

ASSE Tech Brief



February 10, 2010

ANSI/ASSE A10.16 Tech Brief: Tunnel, Shaft & Caisson Construction Safety

As employers prepare for the upcoming construction season, many have asked what they can do to better protect their employees from the hazards of tunnel, shaft and caisson construction.

When constructing tunnels, shafts and caissons, workers are often exposed to extreme conditions, such as reduced natural ventilation and light and the potential for fires, explosions, floods and earthquakes. Workers must also watch for loose soil, rock or fractured materials, moving loading or hauling equipment and flying debris. In addition, limited means of access and egress, risk of exposure to dangerous gases, such as hydrogen sulfide, and work conducted in confined spaces or compressed air or near electrical, drilling and blasting sites can pose serious hazards to workers.

ASSE's new revised A10.16 Standard, <https://www.asse.org/cartpage.php?link=A10-construction-standards> establishes safety requirements for the construction of tunnels, shafts and caissons. The standard addresses environmental control, related facilities, fire prevention, hoisting, haulage and electrical, drilling, blasting and compressed air work.

The A10 Accredited Standards Committee is currently working to have U.S. government agencies recognize the A10.16 standard, especially as more construction projects are undertaken as part of the American Recovery and Reinvestment Act of 2009.

Title: ANSI/ASSE A10.16-2009 "Safety Requirements for Tunnels, Shafts, and Caissons"

Approval Date: November 10, 2009

Effective Date: February 10, 2010 (Fifty Pages)

Past Versions: 1981 (First version released)

1988 (This was a revision of the 1981 Standard)

1995 (This was a revision of the 1988 Standard)

1995 (R2001 – This was a reaffirmation of the 1995 Standard)

Scope. This standard establishes safety requirements pertaining to the construction of tunnels, shafts, and caissons. The requirements set forth in this standard cover environmental control; related facilities; fire prevention; hoisting; haulage; and electrical, drilling and blasting, and compressed air work. This standard is not intended for application to mining or quarrying operations.

Purpose. The purpose of this standard is to establish reasonable and practical safety requirements and practices for the construction of tunnels, shafts, and caissons.

Scope:

Table of Contents – Attached Below

Table of Contents – A10.16 – Approved Standard

Contents	SECTION.....	PAGE
	1. General.....	11
	1.1 Scope.....	11
	1.2 Purpose.....	11
	1.3 Exceptions.....	11
	2. Referenced Standards.....	11
	2.1 Related American National Standards	11
	2.2 Other Standards.....	12
	3. Definitions.....	12
	4. General Provisions	14
	4.1 Accident Prevention Program	14
	4.2 Inspection and Maintenance of Excavations.....	14
	4.3 Access	14
	4.4 Existing Utilities	14
	4.5 Safety Precautions.....	15
	4.6 Protection Against Flooding	16
	4.7 Protection of Openings	16
	4.8 Structural Adequacy.....	16
	4.9 Shaft and Tunnel Lining, Roof Support, and Rock Bolting	16
	4.10 Stairways.....	16
	4.11 Ladders.....	17
	4.12 Platforms, Runways, and Ramps	17
	4.13 Lasers	17
	4.14 Tunnel and Raise Boring Machines	17
	4.15 Raise Boring.....	17
	5. Environmental Control.....	17
	5.1 Ventilation.....	17
	5.2 Oxygen	18
	5.3 Air Quality	18
	5.4 Testing Records	19

5.5	Internal-Combustion Engines	19
6.	Related Facilities.....	19
6.1	First Aid and Medical	19
6.2	Drinking Water	20
6.3	Toilets	20
6.4	Change House	20
6.5	Communication Systems	20
6.6	Rescue Equipment and Personnel.....	20
7.	Fire Prevention.....	21
7.1	General.....	21
7.2	Combustible Structures.....	21
7.3	Combustible Materials.....	21
7.4	Storage and Handling of Flammable and Combustible Liquids....	22
7.5	Welding or Cutting	22
8.	Hoisting.....	23
8.1	General.....	23
8.2	Emergency Provisions	23
8.3	Construction.....	23
8.4	Operation.....	23
8.5	Maintenance.....	24
9.	Haulage Systems	24
9.1	Track	24
9.2	Automatic Derailers	24
9.3	Holding Devices on Inclines.....	25
9.4	Locomotives and Similar Off-Track Equipment	25
9.5	Transportation of Workers.....	25
9.6	Automatic Coupling Devices.....	26
9.7	Block Signals	26
9.8	Safe Access	26
9.9	Mobile Equipment	26
10.	Electrical	26
10.1	General.....	26
10.2	Illumination.....	27
10.3	Conductors	27
10.4	Grounding of Equipment	27
10.5	Protection of Circuits	27
10.6	Protection of Personnel.....	27
10.7	Protection of Equipment	28
10.8	Switchboards.....	28
10.9	Transformers.....	28
10.10 Switches and Circuit Breakers	28
10.11 Battery Charging	29

10.12.....	Lightning Arresters	29
11. Drilling and Blasting.....		29
11.1 Regulations		29
11.2 Drilling Operations		29
12. Compressed Air		30
12.1 General.....		30
12.2 Air Plant.....		31
12.3 Locks.....		34
12.4 Medical Care of Compressed-Air Workers		38
12.5 Compressed-Air Operations.....		40
12.6 Fire Prevention Under Compressed Air.....		43
13. Training.....		44
13.1 Designated Persons		44
13.2 Lockout/Tagout.....		45
13.3 Compressed Air		45
13.4 Emergency Action		45

Appendices:

Appendix A – Instruction for the Guidance of Compressed-Air Workers ...	46
---	----

Appendix B – Survey of Job Site.....	47
--------------------------------------	----

Below are the first ten pages from the standard:

1. GENERAL

1.1 Scope. This standard establishes safety requirements pertaining to the construction of tunnels, shafts, and caissons. The requirements set forth in this standard cover environmental control; related facilities; fire prevention; hoisting; haulage; and electrical, drilling and blasting, and compressed air work. This standard is not intended for application to mining or quarrying operations.

1.2 Purpose. The purpose of this standard is to establish reasonable and practical safety requirements and practices for the construction of tunnels, shafts, and caissons.

1.3 Exceptions. The enforcing author-ity may grant an exception to the literal requirements of this standard or may permit alternative methods if compliance with these requirements presents a greater hazard or significant hardship, is impractical or involves other extenuating circumstances.

2. REFERENCED STANDARDS

2.1 Related American National Standards. The following American National Standards are referred to, supplement or are related to this document. All provisions of the referenced standards that are applicable to demolition operations shall be observed. When the following American National Standards are superseded by a revision approved by the American National Standards Institute, the revision shall apply:

ANSI/ASSE A10.33, Safety and Health Program Requirements for Multi-Employer Projects

ANSI/ASSE A10.38, Basic Elements of an Employer's Program to Provide a Safety and Healthful Work Environment

ANSI/ASSE A10.9, Concrete and Masonry Work Safety Requirements

ANSI/ASSE A10.12, Safety Requirements for Excavation

ANSI/ASSE A10.18, Safety Requirements for Temporary Floors, Holes, Wall Openings, Stairways and Other Unprotected Edges in Construction and Demolition Operations

ANSI/ALI A14.1, Safety Requirements for Wooden Ladders

ANSI/ALI A14.2, Safety Requirements for Portable Metal Ladders

ANSI/ALI A14.3, Safety Requirements for Fixed Ladders

ANSI/ALI A14.4, Safety Requirements for Job-Made Wooden Ladders

ANSI/ALI A14.5, Safety Requirements for Portable Reinforced Plastic Ladders

ANSI/NFPA 30, Flammable and Combustible Liquids Code

ANSI/NFPA 70, National Electrical Code

ANSI Z87.1, Practice for Occupational and Educational Eye and Face Protection

ANSI/ISEA Z89.1, Industrial Head Protection

ANSI/LIA Z136.1, American National Standard for Safe Use of Lasers

ANSI/ASTM F2413, Standard Specification for Performance Requirements for Foot Protection

2.2 Other Standards.

ASME, Boiler Pressure Vessel Code

3. DEFINITIONS

3.1 Air Supply. Compressed air used in the working chamber.

3.1.1 Low-Air Supply. Compressed air used to raise and maintain pressure in the working chamber and in the air locks.

3.1.2 High-Air Supply. Compressed air normally used to activate pneumatic equipment and tools.

3.2 Barricade. An obstruction or barrier to deter the passage of persons or vehicles.

3.3 Blow. A rapid loss of air pressure, which may be caused by a breach of the surface areas in a tunnel being constructed under compressed air conditions. A blow may, or may not, involve a reverse flow of solid or liquid materials (flooding of a tunnel under water, etc).

3.4 Bulkhead. An airtight vertical wall or partition separating the working chamber from free air or from another chamber under a lesser pressure than the working pressure. Generally, one or more air locks pierce the bulkhead, in addition to a number of openings for air pipes and other facilities.

3.5 Caisson. A watertight chamber, usually of wood or steel sheeting, some-times a cylinder of steel or concrete, used in construction work underwater or as a foundation. When the bottom of the structure extends below the surface of free water and excavation is performed by workers in a working chamber at an air pressure greater than atmospheric pressure, the caisson is said to be a compressed-air caisson.

3.6 Competent Person. One who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

3.7 Decanting. A method of de-compression under emergency conditions requiring recompression in a second and separate lock.

3.8 Engineer. A person qualified by training and experience in a branch of engineering and registered in the state where the work is to be performed.

3.9 Engineering. The profession in which a knowledge of the mathematical and physical sciences gained by study, experience, and practice is applied with judgment to develop ways to economically utilize the materials and forces of nature for the progressive well-being of mankind.

3.10 Escape Respirator. A mouthpiece respirator designed for self-rescue in case of a fire or explosion.

3.11 Face. The area of farthest advance of the tunnel excavation in which the major excavation process is taking place. Synonymous with Working Face.

3.12 Free Air. Air at normal atmospheric pressure.

3.13 Heading. The portion of a tunnel where major work of excavating and initial lining is taking place, or the portion immediately behind a working face.

3.14 Lock. A compartment designed to permit passage of personnel, material, or equipment in either direction between free air and a compressed-air working chamber.

3.14.1 Combination Lock. A lock that serves both as a material and a man lock.

3.14.2 Emergency Lock. A lock designed to permit all the workers employed on any shift to exit from the working chamber.

3.14.3 Long Lock. A lock designed to provide greater comfort for workers being discharged from the working chamber when the total time of decompression exceeds 75 minutes.

3.14.4 Man Lock. A lock through which only workers may pass. Synonymous with Person Lock.

3.14.5 Material Lock. A lock designed for and primarily used for the passage of materials and equipment.

3.14.6 Medical Lock. A special lock in which workers suffering from decompression illness may be placed for medical attention and treatment. The medical lock may also be used for pre-employment physical examinations to determine the adaptability of prospective employee(s) to changes in pressure.

3.14.7 Working Man Lock. A personnel lock, combination lock, or long lock that is normally used by personnel for entering or leaving the working chamber. Synonymous with Working Person Lock.

3.15 Pressure. A force exerted over a unit area, usually indicated in pounds per square inch (psi).

3.15.1 Atmospheric Pressure. The normal air pressure of free atmospheric air at sea level. In this standard, atmospheric pressure is assumed to be 14.7 psi. Atmospheric pressure is always 0 psig (101.4 kPa) (see Gauge Pressure).

3.15.2 Gauge Pressure. Pressure measured by gauge indicating the air pressure in excess of atmospheric pressure, usually in psig (pounds per square inch gauge).

- 3.15.3 Mild Pressure.** A working pressure not greater than 14.7 psig (101.4 kPa).
- 3.15.4 Strong Pressure.** A working pressure greater than 14.7 psig (101.4 kPa).
- 3.15.5 Working Pressure.** The pressure established at any time by the air master, or his/her duly authorized alternate, to be the required air pressure in the working chamber.
- 3.16 Primary Lining.** A support, usually of timber or steel, or both, that is placed to retain soil or rock loads immediately after excavation and is usually covered afterward by a permanent lining of masonry or concrete. Synonymous with Primary Liner.
- 3.17 Qualified Person.** A person who, by possession of a recognized degree, certificate, or professional standing, or by extensive knowledge, training, and experience, has demonstrated his/her ability to solve or resolve problems relating to the subject matter of this standard.
- 3.18 Rapid Flooding.** A hazardous condition resulting in the rapid rise of water in the working chamber when the air pressure is lowered, whether by design or otherwise.
- 3.19 Safety Screen.** An airtight and watertight diaphragm placed across the upper part of a compressed-air tunnel, between the face and the bulkhead, in order to prevent flooding the crown of the tunnel between the screen itself and the bulkhead, thus providing a safe refuge and means of exit from a flooding or flooded tunnel.
- 3.20 Scaling.** Prying loose pieces of rock from a face or roof to avoid danger of their falling unexpectedly.
- 3.21 Shaft.** A passage made from the surface of the ground to a point underground, the longer axis of which makes an angle greater than 20 degrees to the horizontal.
- 3.22 Shall.** Denotes a mandatory requirement.
- 3.23 Shotcrete.** Mortar or concrete conveyed through a hose and projected at high velocity onto a surface.
- 3.24 Should.** Denotes a recommendation.
- 3.25 Standard.** An established measure, type, model, or example that has been accepted and recognized in the construction industry.
- 3.26 Tunnel.** An excavation beneath the surface of the ground, the longer axis of which makes an angle not greater than 20 degrees to the horizontal.
- 3.27 Utility.** Any public or private facility used in the supply, transmission, or storage of electrical energy, water, sewage, gas, chemicals, steam, or petroleum products, or in the transmission of communications, or for public transit facilities.

3.28 Verify. Verify, verification, etc. means to establish the truth, accuracy, or reality of the condition in question, and to certify in writing that the condition is true, accurate, or real.

3.29 Working Chamber. The space in which work is being done in compressed air.

4. GENERAL PROVISIONS

4.1 Accident Prevention Program. The employer shall develop and maintain a safety and health program that meets the requirements of ANSI/ASSE A10.33, *Safety and Health Program Requirements for Multi-Employer Projects* and ANSI/ASSE A10.38, *Basic Elements of an Employer's Program to Provide a Safe and Healthful Work Environment*. All supervisory personnel shall be active participants in the direction and enforcement of this program. Each employee shall be given an initial indoctrination in safe working procedures and safety rules. There shall be safety training meetings at least weekly with attendance and subjects discussed verified by the senior project supervisor.

4.2 Inspection and Maintenance of Excavations. The exposed roof and side walls, tunnel, and shaft supports shall be thoroughly inspected and documented at least daily by a qualified person.

4.2.1 Loose rock and other material shall be scaled or barred down. The space directly beneath such operations shall be closed to passage.

4.2.2 Inspection and scaling shall also be carried out prior to each shift.

4.2.3 After each blast, the tunnel supports in the blast zone shall be checked and rewedged or secured as necessary before work is resumed in the heading.

4.3 Access. A safe means for access to, and egress from, all work areas shall be provided and maintained. Whenever practical, two means of access and egress shall be provided.

4.4 Existing Utilities. Prior to the commencement of work, the employer shall identify and ascertain the location of each underground utility and any other utility adjacent to the work. Utility companies shall be contacted and advised of proposed work prior to the start of actual excavation. When it has been verified that locations have been marked, the work may start. Any utilities creating a hazard to employees or the public shall be properly safeguarded or removed.

4.4.1 The employer shall at all times, by appropriate means, maintain, support, work around, and protect in a safe and undamaged condition each existing utility and its applicable components that are to be retained in place within and immediately adjacent to a tunnel, shaft, or caisson.

4.4.2 If the condition of the utility is such that it cannot be safely retained in place, then the utility shall be temporarily or permanently moved and reconstructed.

4.4.3 Where the continued operation of a utility during the course of the work will, in the event of its rupture due to settlement or other effects, constitute a hazard to the public, the working personnel, or the work, appropriate means shall be taken to mitigate the hazard. The rupture of pipes and/or dislocation of pipe joints, pipe valves, manholes, and junction chambers conveying the following materials, among others, shall be deemed to constitute a hazard:

1. Water in large volumes under pressure
2. Gas or steam
3. Petroleum products
4. Power and communication lines

4.4.4 Appropriate means of reducing the hazard may include, but are not limited to, deactivation or relocation of the utility, installation of alarm systems coupled with quick-acting automatic closure devices, or installation of temporary support systems.

4.5 Safety Precautions. Every precaution shall be taken to ensure the safety of the workers, whether or not such precaution is provided for in this standard.

4.5.1 No person shall be required to work in an unsafe place except for the purpose of making it safe, and then only after adequate precautions have been taken to protect the person doing such work.

4.5.2 Each underground operation shall have a check-in and check-out system that will provide positive identification of every person underground. A record of the appropriate location of each employee underground shall be maintained on the surface.

4.5.3 No person shall be permitted to carry or use intoxicating liquor or controlled substances in a tunnel, shaft, or caisson. Any person known to be under the influence of intoxicating liquor or controlled substances shall not be permitted to enter such premises. Any worker using prescription medicines shall obtain a work clearance from the physician prior to working underground.

4.5.4 Employees working alone and out of range of natural unassisted voice communication shall be provided with an effective means of communicating and obtaining assistance in an emergency. A system for checking in no less than once each hour shall be provided, and failure to check in will initiate an immediate investigation.

4.5.5 All machinery, equipment, appliances, materials, structures, and work places shall be maintained in a safe condition, free of all recognized hazards at all times, in accordance with the equipment manufacturers' instructions, and shall be periodically inspected for unsafe conditions or defects by a competent person(s) designated by the employer. Every employee shall be

directed to advise his or her supervisor immediately of any observed defects or unsafe conditions.

4.5.6 All points of spikes or nails that are projecting from lumber in work areas or pathways shall be bent down or removed.

4.5.7 Unnecessary accumulations of muck, timber, rails, and similar materials stored underground shall be avoided. Particular attention shall be given to maintaining clear areas at shaft stations, between track, and at the sides of tunnels.

4.5.8 Each employee underground shall be protected by protective headwear in accordance with ANSI/ISEA Z89.1, *Industrial Head Protection*.

4.5.9 When necessary due to wet work conditions underground, waterproof clothing, including safety boots, shall be worn.

4.5.10 Safety shoes or boots shall be worn by every employee underground. Safety footwear shall be in accordance with ANSI/ASTM F2413.

4.6 Protection Against Flooding. Where access shafts or tunnel portals are located adjacent to waterways, the surfaces of which may be raised because of the effects of river discharge, tide, wind, or other factors, considered singly or in combination, verified measures shall be taken to ensure that the shafts or tunnels cannot be flooded at a time when they contain workers.

4.7 Protection of Openings. All openings into shafts that are used for the passage of persons or material shall be guarded by means of a standard guardrail or tight and secured covering. Standard guardrails and shaft-opening protection shall be in accordance with ANSI/ASSE A10.18.

All abandoned excavations or shafts shall be securely barricaded to completely close them to the passage of persons.

4.8 Structural Adequacy. The design of the various elements of the construction, enabling them to withstand the loads and forces to which they may be subjected, shall be certified by a professional engineer.

4.9 Shaft and Tunnel Lining, Roof Support, and Rock Bolting.

4.9.1 The composition and configuration of the primary liner are dependent on local soil conditions. The installation of a liner shall be under the direction of a qualified person. The following conditions shall be met:

1. Tunnel excavation shall not be carried out more than 6 feet (1.8m) in advance of supports or roof bolting. In loose soil conditions, excavations shall not exceed 2 feet (.6m) in advance of support system.
2. Supports used shall be of good quality, shall fit snugly, and shall be inspected frequently.
3. Void spaces behind sheeting and liner plates shall be solidly filled or properly lagged and cribbed.
4. All supports shall be designed by a professional engineer and shall be of sufficient strength to resist all loads until the final lining has been placed.

4.9.2 Shaft Lining. Where there is danger that loose material can fall from the shaft walls into the shaft, the shaft walls shall be provided with a protective lining, or other means shall be used to prevent the fall of rocks and earth (e.g., wire mesh, rock bolts, or shotcrete).

4.10 Stairways. Where space in the shaft permits, stairways shall be installed and maintained for passage between the various working levels, platforms, walkways, and the surface. Stairways shall be maintained free of debris, materials, tools, and equipment. Riser heights and tread widths shall be uniform throughout a given stairway. Handrails and intermediate rails shall be installed on the exposed sides of stairways having four or more risers. Stairways shall conform to the following specifications:

General: Handrail live load	200 pounds (90.7kg) in any direction
Angle of Inclination: Inclination, minimum Inclination, maximum	30 degrees 50 degrees
Handrails: Height above nosing	30 inches to 34 inches (48.3cm to 58.4 cm)
Outside hand clear- ance minimum	3 inches (7.6cm)

4.11 Ladders. Where the installation of a stairway is not practical, temporary or fixed ladders shall be installed and maintained for safe passage between the various working levels, platforms, and walkways.

4.11.1 Job-made ladders shall be in accordance with the following standards as applicable: ANSI/ALI A14.1, A14.2, and A14.4.

4.11.2 Fixed ladders shall be in accordance with ANSI/ALI A14.3.

4.12 Platforms, Runways, and Ramps. All open sided floors, platforms, runways, and ramps 4 feet (1.22m) or more above the adjacent ground level or surface shall be guarded by a standard guardrail in accordance with the following minimum specifications:

General: Top Rail live load	200 pounds (90.7kg) in any direction
Top Rail: Height above platform	42 inches (106.7cm) +/- 3 inches
Mid Rail: Height above platform	19 inches to 23 inches (76.2cm to 86.4cm)
Posts:	

Spacing, maximum	8 feet (2.4m)
------------------	---------------

4.13 Lasers. The operation and use of lasers in underground work shall be in accordance with ANSI/LIA Z136.1.

4.14 Tunnel and Raise Boring Machines.

4.14.1 Machine Guarding. All gears, drive belts, drive shafts, and similar machinery shall be guarded.

4.14.2 Manufacturer's Specifications. Operating and maintenance manuals shall be provided by the manufacturer and be readily available for use by the machine operator and work crews. All operating instructions provided by the manufacturer shall be followed.

4.14.3 Lockout/Tagout. A positive lockout/tagout system shall be used whenever the possibility of the unexpected energization or start-up of machines or equipment or the release of stored energy could cause injury to employees.

4.15 Raise Boring.

4.15.1 Overhead Protection. Suitable protection shall be provided to the workers at the base of the bore to protect them from falling materials.

4.15.2 Jams. A qualified person shall be in charge of removing jams. Water shall not be used for forcing out jams from above.

Links and information related to the A10.16 American National Standard:

- The [ANSI Essential Requirements Document](#), (pdf) which is the guiding document used in the development of American National Standards.
- ASSE did a [column addressing standards development activities](#) (pdf) and would serve as a good informational piece to readers about the standards development process.
- Here is the link to an [official memorandum of understanding between OSHA and ANSI](#).
- The [Office of Management and Budget Circular OMB-A119](#), which explains how governmental agencies such as OSHA use voluntary national consensus standards.
- There have been a number of questions asking us how voluntary national consensus standards relate to agencies such as OSHA.

http://www.occupationalhazards.com/Issue/Article/37355/Safeguarding_Are_ANSI_Standards_Really_Voluntary.aspx

<http://www.asse.org/publications/standards/docs/Dembystandardsarticle3-21-2006.doc>

Examples of A10.16 Recognition:

Below is a link addressing recognition of the 1981 version of the standard by the Occupational Safety and Health Review Commission:

http://www.oshrc.gov/decisions/html_1999/96-0001.html

Below are two links from OSHA addressing recognition of the standard by OSHA:

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=24275

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=22590

Below is a link from the State of Maryland:

http://www.wssc.dst.md.us/dsg-PERMITS/documentforms/details_2009/specs_sep_2009/02446_Horiz_Directional_Drilling_Sep.pdf

Below is a link to a story written about the creation of the standard from June 2008:

<https://www.asse.org/publications/standards/a10/docs/A1019Article-Kyle-June2008.pdf>

Additional Resources

OSHA

ANSI/ASSE A10.12 ANSI/ASSE A10.12-1998 (R2005): Safety Requirements for Excavation -

<https://www.asse.org/shonline/products/3812.php>

Underground Construction: 1926.800

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10790

Underground Construction (Tunneling) Info

<http://www.osha.gov/Publications/osha3115.html>

Compressed Air: 1926.803

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10793

Electric Power: Enclosed Spaces & Working Underground

http://www.osha.gov/SLTC/etools/electric_power/enclosed_spaces_workunderground.html

NIOSH

Confined Spaces

<http://www.cdc.gov/niosh/topics/confinedspace/default.html>