

SAFETY INFORMATION PROFILE

Overview of Building Construction,
Including the Use of Insulating Materials

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16. Abstract (Limit: 200 words) A safety information profile for the building construction industry, including the use of insulation materials, (Standard Industrial Classifications 15 and 17) is presented. Major areas of construction within each SIC code are described. Potential safety, chemical, and physical hazards are reviewed, and existing controls are discussed. Available accident and illness statistics are presented. Industry growth trends are described. Current federal, industrial, and national consensus standards are described. Names and addresses of industries, associations, unions, and other interested parties are provided. It is concluded that this industry has a historically high rate of injury and illness, and further study is needed to determine causes and prevention. Engineering controls are considered to be the most effective prevention methods. Also recommended is the use of personal protective clothing and equipment.				
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PREFACE

The information in this profile was prepared in accordance with the provisions of NIOSH Contract #210-78-0130-0000 and is only one of twenty-seven Industry Profiles prepared under the contract. The reader should understand that this study is not intended to be an in-depth analysis, but rather, a limited overview of the industry. Each individual profile was prepared by a Profile Manager utilizing approximately 45 hours of professional time. Each profile is a reflection of the available literature, and other information obtained from industry, government, and labor contacts. Information Profiles are primarily intended for use in determining future study needs, priorities and directions. From this preliminary study may come various in-depth studies such as criteria documents, technology assessments, epidemiological studies, etc.

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EXECUTIVE SUMMARY

There is a surprising lack of technical safety-related information dealing with the building construction industry as a whole. Additional work is needed, especially in the area of gathering defined statistical data and in the definition of hazards.

Contract construction, excluding heavy construction, has shown an illness and injury rate that has held almost constant at 1.8 times that for the private sector over the past few years.

General building construction and all related sub-categories indicate an injury and illness rate higher than the overall private sector.

Roofers and sheet metal workers are maintaining an incidence rate much higher than that of any other division.

Falls from elevations and strains and overexertion account for the major classes of disabling injuries.

Ladders and scaffolds are implicated as the surfaces involved in most falls.

Falls are the most common cause of death among young construction workers.

Insulators and acoustical tile workers suffer from an excess of lung cancer.

OVERVIEW OF BUILDING CONSTRUCTION, INCLUDING THE USE OF INSULATING MATERIALS

A. Standard Industrial Classifications Included

This profile involves an industry that is as broad as most others in the U.S. today. The total construction industry consists of some 4 million workers or approximately 5% of the 80 million workers in the U.S. workforce.(1) Not only is this industry one of the largest, but it has had one of the highest injury and illness rates of all major industries.(2)

This profile is limited to building construction and special trades associated with building construction, and excludes all forms of heavy construction (highways, dams, power plants, etc.). The following is a representation of the occupational categories incorporated in this study. They are presented by standard industrial classification (SIC) code with descriptive excerpts taken from the "Standard Industrial Classifications Manual - 1972".(3)

SIC 15-- Building Construction - General Contractors and Operative Builders -

This major group includes general contractors and operative builders primarily engaged in the construction of residential, farm, industrial, commercial, or other buildings. General building contractors who combine a special trade with the contracting are included in this major group.

SIC 17-- Construction - Special Trade Contractors

SIC 171 Plumbing, Heating (Except Electric) and Air Conditioning - Special trade contractors primarily engaged in heating (except electric), plumbing, air conditioning, and similar work, or any combination of these types of work. Electrical heating contractors are classified in Industry 173.

SIC 172 Painting, Paper Hanging, and Decorating - Special trade contractors primarily engaged in painting, paper hanging and decorating. This industry does not include stores furnishing interior decorator services.

SIC 173 Electrical Work - Special trade contractors primarily engaged in electrical work at the site. This category does not include construction of transmission lines nor electrical work in a repair shop.

SIC 174 Masonry, Stonework, Tile Setting and Plastering - Special trade contractors primarily engaged in masonry work and stonework; also in applying plaster, and setting and installing tile, marble or mosaic. Plastering includes the installation of lathing and other appurtenances to receive plaster, or in drywall, acoustical and building insulation work. Tile setting includes mixing marble particles and cement to make terrazzo at the site of construction, but does not include establishments manufacturing precast terrazzo steps, benches, and other terrazzo articles.

- SIC 175 Carpentering and Flooring - Special trade contractors primarily engaged in carpentry work and in laying, scraping and finishing other hardwood and parquet flooring. Carpentry work done by general contractors engaged in building construction and carpentry work done in repair shops are not included. This industry also includes the installation of asphalt tile, linoleum and resilient flooring.
- SIC 176 Roofing and Sheet Metal Work - Special trade contractors primarily engaged in the installation of roofing and siding. This industry does not include contractors engaged in sheet metal work in connection with plumbing, heating or air conditioning.
- SIC 177 Concrete Work - Special trade contractors primarily engaged in concrete work. This industry includes the construction of residential driveways and walks of all materials. Concrete work incidental to the construction of foundations and concrete work included in an excavation contract is classified in Industry 179. Construction or paving of streets and highways is classified under heavy construction and is therefore excluded from building construction.
- SIC 179 Miscellaneous Special Trade Contractors - Special trade contractors primarily engaged in the erection of structural steel, glass and glazing work and excavation and foundation work (including digging and loading) and others.

Table 1 shows the size of each of the different industrial classifications by number of establishments and employees as reported by the Department of Commerce.(4) Additionally, the distribution of the establishments and employees are shown by employment size class.

UNITED STATES - ESTABLISHMENTS, EMPLOYEES, AND PAYROLL BY INDUSTRY BY EMPLOYMENT - SIZE CLASS: 1976

TABLE 1

(Excludes government employees, railroad employees, self-employed persons, etc. - see "General Explanation" for definitions and statement on reliability of data. Size class 1 to 4 includes establishments having payroll but no employees during mid-March pay period. "D" denotes figures withheld to avoid disclosure of operations of individual establishments, the other alphabets indicate employment-size class - see footnote.)

SIC code	Industry, establishments, employees, and payroll	Employment-size class									
		Total	1 to 4	5 to 9	10 to 19	20 to 49	50 to 99	100 to 249	250 to 499	500 to 999	1000 or more
15	General Contractors & Operative Builders										
	Number of Establishments	116,946	79,954	19,285	10,086	5,401	1,389	630	130	54	17
	Number of Employees	920,747	142,065	141,036	145,790	168,516	97,749	95,797	44,506	40,623	44,665
151	General Building Contractors										
	Number of Establishments	62,699	36,231	11,805	7,788	4,842	1,281	569	118	49	16
	Number of Employees	713,958	73,443	84,094	110,727	150,252	89,687	86,384	39,961	(D)	(D)
153	Operative Builders										
	Number of Establishments	10,764	7,216	1,909	994	463	104	60	12	5	1
	Number of Employees	83,749	14,504	13,903	14,108	14,029	7,483	9,299	4,545	(D)	(D)
17	Special Trade Contractors										
	Number of Establishments	249,931	167,771	42,916	23,197	12,098	2,742	978	163	49	17
	Number of Employees	1,777,321	298,498	310,242	332,586	375,372	192,490	147,332	58,856	35,002	26,943

A: 0-19; B: 20-99; C: 100-249; D: 250-499; E: 500-999; F: 1,000-2,499; G: 2,500-4,999; H: 5,000-9,999; I: 10,000-24,999; J: 25,000-49,999; K: 50,000-99,999; L: 100,000 or more.

UNITED STATES - ESTABLISHMENTS, EMPLOYEES, AND PAYROLL BY INDUSTRY BY EMPLOYMENT - SIZE CLASS: 1976
TABLE 1 (CONT.)

(Excludes government employees, railroad employees, self-employed persons, etc. - see "General Explanation" for definitions and statement on reliability of data. Size class 1 to 4 includes establishments having payroll but no employees during mid-March pay period. "D" denotes figures withheld to avoid disclosure of operations of individual establishments, the other alphabets indicate employment-size class - see footnote.)

SIC code	Industry, establishments, employees, and payroll	Employment-size class									
		Total	1 to 4	5 to 9	10 to 19	20 to 49	50 to 99	100 to 249	250 to 499	500 to 999	1000 or more
171	Plumbing, Heating, Air Conditioning Number of Establishments Number of Employees	51,406 399,718	31,970 60,743	10,153 72,942	5,666 79,767	2,767 85,310	567 39,460	233 35,218	34 12,271	11 (D)	5 (D)
172	Painting, Paperhanging, and Decorating Number of Establishments Number of Employees	23,745 106,072	18,601 30,069	3,081 22,364	1,300 18,919	583 18,373	140 9,427	34 4,646	6 2,274	- -	- -
173	Electrical Work Number of Establishments Number of Employees	32,818 321,936	19,970 37,572	6,182 44,365	3,782 53,702	2,049 62,148	481 33,872	256 39,214	64 21,895	28 19,847	6 9,321
174	Masonry, Stonework, Plastering Number of Establishments Number of Employees	38,231 271,943	25,753 44,676	6,396 46,506	3,434 50,205	1,992 63,463	504 36,265	130 20,070	18 6,062	3 (D)	1 (D)

A: 0-19; B: 20-99; C: 100-249; E: 250-499; F: 500-999; G: 1,000-2,499; H: 2,500-4,999; I: 5,000-9,999; J: 10,000-24,999; K: 25,000-49,999; L: 50,000-99,999; M: 100,000 or more.

UNITED STATES - ESTABLISHMENTS, EMPLOYEES, AND PAYROLL BY INDUSTRY BY EMPLOYMENT - SIZE CLASS: 1976
TABLE 1 (CONT.)

(Excludes government employees, railroad employees, self-employed persons, etc. - see "General Explanation" for definitions and statement on reliability of data. Size class 1 to 4 includes establishments having payroll but no employees during mid-March pay period. "D" denotes figures withheld to avoid disclosure of operations of individual establishments, the other alphabets indicate employment-size class - see footnote.)

SIC code	Industry, establishments, employees, and payroll	Total	Employment-size class								
			1 to 4	5 to 9	10 to 19	20 to 49	50 to 99	100 to 249	250 to 499	500 to 999	1000 or more
175	Carpentry and Flooring Number of Establishments Number of Employees	29,811 128,133	23,424 42,119	4,141 29,712	1,500 21,425	593 18,917	116 8,451	31 4,197	5 (D)	- -	1 (D)
176	Roofing and Sheet Metal Work Number of Establishments Number of Employees	17,006 134,683	10,494 18,543	3,032 22,152	1,969 28,719	1,167 35,563	266 17,762	74 9,924	3 (D)	1 (D)	- -
177	Concrete Work Number of Establishments Number of Employees	14,721 89,061	10,051 16,240	2,576 18,673	1,331 19,412	614 19,211	115 8,519	27 4,313	7 2,693	- -	- -
179	Miscellaneous Special Trades Number of Establishments Number of Employees	35,760 298,368	22,566 40,578	6,411 46,685	3,835 54,886	2,194 67,907	527 36,826	192 29,536	25 10,061	6 4,441	4 7,548

A: 0-19; B: 20-99; C: 100-249; E: 250-499; F: 500-999; G: 1,000-2,499; H: 2,500-4,999; I: 5,000-9,999; J: 10,000-24,999; K: 25,000-49,999; L: 50,000-99,999; M: 100,000 or more.

A: 0-19; B: 20-99; C: 100-249; E: 250-499; F: 500-999; G: 1,000-2,499; H: 2,500-4,999; I: 5,000-9,999; J: 10,000-24,999; K: 25,000-49,999; L: 50,000-99,999; M: 100,000 or more.

B. Process Descriptions

A general building contractor may experience a variety of processes depending on the kind of structure and the firm's special-trade construction activities. Normally, general contractors subcontract to several of the following special-trade contractors: roofers, sheet-metal workers, carpenters, excavation specialists, plumbing contractors, mechanical contractors (heating and air conditioning), electrical contractors, concrete workers, painters, masonry contractors, and others.

Due to the extreme range of processes involved in the building construction industry it would be unrealistic to attempt to describe each. The descriptive paragraphs in Section A should provide a general scheme of activities for the major areas of building construction.

C. Potential Hazards

The types of hazards that building construction workers and associated special trade workers may be exposed to are numerous and wide ranging. The construction industry is unique in that the workers' environment is uncontrolled and constantly changing. There is not always the potential for instituting engineering controls. Often the safety and health of the worker relies on safe practices and inspection of machinery and materials used. The following paragraphs present the various hazards that might be encountered.

(1) Safety Hazards

(a) Falls

Falls include persons falling from a height to a lower surface (such as from a scaffold, ladder, or roof) and those falling on the same level. The falls from heights can potentially involve any of the construction subgroups, but especially masons, stoneworkers, plasterers, carpenters, roofers, painters, and structural steel workers. Falls on the same level can include slipping or tripping on the walking surface or on an object and landing on the same surface. Falls on the same surface may involve members of any of the construction subgroups and may be the result of insufficient marking of a hazard, poor housekeeping, or a slipper surface. Falls from heights may include the same causes, but also may result from falling through an opening or off the edge of an elevated surface, or from a collapse or shift of a ladder or scaffold.

(b) Materials Handling Injuries

Injuring occurring while handling materials may also happen to any construction worker, such as during the loading, moving, or unloading of bricks, concrete blocks, roofing materials, lumber, etc. These injuries may be in the category of overexertion or strain, cuts, bruises, and minor crushes.

(c) Hand Tool Injuries

Injuries may occur from use of non-powered hand tools (handsaw, hammer, crowbar, etc.) or powered hand tools (skillsaws, power drills, power grinders, etc.). Injuries sustained from non-powered hand tools are commonly minor cuts, bruises, and crushes, while those from powered hand tools include, eye injury, minor cuts, amputations, and electrical shock. Hand tool injuries may be expected to impact such groups as general contractors, carpenters, floorers, and roofers and sheet metal workers.

(d) Injuries From Machinery and Equipment

Items in this category may be stationary or mobile machinery not of the hand-held variety. These items include table saws, jointers, concrete or mortar mixers, tractors, and others. Injuries may include cuts, amputations, crushes or strains. Many of the injuries result from being caught in the mechanical system or from having the mobile equipment roll over.

(e) Injuries From Falling Objects

In the construction industry it is common to have personnel working on various levels of elevation where one may be injured by items dropped from one level to another. The extent of the injury depends on the shape and mass of the object and the distance fallen. Injuries of this type may occur to members of any construction subgroup.

(f) Contact Burns

Burns to the skin from contact with an extremely hot substance or surface would only be expected to impact certain construction subgroups. Roofers often experience accidents where they are burned with the hot tar they are working with. Burns involving roofing tar may occur from falling while carrying a bucket, sloshing tar out of the bucket, creating a splash from the kettle while adding tar to the kettle, leaks in a liquid transport system, or from blown tar if the kettle is allowed to overheat. Other burns may occur as a result of contacting a freshly welded or soldered metal area or the outside of the roofing tar kettle. Plumbers and other pipe fitters are subject to burns from molten lead used in some pipe joints.

(g) Injuries From Cave-Ins

Excavation and trenching employees are highly subject to cave-ins while working in areas below ground level. Cave-ins often result in suffocation and death of the workers. A 1977 engineering study showed that the major factors influencing trench failure are the presence of construction equipment near the edge and adverse climatic conditions.(5) Cave-ins

may happen in any type of soil and in any part of the country. Other injuries sustained during cave-ins may include being crushed or hit by heavy chunks of earth, falling rocks or other materials.

(h) Contact With Electrical Lines

The extent of the injury would depend on the line voltage and whether the individual was grounded; death would not be uncommon. Construction groups probably most likely to come in contact with electrical lines are electrical contracting personnel, roofers, trenchers and excavators, and heavy equipment operators.

(i) Fires and Explosions

The storage and use of various flammable and combustible substances on a construction site present a constant hazard. Such sources are gasoline, liquid propane, solvents and thinners, paints, glues, fillers, gas cylinders, and others are often found on a construction site in addition to multiple ignition sources.

(2) Health Hazards

(a) Chemical Hazards

Inhalation of toxic dusts, fumes, gases, and vapors at construction sites could be an extensive problem if the exposure took place in an enclosed or confined area. The hazards include damage to various organs and systems of the body and can range up to the development of cancer and other fatal

diseases. Some of the general inhalation hazards are metal fumes from welding and soldering operations; silica exposure from earth moving and sand handling operations; asbestos from insulation; formaldehyde from insulation operations; solvents in paints, varnishes, and glues; Portland cement in concrete and mortar mixing; nuisance wood dust from sawing and woodworking; lead from leaded paints; plumbers molten lead pots and soldering; chromates from paints; carbon monoxide from internal combustion engines; phosgene from fluorocarbons (refrigerants, etc.). Suspect cancer-causing agents that could possibly exist on a construction site are acetylene, butane, nickel, coal-tar pitch, iron oxide, benzene, and asbestos.(6)

Additionally, contact with the skin or eyes of acids, solvents, or other irritants are important hazards. Occupational dermatitis and skin burns are a very common problem in the construction industry. Contact with noxious agents represents the largest class of disabilities to construction workers.(7) Agents which may cause dermatitis or skin conditions are Portland cement, plastics, glass dust, phenolic wood preservatives, solvents and thinners, calcium hydroxide (lime), epoxy resins, and petroleum fractions. (7, 8)

(b) Physical Hazards

Radiation is a physical hazard that may be of significant interest. The two categories are ionizing and non-ionizing radiation. Ionizing radiation should only be of concern if industrial x-ray units are being used on-site.

Non-ionizing radiation would primarily concern ultraviolet (UV) and infrared (IR) radiations. Common sources of UV radiation are welding and cutting operations and sunlight. IR radiation is generated by any mass heated above absolute zero degrees. Welding, soldering, furnaces, and etc. may produce hazardous levels of IR radiation. Lasers may also be found on construction sites, which can create a hazard to the eyes of workers if they are caught within the beam.

Noise can be damaging to the hearing of workers if they are exposed to high intensities for long durations. Sources of hazardous noise may be power machinery (table saws, grinders, etc.), hand powered tools, or mechanical equipment (tractors, trenchers, or others).

D. Existing Hazard Controls

Hazard controls may be in the form of engineered controls, administrative controls, or personal protective equipment. Engineered controls are considered to be the most protective, since they control the source of the potential illness or injury.

Controls available to prevent falls from elevations are the use of safety belts and safety nets, the installation of stairway and working surface guardrails and toe boards, and the quality control of ladders and scaffolds used on the site. Falls may be effectively limited by marking floor openings and tripping hazards and requiring scaffold permits.

Materials handling injuries could be limited by encouraging the use of hoists, lifts, and etc., and by training employees in proper lifting and moving techniques. The prevention of falling objects from overhead conveyors is accomplished by installing guards around the conveyor. Other falling object injuries are guarded against by requiring personnel on the site to wear hard hats.

Falls from the same level may be reduced by assuring that proper illumination is available, that good housekeeping is a part of everyone's daily activities, and that sand and salt are spread on icy surfaces. Additionally, tripping hazards can be covered, smoothed out, or marked.

Guards and deadman controls may be used extensively to limit injuries from hand powered tools. Positive connections of air lines with pneumatic tools can prevent accidents due to a loose compressed air line. Ground fault interrupters are a requirement on all 120 volt temporary construction power lines and could eliminate serious injury to personnel operating hand power tools if a short occurred.

Controls on machinery and equipment include guards on saws, grinding wheels and belt sanders, and the use of rollover protective devices for mobile heavy equipment. The use of feeder devices should also be encouraged on power machines where a stock product is normally fed by hand.

Injuries due to contact with electrical lines can be reduced by restricting the use of conductable metal ladders and shutting off the power in the area of the work. Temporary construction power lines installed with ground fault interrupters should eliminate serious injury if human contact is made.

Injuries due to the use of non-powered hand tools are virtually dependent on the skill of the operator, quality of the tools, and the wear of protective clothing by the operator. Personal protective clothing that may reduce injuries to these workers are heavy boots and shoes, gloves, eye protection, and head gear.

Burns to the eyes and skin, due to working with hot substances, can be controlled by personnel wearing protective equipment on the arms, hands, and face. Caution should be taken when transporting vessels of hot substances, especially up and down ladders. The same precautions should be taken when using chemicals capable of causing burns, however, if the chemical is an acid, then acid resistant equipment should be worn.

Cave-ins in trenching and excavating operations are most effectively limited by using proper shoring and sloping techniques. Shoring should be installed from the top down and removed from the bottom up.(9)

Explosion and fires can be controlled by proper storage of flammable substances in posted areas where smoking is forbidden, use of safety containers to carry highly flammable substances such as fuel, and use of chains for storing compressed gas cylinders upright.

The preferred method of controlling respiratory exposure to toxic dusts, fumes, gases, and vapors is the use of engineered ventilation systems, but in the field the feasibility of engineered controls is unlikely. The next best control is to substitute a less toxic substance for the one of concern, if possible, or to reduce the duration of the exposure. The control method of last resort is the use of personal protective equipment (respirators). Control of skin conditions due to contact with irritants can be accomplished in some cases by the use of protective gloves and clothing and by the use of protective barrier creams.

Protection from physical health hazards is often accomplished by isolation of the source or limitation of the duration of exposure. In control of ionizing radiation or X-ray exposures on a construction site, the beam is collimated as much as possible, the area of the operation is controlled, and the operators are monitored. IR radiation and UV radiation exposures to operators are controlled by wearing protective clothing and eye protection, such as a welders hood. Other workers in the area of UV and IR sources should be protected by the use of shields around the operator and the source. Personnel working in laser operations should wear laser goggles and the laser area should be posted. Control of noise exposure is accomplished by reducing the noise level generated by using engineered controls on the source, isolating the source from other workers, limiting the duration of the exposure, and by using ear plugs or muffs to effectively reduce the noise level reaching the inner ear.

E. Accident and Illness Statistics

As stated earlier, contract construction has had one of the highest injury and illness rates of all major industries over the years. In a nationwide study of construction injuries and illnesses from 1972 to 1975 the Bureau of Labor Statistics (BLS) reports that illness and injury incidence declined consistently over the period by almost 16%.⁽²⁾ At the same time this decrease in incidence occurred in the construction industry, a corresponding decrease in all other private industry also occurred, causing the construction to private industry ratio to remain at about 1.8 to 1. The major decline was in the number of nonfatal injuries and illnesses involving no lost workdays. Additionally, the number of fatalities. The average annual incidence rate for total recorded occupational injuries and illnesses during the four year period was 18.3, compared to the private sector with 9.9.

According to 1975 and 1976 BLS data, the illness and injury incidence rates for all of the subject SIC's were higher than the average for the private sector, as shown in Table 2.⁽¹⁰⁾ The subject SIC industries ranked as follows in decreasing order with regard to illness and injury incidence rates: roofing and sheet metal work (SIC 176); then miscellaneous special trade contractors (structural steel erection - SIC 1791; glass and glazing - SIC 1793; excavating and foundation work - SIC 1794, and etc.); plumbing, heating, and air conditioning (SIC - 171); general building contractors (SIC 15); concrete work (SIC - 177); masonry, stonework, tile setting, and plastering (SIC - 174); electrical work (SIC - 173); carpentering and flooring (SIC - 175); and painting, papering, and decorating in order of decreasing hazard.

BY INDUSTRY, UNITED STATES, 1975 AND 1976

Industry 1/	SIC code 2/	1976 annual average employment (in thousands) 3/	Incidence rates per 100 full-time workers 4/							
			Total cases 5/		Lost workday cases		Nonfatal cases without lost workdays		Lost workdays	
			1975	1976	1975	1976	1975	1976	1975	1976
Private Sector		64,689.8	9.1	9.2	3.3	3.5	5.8	5.7	56.2	60.5
General Building Contrs.	15	1003.6	15.5	14.5	5.3	5.2	10.2	9.2	91.7	100.0
Special Trade Contractors	17	1793.4	15.5	15.3	5.4	5.6	10.1	9.7	98.7	105.8
Plumbing, Heating, Air Conditioning	171	437.8	16.1	16.3	4.7	5.0	11.4	11.3	71.4	89.7
Painting, Paperhanging, and Decorating	172	118.7	8.7	10.1	3.6	4.6	5.0	5.5	79.9	113.9
Electrical Work	173	317.5	14.5	13.6	4.3	4.3	10.2	9.3	89.9	76.6
Masonry, Stonework, and Plastering	174	274.3	15.1	14.1	5.8	5.6	9.2	8.5	100.7	94.6
Carpentry and Flooring	175	106.0	13.5	12.7	6.1	5.5	7.4	7.2	95.4	97.8
Roofing and Sheetmetal	176	125.6	21.5	21.4	9.5	9.6	12.0	11.8	195.4	205.1
Concrete Work	177	97.2	15.2	14.2	5.5	6.5	9.7	7.7	102.2	117.6
Miscellaneous Special Trade Contractors	179	299.3	17.0	17.3	6.2	6.3	10.8	10.9	117.2	127.8

1/ Totals for divisions and 2- and 3-digit SIC codes include data for industries not shown separately.

2/ Standard Industrial Classification Manual SIC, 1972 Edition.

3/ Annual average employment for nonagricultural industries is based primarily on employment covered by State unemployment insurance program. For those industries in which the unemployment insurance program does not have complete coverage and there is no change in the content of the industry classification between the 1967 and 1972 SIC manuals, estimates from the U.S. Department of Labor's Employment and Earnings Survey, which are based on the 1967 manual, are used. Annual average employment for the agriculture, forestry and fishing division is a composite of data from the unemployment insurance program, and estimates of hired-farm workers engaged in agricultural production (SIC 01 and 02) provided by the Statistical Reporting Service, U.S. Department of Agriculture. The agricultural production estimates are adjusted to exclude employment on farms with fewer than 11 employees.

4/ The incidence rates represent the number of injuries and illnesses or lost workdays per 100 full-time workers and were calculated as: $(N/EH) \times 200,000$ where

N = number of injuries and illnesses or lost workdays

EH = total hours worked by all employees during calendar year

200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year).

5/ Includes fatalities. Because of rounding, the difference between the total and the sum of the rates for lost workday cases and nonfatal cases without lost workdays does not reflect the fatality rate.

6/ Excludes farms with fewer than 11 employees.

7/ Data conforming to the OSHA definitions for coal and lignite mining (SIC 11 and 12) and metal and non-metal mining (SIC 10 and 14), and for railroad transportation (SIC 40) were provided by the Mining Enforcement and Safety Administration, U.S. Department of the Interior, and by the Federal Railroad Administration, U. S. Department of Transportation.

NOTE: Dashes indicate no data reported, or data that do not meet publication guidelines.

n.e.c. = not elsewhere classified.

SOURCE: Bureau of Labor Statistics, U.S. Department of Labor.

Chartbook on Occupational Injuries and Illnesses in 1976. U.S. Department of Labor, Bureau of Labor Statistics, 1978, Report 535, Table 1.

According to 1975 California work injury and illness data, all construction categories listed working surfaces as the major agency causing disabling injury, except for concrete workers and carpentry and flooring workers, which showed hand tools as the major cause.(11) Strains and overexertion were the major type of disabling injury for structural steel erection, plumbing, heating, air conditioning, electrical, masonry, carpentry and flooring, concrete, and drywall. Falls and slips were most frequently named as the accident type responsible for disabling injuries for painting, roofing, and insulation and acoustical workers; while struck by or against accidents were the most frequent type for general building contractors and operative builders, glazing workers, and other special trades.

A Wisconsin study of the general contracting industry (SIC 15) during the period of 1971 through 1974 showed a distribution of lost workday injuries by accident type as follows:(12)

<u>Injury Type</u>	<u>% Of All Cases</u>
Materials handling injuries	16.5%
Falls from elevations	14.6%
Falls on same level	11.7%
Injuries from powered hand tools	5.5%
Injuries from non-powered hand tools	5.3%
Injuries from machine saws	2.5%
Vehicle related injuries	2.4%

The most frequent material handling injury was a sprain or strain and most often hurt were laborers (44%) and then carpenters (31%). Falls from elevations most often involved scaffolds and then ladders. The highest number of scaffold accidents occurred due to improper construction, installation, or maintenance of the scaffold. The highest number of ladder accidents involved the absence or failure of non-slip devices at the base of the ladder. The most often hurt workers in falls were laborers (40%) and then carpenters (39%). Falls on the same level were mostly due to slippery or littered surfaces, most often injuring laborers (43%) and carpenters (34%). The most frequently involved hand power tools in decreasing significance were powered hand saws and skillsaws, air hammers, electric drills, power nailers, and abrasive stone wheel grinders, causing a high frequency of cuts on the hands. The most frequently involved non-powered hand tools by decreasing frequency were hammers, sledges, shovels, knives, and crowbars, causing cuts and broken bones in the hands to be the most common injury. Machine saw accidents resulted in cuts and amputations of the hands by the blade most frequently by table saws, then stationary saws, chain saws, and radial arm saws.(12)

Roofing and sheet metal contractors represent one of the five target industries tagged by OSHA in 1972 for special emphasis. A special study by California in 1970 of injuries to roofers and sheetmetal workers indicated that the largest single source of injuries to roofers (about 29%) were slips and falls.(13) The bulk of these were from elevated surfaces. The same study indicated that 23% of injuries to roofers were caused by hot tar and 19% due to strain and overexertion. About 30% of the injuries to workers occurred while working with dry roofing materials and 20% while working with hot tar.

In an evaluation of job hazards of the roofing industry NIOSH drew conclusions from the California study, stating that burns are the accident type with highest frequency.(14) They went on further to state that slips and falls (from a different level or on the same level) are two of the most important accident types in terms of frequency and severity in the roofing industry.

Another California study of trenching and excavation operations investigated 80 fatalities.(9) Nearly 40% of the cave-in fatalities occurred at sites where no shoring and sloping had been used; 20% occurred because of improper installation or removal of shoring; 14% occurred because of inadequate shoring or sloping; and 11% occurred while working beyond the shoring.

A large number of all construction work injuries are due to falls from elevations. A 1975 California study, looking at falls from elevations in the construction industry, showed a marked decrease in the incidence during 1971 through 1974. Even with this decrease, the 1975 figure for the construction industry was three times higher than the all-industry average.(15) Ladders were found to account for the majority of the falls (31%), scaffolds for 19%, and roof top falls for 14%. Sixty percent of the disabling injuries from ladders involved special trades employees. Carpenters sustained the highest number of injuries for a single employee class (24% of the ladder-related injuries). General building contractors and roofers each accounted for about 40% of the falls from roofs. General building contractors were involved in 31% of the falls from all sources resulting in injury. During 1972-1976 falls were the cause of 23% of

construction deaths. Approximately 29% of fatal falls from roof tops occurred when working around unguarded openings. Another California study indicated that falls were responsible for over 50% of all scaffold-related injuries.(16) Forty percent of these falls indicated that unsafe scaffold conditions precipitated the fall. Two-thirds of all scaffold injuries involved special trade contractors (half of which were masonry, stone and plaster workers). Carpenters sustained 20% of the injuries, heading the list as the single occupation with the most scaffold-related injuries.

A NIOSH mortality study of the AFL-CIO United Brotherhood of Carpenters and Joiners of America found that the major source of the elevated fatality level experienced among young construction workers was falls.(17) The study also showed an excess level of lung cancer for acoustical tile applicators and insulators, probably from past asbestos exposures.

F. Exposure Levels

Levels of exposure to chemical and physical hazards are extremely variable, because of several factors. Airborne levels of dusts, gases, and vapors depend upon the generation rate, the environmental conditions, and the degree of dispersion or dilution afforded by the amount of fresh air available. The lack of a controlled environment makes it impossible to predict what exposure levels may be encountered by workers. Physical hazards will also vary. Noise hazard levels depend upon the duration of the exposures and in some cases the type of material being worked on. Thermal stress is dependent on the ambient conditions and the acclimatization of the workers.

An exhaustive search was made for data representing exposure levels to the health hazards of the construction industry, without success. Some foreign literature is available which provides data on exposure levels, but lack of English interpretation made it of little use.

G. Related Studies

There were no other on-going related studies identified during the course of this profile preparation.

H. Industry Trends

In 1978 new construction work was up by 10% in dollar value (excluding home building), and an 8% growth is being forecast for 1979.(18) The contracting volume is within 5% of the all time peak set in 1973. A decrease in single unit housing construction is expected this year with a corresponding increase in commercial and industrial building. Office building has currently been the hottest planning prediction for the near future, with plans running 72% ahead of the 1977 rate. Store construction and educational building construction are also predicted to experience decreases. Multi-unit residential construction is also expected to pick up, in fact, the design activity for apartments is up 45%.

OSHA inspections in the construction industry accounted for one-third of all OSHA inspections in 1973 and 1974, and accounted for 30% of the inspections in 1975.(2) The decreasing illness and injury rate mentioned earlier indicates that the strong emphasis in this industry may be having a positive effect.

I. Existing Standards

(1) OSHA Standards

In the past, the construction industry has been overwhelmed by conflicts over which OSHA regulations were applicable to their operations. The construction industry is subject to both 29 CFR 1910, "General Industry Standards", and 29 CFR 1926, "Construction Standards and Interpretations". The construction employer has been obligated to comply with general industry standards (from Part 1910), when specific construction standards (from Part 1926) were not available for an area of concern. This meant that construction employers had to constantly keep up with two sets of regulations and many conflicts arose between the industry and OSHA.

A move is currently underway by OSHA to verticalize the 29 CFR 1926 by removing all portions of 29 CFR 1910 which pertain to the construction industry and place them in 29 CFR 1926. As the first phase of the "verticalization" process, a program directive was established, including a list of applicable Part 1910 standards, and was endorsed by the Advisory Committee on Construction Safety and Health.(19) The program directive (OSHA Program Directive #200-88) basically stated that OSHA personnel would continue to enforce Part 1926 standards, and that they would only enforce those Part 1910 standards that were endorsed as applicable to the industry by the Advisory Committee. It further stated that the only way a citation can be made for a violation of a Part 1910 standard, not contained on the endorsed list, is to seek the approval of the Regional and National Offices. A copy

of the newly integrated list of applicable Part 1910 and 1926 standards is presented in Appendix A.(19) All of the subparts potentially apply to the building construction industry with the possible exception of subparts S, T, and U.

In a previously mentioned study in Wisconsin over the period of 1971-74 it was found that the particular OSHA standards in Table 3 were the most applicable to problem areas in the general contracting classification SIC 15.(12) In fact, those standards listed were relative to a total of 39.6% of all the cases in the industry.

In a conversation with members of the OSHA Construction Standards Division it was learned that subparts M (Floors and Wall Openings), L (Ladders and Scaffolds), and S (Tunnels) will be reviewed and revised during FY 1979.(20)

(2) State Standards

In some instances states have their own occupational safety and health regulations. In all cases they must be as stringent or more stringent than those of OSHA.

(3) Association Guidelines

Some trade associations have established safety and health guidelines that are consistent with OSHA standards. In areas of specific concern to the industry the guidelines may expand more on control techniques, and association members may follow these guidelines in addition to those of OSHA or the state. One typical set of guidelines for the

TABLE 3-

GENERAL CONTRACTING
STANDARD INDUSTRIAL CLASSIFICATION 1500

Table of Existing O.S.H.A. Standards
Relating to Safety Problem Areas

<u>Safety Problem Area</u>	<u>Existing Standards</u>	<u>Relate to % of all Cases</u>
1. Materials Handling Operations (e.g., lifting building materials by hand	none	
2. Falls from Elevation	1926.451 Scaffolding 1926.450 Ladders 1926.500 Guardrails 1926.1000 <u>through</u> .1003 Rollover Protection for Mobile Equipment 1926.104 Safety Belts 1926.105 Safety Nets 1926.501 Stairways	14.6%
3. Falls on the Same Level	1926.25 Housekeeping	11.7%
4. Powered-Hand Tool Injuries	1926.304 Woodworking Tools 1926.302 Powered Hand Tools 1926.303 Abrasive Wheels	5.5%
5. Non-Powered Hand-Tool Injuries	1926.301 Hand Tools	5.3%
6. Machine-Saw Injuries	1910.213 Woodworking Machinery	2.5%
7. Highway Accidents	none	

The O.S.H.A. standards listed above relate to a total of 39.6% of all the cases for the industry, 1971-74.

construction industry is the Associated General Contractors of America -- Manual of Accident Prevention in Construction.

(4) National Consensus Standards

(a) American National Standards Institute (ANSI)

The American National Standards Institute is the clearinghouse and coordinating body for voluntary standards activity on the national level.(21)

Some 250 ANSI standards have been adopted or referenced in the OSHA standards. Others may simply be useful as standard procedures to follow in daily operations. The A-10 series of the ANSI standards deal specifically with the construction industry, while other general standards that apply may be found in other series. A complete list of the ANSI standards that may be applicable to the construction industry are provided in Appendix B.(21)

(b) National Fire Prevention Association (NFPA)

The NFPA publishes both fire codes and electric codes for buildings and operations. Most of those that are applicable to the construction industry employees' safety and health are referenced directly in the OSHA standards.

(c) Consensus Standards Referenced by the OSHA standards

Some of the national consensus standards are referenced only by the OSHA standards and it is up to the employer to find out the details. Some of the referenced standards that an employer in the construction industry should have on hand have been listed below:(1)

<u>Subject Area</u>	<u>Referenced Standard</u>
Inspect and Maintain Portable Fire Extinguishers	NFPA N 10A-1970
Electrical Installations	NFPA 70 - 1971
	ANSI C 1 - 1971
Traffic Control Signals, Signs and Barricades	ANSI D 6.1 - 1971
Accident Prevention Tags	ANSI Z 35.1 & .2 - 1968
Crane and Hoist Signals	ANSI
Cranes and Derricks	ANSI B 30.2.0 - 1967
	ANSI 30.6 - 1969
Material Hoists	ANSI A 10.5 - 1969
Permanent Elevators	ANSI A 17
Concrete Construction	ANSI A 10.9 - 1970
Machinery Guards	ANSI B 15.1 - 1958
Woodworking Tools	ANSI O 1 - 1961
Ladders	ANSI A 14.2 & .3 - 1956
Gas Welding and Cutting	ANSI Z 49.1 - 1967
Arc Welding and Cutting	National Elec. Code, Art 63
	NFPA 70 - 1971
	ANSI C 1 - 1971
Powder Actuated Tools	ANSI A 10.3 - 1970
Storage of Explosives	I.R.S. regulations 26 - CFR - 181 Commerce in Explosives

(d) Foreign Standards

During the course of searching through the available literature and talking with persons in the building construction field, no foreign safety and health standards were overturned.

J. Names of Industries, Associations, Unions, or Other Interested Parties

Associated General Contractors of America (AGC)

1957 E St., N.W.

Washington, D.C. 20006

(202)393-2040

Associated Builders and Contractors, Inc.

Room 409, 444 North Capitol St., N.W.

Washington, D.C. 20001

(202)347-8681

Laborer's International Union of North America

905 16th St., N.W.

Washington, D.C. 20006

(202)737-8320

National Association of Home Builder's of the U.S.

15th and M Streets, N.W.

Washington, D.C. 20005

(202) 452-0200

American Federation of Labor and Congress of Industrial Organizations (AFL-CIO)

815 16th St., N.W.

Washington, D.C. 20006

(202)637-5000

K. Names and Addresses of Companies

Several attempts were made through different associations to identify large and small companies within the field. The associations did not have the information available in the form necessary. In other sources, such as the Thomas Registry, the major business area was not broken down to the point where one could delineate between residential constructors, commercial constructors, or heavy constructors.

In most cases, building construction firms should be easy to identify for a specific area by consulting the telephone book yellow pages. The time limitation of this project did not permit such a search.

L. Summary Analysis of Data

Contract construction has one of the highest injury and illness rates, historically. The rate has been almost twice as high as that for the private industry sector.

The incidence rate has been decreasing over the past several years with a corresponding decrease in employment.

The individual building construction subgroups with the highest incidence rates are in decreasing order: roofing and sheet metal workers, miscellaneous trade contractors, excavation and foundation workers, plumbing and heating and air conditioning worker, general building contractors, concrete workers, masonry and related workers, electrical workers, carpentry and flooring workers, and painting and related workers.

It appears that the greatest number of disabling injuries within the industry are from falls from an elevation and strains and overexertion. Ladders and scaffolds are implicated as the major sources of the injuries.

Falls are the major cause of fatality among young construction workers and lung cancer is excessive for acoustical tile and insulation workers.

REFERENCES AND SOURCES

- (1) Bush, V.G., (1975), Safety in The Construction Industry: OSHA Reston Press, Reston, VA., 1975, p. 8, 10.
- (2) Wang, C.L. and Hilaski, H.J. (1972-1975), "The Safety and Health Record in the Construction Industry", Monthly Labor Review, U.S. D.O.L., BLS, March 1978, pp. 3-9.
- (3) --- (1972), Standard Industrial Classification Manual, Office of Management and Budget, Washington, D.C., 1972, pp. 47, 48, 52-56.
- (4) --- (1976), County Business Patterns, U.S. Department of Commerce, U.S. Bureau of Census, Washington, D.C., 1976, pp. 8-10.
- (5) Thompson, L.J. and Tanenbaum, R.J. (1976), "Survey of Construction Related Trench Cave-Ins", American Society Civil Engineers Journal of the Construction Division, 103(3), September 1977, pp. 501-512.
- (6) --- (1978), "Cancer Hazard Reg. Coming Soon", Construction Contracting, Vol. 60, No. 10, October 1978, p. 93.
- (7) deStwolinski (1969), "Occupational Health in the Construction Industry", Technical Report No. 105, Department of Civil Engineering, Stanford University, Stanford, California, May 1969, p. 173.

- (8) Calnan, C. D. (1972), "Cutaneous Hazards for Construction Workers", Chemistry and Industry, Vol. 21, 1973, pp. 1019-1022.
- (9) --- (1974), "Work Fatalities Resulting from Cave-In of Ditch, Trench, or Excavation", Work Injuries in California Quarterly, California Department of Industrial Relations, Division of Labor Statistics and Research, June 1974, pp. 2-6.
- (10) --- (1976), Chartbook on Occupational Injuries and Illnesses in 1976, U.S. D.O.L., BLS, Washington, D.C., Report No. 535, 1978, p. 19.
- (11) --- (1975), California Work Injuries and Illnesses 1975, California Department of Industrial Relations, Division of Labor Statistics and Research, San Francisco, Calif., August 1977, pp. 39, 40, 46, 47.
- (12) McPeck, J. (1971-1974), "Analysis of Occupational Injuries and Illnesses for Wisconsin Industry General Contracting SIC 1500", State of Wisconsin Department of Industry, Labor and Human Relations, Madison, Wis., July 1976.
- (13) --- (1970) "Work Injuries in Roofing and Sheet Metal Work", State of California Department of Industrial Relations, San Francisco, Calif., July 1972, pp. 5-7.

- (14) Prather, K., Crisera, R. A. and Fidell, S. (1975), "Behavioral Analysis of Workers and Job Hazards in the Roofing Industry", performed under contract No. HSM-99-72-121 to NIOSH by Theodore Barry and Associates, HEW Pub. No. (NIOSH) 75-176, U.S. GPO, Washington, D.C., June 1975, p.5-1.
- (15) --- (1975), "Falls from Elevations in Construction in California", Work Injuries and Illnesses in California - Quarterly, State of California Department of Industrial Relations, San Francisco, California, November 1977, pp. 3-10.
- (16) --- (1970-1972), "On-the-Job Scaffold Accidents, California", Work Injuries in California - Quarterly, State of California Department of Industrial Relations, San Francisco, Calif., August 1974, pp. 3-7.
- (17) Milhan, S. (1974), "Mortality Experience of the AFL-CIO United Brotherhood of Carpenters and Joiners of America 1969-1970", performed under Contract No. HSM 99-72-65, HEW Pub. No. (NIOSH) 74-129, Cincinnati, Ohio, July 1974, pp. 14, 15.
- (18) --- (1978), "Construction Forecast '79", Construction Contracting, McGraw-Hill, Hightstown, N. J., Vol. 60, No. 12, December 1978, pp. 15-17.

- (19) U. S. Department of Labor Program Directive No. 200-88,
October 10, 1978.
- (20) Personal communication with Mr. Allan (Ike) Martin, U.S. D.O.L.,
OSHA, Construction Standards Division, Washington, D. C.,
December 14, 1978.
- (21) American National Standards Institute (ANSI), American National
Standards for Safety and Health, ANSI, New York, N.Y., October 1978,
p. 1, 4-6.

APPENDIX

A - ANSI Standards Applicable to Construction

B - 29 CFR 1926 Safety and Health Regulations Applicable to
Construction Work

APPENDIX A

ANSI Standards Applicable to Construction

Drinking Water Coolers, Drinking Fountains and Self-Contained, Mechanically-Refrigerated, ANSI/ARI 1010-73, \$3.25
[A112.11.1]

Electrical Safety — National Electrical Code, ANSI/NFPA No. 70-1978, \$6.25 [C1]

Electrical Safety, Generation and Distribution

National Electrical Safety Code, ANSI C2 (1977 Edition), \$6.50 [C2]

*Installation and Maintenance of Electric Supply Stations and Equipment, ANSI C2.1-1971 [C2.1]

*National Electrical Safety Code, Part 2, Installation and Maintenance of Overhead Electric Supply and Communication Lines, ANSI C2.2-1976 [C2.2]

*Installation and Maintenance of Underground Electric Supply and Communication Lines, ANSI C2.3-1973 [C2.3]

*Operation of Electric Supply and Communications Lines and Equipment, ANSI C2.4-1973 [C2.4]

*This standard is not sold separately, but is contained in the National Electrical Safety Code, ANSI C2 (1977 Edition)

Elevators

Elevators, Dumbwaiters, Escalators, and Moving Walks, ANSI A17.1-1978
Bound Edition \$30.00
Loose-Leaf Edition 30.00
Loose-Leaf Binder 5.00

Note: Price of either edition includes automatic updating service through 1980.
[A17.1]

Elevators, Escalators, and Moving Walks, Practice for the Inspection of (Inspector's Manual), ANSI A17.2-1973, \$10.00 [A17.2]

Explosives

Explosive Materials, Manufacture, Transportation, Storage, and Use of, ANSI/NFPA No. 495-1973, \$3.00 [Z271.1]

†Transportation, Storage, Handling, and Use of Commercial Explosives and Blasting Agents in the Construction Industry, ANSI A10.7-1970, \$4.75 [A10.7]

Face Shields — see Personal Protective Equipment

Fire Doors and Windows

Fire Door Frames, ANSI/UL 63-April 1970, \$4.00 [A155.1]

Fire Doors and Windows, ANSI/NFPA No. 80-1977, \$5.00 [A2.7]

Sliding Hardware for Standard, Horizontally Mounted Tin-Clad Fire Doors, ANSI/UL 14(b)-March 1973, \$3.50
[A143.1]

Swinging Hardware for Standard Tin-Clad Fire Doors Mounted Singly and in Pairs, ANSI/UL 14C-March 1973, \$3.50
[A133.1]

Tin Clad Fire Doors, ANSI/UL 10(a)-October 1973, \$3.50 [A147.1]

Abrasive Wheels, Use, Care, and Protection, ANSI B7.1-1978, \$7.50 [B7.1]

Boats — Marine Through-Hull Fittings and Sea-Valves, ANSI/UL 1121-March 1973, \$3.50 [Z254.1]

†Ceramic Tile, Terrazzo, and Marble Work, ANSI A10.20-1977, \$4.50 [A10.20]

Compressed Gas Equipment

Compressed Gas Cylinder Valve Outlet and Inlet Connections, ANSI/CGA V-1-1977, \$15.00 [B57.1]

Marking Portable Compressed Gas Containers to Identify the Material Contained, Method of, ANSI/CGA C-4-1954, \$2.00 [Z48.1]

†Concrete Construction and Masonry Work, ANSI A10.9-1970, \$4.75 [A10.9]

Conveyors and Related Equipment, ANSI B20.1-1976, \$4.00 [B20.1]

Cranes

Base Mounted Drum Hoists, ANSI B30.7-1977, \$4.50 [B30.7]

Crawler, Locomotive, and Truck Cranes, ANSI B30.5-1968, \$4.00 [B30.5]

Derricks, ANSI B30.6-1977, \$4.50 [B30.6]

Floating Cranes and Floating Derricks, ANSI B30.8-1971, \$4.50 [B30.8]

Hammerhead Tower Cranes, ANSI B30.3-1975, \$4.50 [B30.3]

Mobile Hydraulic Cranes, ANSI B30.15-1973, \$5.50 [B30.15]

Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder), ANSI B30.20-1976, \$6.00 [B30.20]

Overhead Hoists, ANSI B30.16-1973, \$4.50 [B30.16]

Portal, Tower, and Pillar Cranes, ANSI B30.4-1973, \$4.50 [B30.4]

Slings, ANSI B30.9-1971, \$5.00 [B30.9]

†Demolition, ANSI A10.6-1969, \$3.75 [A10.6]

†Dredging, ANSI A10.15-1974, \$5.00 [A10.15]

Fire Fighting Equipment

- Fire Extinguishers, Rating and Fire Testing of, ANSI/UL 711-January 1973, \$3.50 [Z211.1]
- Portable Fire Extinguishers, Installation, Maintenance, and Use of, ANSI/NFPA No. 10-1976, \$4.25 [Z112.1]

Fire Protection

- Construction and Protection of Airport Terminal Buildings, ANSI/NFPA No. 416-1975, \$3.50 [Z246.1]
- Metal Safety Cans, ANSI/UL 30-1977, \$3.50 [Z218.1]
- Metal Waste Cans, ANSI/UL 32-September 1971, \$3.50 [Z221.1]
- Fire Protection, Construction — Building Construction and Demolition Operations, ANSI/NFPA No. 241-1975, \$3.00 [A10.21]
- Fire Protection, Exits — Safety to Life from Fire in Buildings and Structures, ANSI/NFPA No. 101-1976, \$6.00 [A9.1]

Fire Tests

- Fire Tests of Building Construction and Materials, Methods of, ANSI/ASTM E119-71, \$1.75 [A2.1]
- Fire Tests of Door Assemblies, Methods of, ANSI/ASTM E152-72, \$1.75 [A2.2]
- Fire Tests of Window Assemblies, Methods of, ANSI/ASTM E163-65 (1972), \$1.75 [A2.6]
- Flammable and Combustible Liquids Code, ANSI/NFPA No. 30-1976, \$4.75 [Z288.1]

- †Floor Loading — Minimum Design Loads in Buildings and Other Structures, Building Code Requirements for, ANSI A58.1-1972, \$7.50 [A58.1]

- †Floor and Wall Openings — Temporary Floor and Wall Openings, Flat Roofs, Stairs, Railings, and Toeboards for Construction, ANSI A10.18-1977, \$4.00 [A10.18]

Fork Lift Trucks — see Industrial Trucks

- Fuel Gas — National Fuel Gas Code, ANSI/NFPA No. 54-1974, \$3.00 [Z223.1]

Fuel Storage and Handling

- Flame Arresters for Use on Vents of Storage Tanks for Petroleum Oil and Gasoline, ANSI/UL 525-September 1973, \$3.50 [Z222.1]
- Liquefied Petroleum Gases, Storage and Handling of, ANSI/NFPA No. 58-1977, \$5.25 [Z106.1]
- Production, Storage, and Handling of Liquefied Natural Gas (LNG), ANSI/NFPA No. 59A-1975, \$4.25 [Z225.1]

Gas — see Fuel Gas; Fuel Storage and Handling

Grinding Wheels — see Abrasive Wheels

- †Handicapped — Making Buildings and Facilities Accessible to, and Usable by, the Physically Handicapped, ANSI A117.1-1961 (R1971), \$2.75 [A117.1]

Hard Hats — see Personal Protective Equipment

Hoists

- Material Hoists, ANSI A10.5-1975, \$4.00 [A10.5]
- Personnel Hoists, ANSI A10.4-1975, \$6.50 [A10.4]
- Rope-Guided and Non-Guided Workmen's Hoists, ANSI A10.22-1977, \$3.50 [A10.22]

Industrial Trucks

- Electric-Battery-Powered Industrial Trucks. (Requirements relative to fire, electric shock, and explosion hazards), ANSI/UL 583-1977, \$3.50 [B56.3]
- Internal Combustion Engine-Powered Industrial Trucks. (Requirements relative to fire hazard aspects), ANSI/UL 558-1977, \$3.50 [B56.4]
- Powered Industrial Trucks, Including Type Designations and Areas of Use. (Relates to a classification of industrial trucks as to areas of use, maintenance, and operation), ANSI/NFPA No. 505-1975, \$3.00 [B56.2]
- Powered Industrial Trucks — Low Lift and High Lift Trucks, ANSI B56.1-1975, \$6.50 [B56.1]
- Jacks, ANSI B30.1-1975, \$4.00 [B30.1]

Ladders

- Fixed Ladders, ANSI A14.3-1974, \$5.50 [A14.3]
- Job-Made Ladders, ANSI A14.4-1973, \$4.50 [A14.4]
- Portable Metal Ladders, ANSI A14.2-1972, including Supplement A14.2a-1977, \$5.75 [A14.2]
- Portable Reinforced Plastic Ladders, ANSI A14.5-1974, including Supplement A14.5a-1977, \$7.00 [A14.5]
- Portable Wood Ladders, ANSI A14.1-1975, including Supplement A14.1a-1977, \$6.50 [A14.1]

- †Ladders, Safe Use of, ANSI Z136.1-1976, \$9.00 [Z136.1]

Life Preservers — see Personal Protective Equipment (Buoyant Devices)

- Lighting — Portable Electric Lighting Units for Use in Hazardous Locations, Class I, Groups C and D, and Class II, Group G, ANSI/UL 781-July 1972, \$3.50 [C33.79]

- Lighting Protection Code, ANSI/NFPA No. 78-1978, \$4.25 [C5.1]

Machinery

- Mechanical Power Transmission Apparatus, ANSI B15.1-1972, \$4.00 [B15.1]
- †Woodworking Machinery, ANSI O1.1-1975, \$5.50 [O1.1]

Motorcycle Helmets — see Personal Protective Equipment

- Noise — Exterior Sound Level for Powered Mobile Construction Equipment, ANSI/SAE J88a-1976, \$2.00 [S6.7]

- Oxidizing Materials, Storage of Liquid and Solid, ANSI/NFPA No. 43A-1975, \$3.50 [Z290.1]

- †Pavement, Asphalt, Construction, Safe Operating Practice for, ANSI A10.17-1975, \$3.50 [A10.17]

Personal Protective Equipment

- Buoyant Cushions, ANSI/UL 1176, \$4.00 [Z243.2]
- †Identification of Air-Purifying Respirator Canisters and Cartridges, ANSI K13.1-1973, \$3.00 [K13.1]
- †Industrial Head Protection, ANSI Z89.1-1969, \$3.75 [Z89.1]
- †Industrial Protective Helmets for Electrical Workers, Class B, ANSI Z89.2-1971, \$3.75 [Z89.2]
- Marine Special Purpose Water Safety Buoyant Devices, ANSI/UL 1123-December 1972, \$3.50 [Z243.1]

- *Men's Conductive Safety Toe Footwear, ANSI Z41.3-1975 [Z41.3]
- *Men's Electrical Hazard Safety Toe Footwear, ANSI Z41.4-1975 [Z41.4]
- *Men's Metatarsal Safety Toe Footwear, ANSI Z41.2-1975 [Z41.2]
- *Men's Safety-Toe Footwear, ANSI Z41.1-1967 (R1972) [Z41.1]
- *Not sold separately. Contained in Safety Footwear ANSI Z41 (1976 Edition), \$5.00 [Z41]

- †Occupational and Educational Eye and Face Protection, Practices for, ANSI Z87.1-1968, \$5.75 [Z87.1]

- †Practices for Respiratory Protection, ANSI Z88.2-1969, \$5.50 [Z88.2]

- †Protective Headgear for Vehicular Users, ANSI Z90.1-1971, including Supplement ANSI Z90.1a-1973, \$4.00; ANSI Z90.1a-1973 sold separately, \$1.50 [Z90.1; Z90.1a]

- Rubber Insulating Blankets, ANSI/ASTM D1048-1977, \$1.75 [J6.4]

- Rubber Insulating Gloves, ANSI/ASTM D120-1977, \$1.75 [J6.6]

- Rubber Insulating Line Hose, ANSI/ASTM D1050-1977, \$1.75 [J6.1]

- Rubber Insulating Sleeves, ANSI/ASTM D1051-1977, \$1.75 [J6.5]

- Rubber Insulator Hoods, ANSI/ASTM D1049-1977, \$1.75 [J6.2]

- Rubber Matting for Use around Electric Apparatus, ANSI/ASTM D178-1977, \$1.75 [J6.7]

- Radiation — Prevention of Radio Frequency Radiation Hazards on the Use of Electric Blasting Caps, ANSI/IME 20 (1971 Edition), \$2.00 [C95.4]

Railings and Toeboards on Flat Roofs, Floors and Stairs — see Floor and Wall Openings

- †Recording Off-The-Job Injuries — Method of Recording and Measuring the Off-the-Job Disabling Accidental Injury Experience of Employees, ANSI Z16.3-1973, \$4.25 [Z16.3]

Recording Work Injuries

- †Method of Recording Basic Facts Relating to Nature and Occurrence of Work Injuries, ANSI Z16.2-1962 (R1969), \$5.50 [Z16.2]

- †Method of Recording and Measuring Work Injury Experience, ANSI Z16.1-1967 (R1973), \$4.75 [Z16.1]
- †Uniform Recordkeeping for Occupational Injuries and Illnesses, ANSI Z16.4-1977, \$4.00 [Z16.4]
- †Safety Belts, Harnesses, Lanyards, Lifelines, and Drop Lines for Construction and Industrial Use, ANSI A10.14-1975, \$3.50 [A10.14]
- †Safety Glass — Safety Glazing Material Used in Buildings, Performance Specifications and Methods of Test for, ANSI Z97.1-1975, including Supplement ANSI Z97.1a-1977, \$4.75 [Z97.1]
- Safety Glasses — see Personal Protective Equipment
- †Safety Nets, ANSI A10.11-1971, \$3.50 [A10.11]
- †Sanitation
- Non-Water Carriage Disposal Systems, ANSI Z4.3-1970, \$2.75 [Z4.3]
- Sanitation in Places of Employment, ANSI Z4.1-1968, \$3.25 [Z4.1]
- Sanitation in Temporary Labor Camps, ANSI Z4.4-1968, \$2.75 [Z4.4]
- †Scaffolding, ANSI A10.8-1977, \$5.00 [A10.8]
- Signs and Symbols
- †Accident Prevention Signs, ANSI Z35.1-1972, \$3.00 [Z35.1]
- †Accident Prevention Tags, ANSI Z35.2-1968 (R1974), \$2.75 [Z35.2]
- †Informational Signs Complementary to ANSI Z35.1-1972, Accident Prevention Signs, ANSI Z35.4-1973, \$3.00 [Z35.4]
- †Marking Physical Hazards, Safety Color Code for, ANSI Z53.1-1971, \$3.00 [Z53.1]
- Slow-Moving Vehicle Identification Emblem, ANSI/SAE S276.2-1968/SAE J943, \$2.00 [B114.1]
- †Space Heating — Temporary and Portable Space Heating Devices and Equipment Used in the Construction Industry, ANSI A10.10-1970, \$3.75 [A10.10]
- †Steel Erection, ANSI A10.13-1978, \$4.00 [A10.13]
- Tools
- †Powder Actuated Fastening Systems, ANSI A10.3-1977, \$3.50 [A10.3]
- Stationary and Fixed Electric Tools, ANSI/UL 987-August 1972, \$4.00 [C33.86]
- Traffic Control — Manual on Uniform Traffic Control Devices for Streets and Highways, ANSI D6.1-1971, \$7.00 [D6.1]
- †Tree Pruning, Trimming, Repairing, or Removal, ANSI Z133.1-1972, including Supplement ANSI Z133.1a-1975, \$5.00; ANSI Z133.1a-1975 sold separately, \$1.50 [Z133.1, Z133.1a]
- †Ventilation
- Ventilation Control of Grinding, Polishing, and Buffing Operations, ANSI Z43.1-1966, \$4.25 [Z43.1]
- Ventilation and Safe Practices of Abrasives Blasting Operations, ANSI Z9.4-1968, \$3.25 [Z9.4]
- Welding
- Fire Prevention in Use of Cutting and Welding Processes, ANSI/NFPA No. 51B-1976, \$3.00 [Z49.2]
- Transformer-Type Arc-Welding Machines, ANSI/UL 551-1976, \$3.50 [C33.2]
- Welding and Cutting, ANSI Z49.1-1973, \$6.00 [Z49.1]
- †Work Platforms
- Elevating Work Platforms, ANSI A92.3-1973, \$3.00 [A92.3]
- Mobile Ladder Stands and Scaffolds (Towers), Manually Propelled, ANSI A92.1-1977, \$3.50 [A92.1]
- Vehicle Mounted Elevating and Rotating Work Platforms, ANSI A92.2-1969, \$3.75 [A92.2]



APPENDIX B

29 CFR 1926 SAFETY AND HEALTH REGULATIONS AND 1910 STANDARDS IDENTIFIED AS APPLICABLE TO CONSTRUCTION WORK

SUBPART A - GENERAL

- 1926.1 Purpose and scope
- 1926.2 Variances from safety and health standards
- 1926.3 Inspections-right of entry
- 1926.4 Rules of practice for administrative adjudications for enforcement of safety and health standards

SUBPART B - GENERAL INTERPRETATIONS

- 1926.10 Scope of subpart
- 1926.11 Coverage under section 103 of the act distinguished
- 1926.12 Reorganization Plan No. 14 of 1950
- 1926.13 Interpretations of statutory terms
- 1926.14 Federal contracts for "mixed" types of performance
- 1926.15 Relationship to the Service Contract Act; Walsh-Healey Public Contracts Act
- 1926.16 Rules of construction
- *1910.11 Applicability of Federal standards
- *1910.12 Construction standards - Part 1926
- *1910.16 Longshoring
- *1910.19 Application of 1910.1001 (Asbestos)

SUBPART C - GENERAL SAFETY AND HEALTH PROVISIONS

- 1926.20 General safety and health provisions
- 1926.21 Safety training and education
- 1926.22 Recording and reporting of injuries (Reserved)
- 1926.23 First aid and medical attention
- 1926.24 Fire protection and prevention
- 1926.25 Housekeeping
- 1926.26 Illumination
- 1926.27 Sanitation
- 1926.28 Personal protective equipment

*The 29 CFR 1910 standards identified in the document will be cited where appropriate.

- *1910.132(b)(c) - Employee owned and design of equipment
- *1910.136 Foot protection
- *1910.136 Footwear for employees

- 1926.29 Acceptable certifications
- 1926.30 Shipbuilding and ship repairing
- 1926.31 Incorporation by reference
- 1926.32 Definitions

SUBPART D - OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROLS

- 1926.50 Medical services and first aid
- 1926.51 Sanitation

- *1910.141(a)(2)(v) - Potable water
- *1910.141(a)(5) - Vermin control
- *1910.141(g)(2) - Eating and drinking areas
- *1910.141(h) - Food handling
- *1910.151 Medical services and first aid
- *1910.151(c) - Quick drenching or flushing of eyes
- 1926.52 Occupational noise exposure
- 1926.53 Ionizing radiation
- 1926.54 Nonionizing radiation
- 1926.55 Gases, vapors, fumes, dusts, and mists

- *1910.161(a), (2) - Safety requirements in using carbon dioxide

- 1926.56 Illumination
- 1926.57 Ventilation

SUBPART E - PERSONAL PROTECTIVE AND LIFE SAVING EQUIPMENT

- 1926.100 Head protection
- 1926.101 Hearing protection
- 1926.102 Eye and face protection
- 1926.103 Respiratory protection

- *1910.94(a)(i)(ii), (5)(i)(ii)(b)(c), (8) - A continuous flow air-line respirator
- *1910.94(c)(3)(i), (4), (7) - Abrasive blasting
- *1910.134 Respiratory protection
- *1910.134(a), (b), (c), (d), (e)(f)(g) - Respiratory protection

- 1926.104 Safety belts, lifelines, and lanyards
- 1926.105 Safety nets
- 1926.106 Working over or near water
- 1926.107 Definitions applicable to this subpart

SUBPART F - FIRE PROTECTION AND PREVENTION

- 1926.150 Fire protection
- 1926.151 Fire prevention
- 1926.152 Flammable and combustible liquids

- *1910.106(a)(22) - Definition of marine service station
- *1910.106(g)(1)(i)(g) - Storage tanks
- *1910.106(g)(4) - Marine service stations

- 1926.153 Liquified petroleum gas (LP-Gas)

- *1910.110(b)(5)(iii) - Marking container
- *1910.110(d)(1), (2) - Other than DOT specifications
- *1910.110(d)(7)(vii)(a-f) - Installation of storage containers
- *1910.110(d)(7)(viii) - Field welding
- *1910.110(d)(10) - Damage from vehicles

- 1926.154 Temporary heating devices
- 1926.155 Definitions applicable to this subpart

SUBPART G - SIGNS, SIGNALS, AND BARRICADES

- 1926.200 Accident prevention signs and tags
- 1926.201 Signaling
- 1926.202 Barricades
- 1926.203 Definitions applicable to this subpart

SUBPART H - MATERIALS HANDLING, STORAGE, USE,
AND DISPOSAL

1926.250 General requirements for storage

*1910.30(a)(1), (2), (4), (5) - Dockboard requirements

*1910.176(c) - Housekeeping

1926.251 Rigging equipment for material handling

*1910.184(c)(2), (3), (5), (7), (10), (11), (12) - Safe operating practices

*1910.184(e)(3)(i), (ii) - Inspection records

*1910.184(f)(2)(3), (4) - Wire rope slings

*1910.184(h)(2)(3)(iv)(v), (4), (5)(i-iv) - Natural and synthetic fiber rope slings

*1910.184(i)(2), (3), (4), (6), (7), (9) - Synthetic web slings

1926.252 Disposal of waste materials

SUBPART I - TOOLS - HAND AND POWER

1926.300 General requirements

*1910.212(a)(3)(i-iii) - General requirements for machine guards

*1910.212(a)(5) - Enclosure of blades

*1910.212(b) - Anchoring fixed machines

1926.301 Hand tools

1926.302 Power operated hand tools

*1910.244(b) - Abrasive blast cleaning nozzles

1926.303 Abrasive wheels and tools

1926.304 Woodworking tools

1926.305 Jacks - level and ratchet, screw and hydraulic

*1910.244(a)(2)(iii-vi) - Operation and maintenance of jacks

SUBPART J - WELDING AND CUTTING

- 1926.350 Gas welding and cutting
- 1926.351 Arc welding and cutting
- 1926.352 Fire prevention
- 1926.353 Ventilation and protection in welding, cutting, and heating
- 1926.354 Welding, cutting and heating in way of preservative coatings

SUBPART K - ELECTRICAL

- 1926.400 General requirements
- 1926.401 Grounding and bonding
- 1926.402 Equipment installation and maintenance
- 1926.403 Battery rooms and battery charging
- 1926.404 Hazardous locations
- 1926.405 Definitions applicable to this subpart

SUBPART L - LADDERS AND SCAFFOLDING

- 1926.450 Ladders
- 1926.451 Scaffolding

- *1910.28(a)(15) - Material hoisted onto a scaffold
- *1910.28(a)(18) - Work on scaffolds during storms
- *1910.28(a)(20) - Tools, materials and debris accumulation
- *1910.29 Manually propelled mobile ladder stands and scaffolds (towers)
- *1910.29(a) - General requirements
- *1910.29(c)(1)-(7) - Mobile tubular welded section folding scaffolds

- 1926.452 Definitions applicable to this subpart

- *1910.21(g) - Definition of manually propelled mobile ladder stands and scaffold towers

SUBPART M - FLOORS AND WALL OPENINGS, AND STAIRWAYS

- 1926.500 Guardrails, handrails, and covers

- *1910.23(b)(5) - Guarding of wall holes

- 1926.501 Stairways
- 1926.502 Definitions applicable to this subpart

*1910.21(a)(10) - Definition of wall hole

SUBPART N - CRANES, DERRICKS, HOISTS, ELEVATORS, AND CONVEYORS

- 1926.550 Cranes and derricks
- 1926.551 Helicopters
- 1926.552 Material hoists, personnel hoists, and elevators
- 1926.553 Base-mounted drum hoists
- 1926.554 Overhead hoists
- 1926.555 Conveyors
- 1926.556 Aerial lifts

SUBPART O - MOTOR VEHICLES, MECHANIZED EQUIPMENT, AND MARINE OPERATIONS

- 1926.600 Equipment

*1910.176(f) - Rolling railroad cars

*1910.169(a), (b) - General, installation and equipment requirements

- 1926.601 Motor vehicles
- 1926.602 Material handling equipment
- 1926.603 Pile driving equipment
- 1926.604 Site clearing
- 1926.605 Marine operations and equipment
- 1926.606 Definitions applicable to this subpart

SUBPART P - EXCAVATIONS, TRENCHING, AND SHORING

- 1926.650 General protection requirements
- 1926.651 Specific excavation requirements
- 1926.652 Specific trenching requirements
- 1926.653 Definitions applicable to this subpart

SUBPART Q - CONCRETE, CONCRETE FORMS, AND SHORING

- 1926.700 General provisions
- 1926.701 Forms and shoring
- 1926.702 Definitions applicable to this subpart

SUBPART R - STEEL ERECTION

- 1926.750 Flooring requirements
- 1926.751 Structural steel assembly
- 1926.752 Bolting, riveting, fitting-up, and plumbing-up

SUBPART S - TUNNELS AND SHAFTS, CAISSONS, COFFERDAMS,
AND COMPRESSED AIR

- 1926.800 Tunnels and shafts
- 1926.801 Caissons
- 1926.802 Cofferdams
- 1926.803 Compressed air
- 1926.804 Definitions applicable to this subpart

SUBPART T - DEMOLITION

- 1926.850 Preparatory operations
- 1926.851 Stairs, passageways, and ladders
- 1926.852 Chutes
- 1926.853 Removal of materials through floor holes
- 1926.854 Removal of walls, masonry sections, and chimneys
- 1926.855 Manual removal of floors
- 1926.856 Removal of walls, floors, and material with equipment
- 1926.857 Storage
- 1926.858 Removal of steel construction
- 1926.859 Mechanical demolition
- 1926.860 Selective demolition by explosives

SUBPART U - BLASTING AND USE OF EXPLOSIVES

- 1926.900 General provisions

*1910.109(g)(2)(ii)(a-f) - Blasting agents

*1910.109(h)(3)(ii)(a-f) - Slurry mixing fixed location

- 1926.901 Blaster qualification
- 1926.902 Surface transportation of explosives
- 1926.903 Underground transportation of explosives
- 1926.901 Storage of explosives or blasting agents

*1910.109(e)(3)(iii) - Pneumatic loading

- 1926.906 Initiation of explosive charged - electric blasting
- 1926.907 Use of safety fuse
- 1926.908 Use of detonating cord
- 1926.909 Firing the blast
- 1926.910 Inspection after blasting
- 1926.911 Misfires
- 1926.912 Underwater blasting
- 1926.913 Blasting in excavation work under compressed air
- 1926.914 Definitions applicable to this subpart

*1910.109(a)(12) - Definition

SUBPART V - POWER TRANSMISSION AND DISTRIBUTION

- 1926.950 General requirements
- 1926.951 Tools and protective equipment
- 1926.952 Mechanical equipment
- 1926.953 Material handling
- 1926.954 Grounding for protection of employees
- 1926.955 Overhead lines
- 1926.956 Underground lines
- 1926.957 Construction in energized substations
- 1926.958 External load helicopters
- 1926.959 Lineman's body belts, safety straps, and lanyards
- 1926.960 Definitions applicable to this subpart

SUBPART W - ROLLOVER PROTECTIVE STRUCTURES;
OVERHEAD PROTECTION

- 1926.1000 Rollover protective structures (ROPS) for material handling equipment
- 1926.1001 Minimum performance criteria for rollover protective structures for designated scrapers, loaders, dozers, graders, and crawler tractors
- 1926.1002 Protective frame (ROPS) test procedures and performance requirements for wheel-type agricultural and industrial tractors used in construction
- 1926.1003 Overhead protection for operators of agricultural and industrial tractors



SUBPART X - EFFECTIVE DATES

1926.1050 Effective dates (general)

1926.1051 Effective dates (specific)

SUBPART INDEX FOR PART 1926

Safety and Health Regulations for Construction

* - 1910.401-441 Commercial Diving Operations

* - 1910.1001-1046 Toxic and Hazardous Substances

*1910.1001 Asbestos

*1910.1002 Coal tar pitch volatiles; interpretation of term

*1910.1003 4-Nitrobiphenyl

*1910.1004 alpha-Naphthylamine

*1910.1006 Methyl chloromethyl ether

*1910.1007 3,3' -Dichlorobenzidine (and its salts)

*1910.1008 bis-Chloromethyl ether

*1910.1009 beta-Naphthylamine

*1910.1010 Benzidine

*1910.1011 4-Aminodiphenyl

*1910.1012 Ethyleneimine

*1910.1013 beta-Propiolactone

*1910.1014 2-Acetylaminofluorene

*1910.1015 4-Dimethylaminoazobenzene

*1910.1016 N-Nitrosodimethylamine

*1910.1017 Vinyl Chloride

*1910.1018 Inorganic arsenic

*1910.1028 Benzene

*1910.1029 Coke Oven Emissions

*1910.1043 Cotton dust

*1910.1044 1,2-dibromo-3-chloropropane

*1910.1045 Acrylonitrile

*1910.1046(a) Exposure to cotton dust in cotton gins