

Regulatory Review of  
29 CFR 1926, Subpart P:

Excavations

Pursuant to  
Section 610 of the Regulatory Flexibility Act  
and Section 5 of Executive Order 12866

Occupational Safety and Health Administration  
Directorate of Evaluation and Analysis  
Office of Evaluations and Audit Analysis

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## Executive Summary

On October 31, 1989, OSHA issued a final revised standard for excavation and trenching.<sup>1</sup> The revision updated the previous standard by simplifying many of the existing provisions, adding and clarifying definitions, eliminating duplicate provisions and ambiguous language, and giving employers added flexibility in providing protection for employees. In addition, the standard provided several new appendices. One appendix provided a consistent method of soil classification. Others provided sloping and benching requirements, pictorial examples of shoring and shielding devices, timber tables, hydraulic shoring tables, and selection charts that provide a graphic summary of the requirements contained in the standard.

This regulatory review of the Excavations Standard meets the requirements of both Section 610 of the Regulatory Flexibility Act and Section 5 of Executive Order (EO) 12866. Under Section 610, this review examines whether the standard should be continued without change, rescinded, or amended to minimize any significant impact on a substantial number of small entities considering the continued need for the rule, comments and complaints received, complexity of the rule, whether the rule is duplicative, and the degree to which technology and economic conditions have changed since its issuance. Under Section 5 of EO 12866, this review examines whether the standard has become unjustified or unnecessary as a result of changed circumstances, and whether the standard is compatible with other regulations or is duplicative or inappropriately burdensome in the aggregate. This review also ensures that the regulation is consistent with the priorities and the principles set forth in EO 12866 within applicable law, and examines whether the effectiveness of the standard can be improved. To assist OSHA in this review, OSHA requested public comments on these issues.

The Section 610 review of the standard finds the following:

- There is a continued need for the standard. The annual number of trenching and excavation fatalities has declined from an estimated 90 fatalities per year prior to the enactment of the 1989 standard, to approximately 70 per year since 1990. This 22% reduction is even more impressive given the 20% real increase in construction activity over this period. Therefore, in relation to increased construction activity, fatalities have been reduced by more than 40%. Although the standard has improved safety, it remains needed in light of the ongoing occurrence of related fatalities most of which result from violations of the standard. OSHA intends to expand outreach and maintain enforcement to further reduce fatalities.
- The standard was revised in 1989 to reduce complexity and add clarity. There is no indication that employers are unable to comply due to the complexity of the revised standard. Nonetheless, public comments suggested some ways in which the standard might be simplified or clarified (although some argued that any changes would only serve to confuse and discourage those who now understand and follow the standard). The expanded outreach will address these matters.
- In general, the standard does not overlap, duplicate, or conflict with other state or federal rules. Several commenters, however, identified a possible conflict between the

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<sup>1</sup> 54 FR 45894, October 31, 1989; 29 CFR 1926, Subpart P.

Excavations Standard and OSHA's standard for confined spaces. OSHA will address this issue in its future rulemaking for confined spaces in construction.

- Economic and technological trends have not reduced the need for the standard. However, the development of so-called "trenchless" technologies (e.g., directional boring machines) has added a new dimension to excavation work (including additional hazards) that OSHA will monitor.
- Public comments contained some specific suggestions for how the standard could be made more effective, although the comments were divided as to whether or not the standard should be modified. In light of the effectiveness of the standard, the certainty it has created, and limited regulatory resources, major modifications are not of high priority.
- The National Transportation Safety Board (NTSB) recommended the OSHA amend the Excavations standard to require employers to notify appropriate authorities after excavation activities create a gas leak or leak of other hazardous substances. Since then, the "Pipeline Inspection, Protection, Enforcement, and Safety Act (PIPES) of 2006" has been enacted. Section 2 of PIPES requires all persons (including employers) engaged in demolition, excavation, tunneling, or construction to immediately call 911 if: (1) they damage a pipeline that may endanger life or cause serious bodily harm or damage to property; and (2) such damage results in the escape of flammable, toxic, or corrosive gas or liquid. The enactment of PIPES may obviate the need for OSHA to promulgate a standard implementing the NTSB's recommendation. It also may affect OSHA's authority to issue such a standard. OSHA will monitor the implementation of PIPES and consider whether amending the excavations standard as suggested by NTSB is necessary and appropriate.
- The standard does not impose an unnecessary or disproportionate burden on small businesses or on industry in general. The cost of protective systems has decreased by about 10 percent in real dollars between 1990 and 2001. The number of small businesses engaged in excavation activity has increased and the percentage of excavation work done by small business has increased. Real construction activity has increased.

Based on the findings of this review, OSHA finds that the Excavations Standard should be continued. OSHA also believes that further increases in safety might be achieved, through increased outreach and training.

OSHA's review of the Excavations Standard under Executive Order 12866 finds the following:

- The standard has significantly reduced the annual number of fatalities (from 90 to 70, on average) resulting from accidents involving excavations and trenching, despite growth in the relevant industry sectors. The standard remains justified and necessary in light of ongoing hazards and fatalities.
- In general, the standard is compatible and not duplicative with other state or federal rules. Several commenters, however, identified a possible conflict between the

Excavations Standard and OSHA's standard for confined spaces which OSHA will address in a further rulemaking for confined spaces in construction.

- The standard remains consistent with the President's priorities to the extent that it has produced the intended benefits, a reduction in trenching and excavation fatalities and injuries, while not causing negative economic effects.
- In light of suggestions contained in public comments, and given the ongoing incidence of accidents, injuries, and fatalities occurring each year during excavation and trenching activities, generally from violations of the standard, OSHA intends to evaluate whether further increases in safety can be achieved by various means such as expanded outreach and training.

# 1. Introduction and Background

Excavation accidents and fatalities most frequently involve cave-ins of excavations or trenches, but also may result from a variety of other accident types, including machine accidents, falling objects, electrocution, vehicular accidents, explosions or fires, falls, drowning, and asphyxiation due to noxious fumes. In 1987, prior to OSHA's 1989 revision of the standards protecting workers in or near excavations and trenches, OSHA estimated the average annual number of excavation-related fatalities at 90.<sup>2</sup> OSHA also estimated that the 1989 revision to the standard would reduce annual fatalities to 70 (a 22 percent reduction).

It now has been over ten years since the promulgation of the 1989 revision to the Excavations Standard. The purpose of this study is to "look back" and review the current standard, in accordance with Section 610 of the Regulatory Flexibility Act and Section 5 of Executive Order 12866, to determine whether the rule has functioned as intended, whether it could be simplified or improved, or whether it is no longer needed and should be rescinded.

The study methodology consists of evaluating the industries that conduct excavation and trenching activities, examining available literature and data on accidents and compliance issues, assessing trends in compliance costs, and considering issues raised by the public with respect to the standard. The remainder of this first chapter provides background information that is helpful in understanding the issues and analyses presented in this study. Section 1.1 discusses, in additional detail, the nature of the review. Section 1.2 briefly introduces and summarizes the basic types of systems available to protect workers from cave-ins of soil at sites where excavation or trenching activities are being conducted. Section 1.3 provides an overview of the history of the Excavations Standard. Finally, Section 1.4 describes the provisions in the current standard.

## 1.1 Nature of the Review

In 2002, the Occupational Safety and Health Administration (OSHA) began a review of its Excavations Standard under Section 610 of the Regulatory Flexibility Act<sup>3</sup> and Section 5 of Executive Order (EO) 12866 on Regulatory Planning and Review.<sup>4</sup>

The purpose of a review under Section 610 of the Regulatory Flexibility Act:

"(S)hall be to determine whether such rule should be continued without change, or should be rescinded, or amended consistent with the stated objectives of applicable statutes to minimize any significant impact of the rules on a substantial number of small entities."

"The Agency shall consider the following factors:

- (1) The continued need for the rule;

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<sup>2</sup> *Economic Impact Analysis of the Proposed Revision to OSHA Subpart P Standard (§1926.650-652) Governing Trenching and Excavation Work*, prepared for OSHA's Office of Regulatory Analysis by Eastern Research Group, Inc., May 19, 1987.

<sup>3</sup> 63 FR 34139, June 23, 1998. For complete text of the Regulatory Flexibility Act, Section 610, 5 U.S.C. 601 *et seq.*, see Appendix I.

<sup>4</sup> For the text of EO 12866, see Appendix II.

- (2) The nature of complaints or comments received concerning the rule from the public;
- (3) The complexity of the rule;
- (4) The extent to which the rule overlaps, duplicates or conflicts with other Federal rules, and, to the extent feasible, with State and local governmental rules; and
- (5) The length of time since the rule has been evaluated or the degree to which technology, economic conditions, or other factors have changed in the area affected by the rule.”

The review requirements of Section 5 of EO 12866 require agencies:

“To reduce the regulatory burden on the American people, their families, their communities, their State, local, and tribal governments, and their industries; to determine whether regulations promulgated by the [Agency] have become unjustified or unnecessary as a result of changed circumstances; to confirm that regulations are both compatible with each other and not duplicative or inappropriately burdensome in the aggregate; to ensure that all regulations are consistent with the President’s priorities and the principles set forth in this Executive Order, within applicable law; and to otherwise improve the effectiveness of existing regulations.”

To carry out these reviews, on August 21, 2002, OSHA asked the public for comments on all issues raised by these provisions (67 FR 54103). Specifically, OSHA requested comments on the impacts of the rule on small businesses; the benefits and utility of the rule in its current form and, if amended, in its amended form; the continued need for the rule; the complexity of the rule; and whether, and to what extent, the rule overlaps, duplicates, or conflicts with other Federal, State, and local government rules. OSHA also asked for comments on new developments in technology, economic conditions, or other factors affecting the ability of covered firms to comply with the standard. Furthermore, OSHA asked for comments on alternatives to the rule that would minimize significant impacts on small businesses, while achieving the objectives of the Occupational Safety and Health Act.

OSHA accepted written comments from August 21, 2002 through November 19, 2002. All documents and comments received relevant to the review and documents discussed in this report are available at the OSHA Docket Office, Docket No. S204A (now Docket No. OSHA-2007-0012), Technical Data Center, Room N-2625, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, DC 20210, Telephone (202) 693-2350, <http://www.regulations.gov>

## **1.2 Overview of Protective Systems Guarding Against Cave-Ins**

Most accidents involving excavations or trenching are the result of soil cave-ins. There are three basic types of systems used to protect workers from the danger of cave-ins: sloping, shielding, and shoring. Although the concept behind each system is relatively simple, differences in soil types and other job-related factors make the selection and implementation of an appropriately designed protective system a matter requiring judgment and qualifications.

The simplest manner of controlling cave-ins is to slope the walls of the excavation at an angle such that soil does not roll into the excavation. The degree of the sloping angle needed depends on the stability of the soil at the site. In more stable soils, the slope can be relatively

steeper than in less stable soils and still be effective. Sloping must be greater if the areas near the excavation are subject to heavy loads (e.g., soil piles, vehicles).

Trench shields do not prevent cave-ins. Instead, they protect employees from cave-ins that might occur by providing sheltered space where employees may work. A typical shield consists of two steel plates separated by structural members to form a box open at the top, bottom, and both ends. The box is lowered into the trench so that the steel plates face the trench's side walls. Employees then climb into the protected area defined by the steel plates. As the work progresses, the box is dragged along the bottom of the trench by a chain or cable suspended from a backhoe above the ground.

Shoring systems are structures made of wood or metal members that press tightly against an excavation side wall to brace and support the sidewalls and thereby prevent cave-ins. Aluminum hydraulic shores consist of two vertical members that support opposite sides of a trench and at least one connecting horizontal member containing hydraulic fluid that is pumped up to exert pressure on the vertical members. Timber shoring achieves similar support but is constructed out of timbers at the excavation site based on job-specific requirements.

### **1.3 Regulatory History**

Trenching and excavation in construction were first regulated in 1969. For almost two decades, trenching and excavation standards were discussed, reviewed, and subject to technical amendments. Following a public hearing and public comments, OSHA issued a new construction standard for excavation in 1989. The important developments leading to the current Excavations Standard are as follows.

In 1969, Congress amended the Contract Work Hours Standards Act (40 U.S.C. 327 et seq.) by adding a new section 107 (40 U.S.C. 333) to provide employees in the construction industry with a safer work environment and to reduce the frequency and severity of construction accidents and injuries. The amendment, commonly known as the Construction Safety Act (Pub. L. 91-54; Aug. 9, 1969), provided occupational safety and health standards for employees in the building trades and construction industry in Federal and federally-financed and federally-assisted construction projects.

In 1971, the Secretary of Labor issued Safety and Health Regulations for Construction in 29 CFR part 1518<sup>5</sup> under the Contract Work Hours and Safety Standards Act. Included in these regulations were safety standards for trenching and excavation. OSHA adopted the trenching and excavation requirements contained in the Construction Safety Act standard as an OSHA standard in 1971.

OSHA made several technical amendments to the trenching and excavations standards, codified in Subpart P, in 1972,<sup>6</sup> after review by the Advisory Committee on Construction Safety and Health (ACCSH) and rulemaking.

Responding to continuing complaints concerning the adequacy of the standards in Subpart P, OSHA engaged the National Bureau of Standards (NBS) in 1976 to study the compatibility of the technical provisions in the standard with actual construction practices. During 1979 and

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<sup>5</sup> 36 FR 7340, April 17, 1971.

<sup>6</sup> 37 FR 3512, February 17, 1972.

1980, six NBS reports were issued after extensive review and public discussion of recommendations. Industry sponsored a series of workshops during 1981 to discuss ways of implementing the NBS recommendations. NBS prepared final recommendations for technical changes to the standard incorporating comments from the workshops.

In 1982, OSHA developed proposed changes to the standard to address continuing excavation-related accidents, compliance problems, and public requests to update the standards. The proposal was modified to reflect review by the ACCSH, and an NPRM was published in April 1987 in the Federal Register.<sup>7</sup> The proposal updated the existing standard to simplify many of the existing provisions, add and clarify definitions, eliminate duplicate provisions and ambiguous language, and give employers added flexibility in providing protection for employees. In addition, the standard provided several new appendices. One appendix provided a consistent method of soil classification. Others provided sloping and benching requirements, pictorial examples of shoring and shielding devices, timber tables, hydraulic shoring tables, and selection charts that provide a graphic summary of the requirements contained in the standard. A public hearing was convened in October 1987.

On October 31, 1989, after receiving comments on its proposed standards, holding a public hearing, consulting with the ACCSH, and examining the costs of compliance for the construction industry, OSHA issued a final standard for excavation and trenching.<sup>8</sup> An amendment promulgated in 1994 provided that walkways crossing over excavations deeper than six feet must be supplied with guardrails.<sup>9</sup>

#### **1.4 Requirements of the Excavations Standard**

OSHA has published a number of documents that describe the provisions of the Excavations Standard for employers and employees in construction.<sup>10</sup> The standard applies to all open excavations made in the earth's surface, which includes trenches.

Protective Systems. To prevent employee exposure to cave-ins, the standard requires sloping or benching the sides of all excavations, supporting the sides of the excavation (shoring), or placing a shield between the side of the excavation and the work area. To address the complexities of designing a protective system based on the many variables that an employer can encounter, the standard provides several different methods and approaches, including four for sloping and four for shoring, including the use of shields. The standard does not require the installation and use of a protective system when an excavation is made entirely in stable rock, or is less than five feet deep and a competent person has examined the ground and found no indication of a potential cave-in.

If sloping is used as the protective system, the employer has the option of using a predetermined slope with an angle not steeper than one and one-half horizontal to one vertical (34 degrees measured from the horizontal). These slopes must be excavated to form configurations that are in accordance with those for Type C soil found in Appendix B of the

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<sup>7</sup> 52 FR 12288, April 15, 1987.

<sup>8</sup> 54 FR 45894, October 31, 1989; 29 CFR 1926, Subpart P.

<sup>9</sup> 59 FR 40730, August 9, 1994.

<sup>10</sup> For example, Excavations, U.S. Department of Labor, Occupational Safety and Health Administration, OSHA 2226, 2000 (Reprinted) was originally issued in print and is now available on line at the OSHA web site: [www.osha.gov](http://www.osha.gov).

standard. A slope of this gradation or less is considered safe for any soil type. Another option is to determine slopes and configurations using Appendices A and B. This approach allows the employer to determine the maximum slope based on site-specific variables.

Another design method that applies to both sloping and shoring allows the employer to use tabulated data, such as tables and charts approved by a professional engineer, to design the excavation. These data must be in writing and must include sufficient explanatory information to enable the user to make a selection, including the criteria for determining the selection and limits of the data. A copy of the information must be kept at the worksite during construction of the protective system. Upon completion of the system, the data may be stored away from the job site, but must be made available to the Assistant Secretary of Labor upon request. A final option allows an employer to use a registered professional engineer to design the sloping or benching system based on professional judgment.

The standard allows an employer to use shoring or a trench box or shield that is either designed or approved by a registered professional engineer or is based on tabulated data prepared or approved by a registered engineer. Timber, aluminum, or other suitable material may be used. The standard permits the use of a trench shield as long as the protection it provides is equal to or greater than the protection that would be provided by the appropriate shoring system. The requirements for trench boxes and shields allow employers more flexibility in design, but impose an obligation to follow manufacturer's instructions for pre-made boxes and shields once a design has been chosen.

Adjacent Structures. The employer must provide support systems, such as shoring, bracing, or underpinning, to ensure the stability of adjacent structures. Excavation below the level of a base or footing of any foundation or retaining wall is prohibited unless a support system, such as underpinning, is provided; the excavation is in stable rock; or a registered engineer determines that the structure is sufficiently removed from the excavation and the excavation will not pose a hazard to employees. The standard prohibits excavations under sidewalks unless an appropriately designed support system is provided.

Installation and Removal. The standard provides procedures for the protection of employees during the installation and removal of protective systems. The employer is also responsible for the safe condition of materials and equipment used for protective systems.

Materials and Equipment. The employer must ensure that materials and equipment are free from damage or defects, are used and maintained according to manufacturer's specifications, and are periodically inspected by a competent person. Unsafe materials and equipment must be removed from service.

Falls and Equipment. Employers must protect employees from secondary hazards by meeting the following requirements: keeping materials that might fall or roll into an excavation from the edge or install a retaining device; providing warning systems to alert operators of the edge of an excavation; removing loose soil or rock or installing barricades or their equivalent; prohibiting employees from working on faces below other workers unless adequately protected from falling equipment; and prohibiting employees under loads that are handled by lifting or digging equipment.

Water Accumulation. The standard prohibits employees from working in excavations where water has accumulated unless adequate protection has been taken. Water removal equipment

must be monitored to ensure proper use. Diversion ditches or dikes must be used for prevention or drainage of water accumulation and must be inspected by a competent person after heavy rains.

Hazardous Atmospheres. The standard requires that a competent person must test excavations greater than four feet in depth or ones where oxygen deficiency or a hazardous atmosphere exist, before an employee can enter the excavation. If hazardous conditions exist, personal protective equipment must be provided and the conditions must be reduced to acceptable levels and periodically monitored. Emergency equipment must be provided, readily available, and attended. Harnesses and lifelines are required for employees entering bell-bottom pier holes and similar deep and confining excavation. An observer must be present to ensure that the lifeline is working properly and to maintain communication with the employee.

Access and Egress. The standard requires the employer to provide safe access and egress to all excavations. For trenches four feet or deeper, the standard requires adequate means of exit, such as ladders, steps, and ramps, at 25 foot intervals. If structural ramps are used by employees, a competent person must design them, or, if for vehicle use, the competent person must be qualified in structural design.

## **2. Industry Profile, Trends, and Issues**

This chapter characterizes the industry sectors affected by the Excavations Standard and how they have changed since the standard's revision in 1989. Section 2.1 first provides background information on trenching and excavation activities and when they are necessary. Section 2.2 then identifies affected industry sectors. Section 2.3 characterizes the economic performance of these sectors since 1989. Finally, Section 2.4 discusses technological advances since 1989.

### **2.1 Background**

Most types of construction require some excavation or trenching work for foundations, footings, or utilities. Excavations are necessary for foundations and footings as part of both building and non-building construction projects.<sup>11</sup> Trenches are narrow excavations and are necessary for installation or repair of water and sewer pipes, gas lines, electrical conduit, or other underground conduits or cables.

Installation of utilities accounts for the majority of trenching activities. The trenches for sewer lines and water lines present the greatest concern for cave-ins because of the depth of these excavations. Sewer lines are typically installed at depths of eight to 15 feet, with some installations as deep as 40 feet. Water lines are typically installed at depths of four to five feet, with some deeper installations in colder climates to prevent freezing. Gas lines, electric, telephone, and other conduits and cables tend to be placed in shallow trenches of about two feet deep.

Most new building construction projects require excavation for foundations and basements. The scale of these excavations ranges from basements for single family homes to city block excavations for major urban buildings. Heavy construction projects, such as for highways, bridges, dams, and sewage treatment plants, also require excavation work. Excavations for these types of projects vary widely in their size.

### **2.2 Industry Sectors Affected by the Standard**

This section identifies and discusses the industry sectors affected by the Excavations Standard in terms of the Standard Industrial Classification (SIC) system.<sup>12</sup>

#### **Affected Sectors in the Construction Industry**

The vast majority of excavation and trenching work is performed by the construction industry. Firms that engage in excavation and trenching operations are primarily construction contractors. These firms are classified as general building contractors (SIC group 15), heavy

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<sup>11</sup> Construction work is frequently divided into building construction and non-building construction. Both types of construction require excavations and trenches. Excavation activities for non-building construction projects, such as for highways, tend to be of a larger scale than for building construction projects.

<sup>12</sup> Although the North American Industrial Classification System (NAICS) has replaced SIC codes in the last few years, this study references the SIC system so that comparisons can be made spanning the entire time period of interest. Information on the construction industry is available through 1998 using the SIC system. See Appendix III for a crosswalk between the SIC codes that are the focus of this chapter and their corresponding NAICS codes.

construction contractors (SIC group 16), or special trade contractors (SIC group 17). Other industries, however, may utilize their own construction crews for trenching or excavation projects. For example, electric and gas utilities may use their own labor force for the trenching required for installation of pipes or cables. Public employees, primarily municipal public works departments, also engage in trenching or excavation projects. Exhibit 2-1 lists the four-digit SIC code industries that account for the bulk of trenching and excavation work.

Building construction requires two types of excavations: an excavation for the foundation and trenches for water, sewer, and other utility hookups. Building excavations are generally dug either by building contractors (SIC group 15) themselves, or by excavation contractors (SIC group 1794). Utility hookups are commonly performed by plumbing contractors (SIC 1711).

**Exhibit 2-1  
Relevant Construction Industry SIC Codes (15, 16, and 17)**

1521	General Contractors-Single-Family Houses
1522	General Contractors-Residential Construction not elsewhere classified
1531	Operative builders
1541	General Contractors-Industrial Buildings and Warehouses
1542	General Contractors-Nonresidential Buildings, Other than Industrial Buildings and Warehouses
1611	Highway and Street Construction, Except Elevated Highways
1622	Bridge, Tunnel, and Elevated Highway Construction
1623	Water, Sewer, Pipeline, and Communications and Power Line Construction
1629	Heavy Construction, NEC
1711	Plumbing, Heating, and Air-Conditioning
1721	Painting and paper hanging
1731	Electrical Work
1741	Masonry and other stonework
1751	Carpentry work
1761	Roofing, siding, and sheet metal work
1771	Concrete Work
1781	Water well drilling
1791	Structural steel erection
1794	Excavation Work
1795	Wrecking and demolition work
1799	Special Trade Contractors, NEC

Excavations for non-building projects include trenches for sewers, water mains, pipelines, and highway drainage systems. Trenching work is done primarily by so-called “utility contractors” (SIC 1623). Other heavy construction contractors as well as some special trade contractors (primarily 1794, excavation contractors, and 1711, plumbing contractors) also do utility work. Excavations for other types of non-building projects are usually performed by heavy construction general contractors (SIC group 16), or by excavation contractors (SIC 1794). Some special purpose excavations such as for outdoor swimming pools are done by contractors classified in SIC 1799 (Special Trade Contractors, N.E.C.).

### **Affected Non-Construction Industry Sectors**

A number of industry sectors outside of the construction industry also conduct trenching and excavation activities on occasion. Exhibit 2-2 lists the SIC code and industry description for non-construction industries that are believed to engage in some excavation and trenching activities and are covered by the Standard.

#### **Exhibit 2-2 Non-Construction Industry SIC Codes Conducting Some Excavation Activity**

0781	Landscape Counseling and Planning
0782	Lawn and Garden Services
1081	Metal Mining Services
1311	Crude Petroleum and Natural Gas
4813	Telephone Communications, Except Radiotelephone
4911	Electric Services
4924	Natural Gas Distribution
4925	Mixed, Manufactured, or Liquefied Petroleum Gas Production and/or Distribution
4931	Electric and Other Services Combined
4932	Gas and Other Services Combined
4935	N/A
4941	Water Supply
5093	Scrap and Waste Materials
7353	Heavy Construction Equipment Rental and Leasing
7389	Business Services, NEC
7699	Repair Shops and Related Services, NEC
8221	Colleges, Universities, and Professional Schools
8222	Junior Colleges and Technical Institutes
8711	Engineering Services
8713	Surveying Services
9199	General Government, NEC
9511	Air and Water Resource and Solid Waste Management
9512	Land, Mineral, Wildlife, and Forest Conservation
9621	Regulation and Administration of Transportation Programs
9631	Regulation and Administration of Communications, Electric, Gas, and Other Utilities

Source: ICF analysis of IMIS Database. See Chapter 3.

## **Sectors Most Affected by Standard**

Although numerous construction industry sectors and non-construction industry sectors are affected by the standard, this study focuses primarily on 12 sectors within the construction industry that collectively account for approximately 89 percent of excavation and trenching fatalities between 1990 and 2000 (as discussed in Chapter 3).

- 1521: General Contractors – Single-Family Houses
- 1542: General Contractors – Nonresidential Buildings, Other than Industrial Buildings and Warehouses
- 1611: Highways and Street Construction, Except Elevated Highways
- 1622: Bridge, Tunnel, and Elevated Highway Construction
- 1623: Water, Sewer, Pipeline, and Communications and Power Line Construction
- 1629: Heavy Construction, NEC
- 1711: Plumbing, Heating, and Air-Conditioning
- 1731: Electrical Work
- 1771: Concrete Work
- 1794: Excavation Work
- 1795: Wrecking and demolition work
- 1799: Special Trade Contractors, NEC

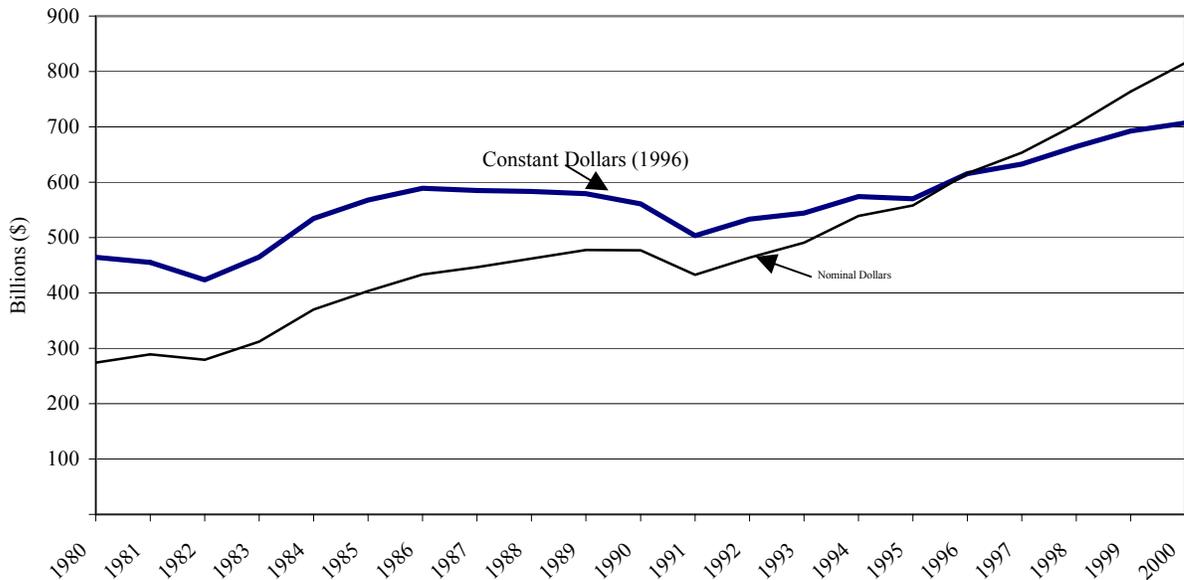
The remaining construction and all non-construction SIC codes are excluded from the analysis because they engage in excavation and trenching on only an occasional basis. Because excavation and trenching activities are such a small portion of the activities of other industry sectors, it could be misleading to include them in the analysis, and it would be hard to evaluate trends and estimate economic impacts attributable to the standard.

### **2.3 Economic Performance of Industry Sectors**

Available statistics do not permit the direct measurement of excavation and trenching activities. Nevertheless, growth in these activities since the Excavations Standard was revised in 1989 can be surmised based on the following:

- The construction industry as a whole has grown during the past two decades. Overall, the value of construction put in place in the United States has risen between 1980 and 2000, both in constant and nominal terms (see Exhibit 2-3). In nominal dollars, the value of the construction industry has risen from less than \$300 billion in 1980 to over \$800 billion in 2000, while the value (in 1996 dollars) has risen from just under \$500 billion in 1980 to approximately \$700 billion in 2000.

**Exhibit 2-3  
Value of Construction Put in Place in the U.S. (1980-2000)**



Source: "Annual Value of Construction Put in Place in the United States," U.S. Census Bureau. <http://www.census.gov/const/C30/tab100.txt>

- The number of firms conducting excavation and trenching activities has grown since the revision of the Excavations Standard.
- As measured by the Census Bureau, the number of employees in the 12 most affected industry sectors has increased by 23 percent, from 3,037,872 employees in 1990 to 3,741,386 employees in 1997.
- The total number of firms in the 12 most affected industries has increased 51 percent from 292,996 in 1989 to 443,686 in 1998.
- The number of firms in individual sectors increased for 11 of the 12 SIC codes (The exception, SIC 1622, is discussed in greater detail in Section 2.3.2.).
- Exhibit 2-4 presents the number of firms and employees by SIC code for the 12 construction SIC codes of interest.

**Exhibit 2-4**  
**Number of Firms and Employees in Selected Construction Industry SIC Codes**

SIC	Number of Firms			Number of Employees		
	1989	1998	Change	1990	1997	Change
1521	56,532	136,912	142%	282,172	476,363	69%
1542	18,299	30,309	66%	375,184	446,056	19%
1611	8,836	10,707	21%	213,172	229,796	8%
1622	911	881	-3%	39,454	36,559	-7%
1623	8,074	10,774	33%	170,830	220,606	29%
1629	10,730	14,512	35%	274,805	281,322	2%
1711	73,459	87,654	19%	644,513	790,052	23%
1731	53,761	65,093	21%	528,264	646,860	22%
1771	22,225	30,710	38%	198,640	244,632	23%
1794	16,198	23,210	43%	101,298	112,025	11%
1795	845	1,336	58%	11,993	17,737	48%
1799	23,126	31,588	37%	197,547	239,378	21%
Total	292,996	443,686	51%	3,037,872	3,741,386	23%

Source: 1989 Figures: "Data by Enterprise," U.S. Census Bureau; 1998 Figures: Small Business Administration (SBA) Office of Advocacy information obtained from the U.S. Census Bureau; Percent Change: ICF analysis of Census Bureau and SBA information.

## 2.4 Developments in Technology

Traditional open-cut trenching methods require the use of protective systems, such as shoring and trench boxes, to prevent cave-ins. There has been incremental refinement in these manufactured systems since the enactment of the revised standard in 1989. For example, shoring has become less expensive, lighter, and more maneuverable. As manufactured systems have improved, the use of site-constructed timber shoring systems has declined.

The most significant technological development, however, has been the emergence of "trenchless technologies." This term applies to a wide range of construction methods used to install or repair pipes and cables without traditional open-cut trenching operations.<sup>13</sup> As discussed in more detail below, these methods typically involve some type of horizontal drilling, tunneling, or ramming. While open-cut trenching methods still predominate, the use of trenchless technologies has increased steadily since 1989, particularly in more highly-developed areas.

<sup>13</sup> Some amount of open excavation may be required with these technologies (e.g., to provide an underground starting point for the technology), but the extent of this open excavation is usually relatively small.

Trenchless operations substantially reduce the size of the excavation required at a particular job, thereby reducing the risk of killing or injuring workers or the public in construction-related accidents. Trenchless methods cost more than open-cut methods for most jobs, but they can be quite cost-effective for some jobs, particularly when the costs of disrupted activities (e.g., routine commerce) are considered, or when open-cut trenches would be difficult or costly to implement. For example, digging an open trench in a congested urban area can be expensive because a crew typically must dig around existing utilities and protect adjacent pavement and structures from collapse. Additionally, sidewalks, pavement, bricks, sod, and other surfaces must be repaired or replaced after the trench is closed. Most of the direct costs of the trenching operations are borne by the utility, but the community must bear the cost of disruption, delay, or damage – including traffic disturbances and delays, lost revenue to businesses, and lost tax dollars to government. Trenchless methods, by minimizing disruption, may reduce total costs in such instances.

Among the more common trenchless methods are the following:

- *Auger boring*, one of the oldest trenchless methods, is still widely used for short distances and small changes in grade (e.g., under highways or railroad tracks). Auger boring works by using a powerful machine to drill through the earth, installing sections of pipe as the bore progresses and carries spoil out of the hole. Auger boring machines are not equipped with guidance systems, but are capable of cutting through hard rock and are relatively low-cost.
- *Horizontal Directional Drilling (HDD)* works by using a rotating drill to break the ground, while another piece of equipment is used to enlarge the hole. At the surface, steering equipment is used to install pipes, conduits, or cables. Location, depth, and position are also monitored on the surface using highly accurate electronic tracking equipment. HDD equipment is generally used for installations where larger and longer piping is required, and for replacing water lines in urban and residential areas.
- *Pipe ramming* uses pneumatic piercing tools and an air compressor to pound equipment into the ground. The material that is being installed is either pulled behind the equipment or is pulled through the completed hole. Soil in the casing is generally removed with compressed air or water. Most of the pneumatic tools cannot be steered, but some models use radio transmitters to track progress with an electronic locator. This method is commonly used to drill under sidewalks and driveways.
- *Pipe bursting* is the most commonly used trenchless method for the replacement of existing pipes. The equipment drives through a section of existing pipe, fragmenting the pipe with a hammering action. Replacement pipe, attached to the rear of the equipment, is pulled into place using a cable, chain, or rod that is attached to the pulling device. Pipe bursting is used when the existing pipe is brittle cast iron, vitrified clay, unreinforced concrete, asbestos cement, or plastic. This method is limited to smaller pipes, although the replacement pipe can be larger than the existing pipe.
- *Microtunneling* begins by creating a hole using a cutting shield, which forms a continuous tunnel lining. Laser-guided, remote-controlled equipment pushes

sections of pipe into the hole and through the ground while soils are removed with augers. Equipment and mobilization costs are high, making this the most expensive trenchless procedure. Microtunneling is most common in Germany and Japan.

- *Vibratory plowing* (the use of a vibratory plow), either a walk behind or ride-on machine, pulls a vertical plow blade through the ground, cutting through soil and vegetation with a minimum of surface disturbance, typically for burying wire, cable, fiber optics, conduit, and water or gas pipe. The ground opens around the plow and closes behind it or leaves a small slit to be back filled. A hydraulic motor driving rotating weights on the plow causes the blade to vibrate as it is pulled through the earth. Plow configuration is matched to the product to be buried. Vibration and ground speed are controlled by the operator to maximize production in various conditions. Some plows pull the material being buried through the earth behind the blade with a special attachment. Others feed the material into the ground through a chute at the back of the blade.

Trenchless methods have some disadvantages, including their own risks to workers and the public. Most notably, operators cannot always see what lies in the way and, consequently, underground utility lines may be cut. Such accidents can result in injuries or deaths depending on the circumstances, in addition to the added expense of repairing the damaged lines. Another risk is that, after construction, unseen voids may be left behind, which could lead to a collapse that could cause physical injuries or property damage.

Several related technological advances have improved the quality and decreased the cost of trenchless methods. These include newer, more precise guidance electronics; new pipe materials (such as high-density polyethylene [HDPE]) that are tough but flexible; cured-in-place pipe lining systems; and new pipe bursting tools. In addition, a variety of new technologies have been developed for repairing pipes. Robotic systems, for example, can make point repairs using special attachments for repairing leaks. Also, more effective materials are available to seal pipe repairs, such as acrylmide, acrylate, urethane gel, and polyurethane foam.

### 3. Fatalities

This chapter estimates the number and rate of excavation-related fatalities to help evaluate the effectiveness of the Excavations Standard with respect to preventing fatalities. Except where noted, all fatality data have been drawn from OSHA's Integrated Management Information System (IMIS) database.<sup>14</sup> The analysis of fatalities begins at the national level before considering individual industries and causes (i.e., types of accidents).

#### 3.1 National Fatalities and Trends

During the eleven-year period 1990-2000, accidents involving excavations resulted in an annual average of 70 fatalities, or a total of 771 for the period as a whole. The actual number of fatalities each year varied within the range of 59-81. Exhibit 3-1 reports the number of fatalities occurring in each year.

**Exhibit 3-1  
Number of Trenching and Excavation Fatalities**

<b>Year</b>	<b>Fatalities</b>
1990	76
1991	72
1992	72
1993	59
1994	74
1995	61
1996	62
1997	72
1998	67
1999	81
2000	75
<b>Total</b>	<b>771</b>
<b>Average</b>	<b>70</b>

Source: ICF analysis of IMIS database.

In 1987, prior to OSHA's 1989 revision of the Excavations Standard, OSHA estimated the annual average number of excavation-related fatalities at 90.<sup>15</sup> Relative to this figure, the post-

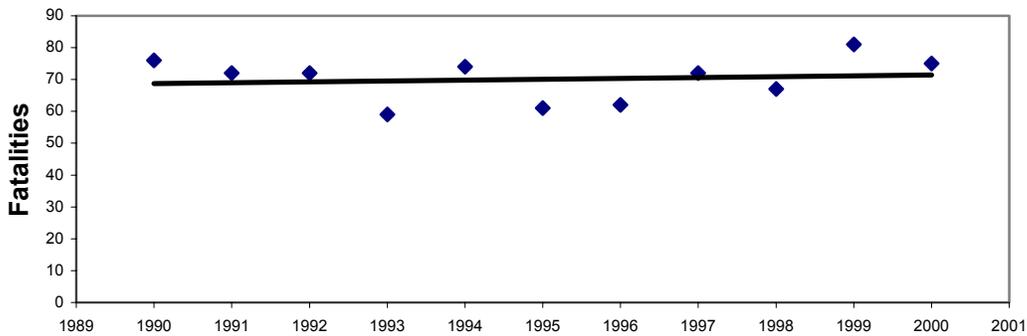
<sup>14</sup> *Integrated Management Information System (IMIS)*, U.S. Department of Labor, Occupational Safety and Health Administration, last updated August 5, 2000. The extraction covered all accidents and associated violations pertaining to reported excavation-related fatalities, including trenching fatalities, for the period 1990-2000. As OSHA does not require reporting of accidents causing three or fewer injuries, available data on injuries are limited and, consequently, this study does not examine the number or rate of excavation-related injuries.

<sup>15</sup> Economic Impact Analysis of the Proposed Revision to OSHA Subpart P Standard (§1926.650-652) Governing Trenching and Excavation Work, prepared for OSHA's Office of Regulatory Analysis by Eastern Research Group, Inc. (ERG), May 19, 1987, discussed at 54 FR 45950 (October 31, 1989). There were no complete national data sets available at the time OSHA was preparing the final Excavations standard on the number of excavation fatalities. Thus, OSHA averaged two approaches to develop the 90 excavation fatality estimate. The first approach combined average California and Texas excavation cave-in deaths and then adjusted this figure to reach an estimate of the total excavation

rule estimate of 70 represents a 22% reduction in the number of fatalities related to excavation since the promulgation of OSHA’s revised standard. Moreover, this 22% reduction has been achieved as construction activity increased by 20% in real terms over this period.

Although the number of excavation-related fatalities per year remained fairly level during the 1990-2000 period, as shown in Exhibit 3-2, these data do not reflect the increase in annual construction activity that occurred during the same period. To gauge fatalities relative to the level of construction, the study divided each year’s number of fatalities by the value of construction put in place for the same year,<sup>16</sup> thereby yielding a fatality rate. The fatality rate did decline over the period, as shown in Exhibit 3-3. In other words, although the annual number of fatalities remained fairly constant, the fatality rate decreased due to an increase in construction activity.

**Exhibit 3-2**  
**Number of Fatalities, 1990-2000**

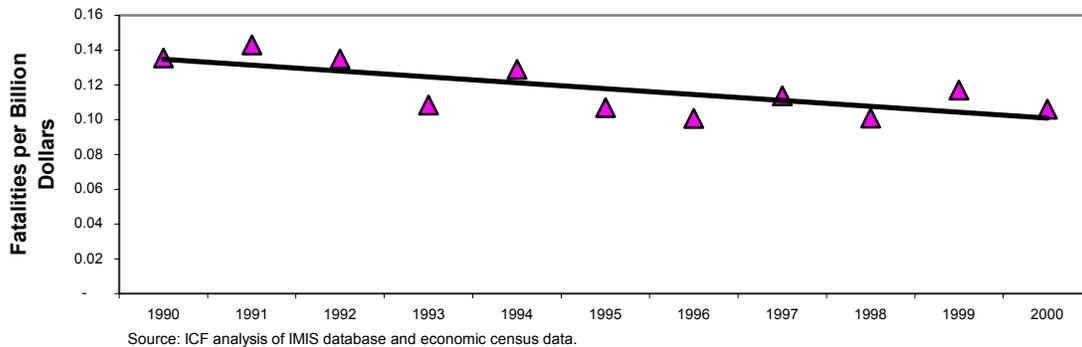


Source: ICF analysis of IMIS database.

deaths in these states (a combined state average). OSHA then extrapolated this number to the entire country (based on national construction receipts) to come up with an estimate of 83 excavation deaths per year. The second approach averaged the 3 years of OSHA Fatality/Catastrophe reports available for excavation deaths in Federal OSHA states and then extrapolated that data to the entire country (including an adjustment for growth in the construction industry), resulting in an estimate of 97 excavation deaths per year. OSHA averaged these two estimates to come up with the estimate in the proposed rule of 90 fatalities a year. There is some uncertainty in this estimate given the data available and the extrapolations necessary.

<sup>16</sup> “Annual Value of Construction Put in Place in the United States 1985-2001,” *Economic Indicators*, U.S. Census Bureau. [http://www.census.gov/pub/const/C30/c30\\_hist.html](http://www.census.gov/pub/const/C30/c30_hist.html). These particular data (stated in constant 1996 dollars) address construction in general, and not just excavation and trenching. Thus, the resulting rate is lower than would result if excavation-specific data had been used. Nevertheless, the trend discussed above remains valid under the logical assumption that the value of excavation activity as a percentage of construction activity remains fairly constant.

**Exhibit 3-3**  
**National Fatalities per Billion Dollars of Construction Value Put in Place, 1990-2000**



### 3.2 Fatalities by Industry

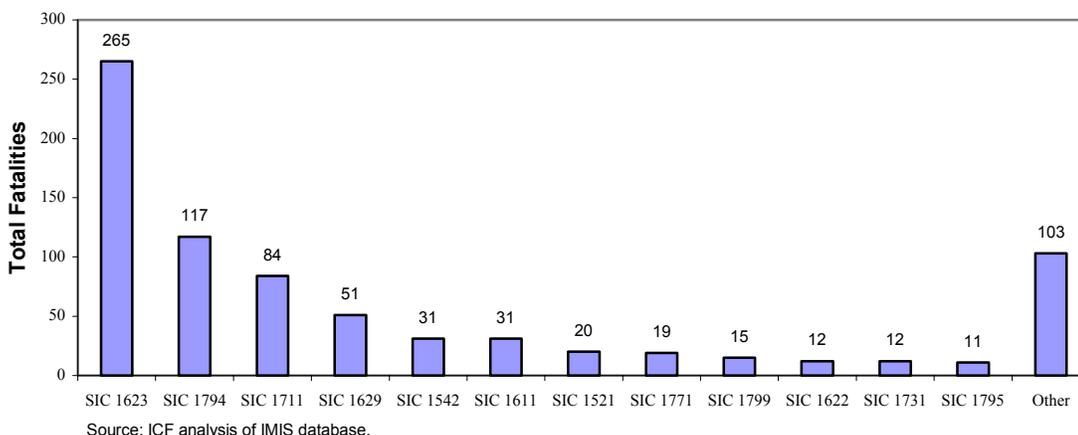
The 1990-2000 data show that excavation fatalities occur in numerous industries but are primarily concentrated in a relatively few. Twelve industries, all of which fall within the construction sector, account for approximately 89 percent of excavation-related fatalities. These industries include the following SIC codes (listed in order of the greatest to the least total number of fatalities over the 11-year period):<sup>17</sup>

- 1623: Water, Sewer, Pipeline, Communications, and Power Line
- 1794: Excavation Work
- 1711: Plumbing, Heating, and Air Conditioning
- 1629: Heavy Construction
- 1542: General Contractors, Non-Residential, Non-Industrial
- 1611: Highway and Street Construction
- 1521: General Contractors, Single Family Homes
- 1771: Concrete Work
- 1799: Special Trade Contractors
- 1622: Bridge, Tunnel, and Elevated Highway
- 1731: Electrical Work
- 1795: Wrecking and Demolition Work

Exhibit 3-4 shows the distribution of fatalities across these 12 industries as well as the “other” remaining industries. As illustrated in the graph, SIC 1623 (Water, Sewer, Pipeline, Communications, and Power Line) reports the highest number of excavation-related fatalities, at more than twice that of the industry with the second highest total fatalities (SIC 1794, Excavation Work). SIC 1623 conducts a substantial amount of trenching activity.

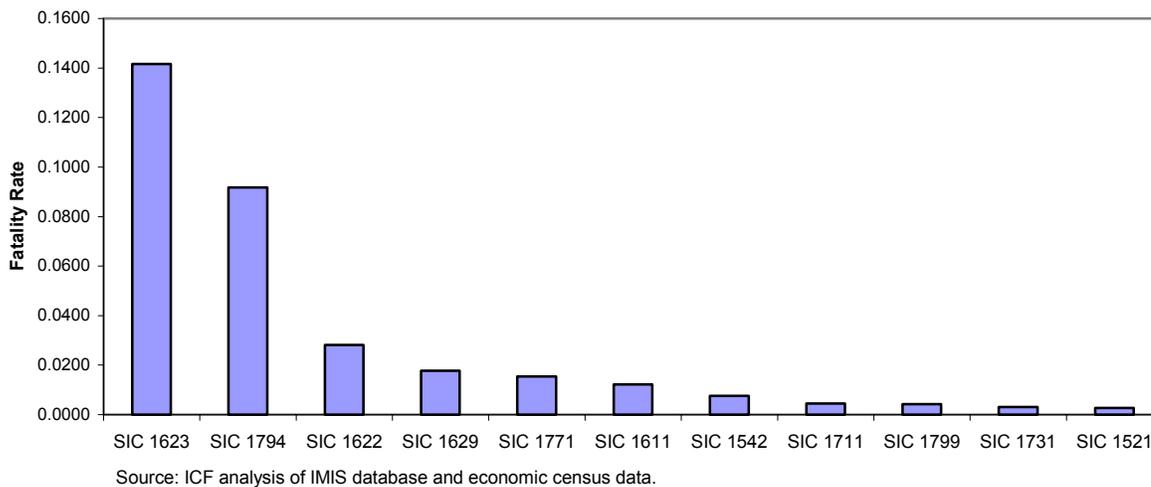
<sup>17</sup> Appendix A presents fatality data spanning all industries that reported excavation-related fatalities.

**Exhibit 3-4**  
**Fatalities by Industry, 1990-2000**



The ranking of these industries changes somewhat when based on the fatality rate per 1,000 employees working within the designated SIC code.<sup>18</sup> Nevertheless, as shown in Exhibit 3-5, SIC 1623 continues to stand out with the number of fatalities substantially higher than the other key industries.

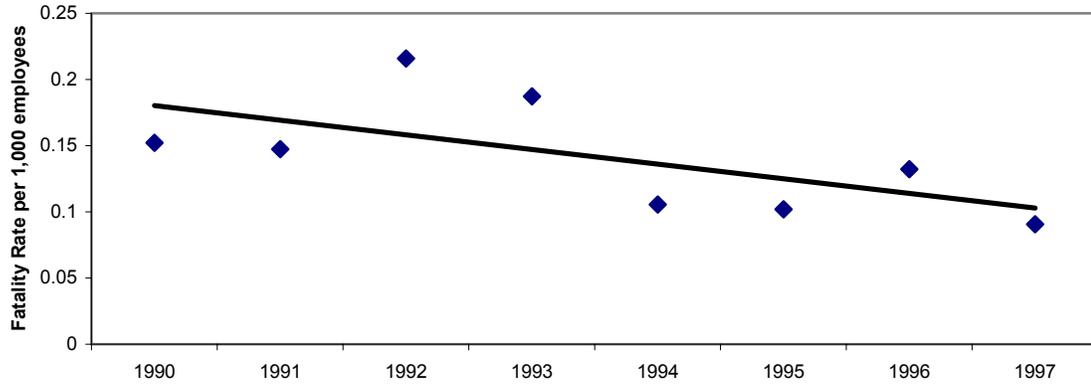
**Exhibit 3-5**  
**Average Fatality Rate by SIC per 1,000 Employees, 1990-1997**



As shown in Exhibit 3-6, however, the fatality rate for SIC 1623 has a decreasing trend from 1990-1997 (which is not the case for SIC 1794 and some of the other industries).

<sup>18</sup> Employee data obtained from U.S. Small Business Administration Office of Advocacy, Statistics of U.S. Businesses 1990-1997, [www.sba.gov/advo/sstats/data.html](http://www.sba.gov/advo/sstats/data.html), obtained February 27, 2002.

**Exhibit 3-6**  
**Fatality Rate for SIC Code 1623, 1990-1997**  
**(Water, Sewer, Pipeline, Communications, and Power Line)**

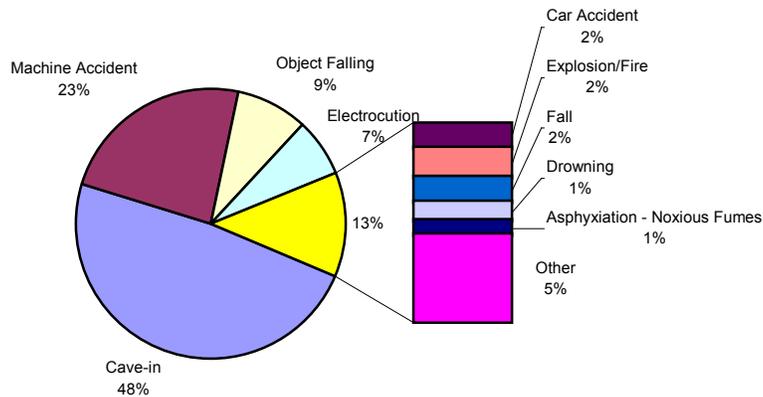


Source: ICF analysis of IMIS database and economic census data.

### 3.3 Fatalities by Cause of Death

Excavation fatalities may result from a variety of accident types, including cave-ins, machine accidents, falling objects, electrocution, car accidents, explosions or fires, falls, drowning, and asphyxiation due to noxious fumes. Exhibit 3-7 shows the relative proportion for each cause of death for the 1990-2000 period. As illustrated in the graph, approximately half of all excavation-related fatalities (approximately 48 percent) result from cave-ins.

**Exhibit 3-7**  
**Distribution of Fatalities by Cause of Death, 1990-2000**



Source: ICF analysis of IMIS database.

## 4. Compliance with the Standard

This chapter evaluates compliance with the Excavations Standard at 29 CFR, Subpart P, §§1926.650-652 and appendices A-F, by evaluating violation data contained in OSHA's Integrated Management Information System (IMIS) database.<sup>19</sup> OSHA does not require employers to report an accident unless three or more employees have been hospitalized, an amputation has occurred, or a fatality has occurred. Therefore, only limited data are available on accidents that do not involve fatalities. Consequently, this study examines compliance by looking at accidents involving fatalities.<sup>20</sup>

Excavation accident reports and news accounts suggest, nearly universally, that compliance with existing safety standards would have prevented the accidents being described.<sup>21</sup> This hypothesis is largely supported by violation data contained in IMIS. These data indicate that OSHA found violations of the Excavations Standard in approximately 80 percent of the 771 cases of excavation-related fatalities that occurred between 1990 and 2000. While the reported data did not specify any violations for almost 20 percent of the reported fatalities, OSHA does not believe this implies full compliance with the Excavations Standard in these cases.<sup>22</sup>

The analysis of compliance first considers the types of violations associated with fatalities. It then reviews related information on monetary penalties associated with the violations.

### 4.1 Compliance Violations

This study found 1,149 violations associated with the 771 excavation fatalities reported during 1990-2000. (Many fatalities are associated with multiple violations.) Of these 1,149 violations, 565 violations (approximately 50 percent) are reported to have been a contributing factor to the corresponding fatal accident (see Exhibit 4-1).<sup>23</sup> In fact, a key finding of this study is that OSHA has identified one or more compliance violations as a contributing factor in over 73 percent of the 771 fatalities examined. As explained above and in footnote 22, OSHA believes the true percentage is even higher. It seems reasonable to conclude, therefore, that the current standard, when met, is protective of worker safety. This does not imply, however, that

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<sup>19</sup> *Integrated Management Information System (IMIS)*, U.S. Department of Labor, Occupational Safety and Health Administration, last updated August 5, 2000. The extraction covered all accidents and associated violations pertaining to reported excavation-related fatalities, including trenching fatalities, for the period 1990-2000.

<sup>20</sup> As a result, this study is unable to address overall compliance levels.

<sup>21</sup> See, for example, "Preventing Deaths and Injuries from Cave-Ins," NIOSH Alert: July 1995, DHHS (NIOSH) Publication No. 85-110; and, "Improper Excavation Procedures Contribute to Death of Construction Worker," OSHA Trade News Release, July 2002.

<sup>22</sup> For example, OSHA believes that some violations may have occurred but not been identified or reported. Analysis of the fatalities for which violations are not reported in IMIS shows that approximately one third (32 percent) involved cave-ins, and many of these cases suggested possible non-compliance with the standard. Non-compliance with the Excavations Standard may have been less of a factor in non-cave-in fatalities at excavation sites, such as fatalities associated with machine accidents (46 percent) or electrocutions (5 percent). Remaining fatalities were due to other or unknown causes.

<sup>23</sup> The IMIS database reports these violations as "related to" a given fatality, which means that the cited violation is a contributing factor to the fatality. Some fatalities reported in the IMIS database cite violations without identifying any as contributing factors. This means that it was not clear whether the violations contributed to the fatality.

the standard need not be modified, as it may be possible to revise the standard in a manner that would increase compliance.

**Exhibit 4-1  
Violations and Fatalities**

Fatalities	771
Fatalities with reported violations	624
Violations associated with fatalities	1,149
Violations identified as contributing to fatalities	565

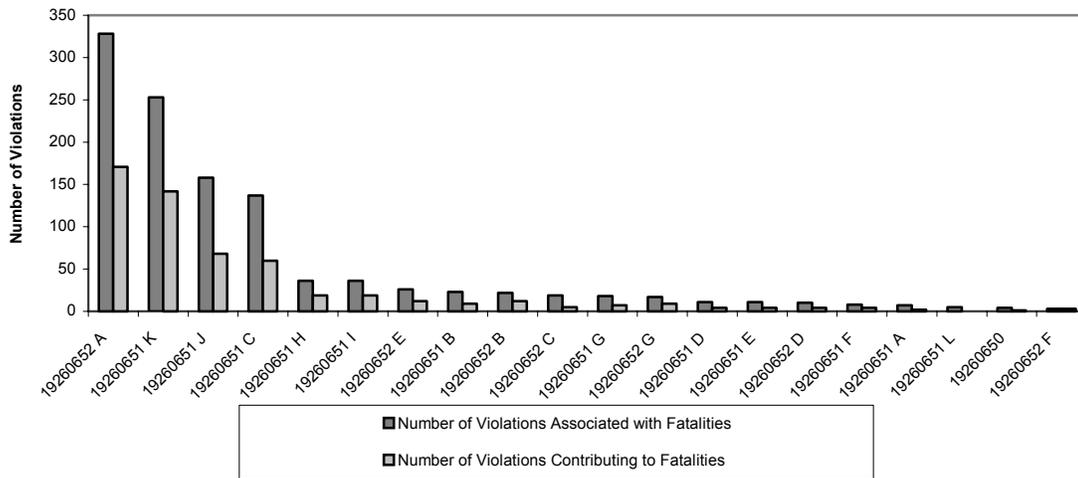
To help evaluate the level of compliance, and the importance of compliance with individual provisions of the Excavations Standard, Exhibit 4-2 summarizes and classifies each provision in the standard with respect to the number of violations associated with, and contributing to, fatalities during the 1990-2000 period. Exhibit 4-3 summarizes this information graphically.

**Exhibit 4-2  
Fatality-Related Violations of the Excavations Standard, 1990-2000**

Section and Description		Violations Associated with Fatalities	Violations Contributing to Fatalities
1926.650 – Scope, application, and definitions		4	1
1926.651 – Specific Excavation Requirements			
(a)	Surface encumbrances	7	2
(b)	Underground installations	23	9
(c)	Access and egress	137	60
(d)	Exposure to vehicular traffic	11	4
(e)	Exposure to falling loads	11	4
(f)	Warning system for mobile equipment	8	4
(g)	Hazardous atmospheres	18	7
(h)	Protection from hazards associated with water accumulation	36	19
(i)	Stability of adjacent structures	36	19
(j)	Protection of employees from loose rock or soil	158	68
(k)	Inspections	253	142
(l)	Walkways and guardrails	5	0
1926.652 – Requirements for Protective Systems			
(a)	Protection of employees in excavations	328	171
(b)	Design of sloping and benching systems	22	12
(c)	Design of support systems, shield systems, and other protective systems	19	5
(d)	Materials and equipment	10	4
(e)	Installation and removal of support	26	12
(f)	Sloping and benching systems	3	3
(g)	Shield systems	17	9

\* The preceding table omits violations reported in IMIS if attributed to a subparagraph of the standard which can not be identified with certainty because of a typographical error in the IMIS data.

**Exhibit 4-3  
Fatality-Related Violations of the Excavation Standard, 1990-2000**



As can be seen from Exhibit 4-3, the sections of the standard that account for the most violations in the dataset include sections 1926.652(a), 1926.651(k), 1926.651(j), and 1926.651(c). These requirements, which are stated in the adjacent text box, are quite fundamental: protect employees in excavation; inspect the site daily; protect employees from loose rock or soil; and provide access and egress. In contrast, far fewer violations occurred with respect to some of the more specific provisions of the Excavations Standard, such as design of sloping and benching systems, design of support systems and shield systems, and protection from hazardous atmospheres. The fact that most violations occur with respect to the standard’s basic requirements (as opposed to its more specific provisions) suggests that fatalities may result more from a failure to understand the risks or the failure to apply any safety systems than from a failure to install safety systems correctly.

## 4.2 Penalties

The average monetary penalty reported by section of the standard is shown in Exhibit 4-4. The amount of the initial penalty may be reduced (to the amount of the “current penalty”) if the violator contests the violation or the associated penalty. Note that zero dollar penalties are included in the calculation of the averages.

Since 1987, OSHA has had in place a special emphasis program on trenching and excavation. For example, OSHA IMIS (Internal Management Information System) data identify 1,382 inspections of excavating contractors during 2000. These inspections include both Federal and State Plan inspections in SIC 1794 (Excavation Work), the SIC with the highest concentration of excavation work. These inspections resulted in 2,205 citations that totaled \$1,907,593 in penalties. Four hundred sixty-five (34%) of these inspections found no violations.

## Most Common Fatality-Related Violations, 1990-2000

### **1926.652(a): Protection of employees in excavations.**

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

- (i) Excavations are made entirely in stable rock; or
- (ii) Excavations are less than 5 feet (1.52m) in depth and examination of the ground by a competent person provides no indication of a potential cave-in.

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

### **1926.651(k): Inspections.**

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

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

### **1926.651(j): Protection of employees from loose rock or soil.**

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

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

### **1926.65(c): Access and egress.**

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

- (ii) Ramps and runways constructed of two or more structural members shall have the structural members connected together to prevent displacement.
- (iii) Structural members used for ramps and runways shall be of uniform thickness.
- (iv) Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom of the runway or shall be attached in a manner to prevent tripping.
- (v) Structural ramps used in lieu of steps shall be provided with cleats or other surface treatments on the top surface to prevent slipping.

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

**Exhibit 4-4**  
**Average Monetary Penalties Associated with the Excavations Standard, 1990-2001**

<i>Standard</i>	<i>Average Initial Penalty</i>	<i>Average Current Penalty</i>
19260650	\$ 540	\$ 340
19260651 A	\$ 12,607	\$ 2,107
19260651 B	\$ 8,900	\$ 7,778
19260651 C	\$ 4,813	\$ 3,104
19260651 D	\$ 1,183	\$ 487
19260651 E	\$ 8,867	\$ 1,798
19260651 F	\$ 2,588	\$ 2,323
19260651 G	\$ 2,101	\$ 1,200
19260651 H	\$ 12,259	\$ 4,907
19260651 I	\$ 4,247	\$ 3,232
19260651 J	\$ 6,545	\$ 4,354
19260651 K	\$ 5,685	\$ 3,804
19260651 L	\$ 829	\$ 797
19260652 A	\$ 15,014	\$ 8,496
19260652 B	\$ 8,782	\$ 5,493
19260652 C	\$ 9,628	\$ 8,096
19260652 D	\$ 7,273	\$ 7,075
19260652 E	\$ 3,259	\$ 1,488
19260652 F	\$ 1,867	\$ 933
19260652 G	\$ 12,956	\$ 12,057
19260652 K	\$ 4,833	\$ 2,833

This table omits penalties reported in IMIS if attributed to a subparagraph of the standard which can not be identified with certainty because of a typographical error in the IMIS data.

## 5. Cost Analysis

The objective of the “lookback” cost analysis is to assess the relative increase or decrease in the cost of required safety measures for excavation since 1990. If costs have increased substantially, then impacts on small businesses are likely to have increased over the period as well. Conversely, if safety-related costs have stayed constant or decreased in real terms, then impacts are not likely to have increased. The analysis and key findings are summarized in Section 5.1. Section 5.2 presents additional details on the comparison of costs.

### 5.1 Overview and Key Findings

The standard requires that walls and faces of all excavations or trenches should be guarded by a shoring system, safe sloping, or equivalent means of protection such as trench shields or trench boxes. This study estimates the 2001 cost of using the four most common types of protective systems: sloping, trench boxes, aluminum shoring, and timber shoring.<sup>24</sup> It then compares the current cost to the corresponding cost (inflation-adjusted) at the time the standard became effective in 1990.<sup>25</sup> These findings are supplemented by research conducted on trends in the use of various types of safety equipment, including telephone discussions with members of government, trade associations, and vendors serving the trenching/excavation market.

The analysis finds that trench boxes, aluminum shoring, and the use of sloping were less expensive in 2001 (by about 10% in real dollars) than they were in 1990. Timber shoring may be more or less expensive today than previously, depending on the type and size of timbers used. In any event, however, timber shoring is used less frequently today than a decade ago.<sup>26</sup> Newer types of protective systems, including the various “trenchless” technologies, slide rail systems, and modular trench boxes, are being used with increasing frequency. Although the costs of these newer systems have not been examined for this study, it is reasonable to assume that each enjoys a net cost advantage over the older methods, at least in those situations where the newer systems are used.

The study concludes, therefore, that the protective systems available in 1990 (when the Excavations Standard was enacted) remain available today and, in fact, cost less in 2001 in real dollars. Furthermore, the entry into the marketplace of new types of protective systems has increased available options and likely has reduced the cost of meeting the standard.

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<sup>24</sup> The analysis does not attempt to calculate the total cost of the standard (e.g., by estimating the cost of every provision in the rule) as would be required in a regulatory impact analysis for a new rule.

<sup>25</sup> “Current” costs are based on 2001 cost data and occasionally from 2002 vendor quotes. Costs from 1990 have been converted to current (2001) dollars using the applicable implicit price deflators for the U.S. gross domestic product.

<sup>26</sup> Several sources indicated that trench boxes and aluminum hydraulic shores are the most common ways of meeting the standard, followed by sloping, and then timber shoring. Timber shoring tends to be used as a last resort, because of the relatively high cost of the timbers, the difficulty in finding larger timbers, and the possibility of occupational injuries to workers handling the heavy timbers.

## 5.2 Cost Analysis of Protective Systems

This section details the cost analysis of the four most common types of protective systems: sloping, trench boxes, aluminum shoring, and timber shoring. The analysis estimates and compares the current cost of each type of system to what the system cost when the Excavations Standard became effective in 1990. This approach implicitly assumes that firms would employ the same type of protective system today as a decade ago. In reality, as the relative costs of systems change, firms will tend to substitute the less expensive systems for the more costly ones. In addition, the analysis does not explicitly account for new technologies (e.g., trenchless technologies) that have, in fact, gained a share of the excavation safety market; these new technologies would not be used if they were not, on net, the most cost-effective option available for certain jobs. For both of these reasons, cost impacts are likely to be overstated by this study.

It is not always the case that cost is the driving factor in selecting a protective system. In some cases, site-specific or job-specific conditions may limit the available choices:

- Sloping frequently is not an option for excavation or trenching work conducted in urbanized areas because roadways, sidewalks, or building foundations limit the width of the area that would need to be excavated.
- When trenches will cross existing utility lines, trench boxes often cannot be used. Some form of shoring is typically used when pre-existing utilities are an issue.
- Soil type also may prevent the selection of a particular safety measure (e.g., use of aluminum shoring is inappropriate in soils lacking internal cohesion).
- Trench boxes may be infeasible or inappropriate for use in trenches that will remain open for prolonged periods. Trench boxes typically are dragged forward to the newer, working portions of a trench while the prior section (where work has just been completed) is quickly filled (after the trench box has left that section). The trench box generally should not be moved until the particular section of the trench containing the trench box is ready to be filled. Consequently, the heavy trench box is not typically used in cases where a trench will remain open long, except where the trench is short in length.

Nevertheless, these considerations are not new, so firms facing a restricted set of options today are no different than similarly situated firms in 1990. In these situations, where there is a reduced ability to select an alternative protective system, a comparison of current costs to 1990 costs is particularly appropriate.

### 5.2.1 Sloping

The study analyzed the cost of digging trenches with sloped sides based on engineering cost data contained in RS Means cost guides.<sup>27</sup> For the years 1990 and 2001, the study reviewed

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<sup>27</sup> Costs for 1990 are taken/derived from RS Means Heavy Construction Cost Data, 1991. Costs for 2001 are from Means Site Work and Landscape Cost Data, 2002.

the relevant guides to identify the combined equipment and labor unit cost (i.e., cost per linear foot) of digging ten different trenches. The trenches differ in slope (five different slopes, including the base case of 0:1 slope [or vertical walls]) and in width (half are 2 feet wide and half are 4 feet wide). All of the trenches have a depth of 10 feet. The analysis then restated the 1990 costs in 2001 dollars using implicit price deflators for U.S. gross domestic product (GDP).

The results of the comparison, presented in Exhibit 5-1 at the end of this chapter, show that the overall cost of trenching using sloping has decreased for all slopes and trench types. The decrease in cost per linear foot ranges from 2.3 to 5.5 percent, and reflects the net result of decreased equipment costs that are partially offset by increased labor costs.

## 5.2.2 Trench Boxes

The primary cost of using trench boxes consists of the cost of the trench box itself. Although there is some increase in the time required to trench using a trench box as opposed to not using any protective system, research conducted for this study indicates that the loss in productivity is not significant in most cases and, moreover, is comparable to the loss associated with using other protective systems (e.g., shoring). The study obtained trench box monthly rental costs for two different sizes of trench boxes (8 x 16 feet, and 10 x 20 feet) for 1989 and 2001 from Means cost guides.<sup>28</sup> The study also considered the total cost of a trenching job using each type of trench box, assuming a production rate of 90 linear feet per day (or 1800 linear feet per month).<sup>29</sup> As necessary, the study converted costs to 2001 dollars using implicit price deflators for GDP.

The results of the analysis show that the cost of the smaller trench box has declined by approximately 25 percent over the past decade, while the cost of the larger trench box has increased by almost 20 percent. When considered within the context of the overall trenching job, however, these changes in trench box costs prove to be almost insignificant to the cost of trenching overall. Using either size trench box, the overall cost of trenching has declined over the past decade. The size of the decrease is over 3 percent if the small trench box is used and almost 1 percent if the large trench box is used. These findings are shown in Exhibit 5-2.

## 5.2.3 Aluminum Shoring

The analysis assumes a typical trenching job that uses aluminum shores involves three H-type shores, as well as one pump and associated accessories for the open length of the trench. Current costs were obtained based on vendor quotes.<sup>30</sup> Past regulatory studies provided information on the 1987 per shore purchase cost associated with a 9 (or 9.5) feet deep, 3-foot wide trench, as well as the pump and accessories.<sup>31</sup> Although there is some increase in the time required to trench using aluminum shores as opposed to not using any protective system, research conducted for this study indicates that the loss in productivity is not significant in most cases and, moreover, is comparable to the loss associated with using other protective

<sup>28</sup> *Ibid.* Also, RS Means Building Construction Cost Data, 1990.

<sup>29</sup> Based on information contained in the *Economic Impact Analysis of the Proposed Revision to OSHA Subpart P Standard (§1926.650-652) Governing Trenching and Excavation Work*, prepared by Eastern Research Group, May 19, 1987.

<sup>30</sup> ICF telephone discussions with trenching and shoring vendors.

<sup>31</sup> *Economic Impact Analysis of the Proposed Revision to OSHA Subpart P Standard (§1926.650-652) Governing Trenching and Excavation Work*, prepared by Eastern Research Group, May 19, 1987.

systems (e.g., trench boxes). As necessary, the study converted costs to 2001 dollars using implicit price deflators for GDP.

This analysis, presented in Exhibit 5-3, estimates that the cost of aluminum shore equipment has declined by approximately 10 percent in real dollars since 1987.

#### **5.2.4 Timber Shoring**

Research conducted for this study indicates that timber shoring is the most expensive method and is only used when necessary (e.g., to keep an excavation open for an extended period of time). Disadvantages of timber shoring include cost, difficulty finding larger timbers, and risk of occupational injuries to workers handling the heavy timbers. The cost of using timber shoring as a protective system depends largely on the cost of the timber shores; other costs of digging trenches have decreased since the enactment of the Excavations Standard, as discussed above. The study analyzed the cost of timber shoring based on engineering cost data contained in RS Means cost guides.<sup>32</sup> The study converted costs to 2001 dollars when necessary using implicit price deflators for GDP.

As shown in Exhibit 4, the real price of lumber has decreased over the last decade, with the exception of the cost of large (8 x 8) timbers. The price also can vary with the type of wood available. Therefore, in many cases it may be less expensive to use timber shoring today than in 1989, but in other cases it may currently be more expensive.

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<sup>32</sup> Costs for 1989 are taken/derived from RS Means Building Construction Cost Data 1990. Costs for 2001 are from Means Site Work and Landscape Cost Data 2002.

**Exhibit 5-1**  
**Comparison of Sloping Costs (\$ per linear foot)**

Trench Size and Slope	1990 Costs			1990 Costs Adjusted to 2001 Dollars			2001 Costs			Percent Change <sup>1</sup>
	Equipment	Labor	Total	Equipment	Labor	Total	Equipment	Labor	Total	
2' wide, 10' deep										
Slope 0:1	\$ 3.10/LF	\$ 4.10 /LF	\$ 7.20/LF	\$ 3.95/LF	\$ 5.23/LF	\$ 9.18/LF	\$ 3.20/LF	\$ 5.70/LF	\$ 8.90/LF	-3.09%
Slope 1/2:1	\$ 8.60/LF	\$11.10/LF	\$19.70/LF	\$10.97/LF	\$14.16/LF	\$25.13/LF	\$ 8.75/LF	\$15.50/LF	\$24.25/LF	-3.49%
Slope 1:1	\$ 14.15/LF	\$17.70/LF	\$31.85/LF	\$18.05/LF	\$22.58/LF	\$40.63/LF	\$14.35/LF	\$24.50/LF	\$38.85/LF	-4.37%
Slope 1 ½:1	\$ 15.65/LF	\$18.25/LF	\$33.90/LF	\$19.96/LF	\$23.28/LF	\$43.24/LF	\$15.80/LF	\$25.50/LF	\$41.30/LF	-4.49%
Slope 2:1	\$ 17.80/LF	\$21.00/LF	\$38.80/LF	\$22.70/LF	\$26.79/LF	\$49.49/LF	\$18.00/LF	\$29.00/LF	\$47.00/LF	-5.03%
4' wide, 10' deep										
Slope 0:1	\$ 6.40/LF	\$ 8.05/LF	\$14.45/LF	\$ 8.16/LF	\$10.27/LF	\$18.43/LF	\$ 6.70/LF	\$11.30/LF	\$18.00/LF	-2.34%
Slope 1/2:1	\$11.50/LF	\$14.15/LF	\$25.65/LF	\$14.67/LF	\$18.05/LF	\$32.72/LF	\$11.90/LF	\$19.85/LF	\$31.75/LF	-2.96%
Slope 1:1	\$15.30/LF	\$18.20/LF	\$33.50/LF	\$19.52/LF	\$23.21/LF	\$42.73/LF	\$15.80/LF	\$25.50/LF	\$41.30/LF	-3.35%
Slope 1 ½:1	\$18.45 /LF	\$21.00/LF	\$39.45/LF	\$23.53/LF	\$26.79/LF	\$50.32/LF	\$18.95/LF	\$29.00/LF	\$47.95/LF	-4.71%
Slope 2:1	\$21.00 /LF	\$23.00/LF	\$44.00/LF	\$26.79/LF	\$29.34/LF	\$56.12/LF	\$21.00/LF	\$32.00/LF	\$53.00/LF	-5.57%

<sup>1</sup> Percent change calculated based on difference between shaded cells.

**Exhibit 5-2**  
**Comparison of Trenching Costs using Trench Boxes (\$/month)**

Cost Element	Units	1989 Costs	1990 Costs	1989-90 Cost Adjusted to 2001 Dollars	2001 Costs	Percent Change <sup>2</sup>
Labor to Dig Trench (4' wide, 10' deep, 0:1 slope)	\$/lf		\$ 8.05		\$ 11.30	
Equipment to Dig Trench (4' wide, 10' deep, 0:1 slope)	\$/lf		\$ 6.40		\$ 6.70	
Subtotal - Dig Trench	\$/lf		\$ 14.45	\$ 18.44	\$ 18.00	
Subtotal - Dig Trench <sup>1</sup>	\$/month			\$ 33,196	\$ 32,400	
Trench Box (8x16)	\$/month	\$ 1,275		\$ 1,685	\$ 1,275	
<b>TOTAL COST USING 8 x 16 BOX</b>	\$/month			<b>\$ 34,881</b>	<b>\$ 33,675</b>	-3.46%
Trench box (10X20)	\$/month	\$ 1,950		\$ 2,577	\$ 3,075	
<b>TOTAL COST USING 10 x 20 BOX</b>	\$/month			<b>\$ 35,774</b>	<b>\$ 35,475</b>	-0.83%

1 Subtotals were converted from (\$/lf) to (\$/month) based on an assumed production rate of 90 ft/day and an assumed working month of 20 days/month, resulting in a conversion factor of 1,800 lf/month.

2 Percent change based on difference between shaded cells.

**Exhibit 5-3  
Comparison of Aluminum Shoring Equipment Costs**

Cost Element	1987 Cost	1987 Adjusted Cost	Quantity	Total 1987 Adjusted Cost	2002 Cost	Quantity	Total 2002 Cost	% Change <sup>1</sup>
Cost per shore	\$ 550.00	\$ 779.11	3	\$2,337.32	\$ 679.00	3	\$2,037.00	
Cost for Pump and Accessories	\$ 475.00	\$ 672.87	1	\$ 672.87	\$ 666.67	1	\$ 666.67	
<b>Total</b>				<b>\$3,010.19</b>			<b>\$2,703.67</b>	<b>-10.18%</b>

(1) Percent change based on difference between shaded cells.

**Exhibit 5-4  
Comparison of Timber Shoring Prices**

Timber Size	Units	1989 Lumber Costs	1989 Costs Adjusted to 2001 Dollars	2001 Lumber Costs	Percent Change <sup>2</sup>
2x6	\$/MBF <sup>1</sup>	\$ 320.00	\$ 422.97	\$ 392.00	-7.32%
4x6	\$/MBF	\$ 550.00	\$ 726.98	\$ 648.00	-10.86%
6x6	\$/MBF	\$ 640.00	\$ 845.94	\$ 817.00	-3.42%
8x8	\$/MBF	\$ 640.00	\$ 845.94	\$ 972.00	14.90%

(1) Dollars per thousand board feet.

(2) Percent change based on difference between shaded cells

## 6. Public Comments and OSHA Responses

As required by the Regulatory Flexibility Act, OSHA invited public comment on the Section 610 review of the rule by publishing a Federal Register notice requesting comments on the Excavations Standard (67 FR 54103, August 21, 2002). OSHA opened public docket S204A (now Docket No. OSHA-2007-0012) to hold this solicited information. A total of 20 commenters provided information to the docket (listed below in alphabetical order, with docket reference number):

1. Associated Builders and Contractors (ABC, Ex. 2-7)
2. American Federation of State, County and Municipal Employees (AFSCME, Ex. 3-7)
3. American Gas Association and American Public Gas Association (AGA/APGA, Ex. 4-1)
4. Associated General Contractors of America (AGC, Ex. 2-8)
5. AFL-CIO Building and Construction Trades Department (BCTD, Ex. 2-5)
6. James F. Burson, P.E. (Ex. 2-3)
7. Cedar Falls Utilities (Ex. 3-2)
8. Coastal Training Technologies (Ex. 3-1)
9. The Dotson Company, Inc. (Ex. 3-4)
10. Duinink Bros Inc. (Ex. 2-2)
11. International Brotherhood of Teamsters (IBT, Ex. 2-10)
12. Robert Kundel (Ex. 3-6)
13. Jack L. Mickle, Ph.D. (Ex. 2-13)
14. The Mosser Group (Ex. 2-1)
15. National Association of Home Builders (NAHB, Ex. 2-9, Ex. 3-8)
16. National Institute for Occupational Safety & Health (NIOSH, Ex. 2-12)
17. National Utility Contractors Association (NUCA, Ex. 2-4)
18. Pipe Line Contractors Association (PLCA, Ex. 2-11)
19. Traffic Control Plan (TCP, Ex. 3-5)
20. Trench Shoring Services (Ex. 2-6)

There was general agreement among commenters that the Excavations Standard, when complied with, helps prevent excavation and trenching accidents and helps protect worker safety. In support of this position, one commenter (NIOSH) submitted a study that found a decline in fatalities since the 1989 revision of the Excavations Standard (Suruda et al., 2002). Commenters also generally agreed that there is a continued need for the standard, particularly given that excavation and trenching fatalities continue to occur. Another widely-held view was that improving compliance rates is the key to further reductions in accidents, injuries, and fatalities.

These statements are supported by the facts found in this review. Furthermore, after reviewing the facts and comments, these statements support OSHA's conclusions for this lookback review. The annual number of trenching and excavation fatalities has declined from an estimated 90 fatalities per year prior to the enactment of the 1989 standard, to approximately 70 per year since 1990. As noted earlier, the 22% reduction was achieved as construction activity increased by 20% in real terms over this period. Therefore, in relation to increased construction activity, fatalities have been reduced by more than 40%. The real cost of protective devices such as shields has dropped, excavation activity has increased, and the number of small business engaged in excavation activities has increased. The evidence indicates that the large majority of deaths are contributed to by violations of the standard.

All this evidence as well as the comments support the view that the Excavation Standard is working to protect workers and has not caused negative economic impacts on small business or generally. These

facts and comments demonstrate and it is OSHA's conclusion, that the Standard needs to be retained substantially unchanged.

OSHA enforces the standard generally and through various special emphasis programs, issuing substantial numbers of citations. OSHA has provided training and outreach materials. (See for example the card in App. IV available in Spanish as well as English). Over the years OSHA has issued many interpretations and the standard has been interpreted by the Review Commission and Courts.

The public has suggested a number of changes which the commenters believe will improve the Standard. These are discussed below along with OSHA's responses.

However, such suggestions, which OSHA welcomes, need to be reviewed in the context of a successful standard. OSHA has limited regulatory resources. Significant modifications to a standard take substantial agency resources which may well be better spent in areas where standards have not been updated and other safety matters could be addressed. Also, as some commenters have pointed out, changes in settled and interpreted regulatory language invariably lead to a period of uncertainty, further interpretations and litigation, which reduces the value of the changes, at least in the near term. OSHA values suggestions to improve its outreach and training materials and efforts, and as resources become available will update and extend those materials and efforts.

Opinions were more varied, however, with respect to how compliance rates could be improved and whether the standard should be revised. As discussed in greater detail below, some commenters argued that OSHA should increase its efforts to enforce the standard (AFSCME, Burson, Mickle, Trench Shoring Services). Other commenters stated that outreach, education, and training would be effective tools for improving compliance (ABC, AFSCME, AGC, Burson, Dotson, Duininck, NIOSH, NUCA). Although a number of commenters stated that the standard can and should be improved (BCTD, Burson, CTT, NUCA), or suggested specific improvements, several commenters opposed revising the standard (AGC, Mickle, Trench Shoring Services). Two commenters argued that changes would only serve to confuse those who now understand and follow the standard (Mickle, Trench Shoring Services).

None of the commenters stated the Excavations Standard should be rescinded as a whole, although two argued that the standard should be rescinded or substantially modified for a particular industry (NAHB, PLCA). In addition, no evidence was presented of economic hardship resulting from implementation of the standard.

The following are public comments, received on specific issues relating to the Excavations Standard.

#### Updating the Standard (General Opinions)

A number of commenters stated that the standard can and should be improved (BCTD, Burson, CTT, NUCA). Several commenters suggested specific improvements, as discussed later in this Chapter.

Several commenters argued against changing the standard (AGC, Mickle, Trench Shoring Services). Two commenters argued that changes would only serve to confuse those who now understand and follow the standard (Mickle, Trench Shoring Services). One stated that it is effective, clear, and easy to understand (AGC). Another stated that technological updates are provided with the manufacturer tabulated data, which are periodically updated by the manufacturers (Mickle). Another stated that the standard should be left as is until a significant effort can be made to revise it. This comment also noted a forthcoming meeting of the ANSI A10.12 Committee to review ANSI's excavations standard (Mickle).

One commenter argued that even though the standard could be made less complex, it is beginning to work because of the stability of the rules and the gradual simplification of related training. If the standard is changed substantially, then confusions and lack of clarity will be renewed for another decade (Trench Shoring Services). A similar comment warned that changes would only serve to confuse and discourage those who have studied and attended classes and are currently following the standard (Mickle).

#### Relative Burden of the Standard on Small Entities and the Industry in General

Most of the comments that addressed the issue of regulatory burden on small entities or on industry as a whole indicated that the standard did not impose an unnecessary or disproportionate burden on small businesses or on industry in general (Burson, Mickle, Trench Shoring Services). One commenter stated that trench boxes are not expensive pieces of equipment even for small contractors (Mosser Group). Two stated that the standard resulted in a level playing field for large and small contractors (Mosser Group, AFSCME). Others suggested that by reducing accidents, the standard may improve productivity (AGC, Burson). Another argued that any burden could not be considered unnecessary until there are no more injuries, deaths, or exposure to the potential of injury (Trench Shoring Services).

One commenter agreed that the standard was not a burden on industry, but assumed that the standard resulted in cost pressures on smaller firms (ABC). Another stated that an unnecessary burden on small contractors results from two specific aspects of the standard (as discussed in more detail later in the chapter): OSHA enforcement efforts, and the rescue equipment required by Section 1926.651(g)(2) (NUCA).

#### Causes of Non-Compliance

Commenters cited three main reasons contractors do not always comply with the standard. The most commonly cited cause was inadequate supervision by contractors that know about the standard (Burson, Mickle, Trench Shoring Services, AFSCME). Similarly, an additional commenter stated that non-compliance is due to lack of self-enforcement by some companies (AGC). Another indicated that, while not pervasive, there is a problem when supervisors themselves are not following the standard (ABC).

The second reason cited for non-compliance was lack of information or adequate training (ABC, AFSCME, Kundel, Mickle). One commenter stated that most small firms and infrequent excavators know of OSHA, but not the specific requirements (Mickle). Another stated that non-compliance is an issue for small contractors and non-union workers, who may not realize that doing things the right way ultimately will save them time and money (Kundel).

The third reason cited as a cause of non-compliance was cost pressure (ABC, AFSCME, Mickle). One commenter stated that cost pressures are a significant factor for those who are not properly capitalized in the first place and that, for them, safety is the first thing to go. This commenter opined that it would be very difficult to modify the standard to reduce costs without reducing worker protection (Mickle). Another commenter suggested that firms that do not comply with the standard have a competitive advantage over those that comply (ABC).

Other commenters, however, suggested that compliance with the standard *reduces* costs. One commenter stated that the use of trench shields and shoring enables contractors to get more production because it establishes a rhythmic, assembly-line type pattern to the job (Kundel). Another suggested that proper training in the use of safety equipment increases productivity (Burson). Several commenters stated that compliance costs will vary based on specific job conditions, including the size of the excavation, soil type, structures and other improvements, environment, and crew qualifications (Burson, Mickle, Trench Shoring Services, AFSCME).

Finally, NIOSH reported that, based on analysis of FACE investigations, compliance barriers are related to factors associated with company policies rather than the actions of individuals, as evidenced by the lack of pre-job hazard analyses and the lack of installation of protective systems. NIOSH also stated that many firms do not have adequate safety programs and the incidence of this is correlated with firms with fewer than 11 employees.

OSHA's enforcement experience indicates that some employers may be aware that OSHA has a standard for trenching and excavation safety, but may lack familiarity with its specific requirements, thereby exposing their employees to various hazards. However, OSHA does have extensive outreach programs to bring excavation requirements to the attention of small businesses and construction employers.

### Enforcement

Several commenters suggested that OSHA should increase enforcement efforts in order to achieve higher compliance levels (AFSCME, Burson, Mickle, Trench Shoring Services). One stated specifically that OSHA should increase the number of inspections (Burson). Two commenters suggested that criminal prosecution may be necessary (Burson, Mickle). Another commenter stated that 80 percent of the excavation sites visited use no protective systems at all, even though there is awareness that a standard exists. This commenter stated that there are no significant measures for additional protection that would make a difference in the current level of compliance other than enforcement (Trench Shoring Services).

Several commenters raised issues with enforcement practices. One stated that OSHA inspectors should not substitute their judgment for that of the project supervisor, presumably a competent person; that care is required before using lab tests to verify or contradict field tests or evaluations; and that fines for violations should be used only for egregious violations or as a last resort (Duininck Bros).

NUCA asserted that an unnecessary financial burden on small contractors results when OSHA compliance officers and area directors are overzealous or not thoroughly versed in the standard. For example, according to the commenter, some area offices still issue violations to contractors for not having protective systems designed by a registered professional engineer even though the tabulated data for the trench box or other protective system (which is approved by a registered professional engineer) clearly indicates that it is adequate. This results in unnecessary consultations with attorneys and engineers, and in inconsistencies in compliance, enforcement, and training efforts around the country. Also, a trench that measures 5 feet 3 inches in a few spots due to land contour, or an excavation with a slope just short of 1½:1 in Type "C" soil, should not warrant a written violation as it is a minor infraction that would not cause the trench or excavation to be less stable (NUCA).

OSHA does extensively enforce the Excavations Standard, as the data in Chapter 4 demonstrate. The Agency has had special emphasis programs in place since 1987, and OSHA also has in place a policy to inspect every regulated trench identified by Area Offices. OSHA inspects excavation contractors of all sizes. Congressional limitations on inspections of small employers just apply to general schedule inspections of employers with ten or fewer employees in industries with below average injury rates; injury rates are above average for excavation contractors. While OSHA imposes civil penalties for violation of the standard, OSHA can only recommend criminal prosecution; the Department of Justice makes the determination, and there are strict statutory requirements for criminal prosecutions.

OSHA does not agree that "(e)nforcement and penalties should be the last resort." We believe that a strong enforcement program is the underpinning for a successful outreach program and compliance. We strongly agree, however, that training and education programs and other outreach assistance significantly enhance worker safety and are to be encouraged; OSHA is willing to do whatever it can to develop, provide and support such outreach.

OSHA does have programs in place through training and manuals for uniform and reasonable citation policies by its compliance officers. OSHA is in the process of developing a new field audit program to help ensure enforcement consistency.

### Education, Training, and Outreach

A number of commenters indicated that education, training, and outreach for contractors and for employees would be effective methods of improving compliance with the standard (ABC, AFSCME, AGC, Burson, Dotson, Duinink, NIOSH, NUCA). Several suggested it would be effective for smaller businesses (ABC, AGC, NIOSH), and one suggested it would be effective for minority contractors (AGC).

Several commenters suggested that OSHA use certain methods or distribution techniques:

- Produce materials in video or brochure format in both English and Spanish and make the materials available to firms that inquire about compliance with the standard (ABC).
- Establish a clearinghouse for excavation and trenching compliance materials (NIOSH).
- Focus efforts on smaller businesses, particularly those with fewer than 11 employees that are not subject to routine inspections (NIOSH).
- Continue to work with organizations such as construction trade associations, the National Federation of Independent Business and the United States Chamber of Commerce, along with their local affiliates, to deliver information to employers and employees through mail, e-mail lists, fax, newsletters and magazines, safety fairs and conferences, and national and local training programs (NIOSH). NIOSH also identified other potential partners or sources of information including insurance companies, the Department of Transportation, and the Office of Pipeline Safety.
- Mirror industry efforts in conducting outreach to small contractors (AGC).
- Provide grant funds to extend OSHA's ability to offer educational and outreach programs (AGC, AFSCME).

In terms of the content of the information, commenters suggested the following:

- Simplified versions of the standards (ABC).
- Compliance resources for both the public and private sectors, including toolbox talks, checklists, manuals, training videos, web training, classroom training, and other specific items (NIOSH).
- Information on the development, availability, and potential applications and limitations of trenchless technologies (NIOSH).
- Cost-saving options, including options for smaller firms (ABC, NIOSH). For example, instructing firms in soil testing allows them to choose the protective device appropriate for the specific requirements of the job rather than simply selecting a device large enough to protect against any soil type, a potentially more expensive choice (NIOSH).

The Agency has placed significant emphasis on promoting understanding of the excavations standard. An Industry task force was assembled to assist us in identifying effective outreach programs which the Agency might undertake. The Advisory Committee on Construction Safety and Health (ACCSH) established a workgroup for the same purpose. As a result OSHA developed and distributed over 100,000 trench safety cards. (See App. IV.) OSHA continues to distribute these cards and, in addition, has developed a worksite poster for distribution as well. OSHA and NIOSH, working together, reached out to over 420 construction stakeholders involved in excavation and trenching activities, calling their attention to the need to focus on eliminating trench-related hazards and asking their cooperation in reducing trench-related fatalities at their worksites. OSHA has received positive responses from many of the recipients of these letters. In light of those comments OSHA will continue to improve its outreach activities in conjunction with NIOSH, employers, and unions.

There were a number of specific suggestions on outreach. The AGC suggested that “OSHA should extend its outreach programs to assist contractors in identifying the safest most efficient method of compliance with the standard. Cost pressures...require more assistance from OSHA to provide educational and outreach programs to small and minority contractors.” They went on to list several examples of safest/most-efficient compliance methods:

“For example, using trench shields in a trenching situation might be less costly, because sloping of the trench creates an additional amount of excavated material that has to be removed and disposed, creating additional surface restoration.

Also, utilizing adequately designed trench shields for a deep sewer project requires a larger excavator to pull and lift the trench shields in and out of excavations. The deeper the cut, the more the trench shield must weigh to support the load.

The safety cost of the project generally increases with the following variables; pipe size, type of pipe, right-of-way easements and soil type.

Marketing to media is another cost-effective way of educating the public on the hazards of excavation.”

OSHA is happy to assist contractors and their trade associations in providing such training to identify the safest and most efficient method of compliance with the standards. OSHA has already taken steps to provide educational and outreach programs to small and minority contractors.

NIOSH provided a comprehensive response regarding increasing awareness of the standard, including a number of specific recommendations. They began by noting that of the 30 FACE investigations of trenching or excavation-related fatalities, the “[d]ata on employers’ knowledge or awareness of complying with safety standards...[Showed that] [m]ore than half (17) of the employers had a written safety and health program...however, the FACE investigations do not provide enough detail to determine if these programs included information on trenching hazards or compliance with the excavations standard...” But NIOSH found that “[a]ll the employers with written safety and health programs had 11 or more employees”. NIOSH then recommended “that OSHA promote employer awareness by increasing outreach, training, and education to smaller businesses ....” As already pointed out OSHA agrees that increased outreach and training, particularly among small employers, are important elements in addressing the problem of trench-related fatalities. Indeed, in 2004, ACCSH established a workgroup to investigate feasible and effective measures to address the problem. The workgroup is charged with devising workable recommendations that might be provided to the Agency for consideration.

## Bid Practices

Commenters noted that most bids do not require any specific safety measures, plans or compliance certifications (ABC, NUCA). One commenter agreed that there is no national consistency in the use of the standard as a component of bid documents in public or private projects, but the commenter stated that this would seem fairly easy to achieve in projects that are federally-funded (Trench Shoring Services). Another commenter stated that although several states have attempted to enact bills requiring this, it is not a particularly popular item for legislation (Mickle).

Other commenters described their perception of the effects of this lack of standardization. For example, one commenter suggested that it leads to a competitive advantage for firms that do not comply with the standard, and ultimately to a shrinking pool of safety-conscious companies bidding on municipal projects (ABC). Along similar lines, another commenter stated that when safety requirements are included in bid documents, this encourages compliance with the standard, and when bids do not explicitly address safety issues, there is a lower likelihood that the project owner will inspect for safety (Burson).

Commenters offered the following suggestions with respect to bid practices:

- Require project designers or owners to include requirements for protective systems and list them in the job specifications with all other bid items (NUCA).
- Require bidding entities to demonstrate their commitment and capacity to comply with all aspects of the standard (AFSCME).

It is unclear whether OSHA has authority to require specific requirements in the bidding process. OSHA is willing to take reasonable steps to encourage and educate contractors to place such requirements in their bidding documents.

## Competent Person

Several commenters argued that the qualifications of a “competent person” should be made more explicit (AFSCME, BCTD, TCP).<sup>33</sup> One of these suggested that each competent person should be trained and have a card with the date issued, date of expiration, name, and photo. The card would be issued only after the person passed an excavation safety course with a score of 80 percent or better. It would expire in two years unless refresher training and re-testing occurs (TCP). Another commenter agreed that the standard should define what training is necessary to qualify someone as a competent person. This commenter, suggesting a relevance to excavations, cited a study of scaffold competent persons that found that (1) most scaffold competent persons had no scaffold safety training, and (2) the scaffolds overseen by those who had received scaffold safety training were safer than those overseen by untrained competent persons (BCTD).

Several commenters suggested expanding the role of the competent person. For example, two commenters pointed to requirements in the U.K. and recommended that competent persons should be required to document and submit reports of daily inspections and corrective actions taken. This record would be useful to identify trends and to assist in re-training (BCTD, NIOSH). NIOSH also stated that under the U.K. construction requirements, the competent person supervises the installation, alteration, or removal of excavation support. AFSCME stated that a competent person is not assigned to all excavation

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<sup>33</sup> Section 1926.650(b) defines a competent person as 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.”

jobs, and that many employers are not aware that a competent person must inspect each site before work begins. Sometimes a senior person or equipment operator assumes the competent person role even if that person is not qualified (AFSCME). Two commenters noted the importance of the job of competent person in protecting workers (Mickle, NIOSH). NIOSH recommended enhanced training or accountability or expansion of the competent person's duties, given that injuries occur even when trenches have been inspected by competent persons.

OSHA has issued several interpretations in recent years that address the requisite knowledge for competent persons in the context of other standards and in general address the public suggestions. In an August 1, 2000, interpretation, OSHA explained that:

“In the situation you have described, the competent person must be able to assess the load of employees, equipment and materials placed on the scaffold's foundation. While an engineering degree is not a prerequisite, that assessment normally requires some technical skills, and the competent person making that determination would have to have those skills.”

In a July 16, 2003 Memorandum, the Agency again elaborated on the qualifications for a competent person under the scaffold standard:

“The preamble to the Final Rule published in the Federal Register (61 FR [46059], August 30, 1996) [for] §1926.451(f)(3) states that “a ‘competent person’ for the purposes of this provision must have had specific training in and be knowledgeable about structural integrity of scaffolds and the degree of maintenance needed to maintain them.

“In order for an employee to assess if a scaffold can withstand the additional, wind-imposed forces from being enclosed, the individual must be a competent person, which in this case means having specific training in and being knowledgeable about the structural integrity of a scaffold and how the loads imposed by a trap enclosure can affect that integrity.”

“Note that in Superior Masonry Builders, OSHRC Docket No. 96-1043 (July 3, 2003) the Occupational Safety and Health Review Commission ruled that an experienced lead laborer who lacked training on the use of wind enclosures was not a “competent person” for purposes of inspecting the scaffold for hazards it stated:

‘Under Commission precedent a person is found to be competent when he [or she] makes an inspection in a competent manner and makes a reasonable determination that the condition is safe. Superior argues that the lead laborer designated as its competent person was an experienced skilled tradesman who exercised his judgment based on his training and experience. However, experience alone does not qualify the designated employee as a ‘competent person.’ We find that the lead laborer was not properly trained and therefore was not a competent person. The evidence shows that he was not instructed about the specific hazards presented by attaching enclosures to scaffolding and thus was not capable of identifying hazards... [Citations omitted.]

Though this guidance is informative to employers who perform work covered by the Excavations Standard, OSHA will consider issuing an interpretation or other guidance to provide further clarification on the term “competent person” in the context of subpart P.

It was suggested that OSHA could strengthen the standard by requiring that a competent person document the findings from the excavation inspection. This suggestion is based on the example of the United Kingdom, where inspections and corrective actions are required to be documented.

In general, the standard currently requires protective systems to be used in all excavations 5 feet or deeper. If a trench is less than 5 feet, a protective system is required except where a competent person finds that it is unnecessary. In the Agency's experience, most fatalities occur in excavations 5 feet or deeper in which no protective system is being used. In those cases a competent person determination was not needed to trigger the requirement for using a protective system. Therefore, with respect to reducing fatalities, it seems unlikely that the type of competent person documentation requirement suggested would reduce the number of these types of accidents. Also the Paperwork Reduction Act makes it difficult for OSHA to increase paperwork requirements in those circumstances (i.e., in situations where the information collected has an uncertain relationship to the prevention of workplace accidents.).

### Excavation Equipment and Trucks

The Building and Construction Trades Department of the AFL-CIO (BCTD), in a comment also supported by the IBT, claimed that 10 percent of trenching deaths are related to excavation equipment or trucks and that additional protection is needed in this regard. One such measure could require the establishment of controlled access zones in the vicinity of excavation equipment working near or in trenches. Only essential workers would be allowed in the controlled access zones. In addition, spotters should be mandatory to alert the equipment operator and protect these workers. It also stated that the existing requirement that allows only employees "qualified by training or experience to operate excavation machinery and equipment" (29 CFR 1926.20(b)(4)) is too vague and does not require certification of training, such as is required for forklift operators in 29 CFR 1910.178(l). AFSCME also recommended enhancing protections related to work zone safety requirements where excavation work is conducted in traffic areas.

This comment raises the possibility that one of the hazards associated with excavation work, powered excavation equipment running forward and hitting workers or collapsing a trench, may not be adequately addressed by the existing standards. Subpart P does not address the hazards described. 29 CFR 1926.601(b)(4)(i) and 1926.602(a)(9)(ii) address the hazard of excavation equipment and trucks with a restricted rearward view striking workers. However, the scenarios described by BCTD include struck-by hazards where the equipment is not backing up. OSHA will consider a suitable way to respond to these hazards, as well as swing radius. It may be appropriate to propose an amendment in Standards Improvement Project III to address these issues.

### Hazardous Atmospheres

Three commenters addressed the related issue of confined spaces, as discussed in this paragraph. One commenter stated that 1926.651(g)(1)(iii) requires taking action when an atmosphere containing flammable gas is 20 percent of the lower flammable limit of the gas, while the confined space standard requires taking action at 10 percent. The commenter urged OSHA to provide a clarification and change the requirements so they are similar (NUCA), claiming that OSHA stated, in a March 23, 1993 letter to NUCA, that "under normal circumstances, a trench would not be considered a confined space" because the Excavations Standard addresses the issue of hazardous atmospheres. NUCA stated that OSHA should clarify that the Excavations Standard did not intend for trenches to be considered confined spaces. An unnecessary financial burden falls on contractors when owners do not recognize the distinctions and require contractors to treat trenches like permit-required confined spaces, which is not practical or required (NUCA). A second commenter suggested that OSHA consider combining the excavation and confined spaces requirements in one standard for ease of use (ABC). Finally, a third commenter suggested that the provisions be reviewed to see if they are useful or burdensome (Duininck Bros).

OSHA is conducting rulemaking for a confined space standard for construction. One of the issues being addressed in that rulemaking is whether that new standard should apply to excavations. When the confined space proposed rule is published the public will have an opportunity to comment on this issue.

### Emergency Rescue Equipment

NUCA suggested that 1926.651(g)(2)(i) could be removed without jeopardizing safety, because it creates an unnecessary financial burden and does not reduce excavation accidents. Workers, few of whom are trained to jump into a confined space in a rescue attempt, should not be encouraged to do so. Rescue operations in these types of situations are better left to experienced and trained rescuers and emergency response teams that are adequately equipped to handle these situations. NUCA also suggested that this requirement would be disproportionately burdensome on small contractors by expecting them to purchase rescue equipment that is not likely ever to be used and to provide rescue training to all workers (NUCA).

The preamble to the final rule (Oct. 31, 1989, 54 FR 45921-45922) points out that during the rulemaking for this subpart, OSHA received a great number of comments on this provision which the Agency weighed before adopting the provisions.

NUCA's comments are, in essence, that having such equipment on site does not add to safety because construction employees are normally not trained to do rescues, and that this work should be left to outside emergency responders. In a March 23, 1992 OSHA interpretation letter to Mr. Kennedy of NUCA, OSHA stated that reliance on a off-site rescue service to provide rescue if needed would not be considered a substitute for compliance with this provision.

Subsequently to the issuance of that letter, in 1994, OSHA enacted a confined space standard for general industry (which does not apply to construction). Under that standard, employers can choose to rely on an outside rescue service if certain conditions are met. OSHA will re-evaluate the 1992 letter to Mr. Kennedy in light of the policy embodied in the 1994 general industry confined space standard.

### Timber Shoring

One commenter stated that Appendix C on timber shoring should be deleted from the rule, as no one uses timber shoring anymore; however, if it is retained, then the formula at the top of each table should be explained. This commenter noted that the numbers for lateral earth pressure in the tables are not mentioned anywhere else in the standard; in addition, the pressures of 25, 45, and 80 psf are arbitrary, and numbers of 20, 40, and 80 psf are more realistic (Burson).

Another commenter urged that the rule continue to address timber shoring (Trench Shoring Services). This commenter stated that timbers are still used, although the frequency has decreased over the last decade and will continue to decrease over the next decade. In contrast to manufactured systems for which "tabulated data" are available, timbers lack any similar resource apart from the Excavations Standard; consequently, it is important that the standard serve as a readily-available archive of tables and charts in case timbers are chosen. The standard charts for timbers should be clarified, however, by removing the relationship to A, B, and C soil and maintaining the relationship to the actual earth pressures the charts are based upon. The contractor can then select the applicable chart based upon actual earth pressure rather than textural classification. This requires no modification to the chart engineering because the earth pressure is already noted and qualified with each chart (Trench Shoring Services).

OSHA's information and experience is that timber shoring is still in use. With respect to the lateral earth pressures, the Agency will investigate the commenter's suggestions.

## Soil Types

A commenter stated that Appendix A, Soil Classification, should be re-written so that it is simpler and less difficult for people in the field to understand and use. The TSSA Classification of C-60 should be added. Classification C-60 should be called something else (maybe B-, or BC), however, because the standard should not specify an earth pressure for each type of soil. The C-60 definition is simple and easy to understand, while the A, B, and C definitions are too complicated (Burson). A few other commenters made similar suggestions.

As discussed extensively in the preamble to the final rule (Oct. 31, 1989, 54 FR 4536-45942), the soil classification system in Appendix A was developed by the National Bureau of Standards (now the National Institute for Standards and Technology), and included several additional ASTM standards to supplement the classification system. The commenters have not provided sufficient new information to justify a reconsideration of the provision.

## Applicability to Homebuilding

The National Association of Home Builders (NAHB) commented on the applicability of the standard to homebuilders. NAHB stated that once foundation walls are in place on a residential structure, the area between the wall and excavated soil is a trench and, under the terms of 1926.650(b), triggers the requirements of the Excavations Standard. In many instances, according to NAHB, it is not possible to use sloping or benching methods correctly due to adjacent property lines, structures, utilities, sidewalks, streets, curbs and gutters, protected environmental areas or other similar obstructions.

OSHA believes there is no need to change the standard. OSHA issued a memorandum of interpretation, dated June 30, 1995, clarifying those matters and resolving the issues raised by NAHB. See [http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=INTERPRETATIONS&p\\_id=21846](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=21846)

## Applicability to Welded Steel Natural Gas and Liquids Cross-Country Pipelines

The Pipe Line Contractors Association (PLCA) requested that OSHA consider exempting welded steel natural gas and liquids cross-country pipelines from the Excavations Standard or, in the alternative, to promulgate different standards that are tailored to the “continuous excavations” common to the mainline pipeline industry. PLCA claims that there has not been a single construction worker employed by PLCA members killed in any excavation failure or cave-in incident in the last ten years. This lower risk is a consequence of the shallower and constant depth of the excavation, the relative experience of the skilled crews (e.g., welders) working in the trench, the fact that most labor is performed outside the trench, the higher chance of noticing changes in soil in a constant excavation, and the contractor’s incentive to avoid re-excavation of the trench after a collapse.

OSHA will seek additional information on this issue as resources permit. It is a technical matter which requires consideration of many different issues and views.

## New Technologies

One commenter stated that there have been incremental improvements and cost reductions in the manufactured protective systems for open excavations (e.g., lighter weight, more maneuverable, able to cross utilities), but no new concepts or technology since the current standard was enacted. The biggest change is the acceptance of manufactured systems as alternatives to site-built systems such as timbers. Developments in trenchless technologies have occurred but do not impact the current standard (Trench Shoring Services). Other commenters noted that directional boring machines, tunneling systems, and

other trenchless technologies have their own set of hazards (BCTD, Kundel, Mickle). During construction, an operator does not always see what lies in the way (e.g., a gas or water line can be ruptured). Further, the work is slow and not always accurate. After construction, there could be unseen voids left behind, which could lead to collapse (Kundel). One commenter suggested that OSHA revise the standard to address directional boring machines, tunneling systems, and other trenchless technologies (BCTD).

NIOSH raised the issue of remotely operated electronic video-monitoring equipment (e.g., sewer cameras), which may reduce the amount of time spent in trenches and underground work areas but also may have inherent hazards in flammable or explosive atmospheres, as addressed in a recent OSHA memorandum (NIOSH).

Many of the above recommendations and new technologies can be accommodated in the current Standard because of its flexibility. The Standard is performance-based (though it does provide specific requirements that an employer may follow and be in compliance). This means the Standard is adaptable to changes in technology.

#### Notification of Gas Line Ruptures

After excavators struck and ruptured an underground natural gas pipeline, and a fatal explosion resulted, the National Transportation Safety Board (NTSB) recommended to OSHA that OSHA “require excavators to notify the pipeline operator immediately if their work damages a pipeline and to call 911 or other local emergency response number immediately if the damages results in a release of natural gas or other hazardous substance or potentially endangers life, health, or property.” OSHA issued a Safety and Health Information Bulletin (SHIB) 03-05-21, “Hazards Associated with Striking Underground Gas Lines,” in response to this NTSB recommendation. In that SHIB, OSHA recommended “notifying the pipeline operator immediately if the excavator causes damage to a pipeline and to call 911 or other emergency response numbers if the damage results in release of natural gas or other hazardous substance.” However, NTSB responded to OSHA’s SHIB recommendation, stating that OSHA’s SHIB recommendation can serve as a helpful reminder to contractors, but that OSHA requirements are more likely to be followed. OSHA then informed NTSB that its recommendation to require excavators to take immediate actions would be considered during OSHA’s Section 610 review of the Excavations Standard.

Since then, the “Pipeline Inspection, Protection, Enforcement, and Safety Act (PIPES) of 2006” has been enacted. Section 2 of PIPES requires all persons (including employers) engaged in demolition, excavation, tunneling, or construction to immediately call 911 if: (1) they damage a pipeline that may endanger life or cause serious bodily harm or damage to property; and (2) such damage results in the escape of flammable, toxic, or corrosive gas or liquid. The enactment of PIPES may obviate the need for OSHA to promulgate a standard implementing the NTSB’s recommendation. It also may affect OSHA’s authority to issue such a standard. OSHA will monitor the implementation of the statute and consider whether amending the excavations standard as suggested by NTSB is necessary and appropriate.

## 7. The Excavations Standard and Small Businesses

This chapter of the review focuses on small businesses affected by the Excavations Standard. Section 7.1 begins by characterizing the number of small businesses affected by the standard. Next, Section 7.2 provides a further breakdown of affected firms by considering various ranges in the number of employees. Section 7.3 relates fatalities to firm size by, first, estimating the distribution of fatalities and the fatality rates for firms in different employment ranges and, second, by estimating the distribution of fatalities by the number of employees at the site. Section 7.4 describes the economic impacts of the standard on small businesses.

### 7.1 Estimation of the Number of Small Businesses

This study estimates the number and proportion of small businesses based on size standards established by the Small Business Administration (SBA). The SBA size thresholds for the 12 sectors of interest are stated in terms of annual revenue and are presented in Exhibit 7.1. However, because firm revenue data are not available, this study uses an alternate definition of small firms, based on employment. Specifically, firms are considered small if they have fewer than 500 employees. The SBA's Office of Advocacy often classifies firms with fewer than 500 employees as small.<sup>34</sup> Therefore, to estimate the impact of this rule on small businesses, this section analyzes the growth in the number of firms with fewer than 500 employees between 1989 and 1998. (Information on the construction industry is available only through 1998 using the SIC system, as discussed in Chapter 2.)

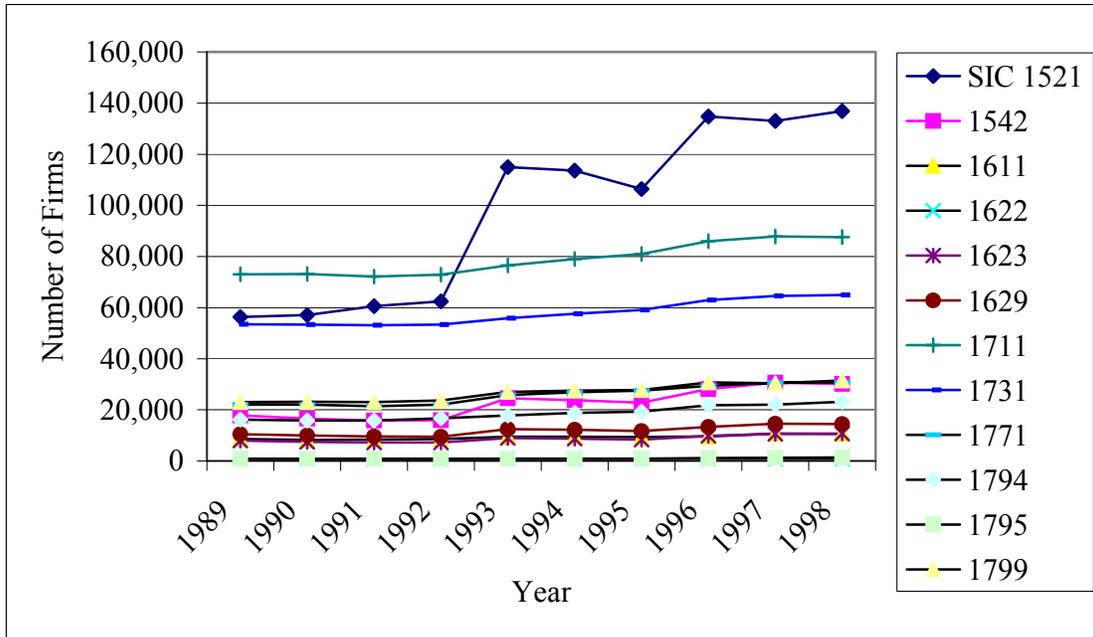
**Exhibit 7-1**  
**2000 SBA Size Standards for Relevant Construction Industry SIC Codes**

SIC Code	Description	Size Standard (in millions)
1521	General Contractors-Single-Family Houses	\$27.5
1542	General Contractors-Nonresidential Buildings, Other than Industrial Buildings and Warehouses	\$27.5
1611	Highway and Street Construction, Except Elevated Highways	\$27.5
1622	Bridge, Tunnel, and Elevated Highway Construction	\$27.5
1623	Water, Sewer, Pipeline, and Communications and Power Line Construction	\$27.5
1629	Heavy Construction, NEC	\$27.5
1711	Plumbing, Heating, and Air-Conditioning	\$11.5
1731	Electrical Work	\$11.5
1771	Concrete Work	\$11.5
1794	Excavation Work	\$11.5
1795	Wrecking and demolition work	\$11.5
1799	Special Trade Contractors, NEC	\$11.5

Source: "Small Business Size Standards Matched to SIC Codes, Effective through September 30, 2000," Small Business Administration. <http://www.sba.gov/size/hist/siccodes-stds.html>.

<sup>34</sup> For example, in a 1998 report titled, *Small Business Growth by Major Industry, 1988-1995*, SBA says, "When evaluating all industries, the Office of Advocacy often defines a firm with fewer than 500 employees as small."

**Exhibit 7-2  
Number of Firms with Fewer than 500 Employees (1989-1998)**

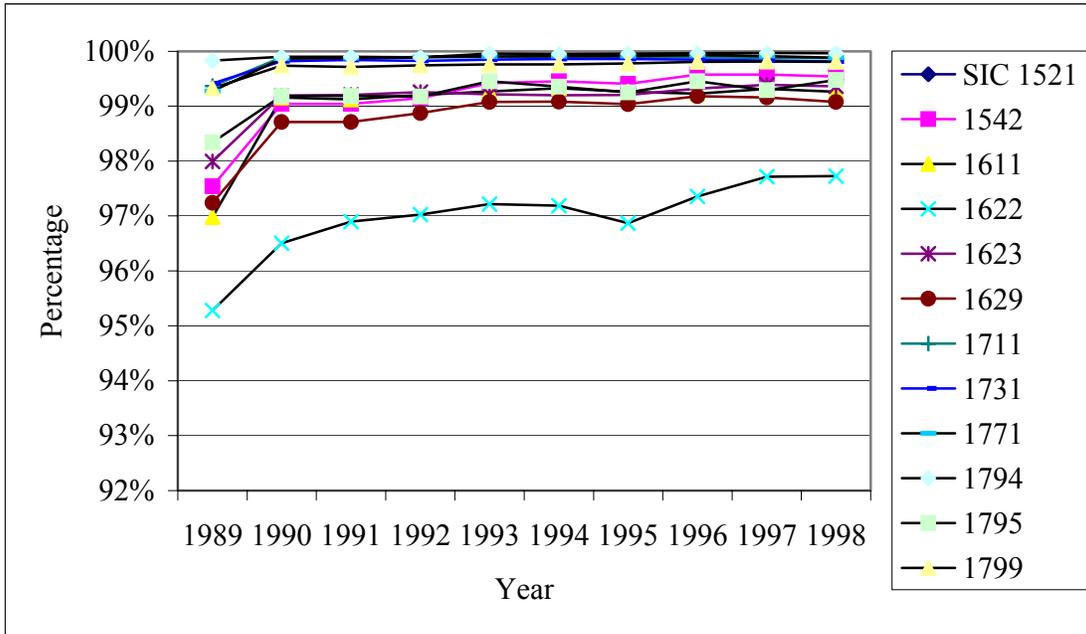


Source: ICF analysis of employee data obtained from U.S. Small Business Administration Office of Advocacy, Statistics of U.S. Businesses, 1990-1998, <http://www.sba.gov/advoc/stats/data.html#us>, obtained December 4, 2003, and 1989 data obtained directly from United States Bureau of the Census.

Analysis of data for each of the 12 relevant SIC codes shows that the Excavations Standard has not adversely impacted small businesses. Not only has the number of small firms increased in each of the SICs between 1989 and 1998, as shown in Exhibit 7-2, but the proportion of all businesses that qualify as small also has increased in each SIC except one, as shown in Exhibit 7-3. These trends are particularly evident in those SIC codes most involved with excavation and trenching activities: 1623 (Water, Sewer, Pipeline, and Communications and Power Line Construction); 1711 (Plumbing, Heating, and Air-Conditioning); and 1794 (Excavation Work).

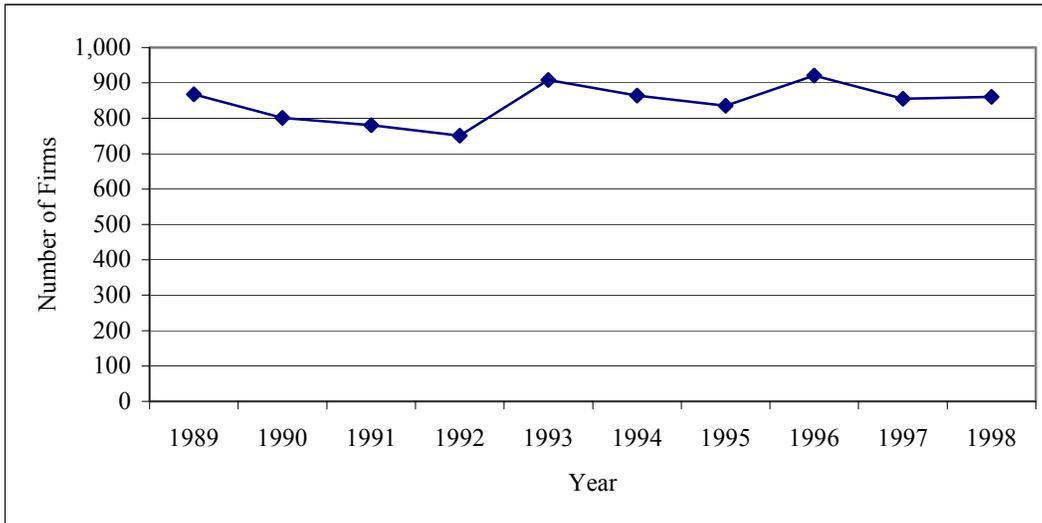
Only one of the 12 SIC codes, SIC 1622 (Bridge, Tunnel, and Elevated Highway Construction), experienced even a slight decline in the number of firms employing fewer than 500 employees between 1989 and 1998, as shown in Exhibit 7-4. In this sector, the number of firms with fewer than 500 employees declined very slightly between 1989 and 1998. However, the percentage of firms with fewer than 500 employees in the SIC code actually increased rather substantially during the same period, as shown in Exhibit 7-5. Therefore, even in SIC 1622, the Excavations Standard did not have a disproportionately negative impact on small businesses.

**Exhibit 7-3**  
**Percentage of Firms with Fewer than 500 Employees (1989-1998)**



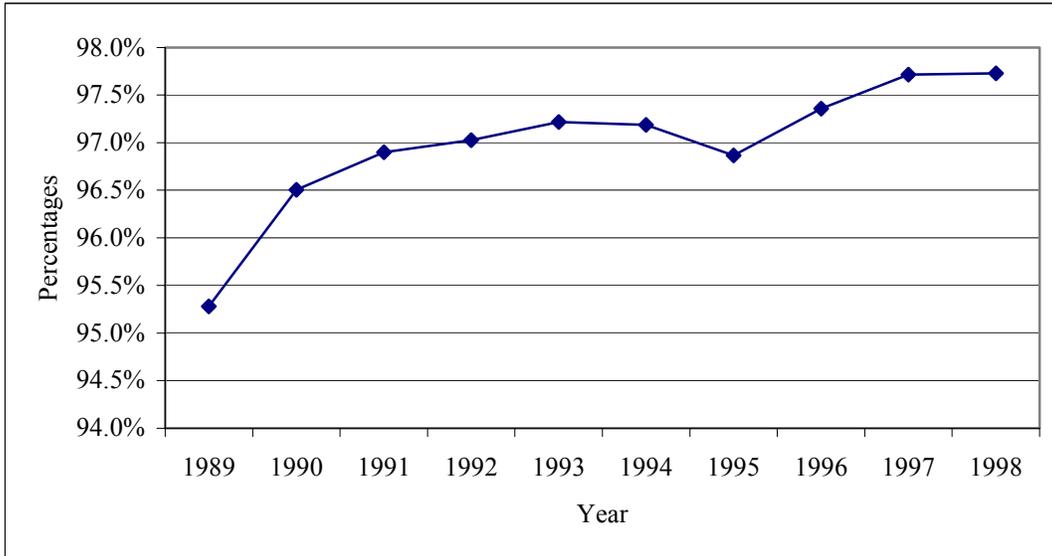
Source: ICF analysis of employee data obtained from U.S. Small Business Administration Office of Advocacy, Statistics of U.S. Businesses, 1990-1998, <http://www.sba.gov/advo/stats/data.html#us>, obtained December 4, 2003, and 1989 data obtained directly from United States Bureau of the Census.

**Exhibit 7-4**  
**Number of Firms with Fewer than 500 Employees in SIC 1622 (1989-1998)**



Source: ICF Analysis of employee data obtained from U.S. Small Business Administration Office of Advocacy, Statistics of U.S. Businesses, 1990-1998, <http://www.sba.gov/advo/stats/data.html#us>, obtained December 4, 2003, and 1989 data obtained directly from United States Bureau of the Census.

**Exhibit 7-5  
Percentage of Firms with Fewer than 500 Employees in SIC 1622 (1989-1998)**

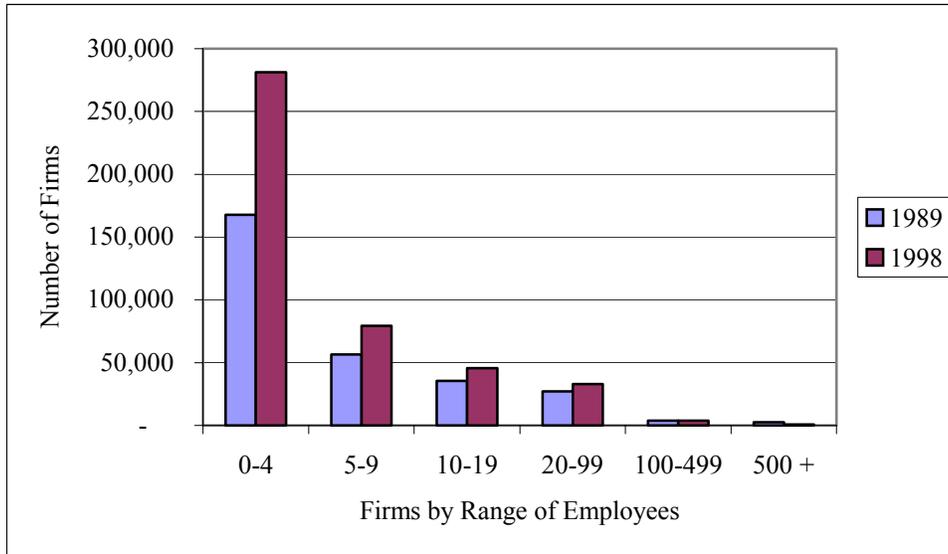


Source: ICF Analysis of employee data obtained from U.S. Small Business Administration Office of Advocacy, Statistics of U.S. Businesses, 1990-1998, <http://www.sba.gov/advo/stats/data.html#us>, obtained December 4, 2003, and 1989 data obtained directly from United States Bureau of the Census.

## 7.2 Distribution of Firms by Number of Employees

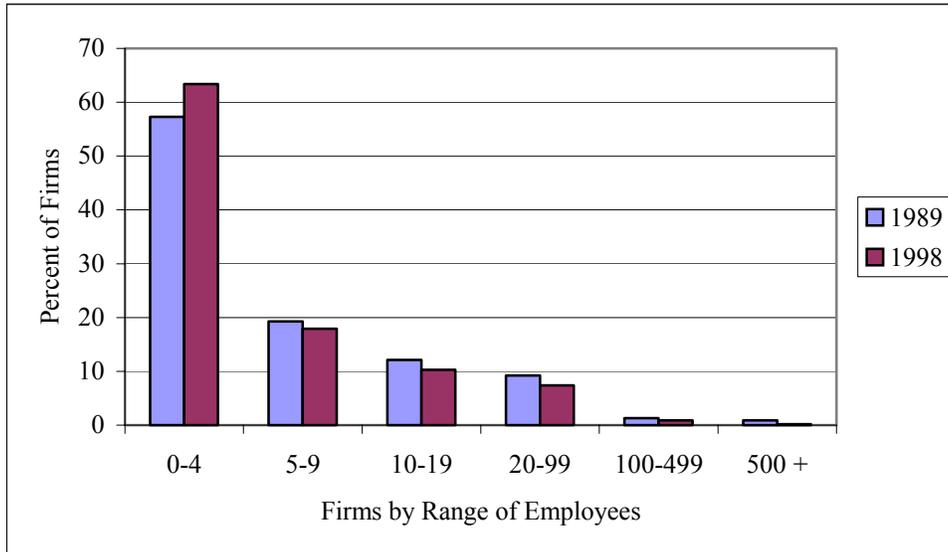
Analysis of the distribution of firms by number of employees shows that there has been the most growth in the number of firms in the smallest size categories, with successively lower growth in each higher size category (see Exhibit 7-6) and percent (see Exhibit 7-7). For example, there has been more growth in the number of firms employing between one and four employees than there has in any other size category. There was a slight decline in the number and percent of firms employing over 500 employees between 1989 and 1998. Exhibit 7-8 shows the percentage change in the number of firms in each employee size category for each of the 12 individual SIC codes. These results suggest that small firms were the fastest growing segment of the construction industry.

**Exhibit 7-6**  
**Number of Firms by Employee Size Categories for Selected Construction Industry SICs (1521, 1542, 1611, 1622, 1623, 1629, 1711, 1731, 1771, 1794, 1795, 1799) for 1989 and 1998**



Source: ICF Analysis of employee data obtained from U.S. Small Business Administration Office of Advocacy, Statistics of U.S. Businesses, 1990-1998, <http://www.sba.gov/advo/stats/data.html#us>, obtained December 4, 2003, and 1989 data obtained directly from United States Bureau of the Census.

**Exhibit 7-7**  
**Percent of Firms by Employee Size Categories for Selected Construction Industry SICs (1521, 1542, 1611, 1622, 1623, 1629, 1711, 1731, 1771, 1794, 1795, 1799) for 1989 and 1998**



Source: ICF Analysis of employee data obtained from U.S. Small Business Administration Office of Advocacy, Statistics of U.S. Businesses, 1990-1998, <http://www.sba.gov/advo/stats/data.html#us>, obtained December 4, 2003, and 1989 data obtained directly from United States Bureau of the Census.

**Exhibit 7-8**  
**Percent Change in The Number of Firms Across Employee Size Categories in Selected Construction SIC Codes Between 1989 and 1998**

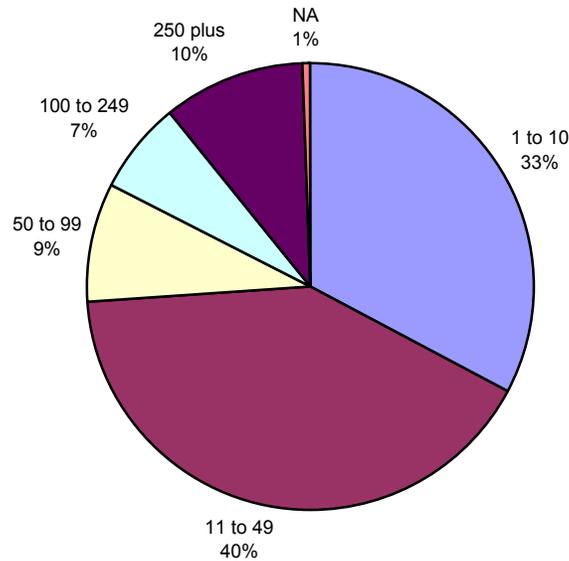
SIC	Percent Change in the Number of Firms					
	0 - 4	5 - 9	10 - 19	20 - 99	100 - 499	500 +
1521	169%	106%	58%	23%	-25%	-66%
1542	132%	64%	43%	13%	-15%	-69%
1611	37%	27%	22%	12%	-20%	-70%
1622	31%	11%	-4%	-17%	-18%	-53%
1623	57%	35%	18%	24%	9%	-57%
1629	36%	52%	42%	34%	-11%	-55%
1711	22%	16%	17%	22%	11%	-77%
1731	21%	18%	23%	29%	29%	-62%
1771	42%	38%	38%	27%	7%	-78%
1794	53%	32%	24%	9%	-26%	-70%
1795	84%	31%	33%	65%	45%	-50%
1799	50%	22%	16%	23%	-8%	-61%
<i>Total</i>	<i>68%</i>	<i>41%</i>	<i>29%</i>	<i>22%</i>	<i>-1%</i>	<i>-67%</i>

### 7.3 Fatalities by Firm Size and Number of Workers on Site

Exhibit 7-9 shows the distribution of excavation-related fatalities by the size of the firm experiencing the fatality. Approximately 73 percent of fatalities occur in firms with fewer than 50 employees. Of these:

- Approximately 33 percent of fatalities occur in the smallest firms, that is, firms with 10 or fewer employees.
- Approximately 40 percent of fatalities occur in firms with between 11 and 49 employees.

**Exhibit 7-9**  
**Distribution of Fatalities by Size of Firm**



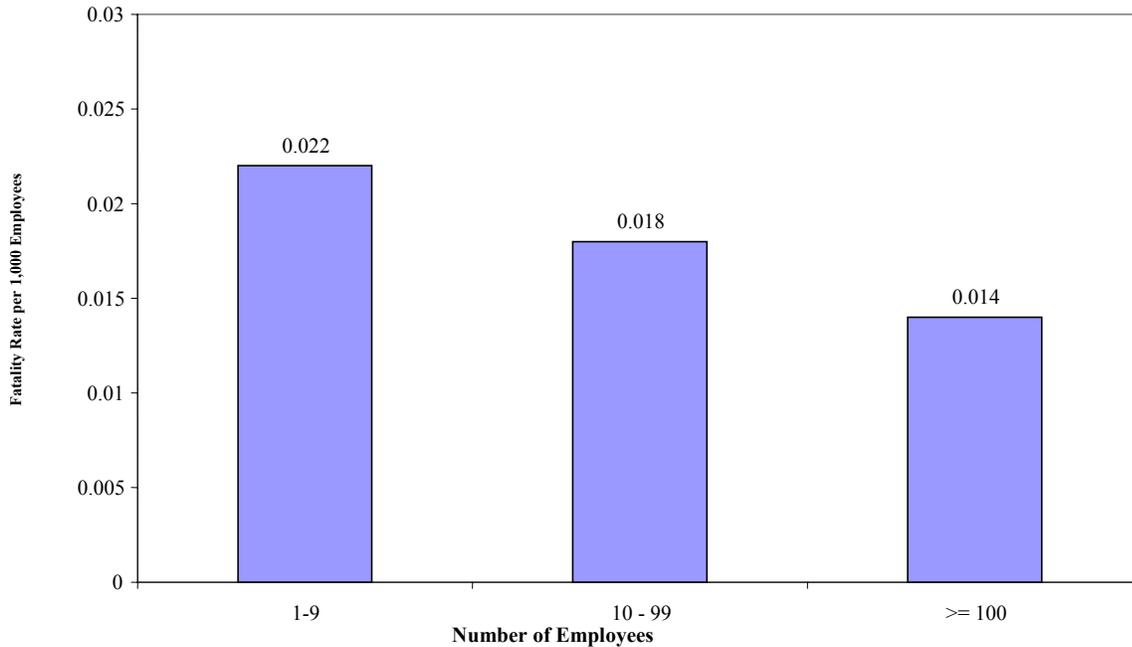
Source: ICF analysis of IMIS database.

This finding raises the question of whether smaller firms incur more fatalities than larger firms because smaller firms (in aggregate) undertake most of the excavations, or because they have less effective safety procedures. To address this question, this study estimated fatality rates (per 1,000 employees) for each firm size category. These rates were calculated by dividing the average number of fatalities in each size category for 1989-2000 by the number of employees (estimated) in the category in 2000. The results, presented in Exhibit 7-10, indicate that the smaller firms, in fact, have higher fatality rates than larger firms.<sup>35</sup>

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<sup>35</sup> The firm size categories supported by the fatality data differ from those supported by US Census firm data. Consequently, the combined data set supports only the three size categories shown in the exhibit. The average number of employees in a given size category was calculated by taking the number of firms in the category (calculated as the number of firms in 2000) and multiplying it by the average number of employees in the category size range (e.g., 3 employees in the 1-9 category; 24 employees in the 10-99 category; 211 employees in the over 99 category). Because fatality data could be analyzed for firms with 1-10 employees but firm data were available only for the range of 0-9 employees, the resulting fatality rate for firms with 0-9 employees may be slightly overstated, while the rate for firms with 10-99 employees may be slightly understated. The magnitude of the bias is believed to be small, however.

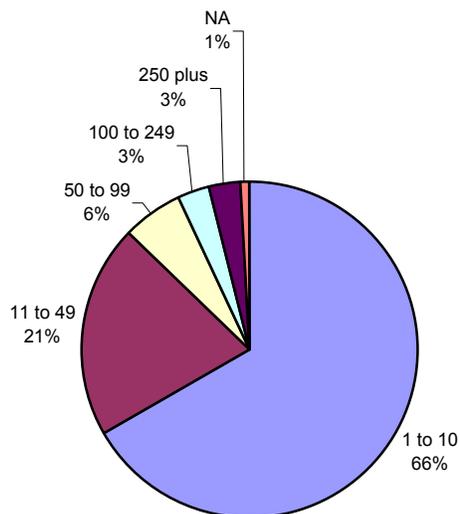
**Exhibit 7-10: Estimated Fatality Rate by Size of Establishment Average 1990-1997**



Source: ICF and OSHA Analysis of IMS Database and US Census and SBA Statistics

Exhibit 7-11 shows the distribution of excavation-related fatalities by the number of workers on site at the time of the fatality. While it is clear that more fatalities occur on smaller jobs (approximately 66 percent of fatalities occur at work sites with 10 or fewer employees), this could be a result of smaller jobs accounting for a majority of excavation and trenching activity. It is also possible, however, that oversight and compliance become less as firm size declines.

**Exhibit 7-11  
Distribution of Fatalities by the Number of Employees at the Site**



Source: ICF analysis of IMIS database

## 7.4 Impacts on Small Businesses

This study examined economic impacts on small businesses in several ways.

- First, it considered the relative growth in the number of small businesses between 1989 and 1998, as well as the change in the percentage of small firms relative to large firms in individual industry sectors. This analysis, which is discussed in Section 7.1, finds that the number of small businesses and the percentage of businesses that are small has increased since the standard was issued.
- The second approach, discussed in Section 7.2, considered different subsets of small businesses (i.e., across several ranges of number of employees) and found that the smallest small businesses (those with 0-4 employees) were the fastest growing segment of the affected industry.
- Third, the study evaluated changes in the costs of protective systems from 1990-2001. As discussed in Chapter 5, the costs of protective systems such as trench boxes, aluminum shoring, and the use of sloping *decreased* by about 10 percent in real dollars between 1990 and 2001.
- Finally, the study considered the public comments submitted to OSHA for purposes of this review. Most of the comments that addressed the issue of regulatory burden on small entities or on industry as a whole indicated that the standard did not impose an unnecessary or disproportionate burden on small businesses or on industry in general. One commenter stated that trench boxes are not expensive pieces of equipment even for small contractors. Two stated that the standard resulted in a level playing field for large and small contractors. Others suggested that by reducing accidents, the standard may improve productivity. Another argued that any burden could not be considered unnecessary until there are no more injuries, deaths, or exposure to the potential of injury. One commenter agreed that the standard was not a burden on industry, but assumed that the standard resulted in cost pressures on smaller firms. Another stated that an unnecessary burden on small contractors results from two specific aspects of the standard (as discussed in more detail in Chapter 6 of this document): OSHA enforcement efforts, and the rescue equipment required by Section 1926.651(g)(2).

Based on all of these findings, OSHA concludes that the Excavations Standard does not impose an unnecessary or disproportionate burden on small businesses or on industry in general. Although the standard does impose costs, these costs are essential to protecting worker safety and by preventing cave-ins also have financial benefits for employers.

## 8. Section 610 Review

Section 610 of the Regulatory Flexibility Act directs agencies to review impacts of regulations on small businesses. The Section 610 review of the general impacts on small business are discussed in Ch. 7. Section 610 also provides that agencies should specifically consider five areas in reviewing the impact of a regulation on small businesses. This section discusses the impact of the Excavations Standard in these five areas, which are as follows:<sup>36</sup>

1. The continued need for the Standard.
2. The concerns about the complexity of the rule.
3. The extent to which the rule overlaps, duplicates, or conflicts with other Federal rules, and with State and local governmental rules.
4. The degree to which technology, economic conditions, and other factors have changed to affect the Standard.
5. The nature of comments received by OSHA about the Standard.

### Continued Need for the Rule

There is a continued need for the standard. The annual number of trenching and excavation fatalities has declined from an estimated 90 fatalities per year prior to the enactment of the 1989 standard, to approximately 70 per year since 1990. This 22% reduction is even more impressive given the 20% real increase in construction activity over this period. In relation to increased construction activity, fatalities have been reduced by more than 40%, demonstrating that the standard has been effective.

Public commenters agreed that the standard, when complied with, helps prevent excavation and trenching accidents and helps protect worker safety. None of the commenters stated that the standard was not needed or should be rescinded as a whole. According to OSHA's inspection data, violations of the standard are a contributing factor in most excavation fatalities. OSHA concludes that the standard has improved safety, and the standard and its enforcement remain needed in light of the ongoing occurrence of fatalities related to its violation. As discussed in Ch. 7, the standard has not had any negative impacts on smaller businesses nor construction, generally.

### Complexity of the Rule

OSHA received a substantial number of public comments related to the issue of the rule's complexity. Although the comments provided no indication that employers are unable to comply due to the complexity of the standard, the comments did suggest several ways in which the standard might be simplified or clarified. For example, commenters identified the following areas as possible ways to simplify the standard or remove complexity:<sup>37</sup>

- The qualifications and duties of a "competent person" could be made more explicit.
- The requirement that allows only employees "qualified by training or experience to operate excavation machinery and equipment" (29 CFR 1926.20(b)(4)) could be clarified.
- The sloping requirements could be simplified by making them the same for everything but rock.

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<sup>36</sup> Regulatory Flexibility Act §610(b)(1).

<sup>37</sup> Refer to Section 6 for additional details regarding the public comments addressed in this section.

- The design of sloping and benching systems and design of support systems, shield systems and other protective systems could be simplified.
- The standard charts for timbers could be clarified by removing the relationship to A, B, and C soil and maintaining the relationship to the actual earth pressures the charts are based on.
- The standard's applicability to homebuilders could be clarified.
- The standard's applicability to welded steel natural gas and liquids cross-country pipelines could be reconsidered and clarified.
- Appendix A, Soil Classification, could be simplified so that it is easier for people in the field to use and understand.

Other commenters, however, argued that changes would only serve to confuse and discourage those who now understand and follow the standard. One stated that even though the standard could be made less complex, it is beginning to work because of the stability of the rules and the gradual simplification of related training; if the standard is substantially revised, then confusions and lack of clarity will be renewed for another decade.

OSHA has reviewed those comments on complexity in Ch. 6 and discusses its conclusions there. In a few cases modifications to the standard may be appropriate as regulatory resources become available. In other situations additional outreach materials will be the best response and in others OSHA has already issued interpretive materials which clarify the issues. In many cases OSHA concludes the current language is the best for clarity and worker protection.

### **Extent to which the Rule Overlaps, Duplicates, or Conflicts with other Rules**

OSHA concludes that in general, the standard does not overlap, duplicate, or conflict with other state or federal rules. Several commenters, however, addressed a possible conflict between the Excavations Standard and OSHA's standard for confined spaces.

OSHA is working on a confined spaces for construction standard. The Agency will address this issue in that rulemaking, and there will be an opportunity for public comment and hearings.

### **Changes in Technology, Economic Conditions, and Other Factors**

The primary economic and technological trend related to the Excavations Standard has been one of incremental refinement in manufactured systems and their increased affordability. As a result, the use of manufactured systems has increased while the use of site-built systems, such as timbers, has declined. However, public comment indicates that timber shoring is still used, albeit with decreasing frequency, and that it therefore is important for the standard to continue to address timber shoring.

A second trend of note involves the rise of so-called "trenchless" technologies (e.g., directional boring machines), which has added a new dimension to excavation work since the enactment of the Excavations Standard. While these technologies do not diminish the relevance of the existing standard, and they do reduce traditional hazards, they may be associated with their own set of hazards (e.g., leaving behind unseen voids). OSHA intends to monitor accidents involving trenchless technologies to determine whether an expansion of the existing standard may be warranted.

Except with respect to the decline in price of manufactured systems, as noted above, economic conditions have not changed in ways that would impact the standard. Public commenters did not present any evidence of economic hardship resulting from implementation of the standard. OSHA therefore, concludes that changes in technology and economic conditions do not warrant major changes in the Standard.

### **Nature of Comments Received**

Section 6 of this report details the nature of the public comments that OSHA received during the course of this review. In general, comments were supportive of the standard and indicated that the standard does not impose an unnecessary or disproportionate burden on small businesses or on industry in general. A few comments indicated that general cost pressures are one cause of non-compliance. Several other commenters, however, cited reasons why the standard actually reduces costs.

Some of the comments argued that OSHA should modify or increase its enforcement and outreach efforts and that doing so would improve compliance rates and reduce fatalities. A number of these comments stated explicitly that these efforts – and not further rulemaking – would be the most effective way to improve safety during excavation and trenching. These comments included suggestions, as discussed in Section 6.

With respect to whether the standard should be revised, a few commenters argued that revisions would be counterproductive. However, another group of commenters favored revision and suggested specific ways that the standard might be improved. In addition to suggestions for reducing the standard's complexity or clarifying the standard, which are noted above, other suggested improvements include the following:

- Increase protections related to the use of excavation equipment and trucks (e.g., use spotters, controlled access zones, and better-qualified operators).
- Remove Section 1926.651(g)(2)(i) on emergency rescue.
- Require increased documentation.
- Add explanations of recent improvements in protective systems that are now available to the construction industry, including illustrations and charts explaining when these systems are appropriate.

OSHA's response to these and other issues are discussed in Ch. 6.

### **Determination of Whether the Rule Should be Continued, Amended, or Rescinded to Minimize Significant Economic Impacts on a Substantial Number of Small Entities**

Based on the preceding analysis, OSHA finds that the Excavations Standard should be continued. It has reduced fatalities in excavation work. The standard does not impose significant or disproportionate economic impacts on small entities. Public commenters support retaining the Standard. OSHA will attempt to increase levels of compliance by expanding outreach and training materials and maintaining enforcement.

There were several suggestions to amend various provisions of the standard and other comments opposing any changes. OSHA is considering the NTSB recommendation on gas line leaks in light of the recently

enacted “Pipeline Inspection, Protection, Enforcement, and Safety Act (PIPES) of 2006”. OSHA will address the possible conflict with the Confined Spaces Standard in the rulemaking on a new Confined Spaces Standard for construction.

Some members of the public have suggested a few other amendments to the standard. However, such suggestions, which OSHA welcomes, need to be reviewed in the context of a successful Standard. OSHA has limited regulatory resources. Significant modifications to a standard take substantial agency resources which may well be better spent in areas where standards have not been updated and other safety matters could be addressed. Also, as some commenters have pointed out, changes in settled and interpreted regulatory language invariably leading to a period of uncertainty, further interpretations and litigation, which reduces the value of the changes, at least in the near term. OSHA values suggestions to improve its outreach and training materials and efforts, and as resources become available will update and extend those materials and efforts.

## **9. Executive Order 12866 Review of the Standard**

Executive Order 12866 on Regulatory Planning and Review states that agencies of the Federal government must review their existing significant rules “to determine whether any such regulations should be modified or eliminated so as to make the Agency's regulatory program more effective in achieving the regulatory objectives, less burdensome, or in greater alignment with the President’s priorities and principles set forth in this Executive Order.” This review focuses on four major points:

1. Whether the standard has become unjustified or unnecessary as a result of changed circumstances;
2. Whether standards are compatible with each other and not duplicative or inappropriately burdensome in the aggregate;
3. Whether the standard is consistent with the President’s priorities;
4. Whether the effectiveness of the standard can be improved.

This review of the Excavations Standard, consistent with Executive Order 12866, finds that the standard has worked to a substantial degree, but there may need to be increased outreach to achieve further safety benefits for trenching and excavation workers.

### **Whether the Excavations Standard Has Become Unjustified or Unnecessary as a Result of Changed Circumstances**

OSHA finds that the standard has significantly reduced the annual number of fatalities resulting from accidents involving excavations and trenching, despite growth in the relevant industry sectors. Nevertheless, approximately 70 fatalities per year still occur mostly from violations of the Standard. Therefore, the standard remains justified and necessary.

### **Whether the Standard is Compatible with Other Regulations and Not Duplicative or Inappropriately Burdensome in the Aggregate**

In general, the standard is compatible and not duplicative with other state or federal rules. Several commenters, however, addressed a possible conflict between the Excavations Standard and OSHA’s standard for confined spaces. As is discussed in Ch. 6, OSHA will be conducting a rulemaking on a confined space standard for construction. OSHA will address the issue in that rulemaking and the public will have the opportunity to comment on the issue.

### **Whether the Standard is Consistent With the President's Priorities**

The standard remains consistent with the President's priorities. In 1970, concerned about the high rates of deaths, injuries, disabilities, and diseases associated with the workplace, Congress passed the Occupational Safety and Health Act (OSH Act). The OSH Act was passed by a bipartisan Congress "to assure so far as possible every working man and woman safe and healthful working conditions and to preserve our natural resources." OSHA was created to develop mandatory job safety and health standards and enforce them effectively.

The objective of Executive Order 12866 is to reform and make more efficient the regulatory process. The regulatory process must be consistent with the President's priorities to enhance planning and coordination with respect to both new and existing regulations; to restore the integrity and legitimacy of regulatory review and oversight; and to make the process more accessible and open to the public.

The Excavations Standard is consistent with these priorities because it has produced the intended benefits, a reduction in trenching and excavation fatalities, without excess costs or conflict with other regulations and with public input and support.

### **Whether the Effectiveness of the Standard Can Be Improved**

OSHA believes that the Excavations Standard is the key factor in reducing the annual number of excavation and trenching fatalities from approximately 90 to approximately 70. However, the occurrence of accidents, injuries, and fatalities remains, mostly because of violations of the standard. Consequently, OSHA intends to improve compliance through improved outreach and training and maintaining enforcement.

## **10. Summary and Conclusions**

OSHA finds that the Excavations Standard has been successful in helping to reduce excavation fatalities. The annual number of trenching and excavation fatalities has declined from an estimated 90 fatalities per year prior to the enactment of the 1989 standard, to approximately 70 per year since 1990. This 22% reduction is even more impressive given the 20% real increase in construction activity over this period. In relation to increased construction activity, fatalities have been reduced by more than 40%.

The standard has not had negative impacts on small businesses or construction activity, generally. The number of small businesses engaged in excavation work has increased in numbers and as a percentage of businesses. Excavation activity has increased, and the cost of various types of safety equipment has declined in real terms. New, safer technology has been developed.

Most remaining fatalities result from violations of the standard. Small firms have higher violation and fatality rates. To reduce fatalities further, OSHA will expand its training and outreach, as resources become available, and maintain enforcement.

## **APPENDIX I: REGULATORY FLEXIBILITY ACT, SECTION 610**

### **§ 610. Periodic review of rules**

(a) Within one hundred and eighty days after the effective date of this chapter, each agency shall publish in the Federal Register a plan for the periodic review of the rules issued by the agency which have or will have a significant economic impact upon a substantial number of small entities. Such plan may be amended by the agency at any time by publishing the revision in the Federal Register. The purpose of the review shall be to determine whether such rules should be continued without change, or should be amended or rescinded, consistent with the stated objectives of applicable statutes, to minimize any significant economic impact of the rules upon a substantial number of such small entities. The plan shall provide for the review of all such agency rules existing on the effective date of this chapter within ten years of that date and for the review of such rules adopted after the effective date of this chapter within ten years of the publication of such rules as the final rule. If the head of the agency determines that completion of the review of existing rules is not feasible by the established date, he shall so certify in a statement published in the Federal Register and may extend the completion date by one year at a time for a total of not more than five years.

(b) In reviewing rules to minimize any significant economic impact of the rule on a substantial number of small entities in a manner consistent with the stated objectives of applicable statutes, the agency shall consider the following factors--

- (1) the continued need for the rule;
- (2) the nature of complaints or comments received concerning the rule from the public;
- (3) the complexity of the rule;
- (4) the extent to which the rule overlaps, duplicates or conflicts with other Federal rules, and, to the extent feasible, with State and local governmental rules; and
- (5) the length of time since the rule has been evaluated or the degree to which technology, economic conditions, or other factors have changed in the area affected by the rule.

(c) Each year, each agency shall publish in the Federal Register a list of the rules which have a significant economic impact on a substantial number of small entities, which are to be reviewed pursuant to this section during the succeeding twelve months. The list shall include a brief description of each rule and the need for and legal basis of such rule and shall invite public comment upon the rule.

## **APPENDIX II: INTRODUCTION AND SECTION 5 OF EXECUTIVE ORDER 12866**

### **REGULATORY PLANNING AND REVIEW**

The American people deserve a regulatory system that works for them, not against them: a regulatory system that protects and improves their health, safety, environment, and well-being and improves the performance of the economy without imposing unacceptable or unreasonable costs on society; regulatory policies that recognize that the private sector and private markets are the best engine for economic growth; regulatory approaches that respect the role of State, local, and tribal governments; and regulations that are effective, consistent, sensible, and understandable. We do not have such a regulatory system today.

With this Executive order, the Federal Government begins a program to reform and make more efficient the regulatory process. The objectives of this Executive order are to enhance planning and coordination with respect to both new and existing regulations; to reaffirm the primacy of Federal agencies in the regulatory decision-making process; to restore the integrity and legitimacy of regulatory review and oversight; and to make the process more accessible and open to the public. In pursuing these objectives, the regulatory process shall be conducted so as to meet applicable statutory requirements and with due regard to the discretion that has been entrusted to the Federal agencies.

Accordingly, by the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:

#### **Section 1. Statement of Regulatory Philosophy and Principles.**

(a) The Regulatory Philosophy. Federal agencies should promulgate only such regulations as are required by law, are necessary to interpret the law, or are made necessary by compelling public need, such as material failures of private markets to protect or improve the health and safety of the public, the environment, or the well-being of the American people. In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.

(b) The Principles of Regulation. To ensure that the agencies' regulatory programs are consistent with the philosophy set forth above, agencies should adhere to the following principles, to the extent permitted by law and where applicable:

(1) Each agency shall identify the problem that it intends to address (including, where applicable, the failures of private markets or public institutions that warrant new agency action) as well as assess the significance of that problem.

(2) Each agency shall examine whether existing regulations (or other law) have created, or contributed to, the problem that a new regulation is intended to correct and whether those regulations (or other law) should be modified to achieve the intended goal of regulation more effectively.

(3) Each agency shall identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.

(4) In setting regulatory priorities, each agency shall consider, to the extent reasonable, the degree and nature of the risks posed by various substances or activities within its jurisdiction.

(5) When an agency determines that a regulation is the best available method of achieving the regulatory objective, it shall design its regulations in the most cost-effective manner to achieve the regulatory objective. In doing so, each agency shall consider incentives for innovation, consistency, predictability, the costs of enforcement and compliance (to the government, regulated entities, and the public), flexibility, distributive impacts, and equity.

(6) Each agency shall assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs.

(7) Each agency shall base its decisions on the best reasonably obtainable scientific, technical, economic, and other information concerning the need for, and consequences of, the intended regulation.

(8) Each agency shall identify and assess alternative forms of regulation and shall, to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt.

(9) Wherever feasible, agencies shall seek views of appropriate State, local, and tribal officials before imposing regulatory requirements that might significantly or uniquely affect those governmental entities. Each agency shall assess the effects of Federal regulations on State, local, and tribal governments, including specifically the availability of resources to carry out those mandates, and seek to minimize those burdens that uniquely or significantly affect such governmental entities, consistent with achieving regulatory objectives. In addition, as appropriate, agencies shall seek to harmonize Federal regulatory actions with related State, local, and tribal regulatory and other governmental functions.

(10) Each agency shall avoid regulations that are inconsistent, incompatible, or duplicative with its other regulations or those of other Federal agencies.

(11) Each agency shall tailor its regulations to impose the least burden on society, including individuals, businesses of differing sizes, and other entities (including small communities and governmental entities), consistent with obtaining the regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations.

(12) Each agency shall draft its regulations to be simple and easy to understand, with the goal of minimizing the potential for uncertainty and litigation arising from such uncertainty.

## **Sec. 5. Existing Regulations.**

In order to reduce the regulatory burden on the American people, their families, their communities, their State, local, and tribal governments, and their industries; to determine whether regulations promulgated

by the executive branch of the Federal Government have become unjustified or unnecessary as a result of changed circumstances; to confirm that regulations are both compatible with each other and not duplicative or inappropriately burdensome in the aggregate; to ensure that all regulations are consistent with the President's priorities and the principles set forth in this Executive order, within applicable law; and to otherwise improve the effectiveness of existing regulations:

(a) Within 90 days of the date of this Executive order, each agency shall submit to OIRA a program, consistent with its resources and regulatory priorities, under which the agency will periodically review its existing significant regulations to determine whether any such regulations should be modified or eliminated so as to make the agency's regulatory program more effective in achieving the regulatory objectives, less burdensome, or in greater alignment with the President's priorities and the principles set forth in this Executive order. Any significant regulations selected for review shall be included in the agency's annual Plan. The agency shall also identify any legislative mandates that require the agency to promulgate or continue to impose regulations that the agency believes are unnecessary or outdated by reason of changed circumstances.

(b) The Administrator of OIRA shall work with the Regulatory Working Group and other interested entities to pursue the objectives of this section. State, local, and tribal governments are specifically encouraged to assist in the identification of regulations that impose significant or unique burdens on those governmental entities and that appear to have outlived their justification or be otherwise inconsistent with the public interest.

(c) The Vice President, in consultation with the Advisors, may identify for review by the appropriate agency or agencies other existing regulations of an agency or groups of regulations of more than one agency that affect a particular group, industry, or sector of the economy, or may identify legislative mandates that may be appropriate for reconsideration by the Congress.

### Appendix III: Crosswalk Between SIC Codes and NAICS Codes

SIC	SIC Description	NAICS	NAICS Description
1521	General Contractors-Single-Family Houses	233210	Single-Family Housing Construction
1522	General Contractors-Residential Construction not elsewhere classified	233220 233320	Multifamily Housing Construction Commercial and Institutional Building Construction
1541	General Contractors-Industrial Buildings and Warehouses	233310 233320	Manufacturing and Industrial Building Construction Commercial and Institutional Building Construction
1542	General Contractors-Nonresidential Buildings, Other than Industrial Buildings and Warehouses	233320	Commercial and Institutional Building Construction
1611	Highway and Street Construction, Except Elevated Highways	234110	Highway and Street Construction
1622	Bridge, Tunnel, and Elevated Highway Construction	234120	Bridge and Tunnel Construction
1623	Water, Sewer, Pipeline, and Communications and Power Line Construction	234910 234920	Water, Sewer, and Pipeline Construction Power and Communication Transmission Line Construction
1629	Heavy Construction, NEC	234930 234990	Industrial Nonbuilding Structure Construction All Other Heavy Construction
1711	Plumbing, Heating, and Air-Conditioning	235110	Plumbing, Heating, and Air-Conditioning Contractors
1731	Electrical Work	235310	Electrical Contractors
1771	Concrete Work	235420 235710	Drywall, Plastering, Acoustical, and Insulation Contractors Concrete Contractors
1794	Excavation Work	235930	Excavation Contractors
1799	Special Trade Contractors, NEC	23592 235990	Glass and Glazing Contractors All Other Special Trade Contractors

## Appendix IV: Working Safely in Trenches

**OSHA** Occupational Safety and Health Administration **Safety Tips**

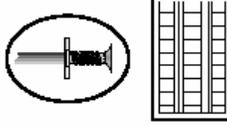
**Working safely in trenches**



Do **NOT** enter an unprotected trench!

Each employee in a trench shall be protected from a cave-in by an adequate protective system.

Some of the protective systems for trenches are:

- ♦ Sloped for stability; or 
- ♦ Cut to create stepped benched grades; or 
- ♦ Supported by a system made with posts, beams, shores or planking and hydraulic jacks; or 
- ♦ Supported by a trench box to protect workers in a trench. 

Additionally, excavated or other materials must be at least 2 feet back from the edge of a trench; and 

A safe means of egress shall be provided within 25 feet of workers in a trench. 

For more complete information:  
**OSHA** Occupational Safety and Health Administration  
 U.S. Department of Labor  
[www.osha.gov](http://www.osha.gov) (800) 321-OSHA  
 TTY (877) 669-9627

OSHA 3240-00R-05

**OSHA** Administración de Seguridad y Salud Ocupacional **Consejos de Seguridad**

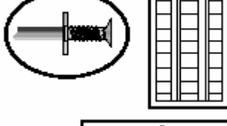
**Trabajando de manera segura en una trinchera**



¡**NO** entre en una trinchera que careza de protección!

Todo empleado en una trinchera tiene que ser protegido de un derrumbe por un sistema de protección adecuado.

Algunos de los sistemas de protección para trincheras son:

- ♦ Indinar para estabilidad, o 
- ♦ Cortar para crear pasos o niveles escalonados, o 
- ♦ Sostener por un sistema formado de postes, vigas, puntales o tablas con gatos hidráulicos, o 
- ♦ Sostener por una caja de zanja que proteja a los trabajadores en la trinchera. 

Además, los materiales excavados u otros materiales tienen que colocarse a un mínimo de 2 pies de la orilla de la trinchera y 

Un medio seguro de salida tiene que ser colocado en una trinchera a un máximo de 25 pies de los trabajadores. 

Para información más completa:  
**OSHA** Administración de Seguridad y Salud Ocupacional  
 Departamento del Trabajo de los EE.UU.  
[www.osha.gov](http://www.osha.gov) (800) 321-OSHA  
 TTY (877) 669-9627