

Underground Construction

TUNNELING



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Preface

This booklet provides an overview and summary of the Oregon Occupational Safety and Health Division (Oregon OSHA) underground construction (tunneling) standard. It is not a substitute for the safety and health rules, which are available from:

Department of Consumer & Business Services
Oregon OSHA Resource Center
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Introduction

Oregon OSHA adopted its current underground construction rules, 1926.800, Subdivision S, on July 7, 1989, as a part of Oregon Administrative Rules, Division 3 – Construction.

Scope and application

The rule applies to construction of underground tunnels, shafts, chambers, and passageways. It also applies to cut-and-cover excavations, both those physically connected to tunnels and those that create conditions characteristic of underground construction. Hazards common to such work include reduced natural ventilation and light, difficult or limited access and egress, exposure to air contaminants, fire, and explosion.

Provisions of the standard

The standard gives employers the flexibility to select from a variety of appropriate and effective methods of controlling workplace hazards in underground construction. It includes a safety program focusing on instructing workers in topics appropriate to specific jobsites, and also gives specific duties and responsibilities to a “competent person.”

Competent person

A “competent person” is one capable of identifying existing and predictable workplace hazards who is authorized to take corrective action to eliminate them. A competent person is responsible for the following:

- Monitoring air
- Testing the atmosphere for flammable limits before restoring power and equipment and before returning to work after a ventilation system’s been shut down due to hazardous levels of flammable gas or methane
- Inspecting the work area for ground stability
- Inspecting all drilling equipment prior to each use
- Inspecting hauling equipment before each shift and visually checking all hoisting machinery, equipment, anchorages, and rope at the beginning of each shift and during hoisting

Safety instruction

Employers must ensure that workers are instructed on the recognition and avoidance of hazards associated with underground construction. Instruction must include the following topics that are appropriate to each jobsite:

- Air monitoring
- Ventilation and illumination
- Communications
- Flood control
- Mechanical and personal protective equipment
- Explosives: fire prevention and protection
- Emergency procedures: evacuation plans and check-in/check-out procedures

Access and egress

Employers must provide safe access to and egress from all workstations and prevent unauthorized underground entry. Completed or unused sections of an underground work area must be barricaded. Unused openings must be covered, fenced off, or posted with warning signs indicating “Keep Out” or other appropriate language.

Check-in/check-out

Employers must maintain a check-in/check-out procedure that ensures above-ground personnel can maintain an accurate count of people who are underground, in case of an emergency. At least one designated person must be on duty at the surface whenever anyone is working underground. That person is responsible for securing immediate aid in case of an emergency.

A check-in/check-out procedure is not required once the underground construction is completed to the point that there is effective permanent environmental controls in place, and when remaining construction activity won't cause an environmental hazard or structural failure.

Hazardous classifications

The rule provides classification criteria for gassy or potentially gassy operations and identifies additional requirements for work in gassy operations.

Potentially gassy operations

Potentially gassy operations occur under either of the following circumstances:

- When air monitoring shows, for more than a 24-hour period, 10 percent or more of the lower explosive limit (LEL) for methane or other flammable gases measured at 12 inches \pm 0.25 inch from the roof, face, floor, or walls in any underground work area
- When the geological formation or history of the area show that 10 percent or more of the LEL for methane or other flammable gases is likely to be encountered in the underground operation

Gassy operations

Gassy operations occur under the following conditions:

- When air monitoring shows, for three consecutive days, 10 percent or more of the LEL for methane or other flammable gases measured at 12 inches \pm 0.25 inch from the roof, face, floor, or walls in any underground work area
- When methane or other flammable gases emitting from the strata have ignited, indicating the presence of such gases
- When the underground operation is connected to a currently gassy underground work area and is subject to a continuous course of air containing a flammable gas concentration

Gassy operations require additional safety precautions, including the following:

- Using more-stringent ventilation requirements
- Using only diesel equipment approved for use in gassy operations
- Posting each entrance with warning signs and prohibiting smoking and personal sources of ignition
- Maintaining a fire watch when hot work is performed
- Suspending all operations in the affected area until all special requirements are met or the operation is declassified

Additional air monitoring is also required during gassy conditions.

Air monitoring

Employers must assign a competent person to perform required air monitoring and to determine proper ventilation and quantitative measurements of potentially hazardous gases.

When the rule requires monitoring of airborne contaminants “as often as necessary,” the competent person is responsible for determining which substances to monitor and how frequently, taking into consideration factors such as jobsite location, geology, history, work practices, and conditions.

The atmosphere in all underground areas must be tested quantitatively for carbon monoxide, nitrogen dioxide, hydrogen sulfide, and other toxic gases, dusts, vapors, mists, and fumes as often as necessary to ensure that prescribed limits are met. Quantitative tests for methane must also be performed in order to determine whether an operation is gassy or potentially gassy.

A record of all air-quality tests (including location, date, time, substances, and amount monitored) must be kept above ground at the worksite and must be made available to Oregon OSHA representatives upon request.

Oxygen

Testing must be performed as often as necessary to ensure that the atmosphere at normal atmospheric pressure contains at least 19.5 percent oxygen but not more than 22 percent.

Hydrogen sulfide

When air monitoring indicates the presence of five parts per million (ppm) or more of hydrogen sulfide, the affected area must be tested at the beginning and midpoint of each shift until the concentration of hydrogen sulfide has been less than five ppm for three consecutive days. Continuous monitoring must be performed when hydrogen sulfide is present above 10 ppm, and employees must be notified.

At concentrations of 20 ppm, an alarm must audibly and visibly signal to show that additional measures may be required (e.g., respirators, increased ventilation, evacuation) to maintain proper exposure levels.

Other precautions

When the competent person determines that there are contaminants present that are dangerous to life, the employer must post notices of the condition at all entrances to underground work areas and ensure that necessary precautions are taken.

In cases where 5 percent or more of the LEL for dangerous gases is present, steps must be taken to increase ventilation air volume to

reduce the concentration to less than 5 percent of the LEL (except when operating under gassy/potentially gassy requirements).

When 10 percent or more of the LEL for methane or other flammable gases is detected in welding, cutting, or other hot work areas, work must be suspended until the concentration is reduced to less than 10 percent of the LEL.

Where there is a 20 percent or more LEL for these gases, all employees must be withdrawn immediately to a safe above-ground location, except those necessary to eliminate the hazard. Electrical power, except for power to pumping and ventilation equipment, must be cut off to the endangered area until the concentration of the gas is less than 20 percent of the LEL.

Potentially gassy and gassy operations require additional air-monitoring steps, including the following:

- Testing for oxygen in the affected work areas
- Using flammable-gas-monitoring equipment (continuous automatic when using rapid excavation machines; manual as needed to monitor prescribed limits)
- Performing local gas tests prior to and continuously during any hot work
- Testing continuously for flammable gas when employees are working underground using drill and blast methods, and testing prior to re-entry after blasting

Ventilation

There are a number of requirements for ventilation in underground construction activities. In general, fresh air must be supplied to all underground work areas in amounts sufficient to prevent any dangerous or harmful accumulation of dusts, fumes, mists, vapors, or gases.

A minimum of 200 cubic feet of fresh air per minute must be supplied for each employee underground. Mechanical ventilation with reversible airflow must be provided in all of these work areas, except where natural ventilation is clearly adequate. In blasting, drilling, or other operations that may cause harmful amounts of dust, fumes, vapors, etc., the airflow velocity must be at least 30 feet per minute.

For gassy or potentially gassy operations, ventilation systems must meet additional requirements. Ventilation systems used during gassy operations also must have above-ground controls for reversing airflow.

Illumination

As in all construction operations, the rule requires that proper illumination be provided during tunneling operations, as specified in 29 CFR 1926.56. When explosives are being handled, acceptable portable lighting equipment must be used within 50 feet of any underground heading.

Fire prevention and control

In addition to the requirements of Subdivision F – Fire Protection and Prevention, open flames and fires are prohibited in all underground construction activities, except for hot-work operations. Smoking is allowed only in areas free of fire and explosion hazards; employers must post signs prohibiting smoking and open flames where such hazards exist.

Various work practices are also identified as preventive measures. For example, there are limitations on the piping of diesel fuel from the surface to an underground location. Also, the pipe or hose system used to transfer fuel from the surface to the storage tank must remain empty except when transferring fuel. Gasoline must not be used, stored, or carried underground.

Gases such as acetylene, liquefied petroleum, and methylacetylene propadiene (stabilized), may be used underground only for hot-work operations. Leaks and spills of flammable or combustible fluids must be cleaned up immediately. The rule also requires specific fire prevention and protection measures, including fire-resistant barriers, fire-resistant hydraulic fluids, fire extinguishers, etc.

Hot work

During hot work such as welding, noncombustible barriers must be installed below work being performed in or over a shaft or raise. Only the amount of fuel gas and oxygen cylinders necessary to perform welding, cutting, or other hot work in a 24-hour period may be kept underground during these operations. Cylinders must be removed when the work is completed.

Cranes and hoists

The rule includes provisions for hoisting that are unique to underground construction, as well as referencing 1926.550. These provisions include:

- Securing or stacking materials, tools, etc., that are being raised or lowered to prevent the load from shifting, snagging, or falling into the shaft.
- Using a flashing warning light for employees at the shaft bottom and subsurface shaft entrances whenever a load is above these locations or is being moved in the shaft.
- Following procedures for the proper lowering of loads when a hoistway is not fully enclosed, and employees are at the shaft bottom. Informing and instructing employees about impending maintenance and repair work in shafts served by cages, skips, or buckets.
- Providing a warning sign at the shaft collar, at the operator's station, and at each underground landing about work being performed in the shaft.
- Using connections between the hoisting rope and cage or skip that are compatible with the wire rope used for hoisting. Using cage, skip, and load connections that won't disengage from the force of the hoist pull, vibration, misalignment, release of lift force, or impact.
- Maintaining spin-type connections in a clean condition. Ensuring that, when they are used, wire rope wedge sockets are properly seated.

Limit switches or anti-two-block devices may be used for cranes only to limit travel of loads when operational controls fail — not as substitutes for other operational controls.

Emergencies

At worksites where 25 or more employees work underground at one time, employers must provide rescue teams or services that include at least two five-person teams (one on the jobsite or within a half-hour's travel time, and one within two hours' travel). When there are fewer than 25 employees underground at one time, employers must provide, or make available in advance, one five-person rescue team on site or within a half-hour's travel time.

Rescue team members must be qualified in rescue procedures and in the use of firefighting equipment and breathing apparatus. Their qualifications must be reviewed annually.

Employers must ensure that rescue teams are familiar with jobsite conditions. Team members must practice donning and using self-contained breathing apparatus on a monthly basis for jobsites where flammable or noxious gases are encountered or anticipated in hazardous quantities.

As part of the emergency procedures, employers must provide self-rescuers (approved by the National Institute for Occupational Safety and Health (NIOSH) and the Mine Safety and Health Administration (MSHA) to be immediately available to all employees at underground workstations who might be trapped by smoke or gas. Selection, use, and care of respirators must be in accordance with 1926.103 (b) and (c).

A “designated” or authorized person must be responsible for securing immediate aid for workers and for keeping an accurate count of underground employees.

Emergency lighting such as an acceptable portable hand or cap lamp must also be provided to workers in their work areas, unless natural lighting or an emergency lighting system provides adequate light for escape.

Recordkeeping

Under Oregon OSHA standards, 1926.33 and 1910.1020, records of exposure to toxic substances and data analyses based on these records must be kept for 30 years. Medical records must be kept for at least the duration of employment, plus 30 years. Background data for exposure records such as laboratory reports and work sheets need be kept only for one year.

Records of employees who have worked for less than one year needn’t be kept after employment, but the employer must provide these records to the employee upon termination of employment. First-aid records of one-time treatment needn’t be retained for any specific period.

Three months before disposing of records, employers must notify the director of NIOSH.

Hazard communication

Under the hazard communication standard (1926.59), employers must inform employees of the hazards and the identities of chemicals to which they’re exposed when working. The standard covers both physical hazards (e.g., flammability) and health hazards (e.g., lung damage, cancer). The rule also requires a written hazard communication program, labels and other forms of warning, material safety data sheets (MSDSs), and employee information and training.

Oregon OSHA Services

Oregon OSHA offers a wide variety of safety and health services to employers and employees:

Consultative Services

- Offers no-cost, on-site safety and health assistance to help Oregon employers recognize and correct workplace safety and health problems.
- Provides consultations in the areas of safety, industrial hygiene, ergonomics, occupational safety and health programs, assistance to new businesses, the Safety and Health Achievement Recognition Program (SHARP), and the Voluntary Protection Program (VPP).

Enforcement

- Offers pre-job conferences for mobile employers in industries such as logging and construction.
- Inspects places of employment for occupational safety and health hazards and investigates workplace complaints and accidents.
- Provides abatement assistance to employers who have received citations and provides compliance and technical assistance by phone.

Appeals, Informal Conferences

- Provides the opportunity for employers to hold informal meetings with Oregon OSHA on concerns about workplace safety and health.
- Discusses Oregon OSHA's requirements and clarifies workplace safety or health violations.
- Discusses abatement dates and negotiates settlement agreements to resolve disputed citations.

Standards and Technical Resources

- Develops, interprets, and provides technical advice on safety and health standards.
- Provides copies of all Oregon OSHA occupational safety and health standards.
- Publishes booklets, pamphlets, and other materials to assist in the implementation of safety and health standards and programs.
- Operates a Resource Center containing books, topical files, technical periodicals, and a video lending library.

Public Education and Conferences

- Conducts conferences, seminars, workshops, and rule forums.
- Coordinates and provides technical training on topics such as confined space, ergonomics, lockout/tagout, and excavations.
- Provides workshops covering management of basic safety and health programs, safety committees, accident investigation, and job safety analysis.
- Manages the Safety and Health Education and Training Grant Program, which awards grants to industrial and labor groups to develop training materials in occupational safety and health for Oregon workers.

For more information, call the Oregon OSHA office nearest you.

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