

WAC 296-155-730 Tunnels and shafts. (1) Scope and application.

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

(b) This section does not apply to excavation and trenching operations covered by Part N of this chapter, such as foundation operations for above-ground structures that are not physically connected to underground construction operations, and surface excavation.

(c) You must comply with the requirements of this part and chapter in addition to applicable requirements of chapter 296-36 WAC, Safety standards—Compressed air work.

(2) Access and egress.

(a) Each operation must have a check-in/check-out system that will provide positive identification of every employee underground. You must keep an accurate record of identification and location of the employees on the surface. This procedure is not required when the construction of underground facilities designed for human occupancy has been sufficiently completed so that the permanent environmental controls are effective, and when the remaining construction activity will not cause any environmental hazard, or structural failure within the facilities.

(b) You must provide and maintain safe means of access and egress to all work stations.

(c) You must provide access and egress in such a manner that employees are protected from being struck by excavators, haulage machines, trains, and other mobile equipment.

(d) You must control access to all openings to prevent unauthorized entry underground. Unused chutes, manways, or other openings must be tightly covered, bulkheaded, or fenced off, and must be posted with warning signs indicating "keep out" or similar language. Completed or unused sections of the underground facility must be barricaded.

(3) Safety instruction. You must instruct all employees in the recognition and avoidance of hazards associated with underground construction activities including, where appropriate, the following subjects:

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

(4) Notification.

(a) You must 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, fire(s), or explosions.

(b) You must record information specified in (a) of this subsection in a shift journal which must be current prior to the end of each shift, and must be located aboveground.

(c) Oncoming supervisory personnel must read the notification prior to going underground, and must signify their understanding of the contents by affixing their respective initials to the log.

(d) You must retain the hazard notification log on the site until the completion of the project.

(e) You must establish and maintain direct communications for coordination of activities with other employers whose operations at the job site affect or may affect the safety of employees underground.

(5) Communications.

(a) When natural unassisted voice communication is ineffective, you must use a power-assisted means of voice communication to provide communication between the work face, the bottom of the shaft, and the surface.

(b) You must provide two effective means of communication, at least one of which must be voice communication, in all shafts which are being developed or used either for personnel access or for hoisting. Additional requirements for hoist operator communication are contained in subsection (22)(c)(xv) of this section.

(c) Powered communication systems must operate on an independent power supply, and must be installed so that the use of or disruption of any one phone or signal location will not disrupt the operation of the system from any other location.

(d) You must test communication systems upon initial entry of each shift to the underground, and as often as necessary at later times, to ensure that they are in working order.

(e) You must provide any employee working alone underground in a hazardous location, who is both out of the range of natural unassisted voice communication and not under observation by other persons, with an effective means of obtaining assistance in an emergency.

(6) Emergency provisions. Hoisting capability. When a shaft is used as a means of egress, you must make advance arrangements for power-assisted hoisting capability to be readily available in an emergency, unless the regular hoisting means can continue to function in the event of an electrical power failure at the job site. Such hoisting means must 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) Self-rescuers. You must provide self-rescuers certified by the National Institute for Occupational Safety and Health under 42 C.F.R. Part 84. The respirators must be immediately available to all employees at work stations in underground areas where employees might be trapped by smoke or gas. The selection, issuance, use, and care of respirators must be in accordance with the requirements of chapter 296-842 WAC.

(8) Designated person. At least one designated person must be on duty aboveground whenever any employee is working underground. This designated person must be responsible for securing immediate aid and keeping an accurate record of the number, identification, and location of employees who are underground in case of emergency. The designated person must not be so busy with other responsibilities that the personnel counting and identification function is encumbered.

(9) Emergency lighting. Each employee underground must have an acceptable portable hand lamp or cap lamp in his or her work area for

emergency use, unless natural light or an emergency lighting system provides adequate illumination for escape.

(10) Rescue teams.

(a) On job sites where 25 or more employees work underground at one time, you must provide (or make arrangements in advance with locally available rescue services to provide) at least two 5-person rescue teams, one on the job site or within 1/2 hour travel time from the entry point, and the other within 2 hours travel time.

(b) On job sites where less than 25 employees work underground at one time, you must provide (or make arrangements in advance with locally available rescue services to provide) at least one 5-person rescue team to be either on the job site or within 1/2 hour travel time from the entry point.

(c) Rescue team members must be qualified in rescue procedures, the use and limitations of breathing apparatus, and the use of fire-fighting equipment. You must review qualification not less than annually.

(d) On job sites where flammable or noxious gases are encountered or anticipated in hazardous quantities, rescue team members must practice donning and using pressure demand mode, self-contained breathing apparatuses monthly.

(e) You must ensure that rescue teams are familiar with conditions at the job site.

(11) Hazardous classifications.

(a) Potentially gassy operations. Underground construction operations must be classified as potentially gassy if either:

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

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

(b) Gassy operations. Underground construction operations must be classified as gassy if:

(i) Air monitoring discloses 10 percent or more of the lower explosive limit for methane or other flammable gases measured at 12 inches (304.8 mm) +/- 0.25 inch (6.35 mm) from the roof, face, floor, or walls in any underground work area for 3 consecutive days; or

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

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

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

(12) Gassy operations—Additional requirements. You must only use acceptable equipment, maintained in suitable condition, in gassy operations.

(a) Mobile diesel-powered equipment used in gassy operations must be either approved in accordance with the requirements of 30 C.F.R.

Part 36 (formerly Schedule 31) by MSHA, or you must demonstrate it to be fully equivalent to such MSHA-approved equipment, and it must be operated in accordance with that part.

(b) You must prominently post each entrance to a gassy operation with signs notifying all entrants of the gassy classification.

(c) Smoking must be prohibited in all gassy operations and you must be responsible for collecting all personal sources of ignition, such as matches and lighters, from all persons entering a gassy operation.

(d) You must maintain a fire watch as described in chapter 296-155 WAC, Part H, when hot work is performed.

(e) Once an operation has met the criteria in subsection (11)(a)(i) of this section, warranting classification as gassy, you must discontinue all operations in the affected area, except the following, until the operation either is in compliance with all of the gassy operation requirements or has been declassified in accordance with (c) of this subsection:

(i) Operations related to the control of the gas concentration;

(ii) Installation of new equipment, or conversion of existing equipment, to comply with this subsection; and

(iii) Installation of above-ground controls for reversing the air flow.

(13) Air quality and monitoring.

(a) General. Air quality limits and control requirements specified in chapter 296-841 WAC apply except as modified by this subsection.

(b) You must assign a competent person who must perform all air monitoring required by this section.

(c) Where this section requires monitoring of airborne contaminants "as often as necessary," the competent person must make a reasonable determination as to which substances to monitor and how frequently to monitor, considering at least the following factors:

(i) Location of job site: Proximity to fuel tanks, sewers, gas lines, old landfills, coal deposits, and swamps;

(ii) Geology: Geological studies of the job site, particularly involving the soil type and its permeability;

(iii) History: Presence of air contaminants in nearby job sites, changes in levels of substances monitored on the prior shift; and

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

(d) You must provide testing and monitoring instruments which are capable of achieving compliance with the provisions of this subsection, and:

(i) Must maintain the testing and monitoring instruments in good condition;

(ii) Must calibrate the instruments on a frequency not to exceed 6 months.

(e) Exposure to airborne contaminants must not exceed the levels established by chapter 296-841 WAC.

(f) You must not substitute respirators for environmental control measures. However, where environmental controls have not yet been developed, or when necessary by the nature of the work involved (for example, welding, sand blasting, lead burning), an employee may work for short periods of time in concentrations of airborne contaminants which

exceed the limit of permissible exposure referred to in (d) of this subsection, if the employee wears a respiratory protective device certified by MSHA-NIOSH for protection against the particular hazards involved, and the selection and use of respirators complies with the provisions of chapter 296-842 WAC.

(g) You must withdraw employees from areas in which there is a concentration of an airborne contaminant which exceeds the permissible exposure limit listed for that contaminant, except as modified in (t)(i) and (ii) of this subsection.

(h) You must test the atmosphere in all underground work areas as often as necessary to assure that the atmosphere at normal atmospheric pressure contains at least 19.5% oxygen and no more than 22% oxygen.

(i) You must perform tests for oxygen content before tests for air contaminants.

(j) You must use field-type oxygen analyzers, or other suitable devices, to test for oxygen deficiency.

(k) You must test the atmosphere in all underground work areas quantitatively for carbon monoxide, nitrogen dioxide, hydrogen sulfide, and other toxic gases, dust, vapors, mists, and fumes as often as necessary to ensure that the permissible exposure limits prescribed in chapter 296-62 WAC, Part H, are not exceeded.

(l) You must test the atmosphere in all underground work areas quantitatively for methane and other flammable gases as often as necessary to determine:

(i) Whether action is to be taken under (q), (r), and (s) of this subsection; and

(ii) Whether an operation is to be classified potentially gassy or gassy under subsection (11) of this section.

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

(n) You must perform testing as often as necessary to ensure that the ventilation requirements of subsection (15) of this section are met.

(o) When rapid excavation machines are used, you must operate a continuous flammable gas monitor at the face with the sensor(s) placed as high and close to the front of the machine's cutter head as practicable.

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

(i) Whenever hydrogen sulfide is detected in an amount exceeding 10 ppm, you must use a continuous sampling and indicating hydrogen sulfide monitor to monitor the affected work area.

(ii) You must inform employees when a concentration of 10 ppm hydrogen sulfide is exceeded.

(iii) The continuous sampling and indicating hydrogen sulfide monitor must be designed, installed, and maintained to provide a visual and aural alarm when the hydrogen sulfide concentration reaches 15 ppm to signal that additional measures, such as respirator use, increased ventilation, or evacuation, might be necessary to maintain hydrogen sulfide exposure below the permissible exposure limit.

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

(i) Prominently post a notice at all entrances to the underground job site to inform all entrants of the hazardous condition; and

(ii) Immediately increase sampling frequency levels to insure workers are not exposed to identified contaminants in excess of the permissible exposure limit(s); and

(iii) Ensure that all necessary precautions are taken to comply with pertinent requirements of this section, and chapter 296-62 WAC.

(r) Whenever 5% or more of the lower explosive limit for methane or other flammable gases is detected in any underground work area(s) or in the air return, you must 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 must be reinstated whenever the 5% level is exceeded.

(s) 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, you must suspend such work until the concentration of such flammable gas is reduced to less than 10% of the lower explosive limit.

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

(i) You must immediately withdraw all employees, except those necessary to eliminate the hazard, to a safe location above ground; and

(ii) Employees who remain underground to correct or eliminate the hazard described in (t) above must be equipped with approved, pressure demand mode, self-contained breathing apparatus, and must have received adequate training in the proper use of that equipment.

(iii) You must cut off electrical power, except for acceptable pumping and ventilation equipment, to the area endangered by the flammable gas until the concentration of such gas is reduced to less than 20% of the lower explosive limit.

(14) Additional monitoring for potentially gassy and gassy operations. Operations which meet the criteria for potentially gassy and gassy operations set forth in subsection (13) of this section must be subject to the additional monitoring requirements of this subsection.

(a) You must conduct a test for oxygen content in the affected underground work areas and work areas immediately adjacent to such areas at least at the beginning and midpoint of each shift.

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

(i) You must use a manual flammable gas monitor as needed, but at least at the beginning and midpoint of each shift, to ensure that the limits prescribed in subsections (11) and (13) of this section are not exceeded. In addition, you must provide a manual electrical shut down control near the heading.

(ii) You must make local gas tests prior to and continuously during any welding, cutting, or other hot work.

(iii) In underground operations driven by drill-and-blast methods, you must test the air in the affected area for flammable gas prior to re-entry after blasting, and continuously when employees are working underground.

(c) Recordkeeping. You must maintain a record of all air quality tests above ground at the worksite and be made available to the director or his/her representatives upon request. The record must include the location, date, time, substance and amount monitored. You must retain records of exposures to toxic substances in accordance with Part B, chapter 296-62 WAC. You must retain all other air quality test records until completion of the project.

(15) Ventilation.

(a)(i) You must supply fresh air to all underground work areas in sufficient quantities to prevent dangerous or harmful accumulation of dust, fumes, mists, vapors, or gases.

(ii) You must provide mechanical ventilation in all underground work areas except when the employer can demonstrate that natural ventilation provides the necessary air quality through sufficient air volume and air flow.

(b) You must supply a minimum of 200 cubic feet (5.7 m³) of fresh air per minute for each employee underground.

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

(d) The direction of mechanical air flow must be reversible.

(e) You must not use air that has passed through underground oil or fuel-storage areas to ventilate working areas.

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

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

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

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

(j) When drilling rock or concrete, you must take appropriate dust control measures to maintain dust levels within limits set in chapter 296-155 WAC, Part B-1. Such measures may include, but are not limited to, wet drilling, the use of vacuum collectors, and water mix spray systems.

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

(ii) Mobile diesel-powered equipment used underground in atmospheres other than gassy operations must be either approved by MSHA in accordance with the provisions of 30 C.F.R. Part 32 (formerly Schedule 24), or you must prove it to be fully equivalent to such MSHA-approved equipment, and it must be operated in accordance with that Part. (Each brake horsepower of a diesel engine requires at least 100 cubic feet (28.32 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.)

(iii) You must submit an application to the mining/explosives section, department of labor and industries, for permission to use specified diesel equipment in a specified underground area and it must include the following:

(A) The type of construction and complete identification data and specifications including analysis of the undiluted exhaust gases of the diesel equipment.

(B) The location where the diesel equipment is to be used.

(C) Before the diesel equipment is taken underground, you must obtain written permission from the department of labor and industries or its duly authorized representative. A satisfactory test on surface, to show that the exhaust gases do not exceed the maximum percentage of carbon monoxide permitted, is required.

(D) You must only use diesel equipment underground where the ventilation is controlled by mechanical means and must not be operated if the ventilating current is less than 100 CFM per horsepower based on the maximum brake horsepower of the engines.

(E) You must take air measurements at least once daily in the diesel engine working area and the measurements entered in the Underground Diesel Engine Record Book. Permissible maximum amounts of noxious gases are as follows:

At engine exhaust ports	Carbon Monoxide	.10%	1,000 ppm ³
Next to equipment	Carbon Monoxide	.0035%	35 ppm
General atmosphere	Carbon Monoxide	.0035%	35 ppm
General atmosphere	Nitrogen Dioxide	.0001%	1 ppm
General atmosphere	Aldehydes	.0002%	2 ppm

³Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 mm Hg. pressure.

(1) Potentially gassy or gassy operations must have ventilation systems installed which must:

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

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

(m) You must provide gassy operations with controls located aboveground for reversing the air flow of ventilation systems.

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

(16) Illumination.

(a) You must provide sufficient lighting in accordance with the requirements of chapter 296-155 WAC, Part B-1, to permit safe operations at the face as well as in the general tunnel or shaft area and at the employees' workplace.

(b) You must only use acceptable portable lighting within 50 feet (15.24 m) of any underground heading during explosive handling.

(17) Fire prevention and control. Fire prevention and protection requirements applicable to underground construction operations are found in Part D of this chapter except as modified by the following additional standards.

(a) Open flames and fires are prohibited in all underground construction operations except as permitted for welding, cutting, and other hot work operations.

(i) Smoking may be allowed only in areas free of fire and explosion hazards.

(ii) You must post readily visible signs prohibiting smoking and open flames in areas having fire or explosion hazards.

(iii) You must prohibit the carrying of matches, lighters, or other flame-producing smoking materials in all underground operations where fire or explosion hazards exist.

(b) You may store underground no more than a 24-hour supply of diesel fuel for the underground equipment used at the worksite.

(c) The piping of diesel fuel from the surface to an underground location is permitted only if:

(i) Diesel fuel is contained at the surface in a tank whose maximum capacity is no more than the amount of fuel required to supply for a 24-hour period the equipment serviced by the underground fueling station; and

(ii) 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; and

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

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

(d) (i) You must not carry, store, or use gasoline underground.

(ii) 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 Part H of this chapter and subsections (13), (15), (17), and (18) of this section.

(e) You must keep oil, grease, and diesel fuel stored underground in tightly sealed containers in fire-resistant areas at least 300 feet (91.44 m) from underground explosive magazines, and at least 100 feet (30.48 m) from shaft stations and steeply inclined passageways. Storage areas must be positioned or diked so that the contents of ruptured or overturned containers will not flow from the storage area.

(f) You must not store flammable or combustible materials above ground within 100 feet (30.48 m) of any access opening to any underground operation. Where this is not feasible because of space limitations at the job site, such materials may be located within the 100-foot limit, provided that:

(i) They are located as far as practicable from the opening; and

(ii) Either a fire-resistant barrier of not less than one-hour rating is placed between the stored material and the opening, or additional precautions are taken which will protect the materials from ignition sources.

(g) You must use fire-resistant hydraulic fluids in hydraulically actuated underground machinery and equipment unless such equipment is protected by a fire suppression system or by multipurpose fire extin-

guisher(s) rated at a sufficient capacity for the type and size of hydraulic equipment involved, but rated at least 4A:40B:C.

(h) (i) You must only use electrical installations in underground areas where oil, grease, or diesel fuel are stored for lighting fixtures.

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

(i) You must clean up leaks and spills of flammable or combustible fluids immediately.

(j) You must provide a fire extinguisher of at least 4A:40B:C rating or other equivalent extinguishing means at the head pulley and at the tail pulley of underground belt conveyors, and at 300-foot intervals along the belt.

(k) Any structure located underground or within 100 feet (30.48 m) of an opening to the underground must be constructed of material having a fire-resistance rating of at least one hour.

(18) **Welding, cutting, and other hot work.** In addition to the requirements of Part H of this chapter, the following requirements apply to underground welding, cutting, and other hot work.

(a) You must not permit 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 underground.

(b) You must install noncombustible barriers below welding, cutting, or other hot work being done in or over a shaft or raise.

(19) **Ground support.**

(a) In tunnels (other than hard rock) you must use timber sets, steel rings, steel frames, concrete liners, or other engineered tunnel support systems. Every tunnel support system must be designed by a licensed professional engineer. Design specifications must be available at the worksite.

(b) Portal areas. You must guard portal openings and access areas by shoring, fencing, head walls, shotcreting, or other equivalent protection to ensure safe access of employees and equipment. Adjacent areas must be scaled or otherwise secured to prevent loose soil, rock, or fractured materials from endangering the portal and access area.

(c) Subsidence areas. You must ensure ground stability in hazardous subsidence areas by shoring, by filling in, or by erecting barricades and posting warning signs to prevent entry.

(d) Underground areas.

(i) (A) A competent person must inspect the roof, face, and walls of the work area at the start of each shift and as often as necessary to determine ground stability.

(B) You must protect competent persons conducting such inspections from loose ground by location, ground support, or equivalent means.

(ii) You must inspect ground conditions along haulageways and travelways as frequently as necessary to ensure safe passage.

(iii) You must take down, scale, or support loose ground that might be hazardous to employees.

(iv) You must use torque wrenches wherever bolts that depend on torsionally applied force are used for ground support.

(v) A competent person must determine whether rock bolts meet the necessary torque, and must determine the testing frequency in light of the bolt system, ground conditions, and the distance from vibration sources.

(vi) You must provide suitable protection for employees exposed to the hazard of loose ground while installing ground support systems.

(vii) You must install support sets so that the bottoms have sufficient anchorage to prevent ground pressures from dislodging the support base of the sets. You must provide lateral bracing (collar bracing, tie rods, or spreaders) between immediately adjacent sets to ensure added stability.

(viii) You must promptly repair or replace damaged or dislodged ground supports that create a hazardous condition. When replacing supports, you must install the new supports before the damaged supports are removed.

(ix) You must use a shield or other type of support to maintain a safe travelway for employees working in dead-end areas ahead of any support replacement operation.

(e) Shafts.

(i) Shafts and wells over 4 feet (1.219 m) in depth that employees must enter must be supported by a steel casing, concrete pipe, timber, solid rock, or other suitable material.

(ii)(A) The full depth of the shaft must be supported by casing or bracing except where the shaft penetrates into solid rock having characteristics that will not change as a result of exposure. Where the shaft passes through earth into solid rock, or through solid rock into earth, and where there is potential for shear, the casing or bracing must extend at least 5 feet (1.53 m) into the solid rock. When the shaft terminates in solid rock, the casing or bracing must extend to the end of the shaft or 5 feet (1.53 m) into the solid rock, whichever is less.

(B) The casing or bracing must extend 42 inches (1.07 m) plus or minus 3 inches (8 cm) above ground level, except that the minimum casing height may be reduced to 12 inches (0.3 m), provided that a standard railing is installed; that the ground adjacent to the top of the shaft is sloped away from the shaft collar to prevent entry of liquids; and that effective barriers are used to prevent mobile equipment operating near the shaft from jumping over the 12-inch (0.3 m) barrier.

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

(f) Blasting. This subsection applies in addition to the requirements for blasting and explosives operations, including handling of misfires, which are found in chapter 296-52 WAC.

(i) You must keep blasting wires clear of electrical lines, pipes, rails, and other conductive material, excluding earth, to prevent explosives initiation or employee exposure to electric current.

(ii) Following blasting, an employee must not enter a work area until the air quality meets the requirements of subsection (13) of this section.

(g) Drilling.

(i) A competent person must inspect all drilling and associated equipment prior to each use. You must correct equipment defects affecting safety before the equipment is used.

(ii) You must inspect the drilling area for hazards before the drilling operation is started.

(iii) You must not allow employees on a drill mast while the drill bit is in operation or the drill machine is being moved.

(iv) When a drill machine is being moved from one drilling area to another, you must secure drill steel, tools, and other equipment and the mast must be placed in a safe position.

(v) You must provide receptacles or racks for storing drill steel located on jumbos.

(vi) You must warn employees working below jumbo decks whenever drilling is about to begin.

(vii) You must anchor drills on columns firmly before starting drilling, and you must retighten them as necessary thereafter.

(viii) You must provide mechanical means on the top deck of a jumbo for lifting unwieldy or heavy material.

(ix) When jumbo decks are over 10 feet (3.05 m) in height, you must install stairs wide enough for two persons.

(x) Jumbo decks more than 10 feet (3.05 m) in height must be equipped with guardrails on all open sides, excluding access openings of platforms, unless an adjacent surface provides equivalent fall protection.

(xi) You must only allow employees assisting the operator to ride on jumbos, unless the jumbo meets the requirements of subsection (20)(e) of this section.

Note: For additional requirements relating to portable fire extinguishers see WAC 296-800-300.

(xii) Jumbos must be chocked to prevent movement while employees are working on them.

(xiii) You must maintain walking and working surfaces of jumbos to prevent the hazards of slipping, tripping, and falling.

(xiv) Jumbo decks and stair treads must be designed to be slip-resistant and secured to prevent accidental displacement.

(xv) Scaling bars must be available at scaling operations and you must maintain them in good condition at all times. You must not use blunted or severely worn bars.

(xvi) Before commencing the drill cycle, you must examine the face and lifters for misfires (residual explosives) and, if found, you must remove them before drilling commences at the face. You must not drill blasting holes through blasted rock (muck) or water.

(xvii) You must protect employees in a shaft either by location or by suitable barrier(s) if powered mechanical loading equipment is used to remove muck containing unfired explosives.

(xviii) You must post a caution sign reading "buried line," or similar wording where air lines are buried or otherwise hidden by water or debris.

(20) **Haulage.**

(a) A competent person must inspect haulage equipment before each shift.

(i) You must correct equipment defects affecting safety and health before the equipment is used.

(ii) Powered mobile haulage equipment must be provided with adequate brakes.

(iii) Power mobile haulage equipment, including trains, must have audible warning devices to warn employees to stay clear. The operator must sound the warning device before moving the equipment and whenever necessary during travel.

(iv) The operator must ensure that lights which are visible to employees at both ends of any mobile equipment, including a train, are turned on whenever the equipment is operating.

(v) In those cabs where glazing is used, the glass must be safety glass, or its equivalent, and you must maintain and clean it so that vision is not obstructed.

(b) You must install antirollback devices or brakes on inclined conveyor drive units to prevent conveyors from inadvertently running in reverse. You must not permit employees to ride a power-driven chain, belt, or bucket conveyor unless the conveyor is specifically designed for the transportation of persons.

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

(d) General requirements also applicable to underground construction for use of conveyors in construction are found in chapter 296-155 WAC, Part R.

(e) No employee must ride haulage equipment unless it is equipped with seating for each passenger and protects passengers from being struck, crushed, or caught between other equipment or surfaces. Members of train crews may ride on a locomotive if it is equipped with handholds and nonslip steps or footboards. Requirements applicable to underground construction for motor vehicle transportation of employees are found in chapter 296-155 WAC, Part M.

(f) Conveyor lockout.

(i) Conveyors must be deenergized and locked out with a padlock, and tagged out with a "Do Not Operate" tag at any time repair, maintenance, or clean-up work is being performed on the conveyor.

(ii) Tags or push button stops are not acceptable.

(iii) You must not allow people to walk on conveyors except for emergency purposes and then only after the conveyor has been deenergized and locked out in accordance with (f) above, and persons can do so safely.

(g) You must not leave powered mobile haulage equipment, including trains, unattended unless the master switch or motor is turned off; operating controls are in neutral or park position; and the brakes are set, or equivalent precautions are taken to prevent rolling.

(h) Whenever rails serve as a return for a trolley circuit, both rails must be bonded at every joint and crossbonded every 200 feet (60.96 m).

(i) When dumping cars by hand, the car dumps must have tiedown chains, bumper blocks, or other locking or holding devices to prevent the cars from overturning.

(j) Rocker-bottom or bottom-dump cars must be equipped with positive locking devices to prevent unintended dumping.

(k) You must load and secure equipment to be hauled to prevent sliding or dislodgement.

(l)(i) You must stop mobile equipment, including rail-mounted equipment, for manual connecting or service work, and;

(ii) Employees must not reach between moving cars during coupling operations.

(iii) You must not align, shift, or clean couplings on moving cars or locomotives.

(iv) You must use safety chains or other connections in addition to couplers to connect person cars or powder cars whenever the locomotive is uphill of the cars.

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

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

(m) Parked rail equipment must be chocked, blocked, or have brakes set to prevent inadvertent movement.

(n) You must provide berms, bumper blocks, safety hooks, or equivalent means to prevent overtravel and overturning of haulage equipment at dumping locations.

(o) You must provide bumper blocks or equivalent stopping devices at all track dead ends.

(p)(i) Only small handtools, lunch pails, or similar small items may be transported with employees in person cars, or on top of a locomotive.

(ii) When small hand tools or other small items are carried on top of a locomotive, the top must be designed or modified to retain them while traveling.

(q)(i) Where switching facilities are available, you must pull occupied personnel cars; you must not push them. If personnel cars must be pushed and visibility of the track ahead is hampered, then a qualified person must be stationed in the lead car to give signals to the locomotive operator.

(ii) Crew trips must consist of personnel loads only.

(21) **Electrical safety.** This subsection applies in addition to the general requirements for electrical safety which are found in Part I of this chapter.

(a) Electric power lines must be insulated or located away from water lines, telephone lines, air lines, or other conductive materials so that a damaged circuit will not energize the other systems.

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

(c) You must not use oil-filled transformers underground unless they are located in a fire-resistant enclosure suitably vented to the outside and surrounded by a dike to retain the contents of the transformers in the event of rupture.

(22) Hoisting unique to underground construction except as modified by this section, the provisions of chapter 296-155 WAC, Part L apply. Requirements for personnel hoists, material hoists, and elevators are found in Part R of this chapter and in this subsection.

(a) General requirements for cranes and hoists.

(i) You must secure or stack materials, tools, and supplies being raised or lowered, whether within a cage or otherwise, in a manner to prevent the load from shifting, snagging, or falling into the shaft.

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

(iii) Whenever a hoistway is not fully enclosed and employees are at the shaft bottom, you must stop conveyances or equipment at least 15 feet (4.57 m) 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.

(iv)(A) Before maintenance, repairs, or other work is commenced in the shaft served by a cage, skip, or bucket, you must inform the

operator and other employees in the area and give them suitable instructions.

(B) You must install a sign warning that work is being done in the shaft at the shaft collar, at the operator's station, and at each underground landing.

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

(vi) You must maintain spin-type connections, where used, in a clean condition and protected from foreign matter that could affect their operation.

(vii) Cage, skip, and load connections to the hoist rope must be made so that the force of the hoist pull, vibration, misalignment, release of lift force, or impact will not disengage the connection. You must use only closed shackles for cage and skip rigging.

(viii) When using wire rope wedge sockets, you must provide means to prevent wedge escapement and to ensure that the wedge is properly seated.

(b) Additional requirements for cranes. Cranes must 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 you must not use them as a substitute for other operational controls.

(c) Additional requirements for hoists.

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

(ii) Control levers must be of the "deadman type" which return automatically to their center (neutral) position upon release.

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

(iv) You must not use hoist machines with cast metal parts.

(v) 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.

(vi) Employees must 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 you must protect them by a body belt/harness system to prevent falling in accordance with chapter 296-880 WAC, Unified safety standards for fall protection.

(vii) You must not hoist personnel and materials (other than small tools and supplies secured in a manner that will not create a hazard to employees) 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.

(viii) Line speed must not exceed the design limitations of the systems.

(ix) Hoists must be equipped with landing level indicators at the operator's station. Marking of the hoist rope does not satisfy this requirement.

(x) Whenever glazing is used in the hoist house, it must be safety glass, or its equivalent, and be free of distortions and obstructions.

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

(xii) Hoist controls must 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.

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

(xiv) You must not use limit switches are to be used only to limit travel of loads when operational controls malfunction and as a substitute for other operational controls.

(xv) You must provide hoist operators with a closed-circuit voice communication system to each landing station, with speaker-microphones so located that the operator can communicate with individual landing stations during hoist use.

(xvi) 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 must be guided by fenders, rails, ropes, or a combination of those means.

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

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

(xix) Wire rope used in load lines of material hoists must 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 chapter 296-155 WAC, Part R, for design factors for wire rope used in personnel hoists. The design factors must 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.

(xx) A competent person must visually check all hoisting machinery, equipment, anchorages, and hoisting rope at the beginning of each shift and during hoist use, as necessary.

(xxi) Each safety device must be checked by a competent person at least weekly during hoist use to ensure suitable operation and safe condition.

(xxii) In order to ensure suitable operation and safe condition of all functions and safety devices, you must inspect and load-test each hoist assembly 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. You must 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. You must maintain the most recent certification record on file until completion of the project.

(xxiii) Before hoisting personnel or material, the operator must 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.

(xiv) You must correct unsafe conditions before using the equipment.

(d) Additional requirements for personnel hoists.

(i) Hoist drum systems must be equipped with at least two means of stopping the load, each of which must 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 under this subsection.

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

(iii) All sides of personnel cages must be enclosed by one-half inch (12.70 mm) wire mesh (not less than No. 14 gauge or equivalent) to a height of not less than 6 feet (1.83 m). However, 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.

(iv) All personnel cages must be provided with a positive locking door that does not open outward.

(v) All personnel cages must be provided with a protective canopy. The canopy must 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 must be sloped to the outside, and so designed that a section may be readily pushed upward to afford emergency egress. The canopy must cover the top in such a manner as to protect those inside from objects falling in the shaft.

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

(vii) During sinking operations in shafts where guides and safeties are not yet used, the travel speed of the personnel platform must not exceed 200 feet (60.96 m) per minute. You must install governor controls set for 200 feet (60.96 m) per minute in the control system and they must be used during personnel hoisting.

(viii) 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.

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

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296-155-730, filed 1/21/86; Order 76-29, § 296-155-730, filed 9/30/76;
Order 74-26, § 296-155-730, filed 5/7/74, effective 6/6/74.]