



DEPARTMENT OF LABOR AND ECONOMIC OPPORTUNITY

CONSTRUCTION STANDARD

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(as amended September 3, 1996) (as amended February 19, 2003 (as amended April 22, 2013)
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These rules take effect immediately upon filing with the secretary of state unless adopted under section 33, 44, or 45a(6) of the administrative procedures act of 1969, 1969 PA 306, MCL 24.233, 24.244, or 24.245a.

Rules adopted under these sections become effective 7 days after filing with the secretary of state.

(By authority conferred on the director of the department of labor and economic opportunity by sections 19 and 21 of the Michigan occupational safety and health act, 1974 PA 154, MCL 408.1019 and 408.1021, and Executive Reorganization Order Nos. 1996 2, 2003 1, 2008 4, 2011 4, and 2019-3, MCL 445.2001, 445.2011, 445.2025, 445.2030, and 125.1998)

R 408.41410, R 408.41461, R 408.41467, R 408.41475a, R 408.41477 and R 408.41478 of the Michigan Administrative Code are amended, as follows:

PART 14, TUNNELS, SHAFTS, CAISSONS, AND COFFERDAMS

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R 408.41401. Scope.

Rule 1401. This part applies to the construction, modification, and major repair of tunnels, shafts, caissons, chambers, passageways, cofferdams, any other aspect of tunnel construction, and the use and maintenance of equipment. This part does not apply to routine maintenance of an existing structure; excavation and trenching operations as prescribed by Construction Safety Standard Part 9 "Excavation, Trenching and Shoring," which is referenced in

R 408.41410, or underground electrical transmission and distribution lines as prescribed in Construction Safety Standard Part 16 "Power Transmission and Distribution," which is referenced in R 408.41410. This part also applies to cut-and-cover excavations which are both physically connected to ongoing underground construction operations within the scope of this part and covered in such a manner as to create conditions characteristic of underground construction.

R 408.41405. Applicability.

Rule 1405. (1) These rules apply to auger boring and jacking operations when occupied by an employee with the exception of R 408.41463.

R 408.41410 Adoption of standards by reference.

Rule 1410. (1) The following standards are adopted by reference in these rules and are available from the U.S. Government Printing Office Bookstore, 710 North Capitol Street N.W., Washington, DC, at the toll-free telephone number: 866-542-1800 or via the internet at website: www.ecfr.gov at no cost as of the time of adoption of these rules:

(a) The provisions of 30 CFR, Mineral Resources Parts 1 to 199 "Mine Safety and Health Administration, Department of Labor," revised July 1, 2000.

(b) The provisions of 42 CFR, Public Health, Part 84 "Approval of Respiratory Protective Devices," revised October 1, 2001.

(2) The standards adopted in subrule (1) of this rule are available for inspection at the Department of Labor and Economic Opportunity, MIOSHA, Standards and FOIA Section, 530 West Allegan Street, P.O. Box 30643, Lansing, Michigan, 48909-8143.

(3) Copies of the standards adopted in subrule (1) of this rule may be obtained from the publisher or may also be obtained from the Department of Labor and Economic Opportunity, MIOSHA, Standards and FOIA Section, 530 West Allegan Street, P.O. Box 30643, Lansing, Michigan, 48909-8143, at the cost charged in this rule, plus \$20.00 for shipping and handling.

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

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

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

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

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

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

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

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

(h) Construction Safety and Health Standard Part 21. "Guarding of Walking and Working Areas," R 408.42101 to R 408.42160.

(i) Construction Safety and Health Standard Part 22. "Signals, Signs, Tags, and Barricades," R 408.42201 to R 408.42243.

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

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

(l) General Industry and Construction Safety and Health Standard Part 451. "Respiratory Protection," R 325.60051 to R 325.60052.

(m) Construction Safety and Health Standard Part 665. "Underground Construction, Caissons, Cofferdams, and Compressed Air," R 325.62991 to R 325.62996.

R 408.41455. Definitions; A to H.

Rule 1455. (1) "Atmospheric pressure" means the pressure of air at sea level, usually 14.7 p.s.i.a. (1 atmosphere) or zero p.s.i.g.

(2) "Auger boring and jacking" means the mechanical removal of soil by use of a rotating auger and cutting head and simultaneously installing pipe or other lining where the section of lining is installed at the opening of the excavation and is jacked or otherwise forced toward the advancing face.

(3) "Auger tunnel" means a tunnel that is excavated by use of a continuous flight auger system, with or without a sleeve or other type of liner.

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

(5) "Caisson" means either a generally vertical foundation unit below grade or a chamber placed in the ground or water for excavating earth and in which it is possible for a person to work under air pressure greater than atmospheric pressure to excavate material below water level.

(6) "Cofferdam" means a temporary structure used to control the flow of water and other material during construction operations.

(7) "Competent person" means a person who is experienced and capable of identifying existing and predictable hazards in the surroundings or under working conditions that are hazardous or dangerous to an employee, and who has the authority and knowledge to take prompt corrective measures to eliminate hazards.

(8) "Compressed air" means an environment that has a pressure greater than atmospheric pressure.

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

(10) "Emergency lock" means a lock designed to hold and permit the quick passage of an entire shift of employees.

(11) "Escape-only respirator" means a respirator intended to be used only for emergency exit.

(12) "High air" means air pressure used to supply power to pneumatic tools and devices.

R 408.41456. Definitions; M to W.

Rule 1456. (1) "Man lock" means a chamber through which employees pass from 1 air pressure environment into another.

(2) "Materials lock" means a chamber through which materials and equipment pass from 1 air pressure environment into another.

(3) "Occupied tunnel" means any tunnel entered by 1 or more employees.

(4) "Pressure" means a force acting on a unit area, usually shown as pounds per square inch (p.s.i.).

(5) "Qualified person" means a person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project.

(6) "Safety screen" means an airtight and watertight diaphragm placed vertically across the upper part of a compressed air tunnel between the face and bulkhead in order to restrain sudden flooding of the crown of the tunnel between the safety screen and the bulkhead, thus providing a means of refuge and exit from a flooding or flooded tunnel.

(7) "Shaft" means a vertical or inclined opening excavated below ground level, that is for the purpose of tunnel operations.

(8) "Tunnel" means a generally horizontal excavation or facility more than 14 inches in diameter, width, or height and more than 6 feet in length below ground or water. Facilities used for the acquisition of minerals, ores, and fossil fuels, which are commonly known as mines, are excluded from this definition.

(9) "Working chamber" means the space or compartment under air pressure in which the work is being done.

R 408.41461. Advance notice of tunnel excavation.

Rule 1461. (1) Before the start of a pressurized tunnel being constructed, modified, or repaired, that is 24 inches or more in diameter, height, or width, and that will be occupied by an employee, a report prepared by the employer performing the tunnel excavation shall be sent to the Michigan Department of Labor and Economic Opportunity, Construction Safety and Health Division, 530 West Allegan Street, P.O. Box 30645, Lansing, Michigan 48909 8145, in addition to the following civil authorities in the area: hospital, police department, fire department, and sheriff department. The report shall contain all of the following information:

- (a) Name of contractor or contractors.
- (b) Starting date.
- (c) Length of tunnel.
- (d) Diameter of cut.
- (e) Finished diameter.
- (f) Number of shafts.
- (g) Depth of shafts.

(h) Location of shafts.

(i) Method of tunneling.

(j) Maximum working pressure in tunnel or shaft.

(k) Type of primary liner.

(l) Number of shifts.

(m) Projected completion date.

(n) Projected maximum work force within tunnel.

(2) An employer shall notify parties notified pursuant to subrule (1) of this rule when the work has been completed.

(3) If, after the start of any tunnel project, a tunnel or shaft that the employer has shown to be constructed, modified, or repaired under atmospheric conditions requires the tunnel to be pressurized, then the employer shall notify the Construction Safety and Health Division at the Michigan Department of Labor and Economic Opportunity, 530 West Allegan Street, P.O. Box 30645, Lansing, Michigan 48909 8145, 24 hours before allowing employees to enter the tunnel.

(4) If the work operations of any occupied and pressurized tunnel projects are discontinued for 30 consecutive days or longer, then the employer shall notify the Construction Safety and Health Division at the Michigan Department of Labor and Economic Opportunity, 24 hours before resuming work operations on the tunnel project.

R 408.41462. Safety generally.

Rule 1462. (1) The employer shall inform oncoming shifts of any hazardous occurrences or conditions that have affected or might affect employee safety, including liberation of gas, equipment failures, earth or rock slides, cave-ins, floodings, fires, or explosions.

(2) A safe means of egress and access to all work areas shall be provided and maintained free of hazards.

(3) When work is not being performed, access to an underground opening shall be covered, bulkheaded, fenced off, or restricted by gates or doors and appropriately posted.

(4) Any section of tunnel that is not in use shall be barricaded to prevent ingress by an unauthorized employee.

(5) Construction of a trench, manhole, or other opening for use in a tunnel or shaft operation shall be as prescribed in construction safety standard Part 9. Excavation, Trenching, and Shoring and construction safety standard Part 45. Fall Protection, which is referenced in R 408.41410.

(6) An area subject to subsidence that is hazardous to an employee shall be fenced and appropriately posted.

(7) Each operation shall have a check-in and check-out system that will provide positive identification of an employee by number or name and will identify the location of each employee who is underground. An accurate record shall be kept on the surface. However, a check-in and check-out system is not required when the construction of underground facilities that are designed for human occupancy has been completed so that the permanent environmental controls are effective and the remaining construction

activity will not cause any environmental hazard or structural failure within the facilities.

(8) All employees shall be instructed in the recognition and avoidance of hazards that are associated with all of the following underground construction activities:

- (a) Air monitoring.
- (b) Ventilation.
- (c) Illumination.
- (d) Communications.
- (e) Flood control.
- (f) Mechanical equipment.
- (g) Personal protective equipment.
- (h) Explosives.
- (i) Fire prevention and protection.
- (j) Emergency procedures, including evacuation plans and check-in and check-out systems.

(9) The employer shall issue each employee a copy of the project's general safety rules before the employee commences work at the project.

(10) Each employer shall designate a qualified person who is responsible for administering the safety program. A written record shall be maintained of the safety training program.

(11) Before an employee enters a tunnel where the atmosphere may be hazardous due to a condition such as a deficiency of oxygen, or may be toxic in excess of the maximum allowable limits, the tunnel shall be tested and the results shall be recorded as prescribed in occupational health standard Part 665. Underground Construction, Caissons, Cofferdams, and Compressed Air, which is referenced in R 408.41410. The records shall be maintained at the jobsite. If the atmosphere is hazardous, either sufficient ventilation to eliminate the hazard shall be provided or respiratory equipment as prescribed by the Department of Licensing and Regulatory Affairs shall be worn.

(12) If an atmosphere is found to be explosive, then sparks, flame, and other sources of ignition shall be prohibited and ventilation shall be provided until the hazard has been reduced and maintained at or below the maximum allowable limits as prescribed by the Department of Licensing and Regulatory Affairs.

R 408.41463. Emergency provisions; plans; equipment; rescue crews.

Rule 1463. (1) The employer shall develop a plan to evacuate a tunnel in an emergency and the procedures to carry out the plan shall be made known to the employees and to the rescue team.

(2) An employer shall ensure that rescue teams are familiar with conditions at the jobsite.

(3) On jobsites where 25 or more employees work underground at 1 time, an employer shall provide, or make arrangements in advance with locally available rescue services to provide, at least 2 5-person rescue teams.

One of the teams shall be on the jobsite or within 1/2 hour of travel time from the entry point and the other team shall be within 2 hours of travel time from the entry point.

(4) On jobsites where fewer than 25 employees work underground at 1 time, an employer shall provide, or make arrangements in advance with locally available rescue services to provide, at least 1 5-person rescue team. The team shall either be on the jobsite or be within 1/2 hour of travel time from the entry point.

(5) On jobsites where flammable or noxious gases are encountered or anticipated in hazardous quantities, rescue team members shall practice donning and using self-contained breathing apparatus monthly.

(6) An emergency hoisting facility, such as a mud box or a crane, shall be readily available at a shaft that is used as a means of egress, unless a hoisting means is provided that is independent of an electrical power failure. The hoisting means shall be designed so that the load hoist drum is powered in both directions of rotation and so that the brake is automatically applied upon power release or failure.

(7) An employer shall provide an escape-only respirator that is a self-contained breathing apparatus with a minimum of a 5 minute air supply. Respirators shall be approved by the national institute for occupational safety and health as prescribed in the provisions of 42 C.F.R. Public Health Service, Part 84 "Approval of Respiratory Protective Devices," as adopted in R 408.41410. Respirators shall be used in accordance with Occupational Health Standard Part 451 "Respiratory Protection," as referenced in R 408.41410. Escape-only respirators shall be immediately available for each employee at work stations in underground areas where employees might be trapped by smoke or gas.

(8) Escape-only respirator that is a self-contained breathing apparatus shall be maintained in good operating condition. Employees shall be trained in its use.

(9) The employer shall maintain a rescue crew for each shift of all underground operations. The rescue crew shall be trained in rescue procedures, the use and limitations of a breathing apparatus, and the use of fire fighting equipment. The crews shall be retrained at least once each year. Local fire and police personnel may be used as rescue teams for tunnel operations. If local personnel are to be used, then the employer shall arrange for assistance before the start of the project.

(10) The employer shall provide the following minimum rescue equipment at the top of the shaft:

(a) Four units of 1/2-hour-rated, self-contained breathing apparatus.

(b) Four additional units of 1/2-hour-rated air bottles.

(c) Four bureau of mines flashlights or lanterns with additional batteries for each light. The flashlights shall be as prescribed in part 20 of subchapter B of the provisions of 30 C.F.R., Mineral Resources, Parts 1-199 "Mine Safety and Health Administration, Department of Labor," as adopted in R 408.41410.

(d) Two 2A-10BC fire extinguishers.

(e) One stretcher, wire basket type or equivalent with slings attached.

(f) One fire blanket.

(g) One 10-ton hand hydraulic rescue kit.

(h) One first aid kit as prescribed in Construction Safety Standard Part 1 "General Rules," as referenced in R 408.41410.

(11) At least 1 employee shall be on duty above ground when an employee is working underground. The primary duty of the employee who is above ground shall be to secure immediate aid for an employee who is underground in case of an emergency.

R 408.41464. Communication system; location; signals

Rule 1464. (1) In a tunnel that is more than 225 feet long, the employer shall provide a communication system at all of the following locations:

- (a) The working face.
- (b) The top of the shaft.
- (c) The bottom of the shaft.
- (d) The hoisting station, if provided.
- (e) Each 1,000 feet of tunnel.

(f) The office, if provided. A public telephone or other communication system shall be provided or available to each tunnel project to secure outside emergency help.

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

(2) An employer shall establish and maintain direct communications for coordination of activities with other employers whose operations at the jobsite affect or may affect the safety of employees who are underground.

(3) If a tunnel is pressurized, then an employer shall provide all of the following additional locations with a communication system:

- (a) The working chamber side of the manlock near the door.
- (b) The interior of all locks.
- (c) The lock attendant's station.
- (d) The compressor plant.
- (e) The first aid station.

(4) Communication systems shall be tested upon initial entry of each shift to the underground, and as often as necessary thereafter, to ensure that they are in working order.

(5) An employee who works alone underground in a hazardous location and who is both out of the range of natural unassisted voice communication and not under observation by other persons shall be provided with an effective means of obtaining assistance in an emergency.

(6) If a gassy condition exists, then all phones that are located within the tunnel shall conform to the United States Bureau of Mines Schedule 9b, Part 23 of the provisions of 30 C.F.R., Mineral Resources, Parts 1-199 "Mine Safety and Health Administration, Department of Labor," as adopted in R 408.41410. The telephone or other signal communication systems shall be independent of the tunnel power supply and shall be installed so that the use or disruption of any one phone

or signal location will not disrupt the operation of the system from any other location.

R 408.41465. Protective clothing or equipment.

Rule 1465. An employee working in a wet shaft, tunnel, or caisson shall wear safety toe rubber boots which have flat gripper-type soles and which are provided by the employer, at no expense to the employee.

R 408.41466. Electrical requirements.

Rule 1466. (1) A power line shall be well separated or insulated from water lines, telephone lines, and air lines.

(2) Lighting circuits shall be located so that the movement of personnel or equipment will not damage the circuits or disrupt service.

(3) Electrical equipment and wiring shall be installed and maintained as prescribed in the provisions of subparts F to J of part 77 of the provisions of 30 C.F.R., Mineral Resources, Parts 1-199 "Mine Safety and Health Administration, Department of Labor," as adopted in R 408.41410. The provisions of subparts F to J are adopted with the following amendments:

(a) Article 305-1(a) is amended to read as follows: Temporary electrical power and lighting installations shall be permitted during the period of construction, remodeling, maintenance, repair, or demolition of buildings, structures, equipment, or similar activities which are located at ground level and which are part of facilities used for the construction of tunnels, shafts, and cofferdams.

(b) Article 310-15, is amended to read as follows: The maximum continuous ampacities for copper, aluminum, and copper-clad aluminum conductors shall be as specified in table 310-16 to 310-19 and accompanying notes 1 to 12. Power and lighting circuits may be loaded to the maximum design temperatures of the wire or cable insulation under the following conditions:

(i) A means shall be provided to disconnect the load if the feeder cable exceeds design temperature by more than 10% for 1 minute.

(ii) Power cable shall have a grounding and a pilot wire that conforms to the Insulated Power Cable Engineers Association (IPCEA) type G grounded cable (G-GC) or equivalent.

(iii) Power cable shall have a loose connector emergency shutdown ability.

(iv) Power cable shall have a ground fault emergency shutdown ability.

(v) Power cable shall have an arc between phases emergency shutdown ability.

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

(4) All electrical power circuits that supply portable or hand-held tools, lights, or equipment shall be protected by approved ground-fault interrupters as

prescribed in Construction Safety Standard Part 17 "Electrical Installations," as referenced in R 408.41410.

(5) The regular system of illumination shall be supplemented by lighting that can be activated upon the failure of the regular system. Supplemental lighting, such as approved flashlights or lanterns, shall be sufficient to allow all employees to evacuate the tunnel.

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

(7) Lighting fixtures in storage areas, or within 25 feet (7.62 meters) of underground areas where oil, grease, or diesel fuel are stored, shall be approved for class I, division 2 locations, as prescribed in Construction Safety Standard Part 17 "Electrical Installations," as referenced in R 408.41410.

R 408.41467. Fire prevention and protection.

Rule 1467. (1) The applicable requirements for fire prevention and protection as prescribed in Construction Safety Standard Part 18. "Fire Prevention and Protection," as referenced in R 408.41410, shall be complied with in all tunnel and shaft operations.

(2) Smoking and open flames are prohibited. An employer is responsible for collecting all personal sources of ignition, such as matches and lighters, from all persons. Welding and cutting, where required, shall comply with the provisions of subrules (9) to (14) of this rule. A fire watch shall be maintained when hot work is performed.

(3) Not more than a 1-day supply of diesel fuel shall be stored in a tunnel or shaft. Gasoline or liquefied petroleum gas shall not be taken in a tunnel or shaft. Acetylene or methylacetylene propadiene stabilized gas may be used underground solely for welding, cutting, and other hot work and only as prescribed in Construction Safety Standard Part 7. "Welding and Cutting," as referenced in R 408.41410.

(4) The piping of diesel fuel from the surface to an underground location is permitted only if all of the following provisions are complied with:

(a) Diesel fuel is contained at the surface in a tank with a maximum capacity that is not more than the amount of fuel required to supply, for a 24-hour period, the equipment that is serviced by the underground fueling station.

(b) The surface tank is connected to the underground fueling station by an acceptable pipe or hose system that is controlled at the surface by a valve and at the shaft bottom by a hose nozzle.

(c) The pipe is empty at all times, except when transferring diesel fuel from the surface tank to a piece of equipment in use underground.

(d) Hoisting operations in the shaft are suspended during refueling operations if the supply piping in the shaft is not protected from damage.

(e) Acetylene, liquefied petroleum gas, and methylacetylene propadiene stabilized gas may be used underground only for welding, cutting, and other hot work and only in accordance with subrules (9) to (14) of this rule.

(f) Not more than the amount of fuel gas and oxygen cylinders necessary to perform welding, cutting, or other hot work during the next 24-hour period shall be permitted underground.

(5) Leaks and spills of flammable or combustible fluids shall be cleaned up immediately.

(6) Oil, grease, or diesel fuel that is stored in a tunnel or shaft shall be kept in tightly sealed containers in fire-resistant areas at safe distances from explosives, magazines, electrical installations, and shaft stations. Electrical installations in underground areas where oil, grease, or diesel fuel are stored shall be used only for lighting fixtures. Lighting fixtures in storage areas, or within 25 feet (7.62 meters) of underground areas where oil, grease, or diesel fuel are stored, shall be approved for class I, division 2 locations.

(7) Fire-resistant hydraulic fluids shall be used in hydraulically actuated underground machinery and equipment. For the purpose of this requirement, a fire-resistant hydraulic fluid means any liquid which has a flash point above 200 degrees Fahrenheit and which has a vapor pressure of not more than 40 p.s.i. (absolute) at 100 degrees Fahrenheit.

(8) An approved 4A:40B:C rating fire extinguisher or equivalent protection shall be provided at the drive pulley of an underground conveyor and at 300-foot intervals along the belt. A minimum of 2 2A-10BC approved fire extinguishers shall be provided at the tunneling machine.

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

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

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

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

(11) For purposes of subrules (9) and (10) of this rule, when an applicable MSHA provision uses the term "mine," use the phrase "underground construction site." (Each brake horsepower of a diesel engine requires at least 100 cubic feet (2.832 m³) of air per minute for suitable operation in addition to the air requirements for personnel. Some engines may require a greater amount of air to ensure that the allowable levels of carbon monoxide, nitric oxide, and nitrogen dioxide are not exceeded.)

(12) Fire-resistant hydraulic fluids shall be used in hydraulically-actuated underground machinery and equipment unless such equipment is protected by a fire suppression system or by multipurpose fire extinguisher or fire extinguishers of sufficient capacity for the type and size of hydraulic equipment involved, but rated at least 4A:40B:C.

(13) A noncombustible barrier shall be installed below welding or burning operations.

(14) In an underground operation, local gas checks shall be made before and during a welding or cutting operation and during a drilling operation that would penetrate the tunnel.

(15) Whenever 5% or more of the lower explosive limit for methane or other flammable gases is detected in any underground work area or in the air return, an employer shall take steps to increase ventilation air volume or otherwise control the gas concentration, unless the employer is operating in accordance with the potentially gassy or gassy operation requirements. Such additional ventilation controls may be discontinued when gas concentrations are reduced below 5% of the lower explosive limit, but shall be reinstated whenever the 5% level is exceeded.

(16) Whenever 10% or more of the lower explosive limit for methane or other flammable gases is detected in the vicinity of welding, cutting, or other hot work, such work shall be suspended until the concentration of such flammable gas is reduced to less than 10% of the lower explosive limit.

(17) A fire watch shall be maintained around welding and cutting operations until all possibility of fire is eliminated. The fire watch shall be provided with a minimum of 1 approved 2A-10BC fire extinguisher.

(18) Flammable materials or supplies, other than those used during 1 shift, shall not be stored within 100 feet (30.48 meters) of any tunnel or shaft opening. If this is not feasible because of space limitations on the jobsite, then such materials may be located within the 100 foot limit, if both of the following provisions are complied with:

(a) The materials are located as far as practicable from the opening.

(b) A fire resistant barrier of not less than a 1-hour rating is placed between the stored material and the opening or additional precautions are taken that will protect the materials from ignition sources.

TUNNELS AND SHAFTS

R 408.41471. Ground support; inspections; repairs.

Rule 1471. (1) A qualified employee shall inspect the roof, face, and walls of portals, work areas, and haulage ways, or travel-ways at the start of each shift and frequently thereafter as needed.

If loose soil or rock or fractured material is encountered, then it shall be scaled or protected and supported.

The employee conducting the inspections shall be protected from loose ground by location, ground support, or equivalent means.

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

Support sets shall be installed so that the bottoms have sufficient anchorage to prevent ground pressures from dislodging the support base of the sets.

Lateral bracing (collar bracing, tie rods, or spreaders) shall be provided between immediately adjacent sets to ensure added stability.

Damaged or dislodged ground supports that create a hazardous condition shall be promptly repaired or replaced.

When replacing supports, the new supports shall be installed before the damaged supports are removed.

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

(2) A scaling bar shall be in good condition. A blunted or severely worn bar shall not be used.

(3) A torque meter and a torque wrench shall be available where rock bolts are used for ground support. Frequent tests shall be made to determine if the bolts are tight. The test frequency shall be determined by rock conditions and distance from vibration sources.

(4) A damaged or dislodged tunnel support shall be repaired or replaced when structural integrity is impaired. A new support shall be installed if possible before removing damaged supports.

(5) Tunnel supports shall be designed and installed to prevent pressure from pushing them inward into the excavation.

(6) Roof supports shall be used where ground conditions are such that there could be a ground failure ahead of tunnel sets.

(7) A tunnel that is to be occupied by employees shall be provided with a steel casing, concrete pipe, timber, or other material of required strength to support the surrounding earth.

(8) If an employee is required to enter a tunnel or an auger boring and jacking operation less than 3 feet in diameter, then a lifeline for instant rescue shall be securely fastened to his or her ankles. Another employee shall be stationed at the tunnel entrance to operate the lifeline. In addition, ventilation shall be provided with an air line.

R 408.41472. Shafts; supports; inspections; lifelines.

Rule 1472. (1) A shaft that an employee is required to enter shall be provided with steel casing, concrete pipe, timber, or other material that is strong enough to support the surrounding earth.

(2) A shaft that is more than 5 feet in depth shall be braced to support the surrounding earth. The bracing shall be provided the full depth of the shaft, or, if rock is encountered, to not less than 5 feet into solid rock, and shall extend not less than 1 foot above the ground level.

(3) After a blasting operation, the bracing shall be inspected. If the bracing is found to be unsafe, then corrections shall be made before the shift operations are continued.

(4) A shaft or caisson shall be protected with a guardrail system as prescribed in Construction Safety Standard Part 45 "Fall Protection," as referenced in R 408.41410, or barricaded as prescribed in Construction Safety Standard Part 22 "Signals, Signs, Tags, and Barricades," as referenced in R 408.41410. A gate opening into the shaft shall be provided and shall be closed at all times, except when necessary to enter or leave the shaft or caisson.

R 408.41473. Drilling; inspection; jumbos.

Rule 1473. (1) Drilling equipment that is to be used during a shift shall be inspected each shift by a qualified employee. Equipment defects affecting safety shall be corrected before the equipment is used.

(2) The drilling area shall be inspected for hazards before starting the drilling operation.

(3) An employee shall not be allowed on a drill mast while the drill is in operation.

(4) When a drill is moved from one area to another, drill steel, tools, and other equipment shall be secured, and the mast shall be placed in a safe position.

(5) Drills on columns or stiff legs shall be anchored firmly before drilling is started and they shall be retightened frequently thereafter.

(6) A jumbo deck more than 5 feet high shall be provided with guardrails on all open sides and on the back platform. A stair or ladder access, wide enough for 2 employees, shall be provided to a jumbo deck 10 feet or more in height.

(7) A jumbo deck, ladders, and stairs shall be kept clean to prevent the hazard of slipping and tripping. The deck shall be an anti-slip type and the deck shall be secured to prevent displacement.

(8) A mechanical means shall be provided for lifting drills, roof bolts, mine straps, and other unwieldy heavy material to the top deck of a jumbo more than 10 feet in height.

(9) Receptacles or racks shall be provided for drill steel stored on a jumbo.

(10) When a jumbo is moved, a rider shall not be allowed on the jumbo unless the employee is assisting the operator.

(11) Jumbo wheels shall be chocked while an employee is working on the jumbo.

(12) Before the drilling cycle is started, a warning shall be given to employees working under jumbo decks.

(13) Before commencing a drilling cycle, the face and lifters shall be examined for misfires. If found, the misfired explosive shall be removed before the drilling starts. A lifter shall not be drilled through a blasted muck pile.

(14) An air line that is buried in the invert shall be identified by signs posted nearby warning all employees.

R 408.41474. Blasting.

Rule 1474. (1) All blasting and explosives handling shall be conducted as prescribed in Construction Safety Standard Part 27 "Blasting and Use of Explosives," as referenced in R 408.41410.

(2) An employer shall not allow an employee to enter a shaft or a tunnel heading after blasting until air quality meets minimum requirements.

(3) Blasting wire shall be kept clear of electrical lines, pipes, rails, and other conductive material, excluding earth, to prevent explosives initiation or employee exposure to electric current.

(4) After blasting operations in shafts, a competent person shall determine if the walls, ladders,

timbers, blocking, or wedges have loosened. If so, necessary repairs shall be made before employees other than those assigned to make the repairs are allowed in or below the affected areas.

R 408.41475. Haulage; inspection; braking; riding.

Rule 1475. (1) Haulage equipment that is to be used during a shift shall be inspected by a qualified person before the start of the shift. Known defects that affect the safety of employees shall be corrected before the equipment is used.

(2) A powered locomotive or other mobile equipment shall be provided with suitable brakes, an audible warning device for use by the operator as needed, and lights at both ends.

(3) Powered mobile haulage equipment that is subject to falling materials shall be equipped with a cab, canopy, or other protective device that is capable of protecting the operator from shifting or falling materials. For cabs where glazing is used, the glass shall be safety glass, or its equivalent, and shall be maintained and cleaned so that vision is not obstructed.

(4) Powered mobile equipment shall not be left unattended unless the power is off, all operating controls are in the neutral position, and the brakes are set or other equivalent precautions are taken to prevent rolling. The operating controls shall be designed to automatically return to a neutral position or shall be equipped with a deadman control.

(5) Backstops or automatic braking shall be installed on an inclined conveyor to prevent the conveyor from running out of control and creating a hazard for the employee.

(6) An employee shall not ride on either of the following unless specifically designed or adapted for transporting employees:

(a) A power-driven chain, belt, or bucket conveyor.

(b) Haulage equipment. An employee shall not ride haulage equipment unless it is equipped with seating for each passenger and protects passengers from being struck, crushed, or caught between other equipment or surfaces.

(7) An employer shall not use an endless belt-type man lift in underground construction.

(8) Cars that are dumped by hand shall be provided with tie-down chains or dumper blocks to prevent the cars from overturning.

(9) A rocker bottom or bottom-dump car shall be equipped with positive-locking devices.

(10) Equipment that is to be hauled shall be loaded or protected so as to prevent sliding or spillage.

(11) Parked rail haulage equipment shall be chocked or chained if subject to accidental movement.

(12) Berms, bumper blocks, safety hooks, or similar means shall be provided to prevent overtravel or overturning at dumping locations and, where necessary, at track dead ends.

(13) Supplies, materials, and tools, other than small hand tools, shall not be transported with employees in the same car and shall not be transported on top of a locomotive.

(14) A train that is used on an incline which would cause the cars to run out of control shall, in addition to couplings, have safety chains, or the equivalent, to connect the cars and the power haulage equipment in a train. The safety chains or other connections shall be capable of maintaining connection between cars in the event of coupler disconnect, failure, or breakage.

(15) When an employee is being transported in a train, the operator shall have clear vision beyond the forward end of the train for safe operation.

(16) Mobile equipment, including rail-mounted equipment, shall be stopped for manual connecting or service work.

(17) Employees shall not reach between moving cars during coupling operations.

(18) Couplings shall not be aligned, shifted, or cleaned when cars or locomotives are moving.

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

R 408.41475a. Hoisting unique to underground construction.

Rule 1475a. Except as modified by this standard, employers shall comply with all of the following:

(a) The requirements of Construction Safety and Health Standard Part 10. "Cranes and Derricks," as referenced in R 408.41410,

(b) Ensure that material hoists comply with Construction Safety and Health Standard Part 10. "Cranes and Derricks," as referenced in R 408.41410.

(c) Ensure that personnel hoists comply with the personnel hoists requirements of Construction Safety and Health Standard Part 10. "Cranes and Derricks," as referenced in R 408.41410.

R 408.41476. General requirements for cranes and hoists.

Rule 1476. (1) A competent person shall check each safety device at least weekly during hoist use to ensure suitable operation and safe condition.

(2) Before hoisting personnel or material, the operator shall perform a test run of any cage or skip whenever it has been out of service for one complete shift, and whenever the assembly or components have been repaired or adjusted.

(3) An employee shall not ride on a material hoist, unless the hoist is in compliance with the requirements of R 408.41478(1).

(4) Before maintenance, repairs, or other work is commenced in the shaft that is served by a hoist, the hoist operator shall be informed of the maintenance, repairs, or other work and given suitable instructions. A sign warning that work is being done in the shaft shall be installed at the shaft collar, at the operator's station, and at each underground landing.

(5) Employees who are at the bottom of an excavated shaft shall be protected from the movement of equipment, tools, or materials overhead or the shaft

shall be vacated during the operations that may be hazardous to persons below.

(6) If an employee is raised or lowered in a shaft, then all other hoisting operations in the shaft shall be stopped until the employee has disembarked at the bottom or top of the shaft.

(7) When a stationary hoist is being used, the drum-operating lever shall be of a type that returns automatically to the "stop" position when the operator's hand is removed, unless, as a substitute, the throttle that controls the drum speed automatically stops the drum and slows the engine to idling speed when the throttle is released.

(8) Only wire rope shall be used for hoisting and it shall be properly secured at both the drum and cage or skip ends. When the hoist is in use, not less than 2 full turns shall remain on the conventional drum hoist to protect the end that fastens at the drum from an overload.

(9) The connection between the hoisting rope and the cage or skip shall be of a type to prevent the cage from spinning.

(10) All hoists shall be equipped with a landing level indicator at the operator's station. Marking the hoist rope does not satisfy this requirement.

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

(12) A warning light, suitably located to warn employees at the shaft bottom and subsurface shaft entrances, shall flash if a load is above the shaft bottom or subsurface entrances or if the load is being moved in the shaft. This subrule does not apply to fully enclosed hoistways.

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

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

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

(16) Hoists shall be designed so that the load hoist-drum is powered in both directions of rotation and so that the brakes are automatically applied upon power release or failure.

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

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

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

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

(21) Spin-type connections, where used, shall be maintained in a clean condition and protected from foreign matter that could affect their operation.

R 408.41477. Additional requirements for hoists.

Rule 1477. (1) A hoist used for raising or lowering materials in a shaft shall have a minimum factor of safety of 5, shall be designed and rated by a qualified engineer, and shall be constructed in accordance with the design. The design shall be constructed so that the hoist cannot exceed the maximum rated speed.

(2) The rated capacity of the hoist shall be posted at all working levels.

(3) To ensure suitable operation and safe condition of all functions and safety devices, each hoist assembly shall be inspected and load-tested to 100% of its rated capacity at the time of installation; after any repairs or alterations affecting its structural integrity; after the operation of any safety device; and annually when in use. The employer shall prepare a certification record which includes the date each inspection and load-test was performed; the signature of the person who performed the inspection and test; and a serial number or other identifier for the hoist that was inspected and tested. The most recent certification record shall be maintained on file until completion of the project.

(4) A competent person designated by the employer shall visually inspect the stationary hoist assembly, anchorages, and hoisting rope at the beginning of each shift.

(5) All unsafe conditions that are revealed by tests, checks, or inspections shall be corrected before use of the equipment.

(6) Hoist equipment and the operator shall be protected from inclement weather by a hoist house with a comfortable temperature maintained.

(7) Where glass is used in hoist house windows, the glass shall be safety glass or its equivalent.

(8) Hoist controls shall be arranged so that the operator can perform all operating cycle functions and reach the emergency power cutoff without having to reach beyond the operator's normal operating position.

(9) Controls for powered hoists shall be of the deadman-type with a non-locking switch or control.

(10) All hoists shall be equipped with landing level indicators at the operator's station. Marking the hoist rope does not satisfy this requirement.

(11) Material hoisting may be performed at speeds higher than the rated speed for personnel hoisting if the

hoist and components have been designed for such higher speeds and if shaft conditions permit.

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

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

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

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

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

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

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

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

(20) Wire rope used in load lines of material hoists shall be capable of supporting, without failure, at least 5 times the maximum intended load or the factor recommended by the rope manufacturer, whichever is greater. Refer to Construction Safety and Health Standard Part 10. "Cranes and Derricks," as referenced in R 408.41410, for design factors for wire rope used in personnel hoists. The design factor shall be calculated by dividing the breaking strength of wire rope, as reported in the manufacturer's rating tables, by the total static load, including the weight of the wire rope in the shaft when fully extended.

R 408.41477a. Additional requirements for cranes.

Rule 1477a. Cranes shall be equipped with a limit switch to prevent overtravel at the boom tip. Limit switches are to be used only to limit travel of loads when operational controls malfunction and shall not be used as a substitute for other operational controls.

R 408.41478. Additional Requirements for personnel hoists.

Rule 1478. (1) A personnel hoist shall be used to raise or lower an employee in a tunnel shaft or caisson. A crane may be used to raise or lower an employee, if the crane and the work platform are as prescribed in Construction Safety and Health Standard Part 10. "Cranes and Derricks," as referenced in R 408.41410.

The hoist shall comply with 1967 PA 227, MCL 408.801 to 408.824, and the elevator safety rules of the Bureau of Construction Codes, Elevator Safety Board, R 408.7001 to R 408.8695.

(2) All sides of personnel cages shall be enclosed by 1/2-inch (12.70 mm) wire mesh, at least no. 14 gauge or its equivalent, to a height of at least 6 feet (1.83 m). When the cage or skip is being used as a work platform, its sides may be reduced in height to 42 inches (1.07 m) when the conveyance is not in motion. All personnel cages shall be provided with a positive-locking door that only opens inward.

(3) Flammable or combustible liquids or gases shall not be permitted on the work platform if the platform is occupied by an employee or employees.

(4) Hoist drum systems shall be equipped with at least 2 means of stopping the load, each of which shall be capable of stopping and holding 150 % of the hoist's rated line pull. A broken-rope safety, safety catch, or arrestment device is not a permissible means of stopping.

(5) The operator shall remain within sight and sound of the signals at the operator's station.

(6) All personnel cages shall be provided with a protective canopy. The canopy shall be made of steel plate, at least 3/16-inch (4.763 mm) in thickness, or material of equivalent strength and impact resistance. The canopy shall be sloped to the outside, and so designed that a section may be readily pushed upward to afford emergency egress. The canopy shall cover the top in such a manner as to protect those inside from objects falling in the shaft.

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

(8) During sinking operations in shafts where guides and safeties are not yet used, the travel speed of the personnel platform shall not exceed 200 feet (60.96 m) per minute. Governor controls set for 200 feet (60.96 m) per minute shall be installed in the control system and shall be used during personnel hoisting.

(9) The personnel platform may travel over the controlled length of the hoistway at rated speeds up to 600 feet (182.88 m) per minute during sinking operations in shafts where guides and safeties are used.

(10) The personnel platform may travel at rated speeds greater than 600 feet (182.88m) per minute in completed shafts.

R 408.41479. Flooding; safety screens; runways.

Rule 1479. If there is a danger of rapid flooding in a tunnel that has a bore of 16 feet or more in diameter, then the employer shall provide both of the following:

(a) A runway from the face to the bulkhead as high in the tunnel as practicable to maintain not less than a 6-foot vertical clearance from the surface of the runway upward to the surface of the tunnel. The runway shall be constructed of noncombustible material and shall have a standard railing installed securely along the length of the runway as prescribed in Construction

Safety Standard Part 21 "Guarding of Walking and Working Areas," and Construction Safety Standard Part 45 "Fall Protection," as referenced in R 408.41410. If the runway is ramped under a safety screen, then the surface shall be made slip-resistant by cleats or other equivalent means.

(b) Metal safety screens or other equivalent means installed with the bottom of the screen 4 feet above the surface of the runway. The first screen shall be located not less than 400 feet from the face of the tunnel.

COFFERDAMS AND CAISSONS

R 408.41481. Cofferdams.

Rule 1481. (1) A cofferdam shall be designed by a qualified engineer and shall be constructed and maintained in accordance with the design.

(2) If overtopping of the cofferdam by high waters is possible, then means shall be provided for controlled flooding of the work area.

(3) The employer shall develop and post warning signals for the evacuation of employees in case of an emergency.

(4) A cofferdam shall have not less than 2 means of egress. Runways, bridges, or ramps shall be provided with guardrails as prescribed in Construction Safety Standard Part 45 "Fall Protection," as referenced in R 408.41410.

(5) If cofferdams are located close to navigable shipping channels, then warning devices that are visible to vessels in transit shall be provided.

R 408.41482. Caisson excavation; employee protection.

Rule 1482. (1) An employee who enters a caisson shall be protected by a steel or concrete casing designed by a qualified employee and approved by a registered engineer.

(2) A copy of the design specifications of the casing shall be maintained at the jobsite.

(3) In the case of belled-bottom caissons, the steel or concrete casing shall be provided for the full depth of that part of each caisson hole that is above the bell.

(4) An employer shall not permit an employee to work below the casing in running or unstable soil.

(5) The steel or concrete caisson shall extend not less than 12 inches above the ground line.

(6) Each employee who is required to enter a caisson excavation shall have a lanyard attached to a body harness and to the load line of a crane. The attachment to the load line shall utilize a screwpin shackle.

(7) An employee whose lanyard is attached to the load line of a crane shall be permitted to be lowered to the bottom of the caisson in the muck bucket.

(8) The maximum rate of travel when lowering an employee shall be 100 feet per minute. Free-spooling when lowering employees into a caisson is prohibited.

(9) All employees shall be removed from the caisson when material is being hoisted from the caisson.

(10) A secondary mechanical means that is capable of removing an employee from the caisson shall be readily available in case the crane performing the caisson work breaks down.

(11) A top person shall be stationed at the caisson and shall constantly monitor any employees who are in the caisson.

(12) A positive means of communication shall be maintained between employees working in the caisson and the top person.

(13) The air quality of a caisson shall be tested and maintained in accordance with Occupational Health Standard Part 665 "Underground Construction, Caissons, Cofferdams, and Compressed Air," as referenced in R 408.41410.

(14) Where space permits, a caisson shall have a stairway for its entire height and shall have landing platforms not more than 20 feet apart. Where this is impracticable, a ladder shall be installed and landing platforms shall be located not more than 20 feet apart to break the climb.

R 408.41483. Caissons used under pressure.

Rule 1483. (1) A caisson used under pressure shall be subjected to a hydrostatic test equal to 200% of the working pressure before being used on a job, at which pressure it shall be tight. The caisson shall be stamped on the outside shell about 12 inches from each flange to show the pressure to which it has been subjected.

(2) All caissons that have a diameter or side greater than 10 feet shall be provided with a man lock and shaft for the exclusive use of employees. In addition to the gauge in the locks, an accurate gauge shall be maintained on the outer and inner side of each bulkhead. These gauges shall be accessible at all times and kept in accurate working order.

(3) In caisson operations where employees are exposed to compressed air working environments, employers shall comply with Occupational Health Standard Part 665 "Underground Construction, Caissons, Cofferdams, and Compressed Air," as referenced in R 408.41410.



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