TRENCH REFERENCE GUIDE

SUNSTATE Equipment

TRENCH SAFETY RENTALS

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TRENCH SAFETY RENTALS

PROJECTS THAT TAKE CREWS BELOW GROUND OR INTO CONFINED SPACES REQUIRE SPECIAL PLANNING FOR SAFETY AND OSHA COMPLIANCE.

IMPORTANT TRENCH SAFETY NUMBERS YOU NEED TO KNOW:

- 2’ minimum a spoil pile must be set back
  - Maximum distance shield may be above the bottom of the excavation
- 3’ minimum distance a ladder must be above the landing surface (trench box or grade)
- 4’ access and egress mandatory
  - Atmospheric testing is needed if hazardous atmospheres are suspected
  - Maximum height of first bench in cohesive B soil
- 5’ trench Protection mandatory (4’ in some states)
- 6’ fall protection may be recommended
- 10’ minimum distance from power lines up to 50,000 volts (20’ distance for cranes)
- 18” minimum distance from the top of the trench shield to the toe of the slope when sloping with shields
- Areas below 19.5% oxygen are considered oxygen-deficient
- Areas with a 20.9% oxygen reading are optimal
- 20’ maximum distance OSHA allows for sloping/ benching, timber shoring
- 25’ Maximum travel distance to access/egress

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Trench Reference Guide

DEFINITIONS

Excavation: Any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

Competent person: 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.

Intent: In order to be a "competent person", one must have had specific training and be knowledgeable about soil analysis, the use of protective systems, and the requirements of this standard.

Inspections: 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.

GENERAL REQUIREMENTS

- Ensure the wearing of appropriate safety vest when exposed to public vehicular traffic.
- Locating underground installations by safe and acceptable means.
- Support/ Remove all surface encumbrances that could pose a hazard to employees.
- Ensure the stability of all adjacent structures.
- Ensure spoil tools and equipment are at 2' from edge of excavation.
- Daily Inspections of the excavation by a Competent Person
- Access and egress provided at 4'.
- Atmospheric testing at 4' if possibility of hazardous atmospheres.
- Protection of employees from hazards associated with water accumulation.
- Warning Systems for mobile equipment
- Eliminate exposure to falling loads.
- Appropriate fall protection when required.

REQUIREMENTS FOR PROTECTIVE SYSTEMS

Trenches five feet (1.5 meters) deep or greater require a protective system unless the excavation is made entirely in stable rock. If less than five feet deep, a competent person may determine that a protective system is not required.

SOIL CLASSIFICATION

Type A Soil

Cohesive soils with an unconfined, compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if:

1) The soil is fissured.
2) The soil is subject to vibration from heavy traffic, pile driving, or similar effects.
3) The soil has been previously disturbed.
4) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater.
5) The material is subject to other factors that would require it to be classified as a less stable material.

Type B Soil

1) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa).
2) Granular cohesionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.
3) Previously disturbed soils except those which would otherwise be classified as Type C soil.
4) Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration.
5) Dry rock that is not stable.
6) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

Type-C Soil

1) Moist, cohesive soil or a moist dense granular soil that does not fit into Type A or Type B classification and is not flowing or submerged.
2) This material can be cut with near vertical sidewalls and will stand unsupported long enough to allow vertical shores to be properly installed.
3) The competent person must monitor the excavation for signs of deterioration of the soil as indicated by, but not limited to, freely seeping water or flowing soil entering the excavation around or below the sheeting.
4) An alternate design for less stable Type C soil will be required where there is evidence of deterioration.

SOIL TESTING

Visual Tests

a) Visual analysis is conducted to determine qualitative information regarding the excavation site in general, the soil adjacent to the excavation, the soil forming the sides of the open excavation, and the soil taken as samples from excavated material.
b) Observe samples of soil that are excavated and soil in the sides of the excavation. Estimate the range of particle sizes and the relative amounts of the particle sizes. Soil that is primarily composed of fine-grained material is cohesive material. Soil composed primarily of coarse-grained sand or gravel is granular material.
c) Observe soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular.
d) Observe the side of the opened excavation and the surface area adjacent to the excavation. Crack-like openings such as tension cracks could indicate fissured material. If chunks of soil spall off a vertical side, the soil could be fissured. Small spalls are evidence of moving ground and are indications of potentially hazardous situations.

Visual Tests *(continued)*

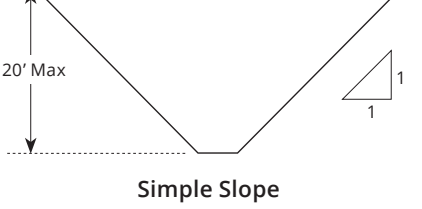
e) Observe the area adjacent to the excavation and the excavation itself for evidence of existing utility and other underground structures, and to identify previously disturbed soil.
f) Observe the opened side of the excavation to identify layered systems. Examine layered systems to identify if the layers slope toward the excavation. Estimate the degree of slope of the layers.
g) Observe the area adjacent to the excavation and the sides of the opened excavation for evidence of surface water, water seeping from the sides of the excavation, or the location of the level of the water table.
h) Observe the area adjacent to the excavation and the area within the excavation for sources of vibration that may affect the stability of the excavation face.

Manual Tests

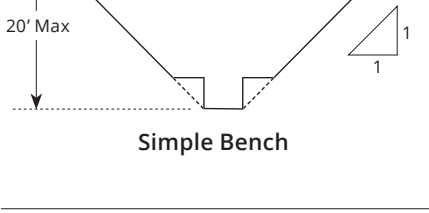
Manual analysis of soil samples is conducted to determine quantitative as well as qualitative properties of soil and to provide more information in order to classify soil properly.

a) Plasticity: Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as 1/8-inch in diameter. Cohesive material can be successfully rolled into threads without crumbling. For example, if at least a two-inch (50 mm) length of 1/8-inch thread can be held on one end without tearing, the soil is cohesive.
b) Dry strength: If the soil is dry and crumbles on its own or with moderate pressure into individual grains or fine powder, it is granular (any combination of gravel, sand, or silt). If the soil is dry and falls into clumps which break up into smaller clumps, but the smaller clumps can only be broken up with difficulty, it may be clay in any combination with gravel, sand or silt. If the dry soil breaks into clumps which do not break up into small clumps and which can only be broken with difficulty, and there is no visual indication the soil is fissured, the soil may be considered unfissured.
c) Thumb penetration: The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. Type A soils with an unconfined compressive strength of 1.5 tsf can be readily indented by the thumb; however, they can be penetrated by the thumb only with very great effort. Type C soils with an unconfined compressive strength of 0.5 tsf can be easily penetrated several inches by the thumb, and can be molded by light finger pressure.

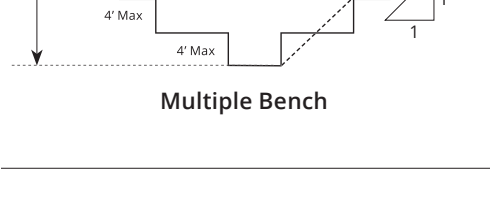
Type B Soil



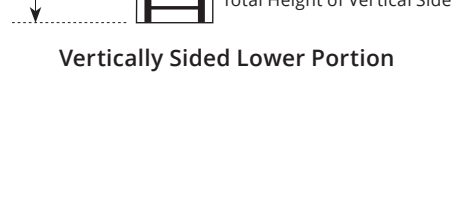
Simple Slope



Simple Bench

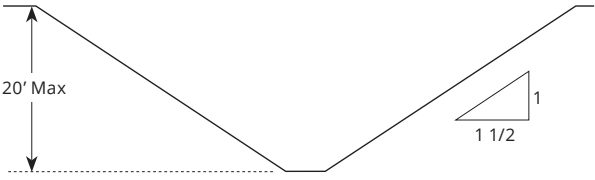


Multiple Bench

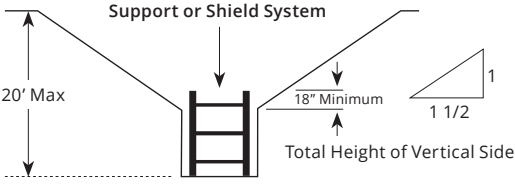


Vertically Sided Lower Portion

Type C Soil

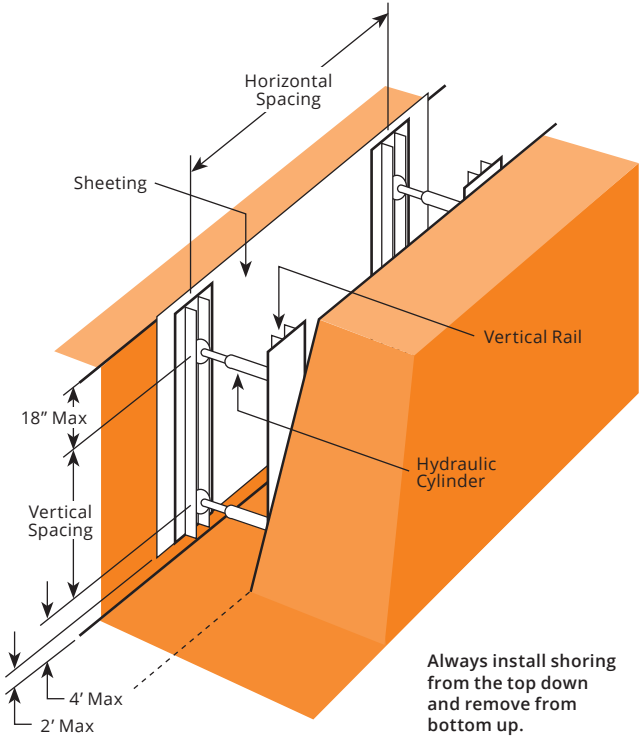


Simple Slope



Vertically Sided Lower Portion

ALUMINUM HYDRAULIC SHORING TYPICAL INSTALLATION



Always install shoring from the top down and remove from bottom up.

Table D 1.1 – Aluminum Hydraulic Shoring
Vertical Shores — For Soil Type A

Depth of Trench (Feet)	Hydraulic Cylinders				
	Maximum Horizontal Spacing (Feet)	Maximum Vertical Spacing (Feet)	Width of Trench (Feet)		
			Up To 8	Over 8 Up To 12	Over 12 Up To 15
Over 5 Up To 10	8	4	2 Inch Diameter	2 Inch Diameter ***Note 2***	3 Inch Diameter
Over 10 Up To 15	8				
Over 15 Up To 20	7				
Over 20	***Note 1***				

Footnotes to tables and general notes on hydraulic shoring are found in **Appendix D to Subpart P of Part 1926 - Aluminum Hydraulic Shoring for Trenches.**
Note(1): See Appendix D, Item (g) (1)
Note(2): See Appendix D, Item (g) (2)

Table D 1.2 – Aluminum Hydraulic Shoring
Vertical Shores — For Soil Type B

Depth of Trench (Feet)	Hydraulic Cylinders				
	Maximum Horizontal Spacing (Feet)	Maximum Vertical Spacing (Feet)	Width of Trench (Feet)		
			Up To 8	Over 8 Up To 12	Over 12 Up To 15
Over 5 Up To 10	8	4	2 Inch Diameter	2 Inch Diameter ***Note 2***	3 Inch Diameter
Over 10 Up To 15	6.5				
Over 15 Up To 20	5.5				
Over 20	***Note 1***				

Footnotes to tables and general notes on hydraulic shoring are found in **Appendix D to Subpart P of Part 1926 - Aluminum Hydraulic Shoring for Trenches.**
Note(1): See Appendix D, Item (g) (1)
Note(2): See Appendix D, Item (g) (2)

Notes to Tables 1.1 and 1.2

1) Two-inch diameter cylinders shall have a structural steel tube oversleeve 3.5 x 3.5 x .01875 inch extension (installed over the aluminum oversleeve extension) or a steel tube oversleeve 3 x 3 x 0.1875 inch extension (installed without the aluminum oversleeve) that extends the full retracted length of the cylinder.
2) The bottom of the sheeting shall extend within two feet of the bottom of the excavation. If there is an indication of a possible loss of soil from behind the excavation. If there is an indication of a possible loss of soil from behind the support system, sheeting must extend to the bottom of the excavation.
3) Sheeting is required at each vertical shore if raveling or sloughing of the excavation face appears likely to occur per the manufacturer's specifications..
4) The bottom hydraulic cylinder shall be a maximum of four feet above the bottom of the excavation.

Hydraulic Shoring Cylinder Sizes						
17"-27"	22"-36"	28"-46"	34"-55"	42"-69"	52"-88"	Available up to 143" wide
Yellow	Red	Green	Blue	Brown	Black	

Hydraulic Shoring Rail Sizes With or Without Finn Boards							
2'	3' 6"	5'	7'	9'	12'	16'	20'

TRENCH SHIELDS

- Shield systems shall not be subjected to loads exceeding those which the system was designed to withstand.
- 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.
- Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields.
- Employees shall not be allowed in shields when shields are being installed, removed, or moved vertically.
- 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.

HAZARDOUS ATMOSPHERES

• Oxygen Deficient	Below 19.5%
• Normal Oxygen Level	Optimum 20.9%
• Oxygen Enriched	Above 23.5%
• Lower Explosive Limit/Lower Flammable Limit	10% LEL/LFL
• Carbon Monoxide (CO)	35ppm NIOSH 50PPM OSHA
• Hydrogen Sulfide (H2S)	10ppm

Other Available Options Using Soil Reports

Blows Per Foot	**Cohesive Soil**	**Granular Soil**
0-4	C – Soft	C – Very Loose
4-8	B – Medium	C – Loose
8-15	B or A – Stiff	C- Medium Loose
15-30	A – Hard	C – Medium
>30	A – Very Hard	*B – Dense

*Could be Type A if hardpan or cementation exists.

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