

## Trenching, Excavation & Heavy Equipment Safety



## Excavations

- ☑ Hundreds of workers killed annually from cave-ins
- ☑ Thousands of workers injured annually from cave-ins
- ☑ Fatality rate for trenching is twice the level for general construction



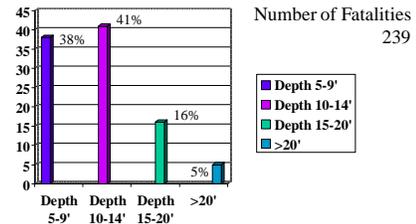
## How do Most Deaths Occur?

- ☑ Instantaneously
- ☑ Trenches 5 to 15 deep
- ☑ With absolutely no warning
- ☑ In seemingly safe conditions
- ☑ With workers in a bent or lying position



## -TRENCH - FATALITIES

### -Percentage of Fatalities

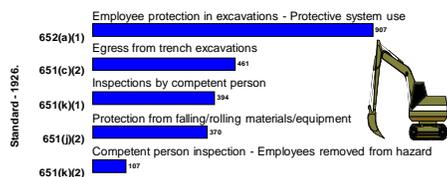


-DEPTH of TRENCH



## Subpart P - Excavations (1926.650 - 652)

### Number of Serious Violations - FY 2004



## Sub Part P - Excavations

### ↪ Scope and Application 1926.650 (a)

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

### ↪ Excavation

- Means any man-made cut, cavity, trench or depression, formed by earth removal



## Sub Part P - Excavations

### ↳ Competent Person

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



## Sub Part P - Excavations

### ↳ Protective System

- Means a method of protecting employees from cave-ins and from material that could fall or roll from an excavation face, 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.



## Sub Part P - Excavations

### ↳ Registered Professional Engineer

- Means a person who is registered as a professional engineer in the state where the work is to be performed.



## General Requirements

### ↳ Surface encumbrances 1926.651 (a)

- If they create a hazard to employees.
  - Support or remove to safe guard
- Pre-plan excavation to avoid these hazards.



## General Requirements

### ↳ Underground installations 1926.651 (b)

- Determine estimated location.
- Contact utility or owner.
- Find exact location.
- Installations shall be protected, supported, or removed.





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## General Requirements

- ⌞ Access and egress 1926.651(c)
  - ⌞ Four feet in depth or greater
    - Ladder, stairway, or ramp.
      - No more than 25 feet lateral travel.
      - Must extend at least 3 feet above the landing
- \*Note heavy equipment should not be used to enter or exit the excavation.**

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## General Requirements

- ⌞ Exposure to vehicular traffic 1926.651(d)
  - Employees shall be provided with, and shall wear, warning vests or other suitable garments marked with or made of reflectorized or high visibility material.
  - Barricades to keep traffic a safe distance from the excavation.

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## General Requirements

- ↳ Exposure to falling loads 1926.651 (e)
  - No employee shall be allowed underneath loads handled by lifting or digging equipment.
  - Use taglines to move or swing loads.

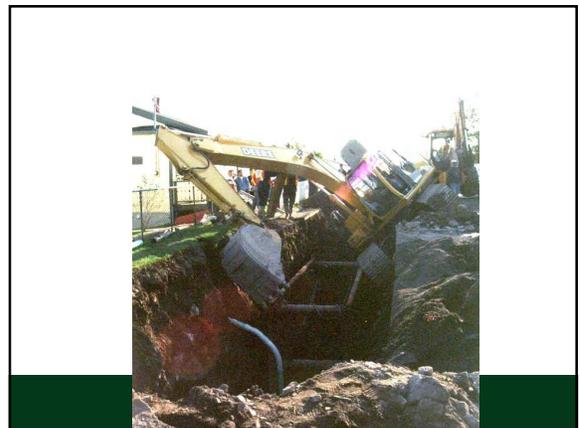
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## General Requirements

- ↳ Warning systems for mobile equipment 1926.651 (f)
  - When mobile equipment is operated adjacent to an excavation, a warning system shall be utilized, such as barricades, hand or mechanical signals, or stop logs.

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## General Requirements

### ⌘ Hazardous Atmospheres 1926.651 (g)

- Where a hazardous atmosphere exists, or could reasonably be expected to exist, the atmosphere in the excavation **shall** be tested before employees enter.
- Adequate precautions could include:
  - Mechanical ventilation
  - Respiratory protection
  - Other PPE



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## General Requirements

### ⌘ Hazardous Atmospheres could include:

- 1. Oxygen deficiency or enrichment.
- 2. Combustible environment.
- 3. Toxic environment.

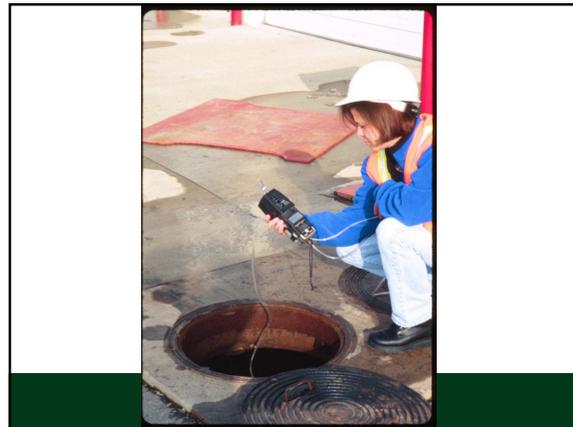


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## Effects of Various Oxygen Levels

⌘ Oxygen by volume	Resulting Condition/Effects on Humans
⌘ 23.5% and above	Oxygen enriched, extreme fire hazard.
⌘ 21%	Oxygen concentration in "Air".
⌘ 19.5%	Minimum "Safe Level" OSHA, NIOSH.
⌘ 16%	Disorientation, impaired judgement and Breathing.
⌘ 14%	Faulty judgement, rapid fatigue.
⌘ 8%	Mental failure, fainting.
⌘ 6%	Difficult breathing, death in minutes.

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## General Requirements

### ⌘ Water accumulation 1926.651 (h)

- Employees shall not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees
- Water removal equipment shall be monitored by a "Competent Person" to ensure proper operation.
- Excavations subject to runoff from heavy rains will require an inspection by a "competent Person."

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## General Requirements

### Stability of adjacent structures 1926.651(l)

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



## General Requirements

### Protection of employees from loose rock and soil 1926.651 (j)

- Adequate protection shall be provided to protect employees from loose rock or soil that could pose a hazard by falling from an excavation face.
- All excavation soil (spoils), materials, and equipment shall be kept at least 2' from the edge of the excavation or be adequately



## General Requirements

### Fall protection



- Where employees or equipment are required or permitted to cross over excavations, walkways or bridges standard guardrails shall be provided.
- Adequate barrier physical protection shall be provided at all remotely located excavations.
- Keep excavations back-filled as closely as

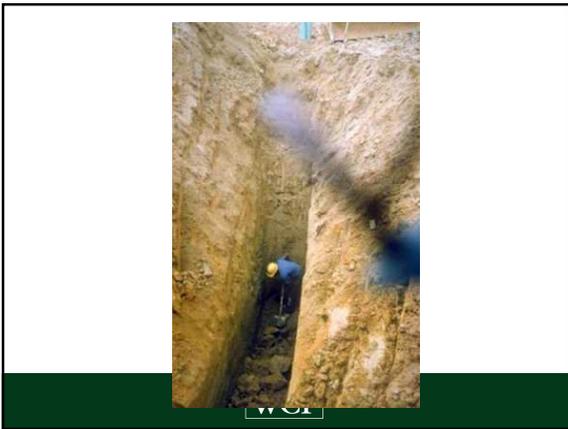




## Requirements for Protective Systems

Each employee in an excavation shall be protected from cave-ins by an adequate protective system except when excavations are made entirely in stable rock or excavations are less than 5' in depth, and a competent person determines no potential for cave-in.

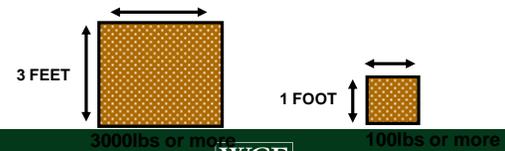
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## Soil Weight

DEPENDENT ON THE DENSITY AND WATER CONTENT:

- ☑ One cubic yard weighs - 3000lbs or more
- ☑ One cubic foot weighs - 100lbs or more



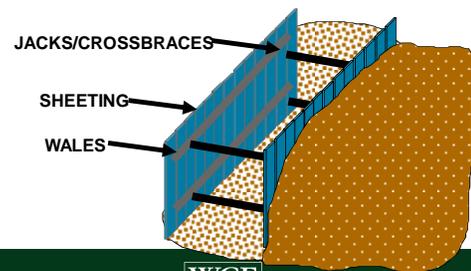
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## 1926.652 Requirements for Protective Systems

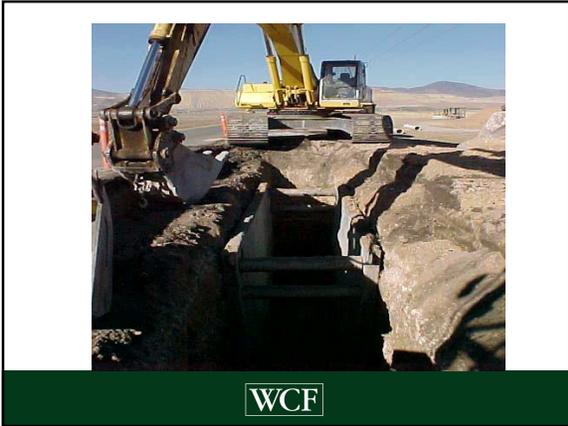
- ↳ Types of protective systems
  - Shoring systems
  - Shielding systems. Surface encumbrances
  - Sloping and benching systems

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## Shoring Example



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## Sloping and Benching Systems

- ↪ Soil Types
  - ↪ Stable Rock
  - ↪ Type A: (Clay) Cohesive soil with a compressive strength of 1.5 ton per square foot or greater.
  - ↪ Type B: (Angular gravel) Cohesive soil with a unconfined compressive strength of .5 ton per square foot but less than 1.5.
  - ↪ Type C: (Gravel, sand) Cohesive soil with an unconfined compressive strength of 0.5 tsf or less.

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## Appendix B - Sloping and Benching Table B-1

- ↪ Maximum Allowable Slopes
 

↪ Stable Rock	Vertical (90%)
↪ Type A	3/4: 1 (53%)
↪ Type B	1:1 (45%)
↪ Type C	1 1/2:1(34%)

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## Equipment (1926.600)

### ⤵ (a) General Requirements (Batteries)

- ⤵ (4) The use, care and charging of batteries **shall** conform to the requirements in subpart K.
  - ⤵ Stored in ventilated area.
  - ⤵ Charged in area with good ventilation to prevent the build up of hydrogen gas.
  - ⤵ Racks must be corrosion resistant
  - ⤵ Floors acid resistant
  - ⤵ Face shields, aprons, and rubber gloves **shall** be provided for handling.
  - ⤵ Eye wash/shower for quick drenching within 25 feet of handling area.
  - ⤵ Neutralizing means for spills.

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## Equipment (1926.600)

### ⤵ (a) General Requirements (Batteries)

- ⤵ (4) The use, care and charging of batteries **shall** conform to the requirements in subpart K Continued.
  - ⤵ Batteries charged in designated area.
  - ⤵ Charging apparatus **shall** be protected from damage by trucks.
  - ⤵ During charging battery vent caps **shall** be left in place to prevent electrolyte spray.
  - ⤵ Vent caps **shall** be maintained in functioning condition.

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## Equipment (1926.600)

### ⤵ (a) General Requirements

- ⤵ (5) **Cab glass:**
  - ⤵ Safety rated glass.
  - ⤵ Have no distortion that would affect the safe operations of the any machine.

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## Equipment (1926.600)

### ⤵ (a) General Requirements

- ⤵ (6) All equipment covered by this subpart shall comply with 1926.550(a)(15):
  - ⤵ Line 50 kV. or below minimum clearance between any part of equipment and line is 10'.
  - ⤵ Lines rated over 50 kV., minimum clearance must be 10' plus .4 inches for every 1 kV. over 50 kV.
  - ⤵ Person shall be designated to observe the clearance if not possible for operator. Sufficient warning must be given to allow the operator to stop prior to contact.
  - ⤵ Overhead lines are to be assumed energized until the person owning the lines indicates that they have been de-energized and they are visibly grounded.

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## Motor Vehicles (1926.601)

### ⤵ (a) Coverage

- ⤵ **Motor vehicles as covered by this part are those vehicles that operate within an off-highway job site, not open to public traffic.**

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## Motor Vehicles (1926.601)

- κ (b) General requirements
- κ All vehicles shall have:
  - κ a service brake.
  - κ a parking brake system.
- κ These shall be in operable condition.

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## Motor Vehicles (1926.601)

- κ (b) General requirements
- κ (2) Whenever conditions warrant additional lights, all vehicles must have:
  - κ two head lights.
  - κ two tail lights.
  - κ brake lights (regardless of light conditions).
- κ These shall be in operable condition.

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## Motor Vehicles (1926.601)

- κ (b) General requirements
- κ (3) All vehicles shall have:
  - κ An adequate audible warning (horn) device at the operators station.
- κ (4) No employer shall use any motor vehicle equipment having an obstructed rear view unless:
  - κ The vehicles has a reverse signal above the surrounding noise level, or:
  - κ an observer is present and signals that it is safe.

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## Motor Vehicles (1926.601)

- κ (b) General requirements
- κ (5) All vehicles with cabs shall be equipped with:
  - κ windshields (cracked windshields shall be replaced).
  - κ powered wipers.
  - κ defogging, or defrosting (if condition warrant it).
- κ (6) All haulage vehicles loaded by cranes, power shovels, loaders, or similar equipment, shall have a cab/shield or canopy to protect the operator from shifting or falling material.
- κ (7) Tools and material shall be secured to prevent movement when in the same

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## Motor Vehicles (1926.601)

- κ (b) General requirements
- κ (8) Vehicles used to transport employees shall:
  - κ Have seats firmly secured.
  - κ Adequate for the number of riders.
- κ (9) Seat belts must meet DOT, and Federal Motor Vehicle Safety Standards.
- κ (10) Trucks with dump bodies Shall:
  - κ Be equipped with Positive means of support (block).
    - κ It must be permanently attached.
    - κ Capable of being locked into position to prevent lowering while repair or inspection work is being done.

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## Motor Vehicles (1926.601)

- κ (b) General requirements
- κ (11) Operating levers controlling hosting or dumping shall:
  - κ Have a latch or device to prevent accidental starting or tripping of the mechanism.
- κ (12) Trip handle for tailgates of dump trucks shall:
  - κ Be arranged so that the operator will be in the clear.
- κ (13) All rubber tired motor vehicle equipment shall:
  - κ Have fenders. Mud flaps may be used in lieu if equipment is not designed for fenders.

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## Motor Vehicles (1926.601)

- ⌘ (b) General requirements
- ⌘ **(14) All vehicles in use shall be inspected at the beginning of each shift:**
  - ⌘ service brakes including trailer brake connections, parking systems (hand brake), emergency stopping system (brake), tires, horn, steering system, coupling devices, seat belts, operating controls, and safety devices.
  - ⌘ **All defects shall be corrected prior to use.**

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## Material Handling Equipment (1926.602)

- ⌘ (a) Earth Moving Equipment: General.
- ⌘ **(1) Regulation applies to the following:**
  - ⌘ Scrapers, loaders, crawler or wheel tractors, bulldozers, off highway trucks, graders, agricultural and industrial tractors, and similar equipment.
- ⌘ **(2) Seat Belts.**
  - ⌘ All equipment **shall** be provided with seat belts.
    - ⌘ **Exceptions;**
      - ⌘ Standup operation equipment.
      - ⌘ Not equipped with ROPS.

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## Material Handling Equipment (1926.602)

- ⌘ (a) Earth Moving Equipment: General.
- ⌘ **(3) Access Roadways and grades.**
  - ⌘ Must accommodate safely the movement of equipment.
  - ⌘ Emergency access ramps **shall** be constructed to restrain all runaway equipment.
- ⌘ **(4) Brakes.**
  - ⌘ Service brake **shall** capable of stopping and holding the equipment fully loaded. See CFR for criteria for specific equipment.
- ⌘ **(5) Fenders.**

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## Material Handling Equipment (1926.602)

- ⌘ (a) Earth Moving Equipment: General.
- ⌘ **(9) Audible Alarms.**
  - ⌘ All bi-directional machines such as rollers, compactors, front end loaders, bulldozers, and similar equipment **SHALL** be equipped with:
    - ⌘ Horn distinguishable from surrounding noise level, which shall be operated as needed when moving in either direction.
- ⌘ **(10) Scissor Points.**
  - ⌘ Scissor points on all front-end loaders that present a

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## Other Places in the OSHA Regulations

- ⌘ **1926.20 (b)(4) The Employer shall permit only those employees qualified by training or experience to operate equipment and machinery.**

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Other Places in the OSHA Regulations

⌞ **Employer Responsibility**

⌞ **1926.21(b)(2)**

- ⌞ **The employer shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment to control or eliminate any hazards or other exposure to illness or injury.**