

Excavation

1. Purpose

The purpose of this policy is to define the requirements for protecting employees, contractors, and members of the public from personal injuries and hazards associated with excavation operations.

2. Scope

This policy applies to USPL controlled pre-digging and excavating operations, and additionally to USPL workforce entry into excavations \geq 4 feet in depth.

The following policies are either referenced or are applicable to this policy and should be referenced for specific related requirements and guidance.

- Air Monitoring
- **Permit to Work**
- HAZWOPER
- USPL-GIS 04-0003 (STP 04-003), *Site Preparation, Earthwork, and In-Line Inspections Excavations*
- Hot Work
- Personal Protective Equipment
- Respiratory Protection
- USPL-GP 04-0112, **Specifications for Ditching & Excavation**
- **GDP 4.5-0002, Use of Temporary Ladders**

3. Minimum Requirements

	Minimum Requirements	Supporting Documentation
1.	Excavation work shall conform to the following BP USPL Technical Practices: 1. USPL-GIS 04-0003, <i>Site Preparation, Earthwork, and In-Line Inspections Excavations</i> 2. USPL-GP 04-0112, Specifications for Ditching & Excavation	Section 8
2.	The location of utility installations shall be determined prior to performing USPL controlled Ground Disturbance operations.	Section 8
3.	All Excavation Checklists shall be completed prior to issuance of a Permit To Work (PTW).	Section 7
4.	All Excavation Checklists shall be revalidated daily or as required. The revalidation shall be performed by the Performing Authority and/or Excavation Competent Person and documented on the PTW.	Sections 5, 7, Appendix I
5.	Air monitoring for O ₂ , CO, and LEL shall be performed daily before personnel enter excavations that are \geq 4 feet in depth and continuously while personnel are in the excavation.	Section 9
6.	Air monitoring for specific contaminants (e.g. benzene, H ₂ S), shall be conducted initially, prior to entering an excavation, if there is known or suspected product or crude oil contamination of the surrounding soil.	Section 9

	Crude Oil—Benzene, H ₂ S Gasoline—Benzene	
7.	The soils of all excavations shall be treated as Type C soil unless the Soil Analysis form has been completed by the Competent Person and the resulting soil classification has been approved by the Operations Team Leader (TL).	Section 11, Appendix V
8.	For excavations ≥ 5 feet in depth (unless state or local codes specify a lesser depth), protective systems shall be implemented to protect personnel from cave-ins, falling dirt, or the collapse of adjacent structures.	Section 11, Appendices IV, V
9.	For excavations ≥ 4 feet in depth that personnel will enter, rescue equipment shall be available on-site where air monitoring indicates a supplied-air required atmosphere exists, or if work can be reasonably expected to cause a supplied-air required atmosphere to develop. A written rescue plan shall be prepared when supplied-air required atmospheric conditions exist in an excavation or could reasonably be expected to develop or if an Excavation Stand-by is required.	Section 10
10.	Personnel who perform excavation work shall be trained and competent to perform their roles.	Section 12
11.	All personnel performing work on behalf of USPL have the responsibility and authority to stop any excavation work they consider to be unsafe.	Section 8
12.	Fall protection shall be used on temporary ladders where the height of climb exceeds 3 m (10 ft).	Section 8

4. Definitions

Aluminum hydraulic shoring—A pre-engineered shoring system comprised of aluminum hydraulic cylinders (cross braces) used in conjunction with vertical rails (uprights) or horizontal rails (wales). Such a system is designed specifically to support the sidewalls of an excavation and prevent cave-ins. Aluminum hydraulic shoring is the preferred shoring system within USPL.

Asset Operator (AO)—A BP employee who is responsible for the operation of the asset where work is being performed. The Asset Operator shall be accountable for the asset equipment being in a safe condition for the scope of work to be performed. The Asset Operator or an Asset Operator Designee (if used) is responsible for the completion of the **PTW form**.

Asset Operator Designee (AOD)—A BP employee or contractor individual who is authorized to issue **PTWs and / or Checklists** on behalf of the Asset Operator.

Note: Reference the **Permit to Work** policy for additional information.

Authorized Gas Tester—An individual who has been trained and demonstrates competency in the elements for Authorized Gas Testers in the USPL Training and Competency Matrix.

Benching—A method of protecting personnel 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. **Benching is not allowed for Type C soil.**

Checklist Issuance—The act of the Asset Operator or Asset Operator Designee issuing a **PTW and associated Checklist(s) if applicable** to a Performing Authority.

Note: Reference the **Permit to Work** policy for additional information.

Competent Person—For the purposes of this policy, a person who (1) is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to personnel; (2) has the authority to take prompt, corrective measures to eliminate these hazards and conditions; and (3) has had training in and is knowledgeable about soil analysis and soil classification (if soil

will be classified as anything other than Type C), the use of protective systems, and OSHA requirements pertaining to excavations (29 CFR 1926.650, 1926.651, 1926.652).

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

Note: An excavation greater than or equal to 4 feet in depth with limited means of entry and exit is considered a confined space by BP Group Standards. The USPL Excavation **Checklist** is compliant with both BP Ground Disturbance and Confined Space Entry requirements, therefore a separate USPL Confined Space Entry **Checklist** is not required. USPL considers “limited means of entry and exit” to be excavations sloped steeper than one and one-half horizontal to one vertical (1.5H/1V, or 34° measured from horizontal). Ladders are considered a limited means of entry and exit.

Ground Disturbance—See Excavation

Immediately Dangerous to Life or Health (IDLH) Atmosphere—An atmosphere that could expose personnel to the risk of death, incapacitation, impairment of the ability to self-rescue, injury, or acute illness from one or more of the following conditions:

- Flammable gas, vapor, or mist in equal to or in excess of 10% of its Lower Explosive Limit (LEL).
- Atmospheric oxygen concentrations below 19.5% or above 23.5%.
- Atmospheric contaminants that equal or exceed the published NIOSH IDLH values.

Mechanical Excavation – When soil is removed by machines such as backhoes, bulldozers, chain type ditches, drag lines, excavators, graders, grader-elevators, loaders, rippers, rock plows, rotors, scrapers, track hoes and trench diggers.

Non-mechanical Excavation – When soil is removed by methods other than mechanical excavation; non-mechanical excavation methods include air knife, hand shovel, hydrojet, and hydrovac.

Performing Authority (PA)—A BP employee or contractor individual who receives a **PTW and Checklist(s)** issued by the Asset Operator or Asset Operator Designee

Note: Reference the **Permit to Work** policy for additional information.

Protective System—A method of protecting personnel 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.

Registered Professional Engineer—A person who is registered as a professional engineer in the state where the work is to be performed. However, for purposes of OSHA’s excavation standards, a professional engineer registered in any state is deemed to be a “Registered Professional Engineer” when approving designs for “manufactured protective systems” or approving “tabulated data” to be used in interstate commerce.

Safety Sweep—A process of using one or more electronic locating methods and techniques to assess for the presence and relative location of foreign underground utilities, facilities, equipment or obstacles prior to and during mechanical excavation.

Shall—Is used where a provision is mandatory

Shield—A structure that is able to withstand the forces imposed on it by a cave-in and thereby protect personnel within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, a shield can be either prefabricated or job-built in accordance with the OSHA Excavation standard. Shields used in trenches are usually referred to as “trench boxes” or “trench shields.”

Shoring—A means of supporting the sides of an excavation to prevent movement of soil and cave-ins. There are several types of shoring systems: timber, mechanical, metal hydraulic, and pneumatic.

Should—Is used where a provision is preferred

Sloping—A method of protecting personnel from cave-ins by sloping the sides of an excavation away from the excavation.

Supplied-air required atmosphere—An atmosphere which, by reason of being flammable, poisonous, corrosive, oxidizing, irritating, oxygen-deficient, toxic, or otherwise harmful, can cause death, illness, or injury. Examples of supplied-air required atmospheres include the following:

- Carbon Monoxide levels 35-1200 ppm
- H₂S levels 10-100 ppm
- Benzene levels 50-500 ppm
- Diesel Fuel levels 500 ppm - 10% LEL
- Total hydrocarbon levels 1350 ppm-10% LEL
- Level of any other toxic chemical which requires a supplied-air respirator

Trench—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.

USPL Controlled Excavation—Excavations which USPL employees or USPL contractors have authority of the excavation and are performing the digging operation.

5. Roles and Responsibilities

5.1. Asset Operator (or designee)

- A. Shall issue the **PTW and Excavation Checklist, if applicable**, (Appendix I) to the Performing Authority or can delegate **PTW and Checklist (if applicable)** issuance to the AOD.

Note: Refer to the **Permit to Work** policy for additional requirements.

- B. Shall determine if changes can be made to a **PTW/Checklist** if conditions are exceeded or if the **PTW/Checklist** should be cancelled and a new **PTW/Checklist** issued

5.2. Authorized Gas Tester

- A. Shall perform air monitoring per the requirements of Section 9 of this policy.

5.3. Competent Person (usually the Performing Authority)

- A. Shall perform daily inspections of excavations, prior to personnel entry. Components of the inspection include the excavation, adjacent areas, any implemented protective systems for evidence of a possible cave-in or potential protective systems failure, the potential for an atmosphere requiring respiratory protection or an IDLH atmosphere, and other hazards related to the excavation. See Section 6 for further requirements.

1. Shall perform additional inspections after every rainstorm or other hazard-increasing occurrence before personnel enter the excavation.

2. shall document the excavation inspection on the Excavation Entry section of the Excavation **Checklist** before personnel enter excavations ≥ 4 feet in depth.

Note: Hazards relating to excavations < 4 feet in depth should be identified and mitigated through the **PTW** process.

3. For non USPL controlled excavations ≥ 4 feet in depth, Damage Prevention personnel shall complete the Excavation **Checklist** prior to entry.

- B. Shall conduct soil classification tests utilizing both visual and manual tests as the job progresses and documents the results on the Soil Analysis form (Appendix V) if the soil type is to be classified and treated as anything other than Type C.

- C. **Shall assure a means of access/egress is provided such as a ramp, ladder, stairs or other suitable means.**

- D. Shall design structural ramps if they are to be utilized only by personnel as a means of entry or exit.
- E. Shall prohibit entry into the excavation if IDLH conditions are present.
- F. Shall determine whether specific work being performed could cause an atmosphere requiring respiratory protection or an IDLH atmosphere to develop within the excavation and, if so, shall verify that air monitoring is performed.
 - 1. If a supplied-air required atmosphere exists or is reasonably expected to develop, the Competent Person shall verify that a written rescue plan has been developed.
- G. Shall verify that corrective measures and controls are implemented when hazardous atmospheric conditions are detected.
- H. Shall verify that personnel exposed to an atmosphere requiring respiratory protection are removed from the hazardous area as soon as hazardous conditions are detected and until the necessary controls are implemented to control the atmosphere requiring respiratory protection.
- I. Shall be at the job site to monitor water removal equipment and operations when this type of equipment is in use.
- J. Shall inspect the stability of adjoining buildings or other structures that are endangered by excavations so that the necessary support systems, such as shoring, bracing, or underpinning, are provided.
- K. Shall examine damaged manufactured materials and equipment used for protective systems to evaluate its suitability for continued use.
- L. Shall determine if air monitoring for specific materials (e.g. benzene, H₂S), is necessary.

5.4. Performing Authority

- A. Shall receive the **PTW and Excavation Checklist** from the Asset Operator or Asset Operator Designee.
- B. Shall verify that all personnel who enter completed excavations ≥ 4 feet in depth have signed the **PTW** to acknowledge their agreement to abide by the conditions documented on the **PTW**.
- C. Shall observe the excavation work to verify that the work is performed within the conditions documented on the **PTW and the Excavation Checklist**.
- D. Shall reassess the job site and revalidate the **PTW/Excavation Checklist** before work can resume if permitted work is interrupted or if the job site is left unattended, or if necessary, cancels the **PTW/Excavation Checklist** and returns it to the AO / AOD.

Note: Reference the **Permit to Work** policy for additional information.
- E. Shall stop work, suspend the **PTW** and notify the AO / AOD if permit conditions are exceeded

5.5. Registered Professional Engineer

- A. Shall determine whether adjacent structures are located at a safe distance from the excavation when an excavation is below the level of the base or footing of any foundation or retaining wall, or protective systems specified by the Competent Person shall be implemented.
- B. Shall design all sloping or shoring designs for excavations deeper than 20 feet.
- C. Shall approve any tabulated data (i.e., tables and charts) used to determine the proper slope or benching for an excavation.
- D. Shall approve the design for sloping or benching excavations for which tabulated data or allowable configurations and slope charts referenced in 29 CFR 1926.652 are not used.
- E. Shall approve any non-manufacturer tabulated data used for the design of protective systems.
- F. Shall approve the design for protective systems to be used in an excavation for which designs for shoring as referenced in 29 CFR 1926.651, manufacturer tabulated data, or non-manufacturer tabulated data are not used.

- G. Shall evaluate damaged equipment used for protective systems whenever the Competent Person cannot determine that this equipment is able to support the intended load or is otherwise suitable for use.
- H. Shall design structural ramps if they are to be utilized by equipment for entry to or exit from the excavation.

5.6. Excavation Stand-by

- A. Shall be positioned outside of the excavation **by the point of access/egress** and shall do the following:
 - 1. Maintain contact with personnel in the excavation.
 - 2. Order evacuation of the excavation if **PTW or Checklist** conditions are exceeded.
 - 3. Implement the documented rescue plan as soon as any personnel appear to need assistance.
- B. Shall perform no task that can interfere with the Excavation Stand-by's primary duty to monitor and protect the personnel in the excavation.

6. Competent Person

- A. A Competent Person shall be designated for each excavation site each day that personnel will enter excavations ≥ 4 feet in depth.
 - 1. The Competent Persons training and competency shall be commensurate with the characteristics and hazards of the excavation.
 - 2. The Competent Person shall perform inspections of the excavation prior to personnel entering the excavation.
 - a) The Competent Person shall document the excavation inspection on the Excavation Entry section of the Excavation **Checklist** before personnel enter excavations ≥ 4 feet in depth.

Note: Hazards relating to excavations < 4 feet in depth should be identified and mitigated through the **PTW** process.
 - b) For non USPL controlled excavations ≥ 4 feet in depth, Damage Prevention personnel shall complete the Excavation **Checklist** prior to entry.
- B. A Competent Person for each excavation site shall be supplied by:
 - 1. BP when BP employees perform an excavation.
 - 2. The contractor when a contractor performs an excavation.
 - 3. The non-USPL 3rd party when a non-USPL 3rd party performs an excavation.

7. Excavation Checklist

The Excavation **Checklist** (Appendix I) is a formal document used as part of a process to effectively manage the risks associated with excavations.

Note: Reference Appendix II for Excavation **Checklist** Applicability

7.1. General Requirements

- A. An Excavation Checklist is valid for no more than seven days for the individuals working under the Checklist, or for the duration of the scope of work documented on the Checklist, whichever period is shorter. If the excavation work requires a Level 2 HITRA, the Checklist is valid for no more than one day, or for the duration of the scope of work documented on the Checklist, whichever period is shorter. See TRCT for specific examples of work that requires a Level 2 HITRA.

- B. The Excavation Checklist shall be completed or revalidated each day that an Excavation Checklist is required.
- C. The Excavation Checklist shall be available at the job site until the excavation work is completed or the Permit To Work expires.
- D. An Excavation Checklist is valid for the duration of the scope of work documented on the Permit To Work form
- E. If PTW conditions are exceeded, work and the PTW shall be suspended until the Asset Operator determines if changes can be made to the PTW or if the PTW should be cancelled and a new PTW issued.
- F. If excavation work is suspended or the job site is left unattended (including normal work breaks) during a shift, the Excavation checklist shall be revalidated before further work can continue; revalidation involves inspecting the excavation for any change in previous conditions and air monitoring.
- G. Expired PTWs and Excavation Checklists shall be retained locally for a minimum of one month.

7.2. Ground Disturbance

- A. The Excavation Checklist shall be issued by the Asset Operator or Asset Operator Designee and received by the Performing Authority.

7.3. Excavation Entry (USPL Controlled Excavations)

- A. The Excavation Entry section of the Excavation Checklist shall be completed prior to personnel entry into an excavation ≥ 4 feet. The Asset Operator / AOD shall issue and revalidate the PTW and the Excavation Checklist with the Performing Authority prior to commencement of excavation entry.
 - 1. If personnel need to enter excavations that are ≥ 4 feet in depth while digging operations are in progress, the Competent Person shall ensure that OSHA's Excavation standards are met before personnel enter.
 - 2. If personnel need to enter excavations that are ≥ 4 feet in depth with limited means of entry and exit, an Excavation Stand-by shall be designated before personnel enter.
 - 3. If further digging is required after the Excavation Checklist has been issued (e.g. expanding the length, depth, or width of the same excavation), those operations can commence under the existing PTW and Excavation Checklist as long as the Competent Person performs an inspection prior to allowing personnel to enter the modified excavation.

Note: Expanding an existing excavation does not require the Asset Operator / Asset Operator Designee to approve the changes to the PTW as long as the sloping or other protective systems implemented for the excavation at the time the PTW was issued are still applicable and in place for the modified excavation.
- B. Any required evaluations, performed by a Registered Professional Engineer, shall be documented and attached to the Excavation Checklist.
- C. The workforce entering the excavation will be directed by the excavation Competent Person.

7.4. Excavation Entry (Non-USPL Controlled Excavations)

BP personnel such as Damage Prevention employees could be required to enter non-USPL controlled 3rd party excavations for the purposes of locating and inspecting BP's assets. The company performing the excavation is required by OSHA to supply the Competent Person therefore BP personnel cannot be the Competent Person for non-USPL controlled excavations. The following requirements apply when BP personnel will enter non-USPL controlled 3rd party excavations ≥ 4 feet in depth:

- A. The Damage Prevention individual(s) shall discuss with the 3rd party, and if available the 3rd party's Competent Person, BP's intent to enter the excavation for the purposes of locating or inspecting BP's assets, and BP's requirement to have an Excavation Stand-by and rescue plan for excavations \geq four feet in depth with limited means of entry and exit. The Damage Prevention Individual(s) can only enter the excavation once the 3rd party has given clearance to do so.

- B. The Excavation **Checklist** shall be completed by a Damage Prevention person.
- C. A Damage Prevention person shall sign the Excavation **Checklist** under the **BP DP AO after discussion with TL** signature line in Section F attesting that the Excavation **Checklist** was filled out by the Damage Prevention person, and that the Damage Prevention person believes the section of the excavation to be entered is properly designed for his / her personal entry.
- D. The Excavation **Checklist** can be validated and issued via telephone if the following requirements are met in addition to the above requirements of Section 7.4:
 - 1. The Asset Operator issuing the **PTW and Excavation Checklist** by phone shall be a Team Leader **or another AO** who has completed the same level of excavation training required for Damage Prevention personnel for safe entry of excavations.
 - 1. The Asset Operator deems the permit conditions acceptable for safe entry based on his / her conversation with the **PA**.
 - 3. The third party Excavation Competent Person shall be on site prior to USPL workforce entering the excavation, and shall be available to answer any questions the Asset Operator might have.
 - 4. The Performing Authority shall be confident that the third party Competent Person is indeed competent through discussions regarding the excavations characteristics and any documentation provided by the third party Competent Person. If the BP PA has any doubt that the third party Competent Person is not fully qualified, the permit shall not be issued by phone.

8. Safe Excavation Practices

8.1. General Requirements

- A. Personnel exposed to public vehicular traffic shall be provided with and shall wear DOT-approved warning vests marked with or made of reflector or high-visibility material **and follow road-work type safe practices**.
- B. Excavation work shall conform to the following BP USPL Technical Practices:
 - 1. USPL STP 04-003, "Site Preparation, Earthwork, and In-Line Inspections Excavations"
 - 2. USPL-GP 04-0112, "**Specifications for** Ditching & Excavation"
- C. Excavations shall be backfilled as soon as practical. Until backfilled, the excavation shall be clearly marked and secured as appropriate if it is left unattended between shifts to prevent unauthorized or unintentional entry.
- D. All personnel performing work on behalf of USPL have the responsibility and authority to stop excavation work they consider to be unsafe.
- E. **During normal operations all personnel shall only enter and exit an excavation via designated entry and exit points.**

8.2. One-Call System and Underground Utilities

- A. The One-Call system shall be used in advance of proposed USPL controlled ground disturbance operations to determine whether underground installations are in the work area and **documented on the PTW and Checklist, if applicable**.
 - 1. The national three-digit One-Call number is 811.
 - 2. The company performing the ground disturbance is accountable for performing the one-call.
- B. Alignment sheets of the area, if available, shall be consulted to provide an initial indication of underground utilities.

Note: The Repair and Inspection Report (R&IR) is used to update alignment sheets when necessary.

- C. A Safety Sweep shall be conducted of the proposed excavation area prior to mechanical excavation. Additional safety sweep(s) should be conducted again at every 4 ft depth interval during mechanical excavation, when practical, to locate any unidentified underground utilities in all practical circumstances.
- D. Visual clues of the aboveground area should be used as another method to determine if unidentified underground utilities may be present, e.g., foreign underground pipeline markers.
- E. At this point in the underground utility identification process, a decision must be made about the confidence level of the preceding steps to locate all foreign underground utilities in the excavation area.
 - 1. If the confidence level is high, excavating can proceed with caution.
 - 2. If the confidence level is not high, consideration must be given for further assessment, e.g., ground penetrating radar, or to safer excavation methods like hydro excavation or air knifing.
- F. While the excavation is open, underground installations shall be protected, supported, or removed as necessary to safeguard personnel.
- G. If unexpected utilities are discovered during excavation, excavation activities shall stop and the one-call system contacted to have the lines remarked. If excavating within a facility, the Asset Operator shall be contacted immediately to provide assistance in identifying the utility and redlining the appropriate drawing(s).

Note: Unexpected utilities must be protected from damage and a safe working condition verified before proceeding.
- H. Where USPL has full control of underground electrical lines within the potential area of excavation and where positive line locations cannot be completed, e.g., grout around conduit, all underground electrical lines exceeding 120V shall be fully locked out when performing mechanical excavation work.

8.3. Overhead Equipment, Fall Protection, Entry and Egress, Mobile Equipment

- A. Personnel should be constantly alert to the hazards of overhead mechanical equipment.
- B. Personnel shall not be located underneath loads handled by lifting or digging equipment or within the reach of operating booms and buckets.
- C. Tools, equipment, and materials shall be stored in a manner and location to prevent trips, slips, and falls. Any items near the edge of the excavation shall be stable or secured so that they do not roll or fall into the excavation.
- D. Personnel shall be protected from excavated soil, equipment, or other materials falling or rolling into the excavation. Protection shall be provided by depositing such materials at least 2 feet from the edge of the excavation or by using sufficient retaining devices, or by a combination of both if necessary.
- E. All terrain obstacles (e.g. trees, boulders, fixed objects) that have the potential to create a hazard during the excavation shall be removed or properly secured.
- F. Walkways or bridges shall be installed when personnel or equipment are expected to cross excavations. Proper handrails are required if walkways are more than 6 feet above the base of the excavation.
- G. Physical barrier protection shall be provided at all excavations, whether remotely located or on BP property, so that individuals do not accidentally enter the excavation and are warned about the dangers of the excavation. Wells, pits, and shafts shall be barricaded or covered.
- H. Stairways, ladders, ramps, or other safe means of entry and egress shall be located in trench excavations that are 4 feet or more in depth so as to require no more than 25 feet of lateral travel for personnel to enter or exit the excavation.
- I. If ladders are used, they shall extend at least 3 feet beyond the landing and be properly "footed" or secured for safe use in an emergency.

- J. Fall protection shall be used on temporary ladders where the height of climb exceeds 3 m (10 ft).
- K. 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.

8.4. Water Accumulation

- A. Personnel shall not work in excavations where water is accumulating or has accumulated unless adequate precautions have been taken to protect workers from the hazards posed by water accumulations.
Note: Precautions can include the use of support or shield systems, water removal equipment, diversion ditches, dikes, safety harnesses and lifelines, or other suitable means.
- B. If water accumulation is controlled or prevented by the use of water removal equipment, the Competent Person shall be at the job site to monitor the water removal operation.
- C. If necessary, adequate drainage shall be provided in the area adjacent to the excavation.

8.5. Use of Spotters

- A. Spotters should be used to assist the operator in maneuvering equipment into position to prevent injury to the operator, spotter or other personnel or prevent property damage. A spotter should be used in busy or congested areas, when the operator does not have a full view of the intended path of travel, when backing up, maneuvering into or inside of buildings or other structures, potential for damage to facility systems or structures, in close proximity to other personnel or within 10 ft of an overhead power line.
 - 1. Ensure that spotters and drivers agree on hand signals before backing up.
 - 2. Instruct spotters to always maintain visual contact with the driver while the vehicle is backing.
 - 3. Instruct drivers to stop backing immediately if they lose sight of the spotter.
 - 4. Not give spotters additional duties while they are acting as spotters.
 - 5. Instruct spotters not to use personal mobile phones, personal headphones, or other items which could pose a distraction during spotting activities.
 - 6. Provide spotters with high-visibility clothing, especially during night operations.

9. Air Monitoring

9.1. General Requirements

- A. Air monitoring shall be performed by an Authorized Gas Tester.
- B. Air monitoring shall be performed with calibrated, direct-reading instruments for oxygen content, flammability, and potential toxic air contaminants, in that order.
Note: If the proposed excavation site is known or suspected to be contaminated from a hydrocarbon release, air monitoring might be required before personnel or equipment are mobilized to the site. In these situations, reference HAZWOPER, Hot Work, Personal Protective Equipment, and Respiratory Protection policies for specific requirements.
Note: Reference Appendix III for Air Monitoring Applicability

9.2. Conditions While Excavating

- A. During the excavation process, if it is discovered or suspected that the surrounding soil is contaminated with product or crude oil, work shall stop and personnel shall be removed from the hazardous area until air monitoring is performed and if necessary, controls are put in place.

- B. **Section C2 of PTW is** required if mobile equipment or other non-intrinsically safe equipment will be utilized in a Class 1 area (see the Hot Work policy).
- C. Personnel who enter excavations while the excavation is being opened shall adhere to the following conditions:
 - 1. Air monitoring shall be performed if soil contamination is suspected prior to personnel entry and continuously while personnel are in the excavation.
 - 2. Air monitoring shall be performed if the in-progress excavation is ≥ 4 feet in depth prior to personnel entry and continuously while personnel are in the excavation.
 - a) The results of **initial** air monitoring performed for excavations ≥ 4 feet in depth shall be documented in the Air Monitoring section of the **Excavation Checklist**.
 - 3. With the permission of the Competent Person.

9.3. Daily Pre-Entry Air Monitoring

The following requirements apply each day that personnel enter completed excavations ≥ 4 feet in depth.

- A. An Authorized Gas Tester shall assess the internal atmosphere of the excavation before each shift.
 - 1. Initial air monitoring shall be performed for O₂, CO, and LEL.
 - 2. If the surrounding soil is known or is suspected to be contaminated with either product or crude oil, initial monitoring for specific toxics (e.g. benzene, H₂S), shall be performed based on the product (see Section 9.5).
- B. Pre-entry air monitoring shall be performed from the outside the excavation or trench by using extended sample lines and probes.

Note: An air monitor with a powered sample pump and extended sample line and probe can be used to thoroughly assess the high, middle, and low points of the excavation. Proper purging times for sampling with extended sampling probes should be consistent with the operation manual for the air monitoring instrument used.

 - 1. If it is not feasible to perform thorough air monitoring from outside the excavation, **the respiratory protection policy shall be consulted to determine respiratory protection requirements.** The Competent Person shall allow entry of the Authorized Gas Tester only after performing an inspection of the excavation.
- C. Pre-entry air monitoring shall be conducted no earlier than 2 hours prior to workforce entry.
 - 1. The atmosphere shall be sampled from outside the excavation before personnel can re-enter the excavation following a work break (e.g., lunch) where air monitoring has stopped and the excavation is vacant for more than two hours.
 - 2. If the excavation space is vacant and reoccupied within two hours of the last reading, the AGT is allowed to resume air monitoring to verify atmospheric conditions inside the excavation are acceptable. If conditions are acceptable, the workforce is allowed to reenter the excavation.
- D. If mechanical ventilation is being used to control the atmosphere inside the excavation, all mechanical ventilation shall be shut down at least 15 minutes before initial air monitoring is conducted.
- E. Results of **daily initial** pre-entry air monitoring shall be recorded in the Air Monitoring section of the **Excavation Checklist**.

9.4. Continuous Air Monitoring

Continuous air monitoring warns excavation occupants of the presence of an atmosphere requiring respiratory protection.

- A. Continuous air monitoring for oxygen, flammability (LEL), and carbon monoxide shall be conducted at all times while excavations **are** occupied under the following conditions:
 - 1. Surrounding soil contamination is suspected regardless of the excavations depth or,

2. The excavation is ≥ 4 feet in depth
- B. Concentrations of hydrogen sulfide (H₂S) shall be continuously monitored if:
 1. Crude oil, bunker fuel, heavy fuel oil, or any other materials containing significant concentrations of H₂S are present; or
There is a likelihood of the presence or infiltration of H₂S or H₂S containing material.
- C. Based on the configuration and size of the excavation, several air monitors can be strategically placed within and around the excavation to continuously monitor the atmosphere.
Note: If there is a reasonable possibility of contaminants infiltrating the excavation from an external source (such as CO generated from the exhaust of backhoes, trucks), consideration should be given to additional continuous air monitors strategically placed outside the excavation. This can provide early warning of hazardous contaminants entering the excavation.
- D. All air monitors used for continuous monitoring shall be inspected by the Authorized Gas Tester at least every two hours to confirm they are functioning properly and atmospheric conditions have not changed.
- E. Personal monitors shall not be used as continuous air monitoring devices unless *all* occupants of the excavation are wearing personal multi-gas monitors. Otherwise, one or more portable continuous monitors shall be placed strategically within the excavation or attended by the Authorized Gas Tester.

9.5. Periodic Air Monitoring for Specific Contaminants

Concentrations of benzene cannot be continuously measured with a typical portable multi-gas detector. The following requirements apply to sampling for these specific contaminants.

- A. Benzene shall be monitored whenever gasoline or crude oil is the source of surrounding soil contamination.
- B. Additional air monitoring for benzene shall be performed:
 1. if conditions in the excavation change (e.g., additional or stronger odors are detected, groundwater infiltration occurs); or
 2. if an excavation occupant requests additional air monitoring; or
 3. at the discretion of the Competent Person.

Note: Monitoring for these toxic air contaminants requires colorimetric detector tubes or more sophisticated equipment such as a photoionization detector (PID). See the Air Monitoring policy, Appendix I, for more information about the capabilities of specific air monitoring equipment.

9.6. Confirmed atmosphere requiring respiratory protection

- A. If at any time an air monitoring detector registers an atmosphere requiring respiratory protection, controls shall be implemented to mitigate the atmospheric conditions.

Note: The use of respiratory protection may change the Task Risk Assessment (TRA) Level and require a Level 2 HITRA.

1. If controls do not eliminate or reduce the atmosphere requiring respiratory protection to safe levels, respiratory protection shall be worn by all personnel while in the hazardous area.
2. Any controls to be implemented shall be documented **on the PTW.**

10. Emergency Rescue

10.1. Rescue Plan

- A. A written rescue plan shall be prepared when supplied-air required atmospheric conditions exist in an excavation or could reasonably be expected to develop or if an Excavation Stand-by is required.

- B. The rescue plan commensurate with the level of risk associated with the task shall specify the plan to:
 - 1. summon either onsite and/or offsite emergency and rescue services in a timely manner
 - 2. rescue entrants from the confined space considering the hazard(s) identified and rescue method(s) required
 - 3. provide necessary emergency services to rescued employees
 - 4. prevent unauthorized personnel from attempting a rescue
- C. *Note:* For complicated excavations (e.g., below city streets with multiple utility lines 10 feet in depth), an excavation and rescue professional should be consulted in the preparation of the rescue plan.
- D. The rescue plan, if required, shall be documented on the Excavation Checklist or attached as a separate document.

10.2. Equipment

- A. Emergency rescue equipment shall be readily available at the site if supplied-air required atmospheric conditions exist or can reasonably be expected to develop during the excavation work. This equipment can consist of the following:
 - 1. Self-contained breathing apparatus (SCBA); air-line respirators with escape bottles.
 - 2. Full-body harnesses and lifelines.
 - 3. Basket stretcher with lines and blankets.
 - 4. Vertical lifting mechanism to raise workers out of an excavation.
- B. The rescue equipment shall be attended by trained rescue personnel when in use.

11. Protective Systems

11.1. General Requirements

- A. The soils of all excavations shall be treated as Type C soil unless:
 - 1. The Competent Person has analyzed the soil and completed the Soil Analysis form (Appendix V); and
 - 2. The resulting classification has been approved by the Operations Team Leader (TL) and the Soil Analysis form is attached to the Excavation Checklist.
 - a) An email from the TL to the Asset Operator can serve as verification of approval
- B. All excavations shall meet the requirements for protective systems as they pertain to the soil type identified by the Competent Person and in accordance with 29 CFR 1926, Subpart P, Appendices B through E.

Note: For information about soil classification, see Appendix IV of this policy.
- C. Excavations \geq 5 feet in depth shall be shored, laid back to a stable slope, or supported by some other means to protect personnel from cave-ins, falling dirt, or collapse of adjacent structures. Appendices IV and V summarize requirements for protective systems in accordance with OSHA regulations.

Note: Excavations less than 5 feet deep are not required to have protective systems (e.g. shoring, benching, bracing) if the excavation has been inspected by a Competent Person, if there is no indication of a potential cave-in, and if a protective system is not required at a lesser depth by state or local codes.
- D. Where an excavation is subject to earth vibration from machinery or superimposed loads from other sources (such as the spoil pile), precautions shall be taken during the installation of the protective system to prevent slides or cave-ins.

- E. If the excavation work endangers the stability of adjoining buildings or other structures, the necessary support system shall be provided. This evaluation and protection shall be provided by a Registered Professional Engineer.
- F. The protective systems of all excavations greater than 20 feet deep shall be designed by a Registered Professional Engineer.

11.2. Shoring Systems

- A. Aluminum hydraulic shoring is the preferred shoring system within USPL.
- B. A Registered Professional Engineer with expertise in timber shoring shall be consulted before this type of system is used. Timber shoring, in general, is not designed or constructed by USPL personnel.

11.3. Sloping Systems

- A. All excavations made in Type C soil (or treated as such) shall meet the following requirements if sloping is to be used as the protective system:
 - 1. Configurations of sloping systems shall be selected and constructed in accordance with one of the following options:
 - a) Sloped at an angle not steeper than one and one-half horizontal to one vertical (1.5H/1V) (34 degrees measured from the horizontal). **Benching Type C soil is not allowed.**
 - b) Excavated to form configurations that are in accordance with the slopes shown for Type C soil in 29 CFR 1926, Subpart P, Appendix B (Sloping and Benching). See Appendices IV and V of this policy.
 - c) Designed using tabulated data, such as tables and charts.
 - d) Designed by a Registered Professional Engineer.
- B. **All excavations made in other than Type C soil (or soil treated as such) shall meet the following requirements if sloping is used as the protective system:**
 - 1. **The Competent Person has analyzed the soil and completed the Soil Analysis form (Appendix V); and**
 - 2. **the resulting classification has been approved by the Operations Team Leader (TL) or CMT Team Leader and the Soil Analysis form is attached to the Excavation Checklist; and**
 - 3. **configurations of sloping systems shall be selected and constructed in accordance with slope configurations for appropriately selected Type B or Type A soils as specified in 29 CFR 1926, Subpart P, Appendix B (Sloping and Benching). (See Appendix VII of this policy).**
- C. Personnel shall not work on the faces of sloped or benched excavations at levels above other workers unless they are protected from falling, rolling, or sliding **material** or equipment.

11.4. Support Systems, Shielding Systems, and Other Protective Systems

- A. Support systems, shield systems, and other protective systems shall be selected, designed, and constructed in accordance with one of the following options:
 - 1. Designed using 29 CFR 1926, Subpart P, Appendix C (Timber Shoring for Trenches), and Appendix E (Aluminum Hydraulic Shoring for Trenches) as these appendices apply to the **identified soil type.**
 - 2. Designed using manufacturer's tabulated data in accordance with all specifications, recommendations, and limitations issued or made by the manufacturer.
 - 3. Designed using other tabulated data, such as tables and charts.
 - 4. Designed by a Registered Professional Engineer.
- B. Members of support systems shall be **compatible and** securely connected together to prevent sliding, falling, kick-outs, or other predictable failures.

- C. Support systems shall be installed and removed in a manner that protects personnel from cave-ins, structural collapses, and from being struck by the members of the support systems.
- D. Shields shall be installed in a manner to restrict lateral or other hazardous movement of the shield in the event of a sudden lateral load.
- E. Personnel shall be protected from the hazards of cave-ins when entering or exiting the areas protected by shields.
- F. Personnel shall not be allowed in shields when shields are being installed, removed, or moved vertically.
- G. Excavations of earth material to a level no greater than 2 feet below the bottom of a shield shall not be permitted unless the shield is designed to resist the forces calculated for the full depth of the trench.

11.5. Materials and Equipment for Protective Systems

- A. Materials and equipment for protective systems shall be free of damage or defects that might impair their proper function.
- B. Manufactured materials and equipment shall not be altered.
- C. A Registered Professional Engineer shall determine if damaged materials and equipment are suitable to be returned to service.

12. Training and Competency


- A. USPL personnel associated with excavation work shall receive training on this policy and its contents. Additionally, individuals serving in specific roles related to this policy shall receive training specific to those roles. Refer to the USPL Control of Work Training and Competency matrix.

13. References

- 1. BP Technical Practice USPL STP 04-003, "Site Preparation, Earthwork, and In-Line Inspections Excavations."
- 2. BP Technical Practice USPL-GP 04-0112, "Specifications for Ditching & Excavation."
- 3. OSHA, Department of Labor, 29 CFR 1926.650, "Excavations: Scope, Application, and Definitions"; 1926.651, "Specific Excavation Requirements"; and 1926.652, "Requirements for Protective Systems."
- 4. GDP 4.5-0002, Use of Temporary Ladders

Appendix I Excavation Checklist

This example of the Excavation Checklist is for reference only. For a downloadable version of the Checklist, go to the HSSE Policies folder in DRM. The electronic version can be filled out online or printed and completed as hard copy.

EX Excavation Checklist EX - [REDACTED] 

For excavations greater than or equal to 4 feet in depth

Issue Date		Complete the following.		
		No	NA	Yes
Section A: General Information	Excavation Competent Person	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Work Description	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Section B: Ground Disturbance	Preparation for Ground Disturbance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	All surface obstructions, creating a hazard to workers, are removed / supported.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Review Alignment Sheets / drawings.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Safety sweep to be performed prior to excavation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Safety sweep should be performed every 4 feet of depth as practical.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	All known underground installations (BP and third party) identified.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	All known underground installations (BP and third party) marked.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
If No, describe the methods to be utilized to avoid damage to underground installations.		<input type="text"/>		
One-Call Ticket Number	<input type="text"/>	Time Called In:	<input type="text"/>	
One-Call Ticket Number	<input type="text"/>	Time Called In:	<input type="text"/>	
Sections C, D, and E shall be completed before personnel enter any excavation ≥ 4 feet in depth.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Air monitoring to be performed for the atmosphere in the excavation prior to entry and continuous during entry for O ₂ , LEL, CD and as needed for toxics (e.g. H ₂ S, Benzene). Record initial results in the Air Monitoring section.				
Section C: Excavation Entry	Protective System(s) To Be Used	No	NA	Yes
	Sloping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Benching	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Shoring	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Certified Trench Shield/Box	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
NA (excavation < 5 ft deep, no indication of cave-in, or local codes do not require protective systems < 5 ft deep)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Access / egress is within 25 ft of each worker.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Excavation Stand-by is designated if limited access / egress or supplied air atmosphere. Rescue plan required		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spoil pile and materials located ≥ 2 ft from excavation.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Workers protected from water accumulation (e.g. special support / shielding and water removal methods)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Assess any ongoing changes to the excavation and surrounding area, specifically subsurface changes such as water accumulation. Document any additional controls that will be implemented.				

EX Excavation Checklist

EX - 

For excavations greater than or equal to 4 feet in depth

Air Monitoring										
Test for Substances	Action Trigger	IDLH Limits	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	
Oxygen (O ₂)	< 19.5% or > 23.5%	< 19.5% or > 23.5%								
LEL	≥ 1%	≥ 10%								
Carbon Monoxide	≥ 35 ppm	> 1200 ppm								
Benzene	≥ 1 ppm	> 500 ppm								
Hydrogen Sulfide (H ₂ S)	≥ 10 ppm	> 300 ppm								
Total Petroleum Hydrocarbons (Gasoline)	≥ 300 ppm	> 1300 ppm								
Diesel Fuel	≥ 25 ppm	> 600 ppm								
Other										
Substances listed above do not exceed IDLH levels?			Yes <input type="checkbox"/>	Yes <input type="checkbox"/>	Yes <input type="checkbox"/>	Yes <input type="checkbox"/>	Yes <input type="checkbox"/>	Yes <input type="checkbox"/>	Yes <input type="checkbox"/>	Yes <input type="checkbox"/>
STOP – NO ENTRY PERMITTED if ANY checkbox indicates "NO"			No <input type="checkbox"/>	No <input type="checkbox"/>	No <input type="checkbox"/>	No <input type="checkbox"/>	No <input type="checkbox"/>	No <input type="checkbox"/>	No <input type="checkbox"/>	No <input type="checkbox"/>
Air monitoring identified an atmosphere that will require the use of respiratory protection for safe entry.			Yes <input type="checkbox"/>	If "Yes", identify the controls / precautions implemented to eliminate or mitigate atmosphere requiring respirator protection.						
			No <input type="checkbox"/>							
Excavation contains a supplied-air required atmosphere.			Yes <input type="checkbox"/>	Work being performed will cause a supplied-air required atmosphere.						Yes <input type="checkbox"/>
			No <input type="checkbox"/>							No <input type="checkbox"/>
If "Yes" for either statement, then rescue equipment and trained personnel shall be on site (except for supplied-air when sand blasting).										
Describe the method to summon emergency and rescue services in a timely manner.										
Check the method used to rescue personnel in the excavation. <input type="checkbox"/> Self-Rescue <input type="checkbox"/> Entry Rescue <input type="checkbox"/> Non-Entry <input type="checkbox"/> Other										
Describe how necessary emergency services will be provided to rescued employees.										
Describe how unauthorized personnel will be prevented from entering excavation.										
Entry into third party excavation and, if applicable, the Competent Person have given consent.										Yes <input type="checkbox"/>
Excavation Competent Person <input type="text"/> Print Name <input type="text"/> <input type="text"/>										

Appendix II

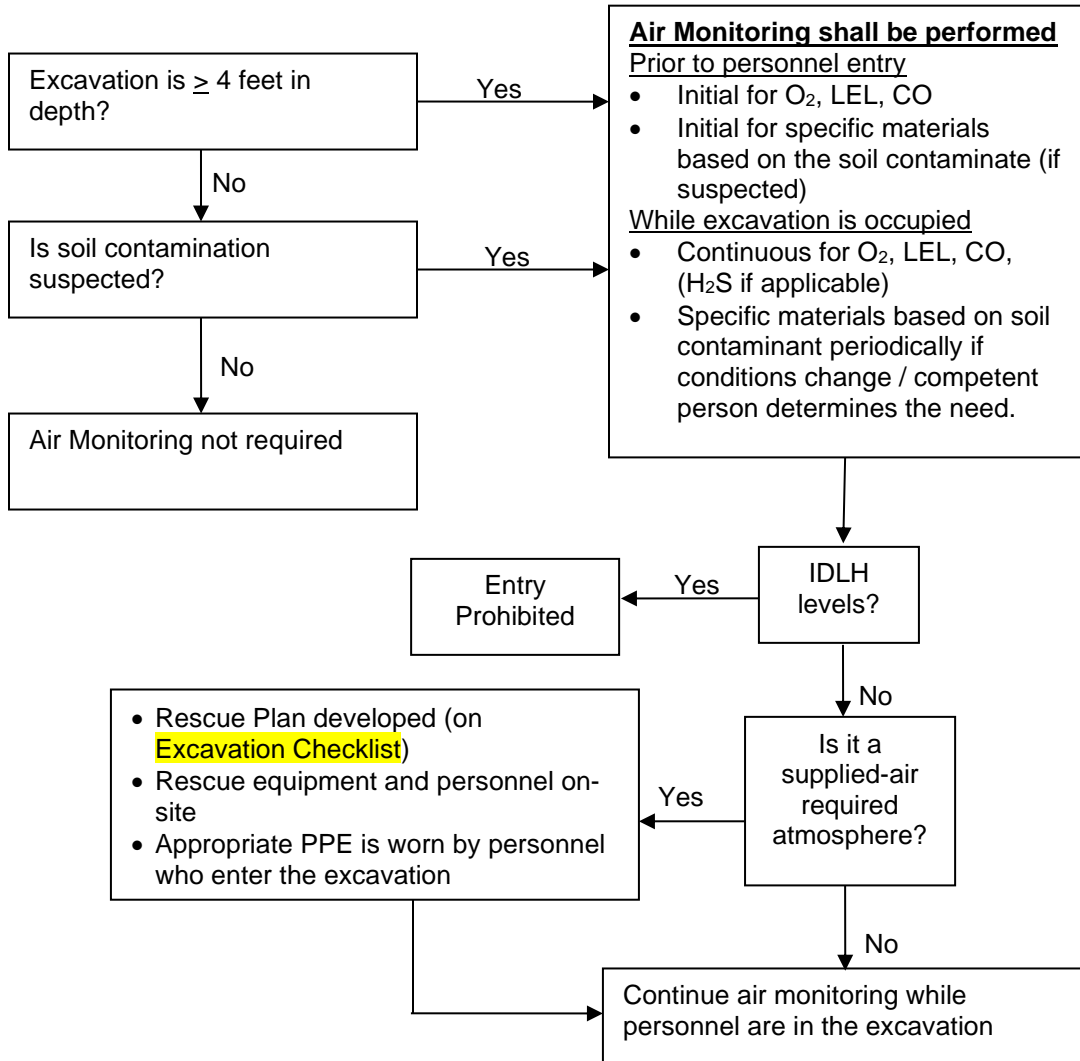
Excavation Checklist Applicability

	USPL Controlled	Non-USPL Controlled
<u>Ground Disturbance</u> <ul style="list-style-type: none"> • Non-mechanical 	Checklist Not Required PTW Section D if < 4 ft.	Checklist Not Required
<u>Ground Disturbance</u> <ul style="list-style-type: none"> • Mechanical 	Excavation Checklist if > 4 ft. PTW Section D if < 4 ft.	Checklist Not Required
Excavation Entry < 4 feet deep	PTW Section D Required	Checklist NOT Required
Excavation Entry ≥ 4 feet deep	Excavation Checklist	Excavation Checklist

**Note: Entry into an excavation < 4 feet deep where the soil is suspected to be contaminated will require air monitoring and may require a documented rescue plan. See Appendix III for more information.*

Appendix III

Air Monitoring Applicability



Appendix IV Soil Classification

The following definitions of soil types and characteristics are taken from 29 CFR 1926 Subpart P, Appendix A (Soil Classification) and are based on ASTM standards D653-85 and D2488, the Unified Soils Classification System, the USDA's Textural Classification Scheme, and the National Bureau of Standards Report BSS-121.

Type A

Cohesive soils with an unconfined compressive strength of 1.5 tons per square foot (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.

No soil is categorized as Type A if:

- The soil is fissured; or
- The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or
- The soil has been previously disturbed; or
- 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; or
- The material is subjected to other factors that would require it to be classified as a less stable material.

Type B

- Cohesive soil with an unconfined compressive strength greater than 0.5 ton per square foot (48 kPa) but less than 1.5 tons per square foot (144 kPa); or
- Granular cohesion-less soils, including angular gravel (similar to crushed rock), silt, silt loam, sandy loam, and, in some cases, silty clay loam and sandy clay loam; or
- Previously disturbed soils except those which would otherwise be classed as Type C soil; or
- Soil that meets the unconfined compressive strength or cementation requirements for Type A but is fissured or subjected to vibration; or
- Dry rock that is not stable; or
- 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

- Cohesive soil with an unconfined compressive strength of 0.5 ton per square foot (48 kPa) or less; or
- Granular soils including gravel, sand, and loamy sand; or
- Submerged soil or soil from which water is freely seeping; or
- Submerged rock that is not stable; or
- Material in a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or steeper.

Layered systems shall be classified in accordance with the weakest layer. However, each layer can be classified individually where a more stable layer lies under a less stable layer.

Soil Definitions

Cemented soil—soil in which the particles are held together by a chemical agent (e.g., calcium carbonate), such that a hand-size sample cannot be crushed into powder or individual soil particles by finger pressure.

Cohesive soil—clay (fine-grained soil) or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical side slopes, and is plastic when moist. Cohesive soil is hard to break up when dry and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, and organic clay.

Dry soil—soil that does not exhibit visible signs of moisture content.

Fissured—a soil material that has a tendency to break along definite planes of fracture with little resistance or a material that exhibits open cracks, such as tension cracks in an exposed surface.

Granular soil—gravel, sand, or silt (coarse-grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

Layered soil system—two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.

Moist soil—a soil that looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small-diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

Plastic—a property of soil that allows the soil to be deformed or molded without cracking or appreciable volume change.

Saturated soil—a soil in which the voids are filled with water. Saturation does not require flow. Saturation or near saturation is necessary for the proper use of instruments such as a pocket penetrometer or shear vane.

Spall—a fragment, usually in the shape of a flake, detached from a larger mass (such as rock or stone) by a blow, the action of weather, pressure, or expansion within the larger mass.

Stable rock—natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

Submerged soil—soil that is underwater or free-seeping.

Unconfined compressive strength—the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing or estimated in the field with a pocket penetrometer, by thumb penetration tests, and other methods.

Wet soil—soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

Appendix V

Soil Analysis Form

A combination of visual and manual tests shall be performed and documented

Visual Tests

Visual analysis provides 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.

Date: _____ Time: _____ Length of time excavation has been open: _____

Excavation measurements: Depth: _____ Width: _____ Length: _____

Sample taken from: Wall: _____ Depth: _____ Bottom: _____

1. Observe the sample of soil that is 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.

RESULTS: _____

2. Observe the 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.

RESULTS: _____

3. Observe the sides of the open 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.

RESULTS: _____

4. Observe the area adjacent to the excavation and the excavation itself for evidence. Look for evidence of existing utilities and other underground structures and identify previously disturbed soil.

RESULTS: _____

5. Observe the open sides of the excavation to identify layered systems. Examine layers for sloping toward the excavation. Estimate the degree of slope of the layers.

RESULTS: _____

6. Observe the area adjacent to the excavation for sources of vibration that can affect the stability of the excavation face.

RESULTS: _____

7. Observe the area adjacent to the excavation and the sides of the open excavation for any evidence of water seepage.

RESULTS: _____

(continued on next page)

Manual Tests

These tests are conducted to determine quantitative as well as qualitative properties of soil and to provide more information for appropriate classification.

1. 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 2-inch length of 1/2-inch thread can be held at one end without tearing, the soil is cohesive.

RESULTS: _____

2. 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 that break up into smaller clumps, but the smaller clumps can be broken up only with difficulty, it can be clay in combination with gravel, sand, or silt. If the dry soil breaks into clumps that can be broken only with difficulty and there is no visual indication that the soil is fissured, the soil can be considered unfissured.

RESULTS: _____

3. Thumb Penetration. The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils.

- Type A—Soil can be readily indented with the thumb but penetrated by the thumb only with very great effort.
- Type B—Soil can be readily indented with the thumb but penetrated with some effort.
- Type C—Soil can be easily penetrated several inches with no effort and can be easily molded with light finger pressure. This test is to be conducted on an undisturbed soil sample such as a clump of soil as soon as practicable after excavation to minimize the effects of exposure to drying influences. Reclassification is needed if the excavation is later exposed to wetting influences (rain, snow, or flooding) and documented accordingly.

RESULTS: _____

4. Other Strength Tests. Estimates of the unconfined compressive strength of soils can also be obtained by using a pocket penetrometer or a hand-operated shear vane.

RESULTS: _____

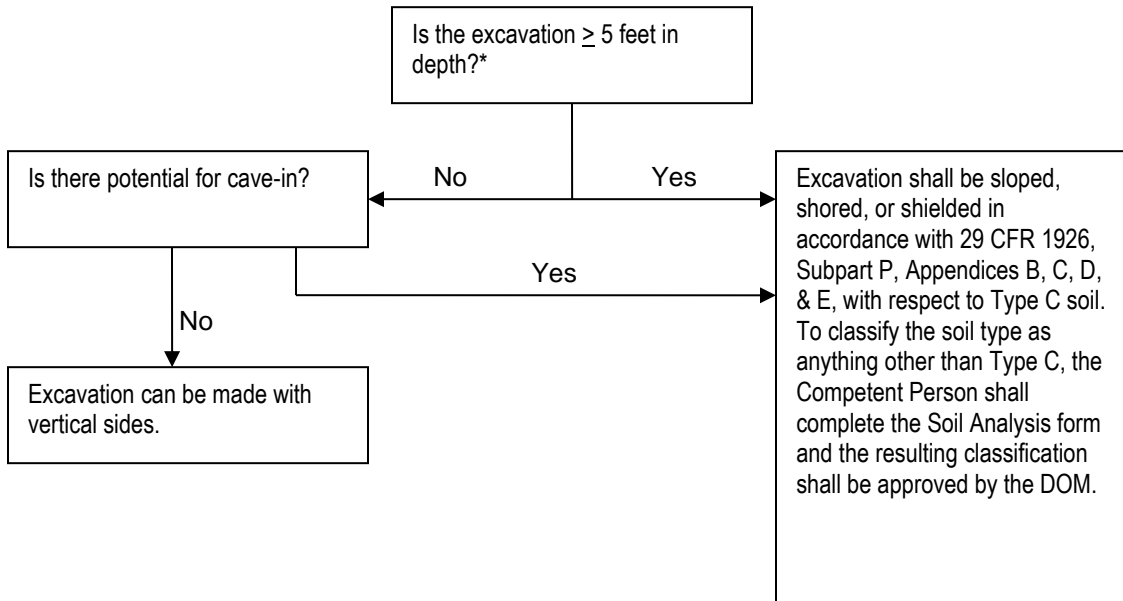
5. Drying Test. The basic purpose of the drying test is to differentiate between cohesive material with fissures, unfissured cohesive material, and granular material. The procedure for the drying test involves drying a sample of soil approximately 1 inch thick and 6 inches in diameter until it is thoroughly dry.

- If the sample develops cracks as it dries, significant fissures are indicated.
- Samples that dry and do not crack are to be broken by hand. If considerable force is necessary to break the sample, significant fissures are indicated.
- If a sample breaks easily by hand, it is either a fissured cohesive material or a granular material. To distinguish between the two, pulverize the dried clumps by hand or by stepping on them. If the clumps do not pulverize easily, the material is cohesive with fissures. If they pulverize easily into very small fragments, the material is granular.

RESULTS: _____

Appendix VI Requirements for Protective Systems

The following figures illustrate the OSHA requirements contained in 29 CFR 1926, Subpart P, for excavations 20 feet or less in depth. A Registered Professional Engineer, in accordance with 1926.652(b) and (c), shall design protective systems for use in excavations more than 20 feet in depth.



* Note: State or local codes could require protective systems to be implemented at <5 feet of depth

Maximum Allowable Slopes for Excavations Less Than 20 Feet Deep

Soil or Rock Type	Maximum Allowable Slopes (H:V)
Stable Rock	Vertical (90 degrees)
Type A	¾:1 (53 degrees)
Type B	1:1 (45 degrees)
Type C	1½:1ft (34 degrees)
Mixed soil types	1½:1ft (34 degrees)

Source: Adapted from 29 CFR 1926, Subpart P, Appendix B, Table B-1.

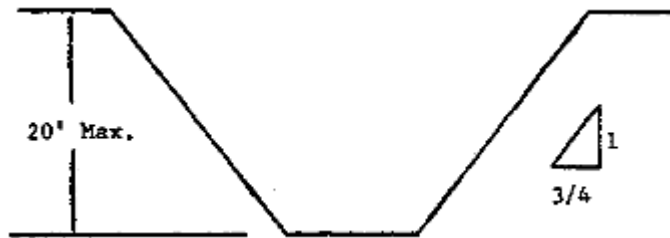
Notes:

1. H = Horizontal. V = Vertical. Angles in parentheses are expressed in degrees from the horizontal. Angles have been rounded off.
2. A short-term maximum allowable slope of ½H:1V (63 degrees) is allowed in excavations in Type A soil that are 12 feet or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet in depth shall be ¾H:1V (53 degrees).
3. Sloping or benching for excavations greater than 20 feet deep shall be designed by a Registered Professional Engineer.

Appendix VII Sloping Requirements:

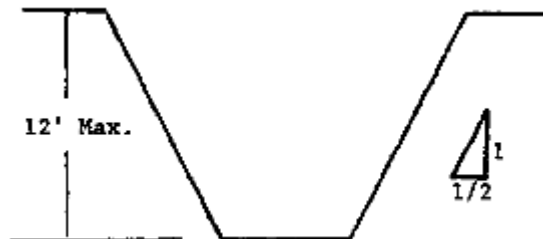
Excavations made in Type A soil.

1. All simple slope excavation 20 feet or less in depth shall have a maximum allowable slope of $\frac{3}{4}$:1.



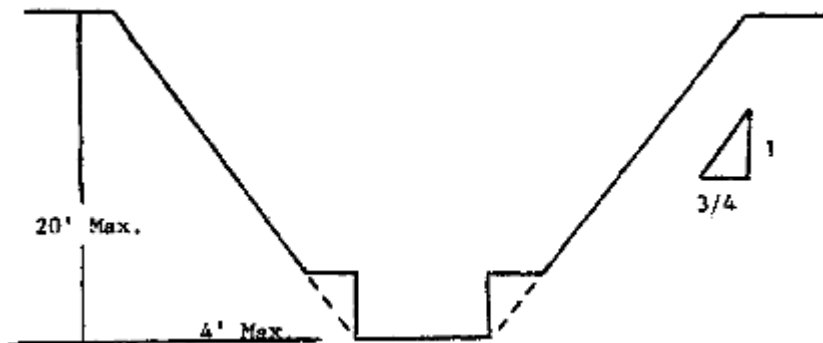
SIMPLE SLOPE -- GENERAL

Exception: Simple slope excavations which are open 24 hours or less (short term) and which are 12 feet or less in depth shall have a maximum allowable slope of $\frac{1}{2}$:1.

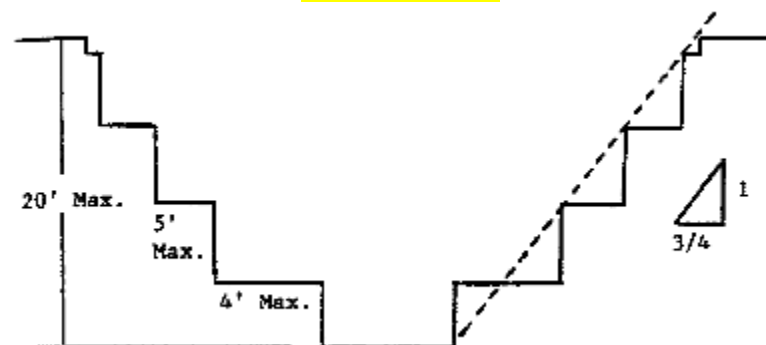


SIMPLE SLOPE -- SHORT TERM

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of $\frac{3}{4}$ to 1 and maximum bench dimensions as follows:



SIMPLE BENCH



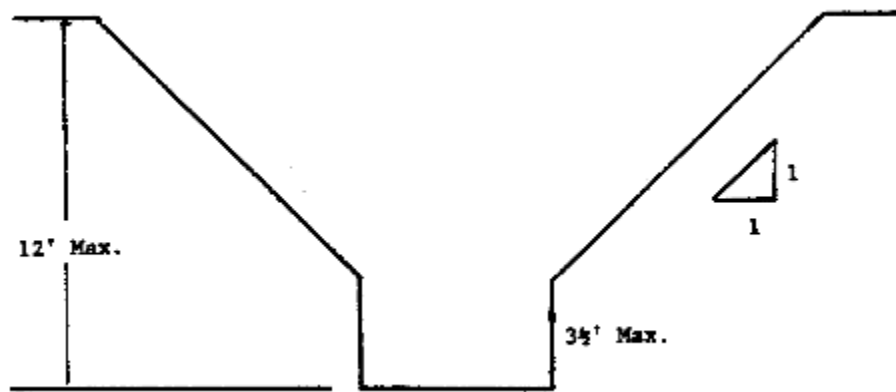
MULTIPLE BENCH

3. All excavations 8 feet or less in depth which have unsupported vertically sided lower portions shall have a maximum vertical side of 3½ feet.



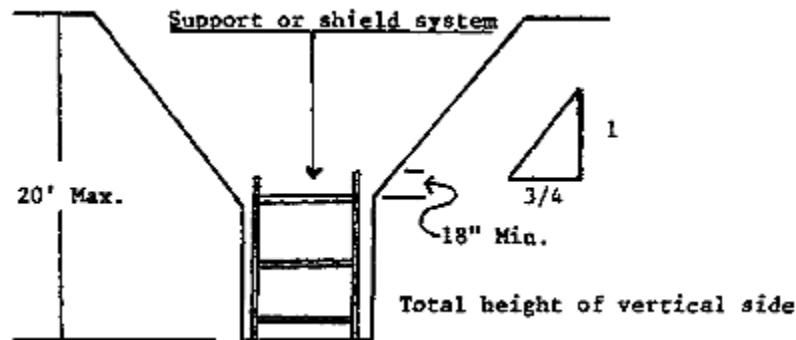
UNSUPPORTED VERTICALLY SIDED LOWER PORTION -- MAXIMUM 8 FEET IN DEPTH)

All excavations more than 8 feet but not more than 12 feet in depth with unsupported vertically sided lower portions shall have a maximum allowable slope of 1:1 and a maximum vertical side of 3½ feet.



UNSUPPORTED VERTICALLY SIDED LOWER PORTION -- MAXIMUM 12 FEET IN DEPTH)

All excavations 20 feet or less in depth which have vertically sided lower portions that are supported or shielded shall have a maximum allowable slope of ¾:1. The support or shield system must extend at least 18 inches above the top of the vertical side.

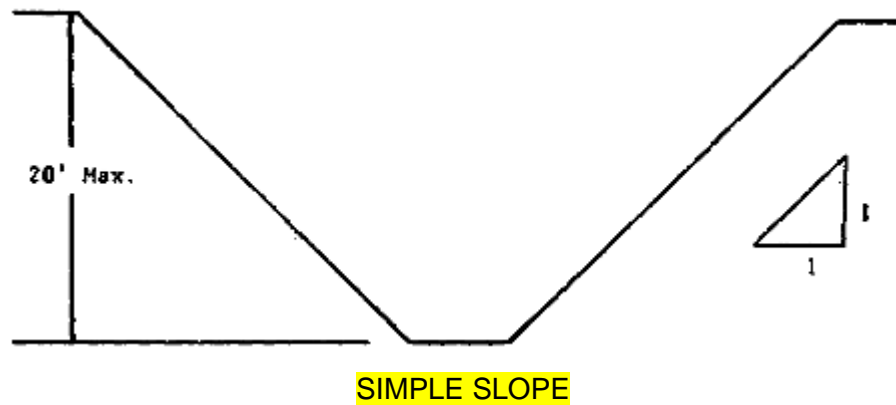


SUPPORTED OR SHIELDED VERTICALLY SIDED LOWER PORTION

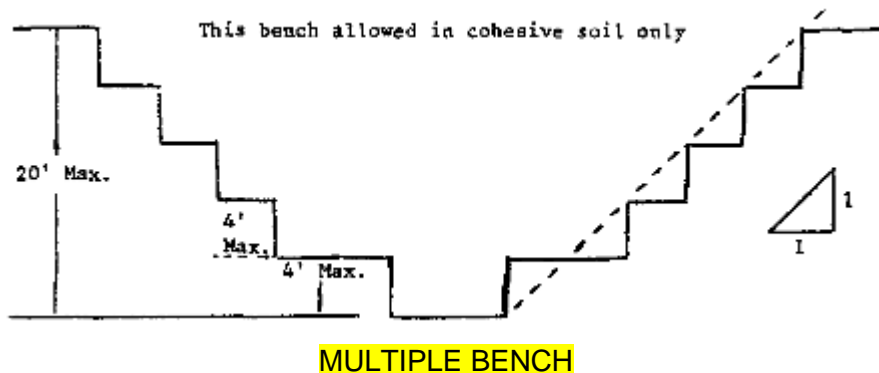
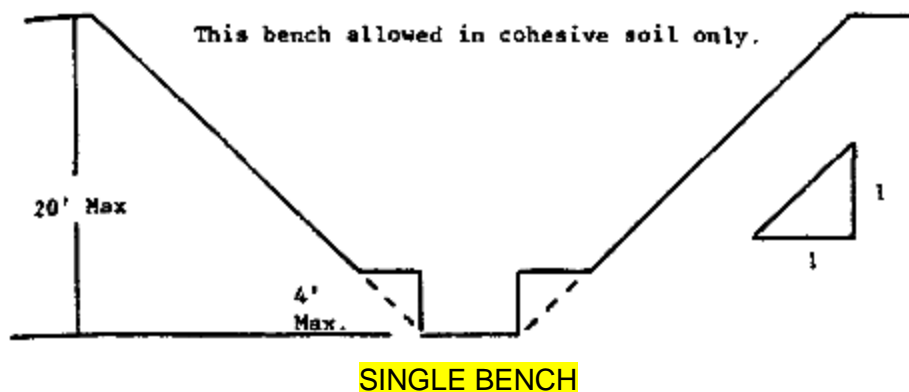
4. All other simple slope, compound slope, and vertically sided lower portion excavations shall be in accordance with the other options permitted under § 1926.652(b).

Excavations Made in Type B Soil

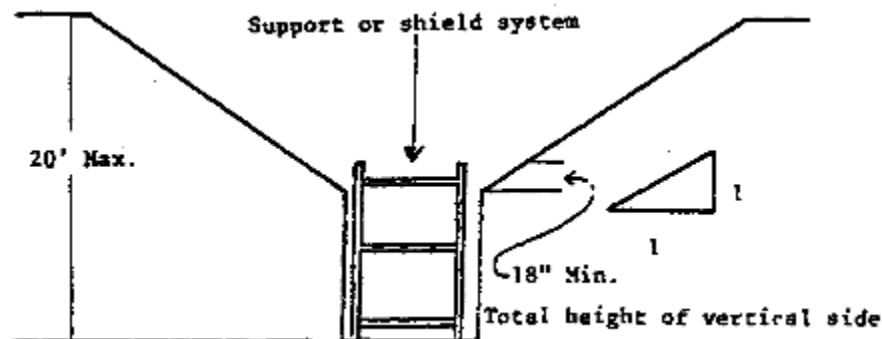
1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1.



2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1 and maximum bench dimensions as follows:



3. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1:1.

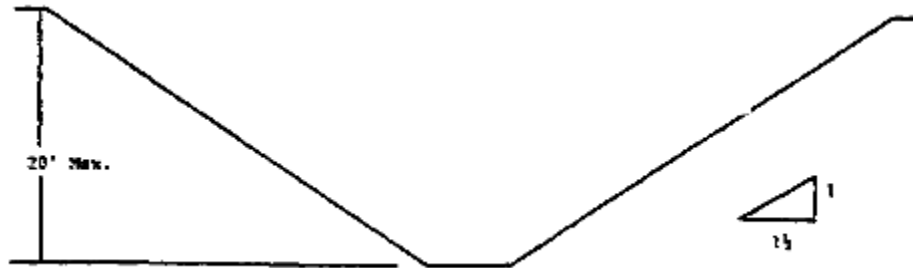


VERTICALLY SIDED LOWER PORTION

4. All other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

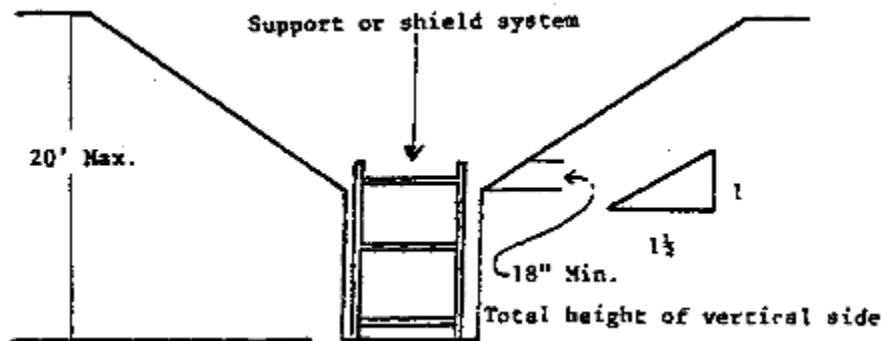
Excavations Made in Type C Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1½:1.



SIMPLE SLOPE

2. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1½:1.



VERTICAL SIDED LOWER PORTION

3. All other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

APPENDIX VIII

Overhead power line signage and goal posting

Goal Posting and additional signage and delimitation barriers should be placed when an excavation is working within 10 ft of an overhead powerline or has to trail under it to get to the worksite.

