 2 pounds per minute.

(3) If the air pressure is 20 pounds or more and less than 30 pounds per square inch, decompression shall be at the maximum rate of 3 pounds every 2 minutes.

(4) If the air pressure is 30 pounds or more per square inch, decompression shall be at the maximum rate of 1 pound per minute.

(c) The time of decompression shall be posted in each man-lock as provided in § 43.54 (relating to pressure gauges).

(d) If air pressure reaches 17 pounds or more, a record of all men working in the air chamber shall be kept by a man detailed for that purpose who shall remain outside the lock near the entrance. This record shall show the period of stay in the air chamber of each person and the time taken for decompression.

§ 43.54. Pressure gauges.

(a) When practicable to do so, a recording gauge shall be attached to the exterior of each man-lock to show the rate of decompression when the pressure exceeds 17 pounds per square inch.

(b) There shall be on the outer side of each working chamber at least one back pressure gauge, which shall be accessible at all times and shall be kept in accurate working order. Additional fittings shall be provided so that test gauges may be attached at all necessary times. Back pressure gauges shall be tested every 24 hours and a record kept of the test.

(c) A competent man shall be placed in charge of the valves and gauges which regulate and show the pressure in the working chamber. He shall not be employed more than eight hours in any 24-hour period. At no time shall he operate more than two separate air lines.

Cross References

This Section cited in 34 Pa. Code § 43.53 (relating to decompression).

§ 43.55. Lighting.

(a) All lighting in compressed air chambers shall be by electricity only. If practicable there shall be two independent lighting systems with independent sources of supply.

(b) The exterior of all lamp sockets shall be entirely nonmetallic.

(c) All portable incandescent lamps used shall be guarded by a wire cage large enough to enclose both lamp and socket.

(d) All incandescent lamps shall be so placed that they do not come in contact with any combustible material.

(e) Only heavy insulated or armored wire shall be used.

§ 43.56. Communication.

Suitable means of communication shall be maintained at all times between the working chamber and the powerhouse and the surface, and if possible, telephones shall be installed.

§ 43.57. Fire prevention.

All reasonable precaution shall be taken against fire, and provisions shall be made so that water lines are available for use at all times. Fire hose connections with hose connected shall be installed in all power plants and work houses. There shall be fire hose connections within reasonable distance of all caissons. Fire hose shall be connected at either side of a tunnel bulkhead, with at least 50 feet of hose with nozzle connection. Water lines shall extend into each tunnel with hose connection every 200 feet and shall be kept ready for use at all times.

§ 43.58. Washrooms and restrooms.

(a) All men shall have individual lockers of reasonable size, preferably metal lockers.

(b) A separate dryroom shall be provided where working clothes may be dried within reasonable time. This room shall be well heated.

(c) One shower bath fitted with regulating valves shall be provided for every eight men coming off shift.

(d) One basin and stopper shall be provided for every eight men coming off shift. Running water shall be supplied.

(e) One toilet and one urinal shall be provided for every 20 men employed on each shift.

(f) A sufficient amount of hot and cold water shall be supplied at all times.

(g) A minimum temperature of 70°F shall be maintained at all times in wash and dressing rooms.

(h) Sufficient hot coffee and sugar shall be supplied to men working in compressed air at the termination of shifts and during rest periods. Coffee shall be heated by means other than direct steam. Coffee containers and cups shall be kept in a clean, sanitary condition at all times. All containers shall be covered at all times.

§ 43.59. Sanitation.

(a) Absolutely no nuisance or horseplay shall be tolerated in the air chambers.

(b) Smoking is not permitted in the air chambers.

(c) Animals are not permitted in the air chambers.

(d) Care shall be taken to keep all parts of tunnel caissons and other working compartments, including lockers, dryrooms, restrooms and other equipment in a sanitary condition and free from refuse or decaying matter.

§ 43.60. Ventilation.

(a) The supply of fresh air to the working chamber shall be sufficient at all times to permit work to be done without danger or discomfort. All air supply lines

shall be equipped with check valves and carried as near to the face as practicable. The air shall be analyzed by the contractor as required and a record shall be kept of such analysis.

(b) Each working chamber shall have exhaust valves, with risers extending to the upper part of the chamber if necessary. The exhaust valves shall be operated at such times as may be required and especially after a blast, and men shall not be required to resume work after a blast until the gas and smoke have cleared.

§ 43.61. Medical locks.

A medical lock shall be established and maintained in connection with all work in compressed air when the maximum pressure exceeds 17 pounds. The locks shall be not less than 5 feet in height and shall be divided into two compartments. Each door shall be provided with a bull's eye and fitted with air valve so arranged to be operated from within and without. The lock shall be kept properly heated, lighted and ventilated, and shall contain a gauge, a telephone and cot. The lock shall be under the control of a physician in charge and there shall be maintained in close proximity a first aid room which shall contain a bathtub and all medical and surgical appliances necessary for first aid in case of accident.

§ 43.62. Physicians.

One or more duly licensed physicians, who have had experience in compressed air, shall be employed. The physicians shall strictly enforce the following:

(1) *Examinations.* No person shall be permitted to work in compressed air before he is examined by the physician and reported to the person in charge to be physically fit to work.

(2) *Reexamination.* In the event of absence from work of an employe for 10 or more successive days for any cause, he shall not resume work until he is reexamined by the physician and his physical condition reported to be such so as to permit him to work in compressed air. After a person has been employed continuously in compressed air for a period of 2 months, he shall be reexamined by the physician and he shall not be permitted to work until such reexamination has been made and he has been reported as physically qualified to engage in compressed air work.

(3) *Intoxicants.* No person known to be addicted to the excessive use of intoxicants shall be permitted to work in compressed air.

(4) *No previous experience.* Persons not having previously worked in compressed air shall not be permitted to work in pressure exceeding 17 pounds without having first been tested by the physician in the medical lock, nor shall any person be permitted to work under any pressure for longer than 1/2 a day period until he shall have been reexamined by the physician and found to be physically fit for the work.

(5) *Records.* The physician shall at all times keep a complete and full record of examinations made by him. The record shall contain dates on which

examinations were made, a clear and full description of the person examined, his age and his physical condition at the time he has been engaged in similar employment. A uniform examination blank, which contains the record of examination in every case of compressed air workers, shall be used by each medical examiner, and the record of the examinations shall be kept on file at the place where the work is in progress and shall be subject to inspection by the Department.

(6) *Badges.* An identification badge shall be furnished to all employes advising police officials that the employe is a compressed air worker. The badge shall state the location of the medical lock and that in case of emergency an ambulance surgeon shall remove the patient to the medical lock and not to the hospital.

(7) *Time of attendance.* When the air pressure exceeds 17 pounds or when 50 or more men are employed at one time in compressed air, the physician shall be in attendance at all times while the work is in progress.

WORK IN COMPRESSED AIR TUNNELS

§ 43.71. Compressor plants.

(a) A good and sufficient compressor plant for the compression of air shall be provided to meet not only ordinary conditions, but emergencies, and to provide margin for repairs at all times. Provision shall be made for storing in tanks at each boiler house enough feed water to last 12 hours, unless connection is made with two independent and separately sufficient sources of supply.

(b) The plant shall be capable of furnishing to each working chamber a sufficient air supply for all pressure to enable work to be done as nearly as possible in the dry.

(c) When electric power is used for running compressors supplying air for compressed air tunnel work, there shall be compliance with the following:

(1) There shall be two or more sources of power from the power stations to the compressor plant. The power feeders shall each have a capacity large enough to carry the entire compressor plant load and normal overload. The feeders should preferably run from separate generating plants of substations and be carried to the compressor plant over separate routes and not through the same duct lines and manholes, so that the breakdown of one feeder should not cause an interruption on the other feeder.

(2) There shall be duplicate feeder bus bars, and feeder connections to the bus bars shall be so that either feeder can feed to each separate bus-bar set, individually, or simultaneously to both sets.

(3) There shall be at least two compressors so connected to the bus bars that they may be operated from either set of busses. The compressors shall be fed from different bus bar sets, that a breakdown of a feeder or bus bar would interrupt the operation of only part of the compressor plant.

(4) Duplicate air feed pipes shall be provided from the compressor plant to a point beyond the lock.

§ 43.72. Locks.

(a) Each bulkhead in tunnels of 12 feet or more in diameter (or equivalent area) shall have at least two locks in perfect working condition, one of which shall be used as a man-lock.

(b) The man-lock shall be large enough so that those using it are not compelled to be in a cramped position, and it shall not be less than 5 feet in height. The emergency lock shall be large enough to hold an entire heading shift.

(c) All locks used for decompression shall be lighted by electricity and shall contain a pressure gauge, a time piece, a glass ''bull's eye'' in each door or in each end, and shall also have facilities for heating.

(d) Valves shall be arranged so that the locks may be operated both within and without.

§ 43.73. Bulkheads.

(a) Whenever the air pressure in a tunnel heading exceeds 21 pounds per square inch above atmospheric pressure, two air chambers shall be in use, except when headings are being started from shafts.

(b) Intermediate bulkheads may be required by the Department and the distances from the intermediate bulkheads to the heading shall not be greater than that prescribed by the Department.

(c) In all tunnels 16 feet in diameter or more, hanging walks shall be provided from working face to nearest lock. An overhead clearance of 6 feet shall be maintained and suitable ramps provided under all safety screens.

§ 43.74. Safety screens.

In the construction of tunnels 12 feet or more in diameter, when the tunnel heading extends beyond the shore line, screens shall be installed when necessary. If screens are installed, they shall at no time be more than 200 feet behind the face.

§ 43.75. Explosives.

When locking explosives and detonators into the air chamber, they shall be kept at opposite ends of the lock. While explosives and detonators are being taken through, no men other than the lock tender and the carriers shall be permitted in the lock.

(242288) No. 282 May 98

WORK IN COMPRESSED AIR—CAISSONS AND OTHER PLACES

§ 43.81. Compressor plants.

(a) A good and sufficient air plant for the compression of air shall be provided to meet ordinary conditions and emergencies, and to provide for repairs at all times. The plant shall be capable of furnishing to each working chamber a sufficient air supply for all pressures to enable work to be done as nearly as possible in the dry.

(b) Duplicate air feed pipes shall be installed on all caissons.

(c) Every effort shall be made by the best available means to keep the temperature in the working chamber below 100°F.

§ 43.82. Locks and shafting.

(a) All caissons in which 15 or more men are employed shall have two locks, one of which shall be used as a man-lock. Man-locks and man shafting shall be in the charge of a man whose duty it shall be to operate the locks and shafting.

(b) Locks shall be so located that the distance between the bottom door and water level shall be at least 3 feet.

(c) All caissons more than 10 feet in diameter shall be provided with a separate man shafting, which shall be kept clear and in operating order at all times.

(d) All man shafting shall be lighted every 10 feet with a guarded incandescent lamp.

(e) All shafting used in pneumatic caissons shall be provided with ladders which shall be kept clear and in good condition at all times. The distance between the centers of the rungs of a ladder shall not exceed 12 inches and shall not vary more than one inch in any one piece of shafting. The length of the ladder rungs shall not be less than 12 inches. The rungs of the ladder shall in no case be less than 6 1/2 inches from the wall or other obstruction in the shafting or opening in which the ladder shall be used. Under no circumstances shall a ladder inclining backward from the vertical be installed. A suitable ladder shall be provided from the top of all locks to the surface.

(f) All outside caisson air locks shall be provided with a platform at least 42 inches wide, and provided with a guardrail 42 inches high.

§ 43.83. Inspections.

While work is in progress, a competent person shall be designated to make a regular inspection at least once every working day of all engines, boilers, steam pipes, drills, air pipes, air gauges, air locks, dynamos, electric wiring, signaling apparatus, brakes, cages, buckets, hoists, cables, ropes, timbers, supports and all other apparatus and appliances; and he shall immediately upon discovery of any defect report such defect in writing to the person in charge.

§ 43.84. Shields.

If, in the prosecution of caisson work in which compressed air is employed, the working chamber is less than 12 feet in length, and when the 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 there for the protection of workmen.

§ 43.85. Signal codes.

(a) The code of signals used shall be printed and posted. Posting shall be in a conspicuous place near entrances to work places and in other places as may be necessary to bring the code to the attention of all persons affected by it. The printing and posting of the code shall be in a language necessary to be understood by all persons affected by it.

(b) Effective and reliable signaling devices shall be maintained at all times to give instant communication between the bottom and top of the shaft.

(c) The code for all work in compressed air, when the whistle and repeating rap are used, shall be as follows:

(1) One whistle or rap—Hoist.
(2) One whistle, or rap, with a rattle—Hoist slowly.
(3) Two whistles or raps—Come to a stop at once.
(4) Three whistles, or raps, with a rattle—Lower slowly.
(5) Four whistles or raps—Open high pressure.
(6) Four whistles, or raps, with a rattle—Shut off high pressure.
(7) Five whistles or raps—Call person in charge.
(8) Six whistles or raps—Lights are out.
(9) Seven whistles or raps—Lights are all right.
(10) Eight whistles or raps—Emergency call.

(d) The code for the operation of any car, cage or bucket shall be as follows:

(1) One bell—Stop if in motion or hoist if not in motion.
(2) Two bells—Lower.
(3) Three bells—Run slowly and carefully.

(e) In all cases reply signals repeating the original signals shall be made before proceeding.

(f) Additional signals to meet local conditions may be adopted.

(g) The minimum size of type to be used in notices shall be at least 1 inch in height.

§ 43.86. Use of explosives.

(a) Only experienced men who have been selected and regularly designated by the engineer or superintendent in charge and whose names have been posted in the field office or at the magazine, may handle, transport, prepare, or use dynamite or other high explosives.

(242290) No. 282 May 98

(b) The composition of explosives shall be the least amount of injurious gases.

§ 43.87. Storage of explosives.

(a) The constructor shall not store any explosive in any section of this Commonwealth under the jurisdiction of the Department until he has obtained a permit from the Department. The permit will be granted upon a sworn application in writing stating the place or building in which the applicant desires to store explosives, and after the place or building has been inspected by a representative of the Department.

(b) The constructor shall place a copy of the permit on some conspicuous part of the building or premises in which explosives are stored.

(c) The permit shall specify what explosive may be stored, and the amount of each explosive which the constructor may store in any one place at any one time.

(d) Each permit shall expire on the first of January of each year.

(e) No explosive shall be stored in any frame or wooden building or in any building within 300 feet of a schoolhouse, church, hospital, theater or hall licensed for public assemblies or any public building.

(f) No matches, smoking or any intoxicated person shall be allowed upon any premises in which explosives are stored.

§ 43.88. Conveyance of explosives.

(a) No greater quantity of explosives than that which is required for immediate use shall be taken into the working chamber.

(b) Explosives shall be conveyed in a suitable covered wooden box painted red.

(c) Detonators shall be conveyed in a separate covered wooden box painted red with a one inch yellow stripe running horizontally entirely around the box.

(d) Explosives and detonators shall be taken separately into the caisson.

(e) After blasting is completed, all explosives and detonators shall be returned at once to the magazine, observing the same rules as when conveyed to the work.

§ 43.89. Loading and drilling.

(a) Detonators shall be inserted in the explosives only as required for each round of blasting. Detonators shall not be inserted in the explosive without first making a hole in the cartridge with a sharpened stick. No holes shall be loaded except those to be fired at the next round of blasting. All explosives remaining after loading a round shall be removed from the caisson before any wires are connected. Blasters shall use only hard wood rods for tamping and they shall not tamp or load any hole with a metal bar, nor shall the wooden rod have any metal parts.

(b) All lights used when loading shall be of an enclosed type. If electric flash lamps are used, they shall be constructed so that it is not possible to obtain a difference of potential between any two points on the outside of the lamp casing.

(c) Drilling shall not be started until all remaining butts of old holes are examined for unexploded charges.

§ 43.90. Blasting.

(a) There shall be one blaster in charge of each section. No one who has not received a permit from the Department shall be employed as a blaster anywhere within the jurisdiction of the Department.

(b) When firing by electricity from power or light wires, a proper switch shall be furnished with the lever in a down position when ''off.'' The switch shall be fixed in a locked box to which no person shall have access except the blaster. There shall be provided flexible leads or connecting wires not less than 5 feet in length with one end attached to the incoming lines and the other end provided with plugs that shall be connected to an effective ground. After blasting, the switch lever shall be pulled out, the wires disconnected and the box locked before any person shall be allowed to return, and shall remain so locked until again ready to blast.

(c) All electric light wires in the working chamber shall be provided with a disconnecting switch, which shall be thrown to disconnect all current from the wires in the working chamber before electric light wires are removed or the charge exploded.

(d) Before he sets off the blast, the blaster shall cause a sufficient warning to be sounded and shall be responsible that all persons retreat to safe shelter, and shall also see that they do not return until he reports it safe for them. He shall report to the foreman and furnish names of all persons refusing to obey his caution.

§ 43.91. Loose rock.

(a) After the blast is fired, loosened pieces of rock shall be scaled from the sides of the excavation and after the blasting is completed, the entire working chamber shall be thoroughly scaled.

(b) The foreman in charge shall inspect the working chamber and have all loose rock or ground removed and the chamber made safe before proceeding with the work.

§ 43.92. Sinking and bracing caissons.

No caisson shall be dropped by the method of removing the air pressure therein for a greater depth than 24 inches, and then only by the person in charge at the time. All caissons shall be properly and adequately braced before loading with concrete or other weight.

(242292) No. 282 May 98

§ 43.93. Form in manlocks.

A copy of the following form shall be filled in and posted in each manlock:

TIME OF DECOMPRESSION FOR THIS LOCK

_____ pounds to _____ pounds in. _____ minutes
_____ pounds to _____ pounds in. _____ minutes
Total _____ minutes

Copies of rules may be obtained from physician in charge.

_____
Superintendent

§ 43.94. Physicians' form.

A copy of the following form shall be filled in by the physician at the time of examination of applicants for work under compressed air:

MEDICAL EXAMINER'S REPORT OF WORKERS
UNDER COMPRESSED AIR

No._____ Location_____
Name_____ Residence_____
Age _____ Nationality _____ Color _____
Single _____ Married _____ Widower _____
Children _____ How many _____

Compressed Air Experience:
When _____ Where _____ Pressure _____
Compressed air illness _____ When _____ Character _____
Previous illness _____
State fully habits with regard to the use of:
(a) Alcohol _____
(b) Tobacco _____
When last attended by a physician and for what cause _____
_____

_____
Signature of Applicant

Height _____ Weight _____ Sight _____ Hearing _____
Pulse _____ Character _____

_____
Signature of Physician

Subchapter B. COMPRESSED AIR APPARATUS

Sec.

Source

The provisions of this Subchapter B adopted February 1, 1915; amended through July 1, 1968, unless otherwise noted.

Cross References

This Subchapter cited in 34 Pa. Code § 33.146 (relating to compressed air apparatus); 34 Pa. Code § 33.254 (relating to compressed air apparatus); and 34 Pa. Code § 45.90 (relating to boring and mortising machines).

§ 43.111. Penalty.

Any person who violates this subchapter or any regulations of the Department or who interferes with the Department or its duly authorized representative in the enforcement of these provisions or regulations shall, upon conviction, be penalized under section 15 of act of May 18, 1937 (P. L. 654, No. 174) (43 P. S. § 25-15).

§ 43.112. Pneumatic hammers in new installations.

In new installations each pneumatic hammer shall be fitted with a device to prevent the piston from leaving the cylinder.

§ 43.113. Pneumatic drills in new installations.

In new installations each portable pneumatic drill and pneumatic wood boring machine shall be provided with an automatic device to stop the machine and prevent accidental starting when the hand of the operator is removed from the controlling valve.

§ 43.114. Pipe connections.

(a) In new installations a straightway valve shall be used where a valve is required in a pipe line between a compressor and its air tank.

(b) In all installations where a stop valve is placed in the discharge line between a compressor and an air tank, a spring pop safety valve shall be placed between the compressor and the stop valve.

§ 43.115. Air tanks in all installations.

(a) In all installations a drain cock shall be fitted at the lowest part of each air tank, and the accumulated oil and water shall be frequently withdrawn.

(b) In all installations the design and construction for air tanks shall conform to specifications approved by the Department.

§ 43.116. Use of compressed air.

Compressed air shall not be handled or used by employes or others except in the performance of their duties.

[Next page is 45-1.]