

- **Part Number:** 1926
- **Part Number Title:** Safety and Health Regulations for Construction
- **Subpart:** 1926 Subpart P
- **Subpart Title:** Excavations
- **Standard Number:** [1926.650](#)
- **Title:** Scope, application, and definitions applicable to this subpart.
- **GPO Source:** [e-CFR](#)

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#### 1926.650(a)

Scope and application. This subpart applies to all open excavations made in the earth's surface. Excavations are defined to include trenches.

#### [1926.650\(b\)](#)

Definitions applicable to this subpart.

"Accepted engineering practices" means those requirements which are compatible with standards of practice required by a registered professional engineer.

"Aluminum Hydraulic Shoring" means a pre-engineered shoring system comprised of aluminum hydraulic cylinders (crossbraces) used in conjunction with vertical rails (uprights) or horizontal rails (wales). Such system is designed specifically to support the sidewalls of an excavation and prevent cave-ins.

"Bell-bottom pier hole" means a type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a belled shape.

"Benching (Benching system)" means a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

"Cave-in" means the separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

"Competent person" means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

"Cross braces" mean the horizontal members of a shoring system installed perpendicular to the sides of the excavation, the ends of which bear against either uprights or wales.

"Excavation" means any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

"Faces" or "sides" means the vertical or inclined earth surfaces formed as a result of excavation work.

"Failure" means the breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

"Hazardous atmosphere" means an atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

"Kickout" means the accidental release or failure of a cross brace.

"Protective system" means a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

"Ramp" means an inclined walking or working surface that is used to gain access to one point from another, and is constructed from earth or from structural materials such as steel or wood.

By Standard Number / 1926.651 - Specific Excavation Requirements.

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#### 1926.651(a)

*Surface encumbrances.* All surface encumbrances that are located so as to create a hazard to employees shall be removed or supported, as necessary, to safeguard employees.

#### 1926.651(b)

*Underground installations.*

##### 1926.651(b)(1)

The estimated location of utility installations, such as sewer, telephone, fuel, electric, water lines, or any other underground installations that reasonably may be expected to be encountered during excavation work, shall be determined prior to opening an excavation.

##### 1926.651(b)(2)

Utility companies or owners shall be contacted within established or customary local response times, advised of the proposed work, and asked to establish the location of the utility underground installations prior to the start of actual excavation. When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours (unless a longer period is required by state or local law), or cannot establish the exact location of these installations, the employer may proceed, provided the employer does so with caution, and provided detection equipment or other acceptable means to locate utility installations are used.

##### 1926.651(b)(3)

When excavation operations approach the estimated location of underground installations, the exact location of the installations shall be determined by safe and acceptable means.

##### 1926.651(b)(4)

While the excavation is open, underground installations shall be protected, supported or removed as necessary to safeguard employees.

#### 1926.651(c)

*Access and egress -*

##### 1926.651(c)(1)

*Structural ramps.*

1926.651(c)(1)(i)

Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person. Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design, and shall be constructed in accordance with the design.

1926.651(c)(1)(ii)

Ramps and runways constructed of two or more structural members shall have the structural members connected together to prevent displacement.

1926.651(c)(1)(iii)

Structural members used for ramps and runways shall be of uniform thickness.

1926.651(c)(1)(iv)

Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom of the runway or shall be attached in a manner to prevent tripping.

1926.651(c)(1)(v)

Structural ramps used in lieu of steps shall be provided with cleats or other surface treatments on the top surface to prevent slipping.

1926.651(c)(2)

*Means of egress from trench excavations.* A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are 4 feet (1.22 m) or more in depth so as to require no more than 25 feet (7.62 m) of lateral travel for employees.

1926.651(d)

*Exposure to vehicular traffic.* Employees exposed to public vehicular traffic shall be provided with, and shall wear, warning vests or other suitable garments marked with or made of reflectorized or high-visibility material.

1926.651(e)

*Exposure to falling loads.* No employee shall be permitted underneath loads handled by lifting or digging equipment. Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped, in accordance with §1926.601(b)(6), to provide adequate protection for the operator during loading and unloading operations.

1926.651(f)

*Warning system for mobile equipment.* When mobile equipment is operated adjacent to an excavation, or when such equipment is required to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system shall be utilized such as barricades, hand or mechanical signals, or stop logs. If possible, the grade should be away from the excavation.

## 1926.651(g)

*Hazardous atmospheres -*

## 1926.651(g)(1)

*Testing and controls.* In addition to the requirements set forth in subparts D and E of this part (29 CFR 1926.50 - 1926.107) to prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions, the following requirements shall apply:

## 1926.651(g)(1)(i)

Where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, the atmospheres in the excavation shall be tested before employees enter excavations greater than 4 feet (1.22 m) in depth.

## 1926.651(g)(1)(ii)

Adequate precautions shall be taken to prevent employee exposure to atmospheres containing less than 19.5 percent oxygen and other hazardous atmospheres. These precautions include providing proper respiratory protection or ventilation in accordance with subparts D and E of this part respectively.

## 1926.651(g)(1)(iii)

Adequate precaution shall be taken such as providing ventilation, to prevent employee exposure to an atmosphere containing a concentration of a flammable gas in excess of 20 percent of the lower flammable limit of the gas.

## 1926.651(g)(1)(iv)

When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing shall be conducted as often as necessary to ensure that the atmosphere remains safe.

## 1926.651(g)(2)

*Emergency rescue equipment.*

## 1926.651(g)(2)(i)

Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, shall be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. This equipment shall be attended when in use.

## 1926.651(g)(2)(ii)

Employees entering bell-bottom pier holes, or other similar deep and confined footing excavations, shall wear a harness with a life-line securely attached to it. The lifeline shall be separate from any line used to handle materials, and shall be individually attended at all times while the employee wearing the lifeline is in the excavation.

## 1926.651(h)

*Protection from hazards associated with water accumulation.*

## 1926.651(h)(1)

Employees shall not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.

## 1926.651(h)(2)

If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations shall be monitored by a competent person to ensure proper operation.

## 1926.651(h)(3)

If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. Excavations subject to runoff from heavy rains will require an inspection by a competent person and compliance with paragraphs (h)(1) and (h)(2) of this section.

## 1926.651(i)

*Stability of adjacent structures.*

## 1926.651(i)(1)

Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.

## 1926.651(i)(2)

Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted except when:

## 1926.651(i)(2)(i)

A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure; or

## 1926.651(i)(2)(ii)

The excavation is in stable rock; or

## 1926.651(i)(2)(iii)

A registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity; or

## 1926.651(i)(2)(iv)

A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees.

## 1926.651(i)(3)

Sidewalks, pavements, and appurtenant structure shall not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

## 1926.651(j)

*Protection of employees from loose rock or soil.*

## 1926.651(j)(1)

Adequate protection shall be provided to protect employees from loose rock or soil that could pose a hazard by falling or rolling from an excavation face. Such protection shall consist of scaling to remove loose material; installation of protective barricades at intervals as necessary on the face to stop and contain falling material; or other means that provide equivalent protection.

## 1926.651(j)(2)

Employees shall be protected from excavated or other materials or equipment that could pose a hazard by falling or rolling into excavations. Protection shall be provided by placing and keeping such materials or equipment at least 2 feet (.61 m) from the edge of excavations, or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary.

## 1926.651(k)

*Inspections.*

## 1926.651(k)(1)

Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the competent person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.

## 1926.651(k)(2)

Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

## 1926.651(l)

Walkways shall be provided where employees or equipment are required or permitted to cross over excavations. Guardrails which comply with §1926.502(b) shall be provided where walkways are 6 feet (1.8 m) or more above lower levels.

[54 FR 45959, Oct. 31, 1989, as amended at 59 FR 40730, Aug. 9, 1994]

"Registered Professional Engineer" means a person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.

"Sheeting" means the members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

"Shield (Shield system)" means a structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either premanufactured or job-built in accordance with 1926.652(c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

"Shoring (Shoring system)" means a structure such as a metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

"Sides". See "Faces."

"Sloping (Sloping system)" means a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

"Stable rock" means natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. Unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against caving-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.

"Structural ramp" means a ramp built of steel or wood, usually used for vehicle access. Ramps made of soil or rock are not considered structural ramps.

"Support system" means a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

"Tabulated data" means tables and charts approved by a registered professional engineer and used to design and construct a protective system.

"Trench (Trench excavation)" means a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 m). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.6 m) or less (measured at the bottom of the excavation), the excavation is also considered to be a trench.

"Trench box." See "Shield."

"Trench shield." See "Shield."

"Uprights" means the vertical members of a trench shoring system placed in contact with the earth and usually positioned so that individual members do not contact each other. Uprights placed so that individual members are closely spaced, in contact with or interconnected to each other, are often called "sheeting."

"Wales" means horizontal members of a shoring system placed parallel to the excavation face whose sides bear against the vertical members of the shoring system or earth.

By Standard Number / 1926.652 - Requirements for protective systems.

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1926.652(a)

*Protection of employees in excavations.*

1926.652(a)(1)

Each employee in an excavation shall be protected from cave-ins by an adequate protective system designed in accordance with paragraph (b) or (c) of this section except when:

1926.652(a)(1)(i)

Excavations are made entirely in stable rock; or

1926.652(a)(1)(ii)

Excavations are less than 5 feet (1.52m) in depth and examination of the ground by a competent person provides no indication of a potential cave-in.

1926.652(a)(2)

Protective systems shall have the capacity to resist without failure all loads that are intended or could reasonably be expected to be applied or transmitted to the system.

1926.652(b)

*Design of sloping and benching systems.* The slopes and configurations of sloping and benching systems shall be selected and constructed by the employer or his designee and shall be in accordance with the requirements of paragraph (b)(1); or, in the alternative, paragraph (b)(2); or, in the alternative, paragraph (b)(3), or, in the alternative, paragraph (b)(4), as follows:

1926.652(b)(1)

*Option (1)-Allowable configurations and slopes*

1926.652(b)(1)(i)

Excavations shall be sloped at an angle not steeper than one and one-half horizontal to one vertical (34 degrees measured from the horizontal), unless the employer uses one of the other options listed below.

1926.652(b)(1)(ii)

Slopes specified in paragraph (b)(1)(i) of this section, shall be excavated to form configurations that are in accordance with the slopes shown for Type C soil in appendix B to this subpart.

## 1926.652(b)(2)

*Option (2)-Determination of slopes and configurations using Appendices A and B.* Maximum allowable slopes, and allowable configurations for sloping and benching systems, shall be determined in accordance with the conditions and requirements set forth in appendices A and B to this subpart.

## 1926.652(b)(3)

*Option (3)-Designs using other tabulated data.*

## 1926.652(b)(3)(i)

Designs of sloping or benching systems shall be selected from and be in accordance with tabulated data, such as tables and charts.

## 1926.652(b)(3)(ii)

The tabulated data shall be in written form and shall include all of the following:

## 1926.652(b)(3)(ii)(A)

Identification of the parameters that affect the selection of a sloping or benching system drawn from such data;

## 1926.652(b)(3)(ii)(B)

Identification of the limits of use of the data, to include the magnitude and configuration of slopes determined to be safe;

## 1926.652(b)(3)(ii)(C)

Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

## 1926.652(b)(3)(iii)

At least one copy of the tabulated data which identifies the registered professional engineer who approved the data, shall be maintained at the jobsite during construction of the protective system. After that time the data may be stored off the jobsite, but a copy of the data shall be made available to the Secretary upon request.

## 1926.652(b)(4)

*Option (4)-Design by a registered professional engineer.*

## 1926.652(b)(4)(i)

Sloping and benching systems not utilizing Option (1) or Option (2) or Option (3) under paragraph (b) of this section shall be approved by a registered professional engineer.

## 1926.652(b)(4)(ii)

Designs shall be in written form and shall include at least the following:

## 1926.652(b)(4)(ii)(A)

The magnitude of the slopes that were determined to be safe for the particular project;

## 1926.652(b)(4)(ii)(B)

The configurations that were determined to be safe for the particular project; and

## 1926.652(b)(4)(ii)(C)

The identity of the registered professional engineer approving the design.

## 1926.652(b)(4)(iii)

At least one copy of the design shall be maintained at the jobsite while the slope is being constructed. After that time the design need not be at the jobsite, but a copy shall be made available to the Secretary upon request.

## 1926.652(c)

*Design of support systems, shield systems, and other protective systems.* Designs of support systems shield systems, and other protective systems shall be selected and constructed by the employer or his designee and shall be in accordance with the requirements of paragraph (c)(1); or, in the alternative, paragraph (c)(2); or, in the alternative, paragraph (c)(3); or, in the alternative, paragraph (c)(4) as follows:

## 1926.652(c)(1)

*Option (1)-Designs using appendices A, C and D.* Designs for timber shoring in trenches shall be determined in accordance with the conditions and requirements set forth in appendices A and C to this subpart. Designs for aluminum hydraulic shoring shall be in accordance with paragraph (c)(2) of this section, but if manufacturer's tabulated data cannot be utilized, designs shall be in accordance with appendix D.

## 1926.652(c)(2)

*Option (2)-Designs Using Manufacturer's Tabulated Data.*

## 1926.652(c)(2)(i)

Design of support systems, shield systems, or other protective systems that are drawn from manufacturer's tabulated data shall be in accordance with all specifications, recommendations, and limitations issued or made by the manufacturer.

## 1926.652(c)(2)(ii)

Deviation from the specifications, recommendations, and limitations issued or made by the manufacturer shall only be allowed after the manufacturer issues specific written approval.

## 1926.652(c)(2)(iii)

Manufacturer's specifications, recommendations, and limitations, and manufacturer's approval to deviate from the specifications, recommendations, and limitations shall be in written form at the jobsite during construction of the protective system. After that time this data may be stored off the jobsite, but a copy shall be made available to the Secretary upon request.

## 1926.652(c)(3)

*Option (3)-Designs using other tabulated data.*

## 1926.652(c)(3)(i)

Designs of support systems, shield systems, or other protective systems shall be selected from and be in accordance with tabulated data, such as tables and charts.

## 1926.652(c)(3)(ii)

The tabulated data shall be in written form and include all of the following:

## 1926.652(c)(3)(ii)(A)

Identification of the parameters that affect the selection of a protective system drawn from such data;

## 1926.652(c)(3)(ii)(B)

Identification of the limits of use of the data;

1926.652(c)(3)(ii)(C)

Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

1926.652(c)(3)(iii)

At least one copy of the tabulated data, which identifies the registered professional engineer who approved the data, shall be maintained at the jobsite during construction of the protective system. After that time the data may be stored off the jobsite, but a copy of the data shall be made available to the Secretary upon request.

1926.652(c)(4)

*Option (4)-Design by a registered professional engineer.*

1926.652(c)(4)(i)

Support systems, shield systems, and other protective systems not utilizing Option 1, Option 2 or Option 3, above, shall be approved by a registered professional engineer.

1926.652(c)(4)(ii)

Designs shall be in written form and shall include the following:

1926.652(c)(4)(ii)(A)

A plan indicating the sizes, types, and configurations of the materials to be used in the protective system; and

1926.652(c)(4)(ii)(B)

The identity of the registered professional engineer approving the design.

1926.652(c)(4)(iii)

At least one copy of the design shall be maintained at the jobsite during construction of the protective system. After that time, the design may be stored off the jobsite, but a copy of the design shall be made available to the Secretary upon request.

1926.652(d)

*Materials and equipment.*

1926.652(d)(1)

Materials and equipment used for protective systems shall be free from damage or defects that might impair their proper function.

1926.652(d)(2)

Manufactured materials and equipment used for protective systems shall be used and maintained in a manner that is consistent with the recommendations of the manufacturer, and in a manner that will prevent employee exposure to hazards.

1926.652(d)(3)

When material or equipment that is used for protective systems is damaged, a competent person shall examine the material or equipment and evaluate its suitability for continued use. If the competent person cannot assure the material or equipment is able to support the intended loads or is otherwise suitable for safe use, then such

material or equipment shall be removed from service, and shall be evaluated and approved by a registered professional engineer before being returned to service.

1926.652(e)

*Installation and removal of support-*

1926.652(e)(1)

*General.*

1926.652(e)(1)(i)

Members of support systems shall be securely connected together to prevent sliding, falling, kickouts, or other predictable failure.

1926.652(e)(1)(ii)

Support systems shall be installed and removed in a manner that protects employees from cave-ins, structural collapses, or from being struck by members of the support system.

1926.652(e)(1)(iii)

Individual members of support systems shall not be subjected to loads exceeding those which those members were designed to withstand.

1926.652(e)(1)(iv)

Before temporary removal of individual members begins, additional precautions shall be taken to ensure the safety of employees, such as installing other structural members to carry the loads imposed on the support system.

1926.652(e)(1)(v)

Removal shall begin at, and progress from, the bottom of the excavation. Members shall be released slowly so as to note any indication of possible failure of the remaining members of the structure or possible cave-in of the sides of the excavation.

1926.652(e)(1)(vi)

Backfilling shall progress together with the removal of support systems from excavations.

1926.652(e)(2)

*Additional requirements for support systems for trench excavations.*

1926.652(e)(2)(i)

Excavation of material to a level no greater than 2 feet (.61 m) below the bottom of the members of a support system shall be permitted, but only if the system is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the support system.

1926.652(e)(2)(ii)

Installation of a support system shall be closely coordinated with the excavation of trenches.

1926.652(f)

*Sloping and benching systems.* Employees shall not be permitted to work on the faces of sloped or benched excavations at levels above other employees except when employees at the lower levels are adequately

protected from the hazard of falling, rolling, or sliding material or equipment.

1926.652(g)

*Shield systems-*

1926.652(g)(1)

*General.*

1926.652(g)(1)(i)

Shield systems shall not be subjected to loads exceeding those which the system was designed to withstand.

1926.652(g)(1)(ii)

Shields shall be installed in a manner to restrict lateral or other hazardous movement of the shield in the event of the application of sudden lateral loads.

1926.652(g)(1)(iii)

Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields.

1926.652(g)(1)(iv)

Employees shall not be allowed in shields when shields are being installed, removed, or moved vertically.

1926.652(g)(2)

*Additional requirement for shield systems used in trench excavations.* Excavations of earth material to a level not greater than 2 feet (.61 m) below the bottom of a shield shall be permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the shield.

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## UNITED STATES DEPARTMENT OF LABOR

Occupational Safety & Health Administration

200 Constitution Ave NW

Washington, DC 20210

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