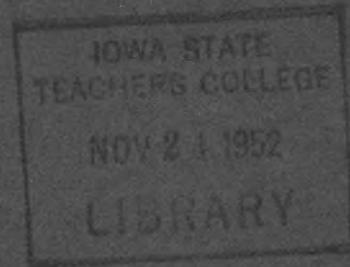


# Injuries and Accident Causes in Plumbing Operations



A Detailed Analysis of  
Accidents Experienced by  
Plumbers During 1948 and 1949

Bulletin No. 1079

UNITED STATES DEPARTMENT OF LABOR

MAURICE J. TOBIN, *Secretary*

BUREAU OF LABOR STATISTICS

EWAN CLAGUE, *Commissioner*





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## Letter of Transmittal

UNITED STATES DEPARTMENT OF LABOR,  
BUREAU OF LABOR STATISTICS,  
Washington, D. C., February 28, 1952.

The SECRETARY OF LABOR:

I have the honor to transmit herewith a report on the occurrence and causes of work injuries experienced by plumbers.

This report constitutes a part of the Bureau's regular program of compiling work-injury information for use in accident-prevention work. The statistical analysis and the preparation of the report were performed in the Bureau's Branch of Industrial Hazards by Frank S. McElroy, George R. McCormack, and Francis J. Rafferty. The specific accident-prevention suggestions were prepared by Roland P. Blake of the Division of Safety Standards of the Bureau of Labor Standards.

EWAN CLAGUE, *Commissioner.*

Hon. MAURICE J. TOBIN,  
*Secretary of Labor.*

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## Abstract

Data from a previous study, covering the year 1948, indicate that plumbers experience fewer work injuries than most of the workers in construction trades. Their injury-frequency rate, however, is considerably higher than the rates for most manufacturing activities.

The previous survey also established that plumbers working on new construction had a higher injury-frequency rate than those working on repairs, but that the repair work produced a much higher proportion of serious injuries. On new construction the frequency rates for residential and nonresidential work were identical, but the injuries tended to be more severe in nonresidential work. On repair work, both the frequency of injury and the general severity of the injuries were higher for residential projects than for nonresidential work.

The present study indicates that the most common injuries experienced by plumbers, in order of frequency, were: Sprains, cuts, bruises, fractures, burns, foreign bodies in the eye, and hernias.

Three-fourths of the injuries resulted from four general types of accidents: Struck by moving objects (28 percent); overexertion (22 percent); bumping or striking against objects (14 percent); and falls (12 percent).

The major physical or mechanical causes of plumbing accidents were found to be: Hazardous working procedures; defective agencies; the lack of personal protective equipment; inadequately guarded agencies; and poor housekeeping.

The leading personal causes in many instances directly associated with the physical hazards, were: Gripping objects insecurely; inattention to footing; inattention to surroundings; taking an unsafe position; exerting excessive pressure; and failure to secure materials or warn others of material movement.

Accident-prevention suggestions, prepared by the Division of Safety Standards of the Bureau of Labor Standards, indicate that most accidents in plumbing operations could be prevented through the application of simple precautions.



# Injuries and Accident Causes in Plumbing Operations

## The Injury Record

Employees of plumbing, heating, and air-conditioning specialty contractors experienced an average of 28.5 disabling injuries<sup>1</sup> for every million employee-hours worked during 1950. This was a slight improvement over the corresponding average of 30.7 for 1949 and 30.6 for 1948. Time lost because of injuries in 1950 averaged 1.7 days for every 1,000 employee-hours worked or more than 3 days for each full-time worker in this division of the construction industry.<sup>2</sup>

In comparison with the injury rates for other types of construction work, the injury-frequency rate<sup>3</sup> for plumbing, heating, and air conditioning in 1950 was relatively low. The all-construction rate, for example, was 41.0; the rate for general contracting operations was 44.5; and the average rate for all types of special-trades contracting was 33.4. The comparison with other construction activities in respect to injury severity was also favorable. The all-construction severity rate<sup>3</sup> (3.8) was more than double, and the average time charge per injury<sup>3</sup> (93 days) was half again as high as the corresponding averages for plumbing, heating, and air-conditioning operations.

### Comparison of the 28.5 injury-frequency rate

<sup>1</sup> A disabling work injury is any injury, occurring in the course of and arising out of employment, which (a) results in death or any degree of permanent physical impairment, or (b) makes the injured person unable to perform the duties of any regularly established job open and available to him, throughout the hours corresponding to his regular shift on any day after the day of injury, including Sundays, holidays, and periods of plant shut-down.

<sup>2</sup> See Bureau of Labor Statistics Bulletin No. 975, *Work Injuries in the United States During 1948*; and press release, dated December 23, 1951, *Work Injuries Rise in 1950*.

for plumbing, heating, and air-conditioning with most nonconstruction activities was much less favorable—it was about double the 14.7 rate for all-manufacturing in 1950. The accidental death rate was also three times that of all-manufacturing, but workers in manufacturing had a much higher ratio of permanent impairments.

Injury-rate data for 1949 and 1950 are available only as totals covering all employees in the plumbing, heating, and air-conditioning division of the construction industry. Therefore, it is not possible to present injury rates for the specific occupation of plumbers for those years. The Bureau's survey of work injuries in construction during 1948,<sup>4</sup> however, did include occupational details. The relationships among the various construction occupations and the general injury patterns indicated at that time probably are reasonably accurate representations of current conditions.

In 1948, plumbers<sup>5</sup> employed by plumbing, heating, and air-conditioning specialty contrac-

<sup>3</sup> The injury-frequency rate is the average number of disabling work injuries for each million employee-hours worked.

The severity rate is the average number of days lost or charged on account of disabling injuries per 1,000 employee-hours worked.

The average time charge is computed by adding the days lost for each temporary-total disability to the standard time charges for fatalities and permanent disabilities, as given in *Method of Compiling Industrial Injury Rates* (approved by the American Standards Association, 1945), and by dividing the total by the number of disabling injuries.

For further discussion of these definitions, see chapter on Scope and Method, p. 2.

<sup>4</sup> See Bureau of Labor Statistics Bulletin No. 1004, *Work Injuries in Construction, 1948-49*.

<sup>5</sup> Includes journeymen, apprentices, helpers, and plumbers' supervisors.

tors had an injury-frequency rate of 28.6, somewhat lower than the average for all workers in this division of the construction industry. The employment of plumbers is, of course, highly concentrated in this segment of the industry, and the record of this group may be generally accepted as representative of the injury experience of the occupation. The survey indicated, however, that the injury rates for plumbers employed in other divisions of the construction industry tended to be somewhat higher so that the average frequency rate for all plumbers, regardless of where employed, was 29.5.

The highest injury-frequency rate for any group of plumbers in 1948 was 50.4 for those employed by heavy and marine construction. These workers, however, experienced relatively few serious injuries. There was little difference

between the frequency rates for plumbers employed by general building contractors (27.8) and for those working for plumbing, heating, and air-conditioning contractors. The latter group, however, had the higher proportion of serious injuries.

Plumbers working on new construction in 1948 had a substantially higher injury-frequency rate than those working on repairs, but the repair work produced a much higher proportion of serious injuries. On new construction, the frequency rates for residential and non-residential work were identical, but the injuries tended to be more severe in the nonresidential work. On repair work, both the frequency of injury and the general severity of the injuries were higher for residential projects than for nonresidential work.

## Scope and Method of Survey

The Bureau of Labor Statistics has compiled annual injury rates since 1938 for the construction industry as a whole and for each of the three primary types of construction—building, heavy engineering, and highway. Most of the reports received in the surveys before 1948 came from general contractors, although some reports were received from special-trades contractors in each classification.

In 1948 the coverage and detail of the survey were enlarged and injury rates were presented in occupational detail for a wide range of special-trades operations. The occupational breakdowns were not continued in subsequent years, but separate injury-rate information was compiled for a number of special-trades contracting operations in 1949 and 1950. All the data assembled in the injury-rate surveys have been collected by mail. Reporting is entirely voluntary.

### Injury Rates

The injury-rate comparisons presented in this report are based primarily upon injury-frequency and severity rates compiled under the definitions and procedures specified in the American Standard Method of Compiling In-

dustrial Injury Rates, as approved by the American Standards Association in 1945. These standard rates have been supplemented by an additional measure of injury severity designated as the average time charge per disabling injury. These measures are computed as follows:

*Injury-frequency rate.*—The injury-frequency rate represents the average number of disabling work injuries occurring in each million employee-hours worked. It is computed according to the following formula:

Frequency rate=

$$\frac{\text{Number of disabling injuries} \times 1,000,000}{\text{Number of employee-hours worked}}$$

*Average time charge per disabling injury.*—The relative severity of a temporary injury is measured by the number of calendar days during which the injured person is unable to work at any regularly established job which is open and available to him, excluding the day of injury and the day on which he returns to work. The relative severity of death and permanent impairment cases is determined by reference

to a table of economic time charges included in the American Standard Method of Compiling Industrial Injury Rates. These time charges, based upon an average working-life expectancy of 20 years for the entire working population, represent the average percentage of working ability lost as the result of specified impairments, expressed in unproductive days. The average time charge per disabling injury is computed by adding the days lost for each temporary injury and the days charged according to the standard table for each death and permanent impairment and dividing the total by the number of disabling injuries.

*Injury-severity rate.*—The injury-severity rate weights each disabling injury with its corresponding time-loss or time-charge, and expresses the aggregate in terms of the average number of days lost or charged per 1,000 employee-hours worked. It is computed according to the following formula:

Severity rate=

$$\frac{\text{Total days lost or charged} \times 1,000}{\text{Number of employee-hours worked}}$$

### Accident-Cause Analysis

The individual accident case records collected for this study were obtained from State workmen's compensation files. This method represents a deviation from the Bureau's regular practice in similar surveys for other industries in which the data are obtained from the records of individual employers. A basic characteristic of the construction industry dictated this change in the method of data collection. Most firms employing plumbers are relatively small and, even though the injury rate is comparatively high, the number of injuries experienced by employees in any one establishment is also small. The number of visits to individual establishments necessary to obtain an adequate volume of case records for analysis, therefore, would have been prohibitive both in terms of time and expense.

Use of the compensation files as the source of the data placed some limitations upon the

analysis, particularly the degree of detail in which the findings could be presented. It is believed, however, that the greater volume of case records obtained by this collection method compensates in large measure for the lack of additional details which could have been obtained through discussion of the individual cases with the employers, supervisors, or workers who might have been familiar with the unreported circumstances associated with the accidents.

The workmen's compensation agencies of 13 States made their files available for this survey. These States—Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia—constitute a cross section of the country, insuring the reflection of all possible variations in hazards introduced by differences in climate or construction procedures as well as by the differences arising from State safety codes and safety-enforcement practices. Records were obtained of 2,719 individual accidents. The primary basis of selection was occupational—the injured person in each instance was either a journeyman plumber, an apprentice plumber, a plumber's helper, or a plumbing supervisor. In the great majority of cases the injured person was employed by a special-trades contractor engaged in the installation or repair of plumbing, heating, and air-conditioning equipment. Some accidents to plumbers employed by contractors in other branches of construction were included. Accidents involving steam fitters, plumbers' helpers, and plumbers employed as maintenance men outside the construction industry were excluded. The selected cases were taken from the records for the years 1948 and 1949.

For each case selected, a representative of the Bureau of Labor Statistics transcribed from the records, insofar as the data were available, the following items of information: Place of accident; work being done by the injured at the time of the accident; nature of injury; part of body injured; and a description of how and why the accident occurred.

The accident-cause analysis procedure used in this study differs in some respects from those specified in the American Standard Method of

Compiling Industrial Accident Causes. The deviations from the Standard include the introduction of an additional analysis factor—the “agency of injury”—and the modification of the standard definitions of some of the other factors in order to permit more accurate cross classifications.

*Agency of injury.*—The standard classification provides for the selection of only one “agency” in the analysis of each accident. By definition, this agency may be either (a) the object or substance which was unsafe and which thereby contributed to the occurrence of the accident, or (b) in the absence of such an unsafe object or substance, the object or substance most closely related to the injury. Under this definition, therefore, a tabulation of “agencies” for a group of accidents will include objects or substances which may have been inherently safe and unrelated to the occurrence of the accidents, as well as those which because of their condition, location, structure, method of use, or other unsafe characteristic led to the occurrence of accidents. The development of the classification “agency of injury” represents an attempt to classify separately these two “agency” concepts.

As used in this study, the “agency of injury” is the object, substance, or bodily reaction which actually produced the injury, selected without regard to its safety characteristics or its influence upon the chain of events constituting the accident.

*Accident type.*—As used in this study, the accident-type classification assigned to each accident is purely descriptive of the occurrence which resulted in the injury and is related specifically to the agency of injury. It indicates how the injured person came into contact with or was affected by the previously selected agency of injury. This represents a change from the standard procedure in two respects: First, the accident-type classification is specifically related to the previously selected agency of injury; and, second, the sequence of selecting this factor is specified.

*Hazardous condition.*— Under the standard

definition, the hazardous condition indicated in the analysis is defined as the “unsafe mechanical or physical condition of the selected agency which could have been guarded or corrected.” This implies the prior selection of the “agency,” but does not provide for recognition of any relationship between the unsafe condition and accident-type classifications. Nor does the standard provide for any definite relationship between the “agency” and “accident type” classifications.

To provide continuity and to establish direct relationships among the various analysis factors so as to permit cross classification, the standard definition was modified for this study to read: “The unsafe mechanical or physical condition is the hazardous condition which permitted or occasioned the occurrence of the selected accident type.” The hazardous-condition classification, therefore, was selected after the determination of the accident-type classification and represents the physical or mechanical reason for the occurrence of that particular accident without regard to the feasibility of guarding or correcting the unsafe condition.

Elimination of the condition “which could have been guarded or corrected” is based upon the premise that statistical analysis should indicate the existence of hazards, but should not specify the feasibility of corrective measures.

*Agency of accident.*—For the purpose of this survey, the agency of accident was defined as the “object, substance, or premises in or about which the hazardous condition existed.” Its selection, therefore, is directly associated with the hazardous condition which led to the occurrence of the accident. In many instances the agency of injury and the agency of accident were found to be identical. The double agency classification, however, avoids any possibility of ambiguity in the interpretation of the “agency” tabulations.

*Unsafe act.*—The unsafe act definition used in this survey is identical with the standard definition, i. e., “that violation of a commonly accepted safe procedure which resulted in the selected accident type.”

## Hazards of the Occupation

In common with most construction trades, plumbers face many hazards which arise more in their work environment than from the specific operations characteristic of their trade. Most of their work is performed away from their employer's shop on premises where neither the employer nor the workman can exercise full control over the physical working conditions.

Much of the plumber's work is performed in new, partially completed structures, where housekeeping problems are particularly prevalent. The premises around the structure are often muddy, slippery, rutted, cut by open trenches, obstructed by piles of dirt or materials, cluttered with the equipment of many trades, and littered with scrap materials. The possibility of injury from a slip or fall or from contact with sharp or rough materials, therefore, arises as soon as the worker enters the construction area. These hazards become most serious when the plumber is moving his tools, equipment, and materials to or from the workplace. The materials are frequently heavy, bulky, or awkward to handle, and, because they usually are moved manually, the operation presents considerable possibility for strains, sprains, or other injuries arising from overexertion. The hazardous surface over which they must be moved multiplies these possibilities.

Inside the structure there are many possibili-

ties of slips, falls, and overexertion because of unfinished floors (which are frequently rough, irregular, and cluttered with materials or scrap), unguarded floor openings, open stairways, and rough access ladders. Falling materials, originating in the operation of other trades on the premises as well as in their own, constitute another important hazard for plumbers on new construction. Many items installed by plumbers must be fitted into relatively inaccessible places. This frequently involves working in cramped or awkward positions where it is difficult to control either the materials or the tools which must be used, and often leads to the use of inadequate scaffolds or work platforms. Bumps, cuts, falls, and crushing injuries frequently occur in these circumstances.

In repair work also, the plumber encounters many hazards arising from poor housekeeping conditions, and frequently finds it necessary to work in tight and extremely inaccessible quarters. The use of hand tools, which normally presents little possibility of injury, can become very hazardous under such conditions.

The inherent hazards of plumbing operations, as contrasted with those created by the environment in which the work is performed, arise primarily in the manual handling of heavy materials and in the use of hand tools. Traffic accidents experienced in moving from job to job also constitute an important source of injuries to plumbers.

## Kinds of Injuries Experienced

Strains and sprains (excluding hernias) were the most common injuries reported for plumbers—nearly a third of the cases—followed by cuts and lacerations (19 percent), bruises and contusions (17 percent), and fractures (10 percent). Of lesser prominence, burns and scalds represented 7 percent of the injury volume; foreign bodies in the eye, 6 percent; and hernias 3 percent. (See appendix tables 1, 2, and 3.)

More than half the strains and sprains were cases involving the back and nearly a fourth were foot and leg injuries. Cuts and lacera-

tions occurred most commonly on the hands and fingers (about half the total) and on the feet and legs (about a fourth). Bruises were common on all parts of the body, but were most frequently reported as leg injuries. The fractures included a relatively high proportion of foot, toe, finger, and rib cases as well as several very serious cases of back and skull fractures. The burns and scalds were primarily hand, eye, and foot cases.

More than 40 percent of the reported injuries occurred when the workers were lifting, moving, or placing objects; 30 percent while the

workers were using hand tools; and 11 percent while they were simply moving about in the workplace. Injuries which happened while moving materials included most of the hernias, well over half the strains and sprains, about half of the fractures, about a third of the bruises, and about a fifth of the cuts and lacerations. In contrast, the injuries experienced while using hand tools included most of the eye cases,

over a third of the cuts and bruises, and many strains, sprains, and fractures. Nearly half the injuries experienced when the workers were moving about the work site were strains or sprains, most of which resulted from trips, slips, or falls on irregular surfaces. Bruises and cuts from contact with rough or sharp materials occurred frequently in this activity and many falls resulted in fractures.

## Accident Analysis

Accident reports frequently are very deficient in specifying the basic causes for injuries. In many instances, the only available information comes from the injured person himself, or from witnesses who lack either the skill or the opportunity to fully investigate the event in order to determine the actual cause of accident. It is common, therefore, to find a high proportion of accident reports which are inadequate for complete cause analysis. This was particularly true of the reports analyzed in this study, inasmuch as they were prepared primarily to satisfy the reporting requirements of the various State workmen's compensation boards. In this type of reporting, injury information is stressed much more than the accident details.

Despite these limitations, however, the analyst can draw much useful information from even the most sketchy accident description. Almost invariably an accident description tends to follow the normal line of thinking on the part of an interested person who hears that a friend or acquaintance has been injured. The first thought is of the injury itself. Was it a burn, a cut, a bruise, a strain, or something else? Then, what produced the injury and how did it happen? These are all descriptive facts which are readily apparent to the witnesses. The more analytical question—Why did it happen?—usually arises only after the desire for descriptive information has been satisfied. It frequently goes unanswered, either because of preoccupation with the descriptive factors, or because the answer may not be readily apparent.

The direct approach in accident analysis, therefore, is to obtain pertinent information in

the order in which it is recorded. The facts should indicate which objects or substances most commonly produce injuries, how they produce the injuries, and should suggest the action necessary for accident-prevention.

## Agencies of Injury

Expressed in broad categories, the principal agencies of injury—i. e., the objects, substances, or bodily reactions which actually inflicted the injuries—were plumbing fixtures, hand tools, working surfaces, hot substances, and flying particles. (See appendix table 8.)

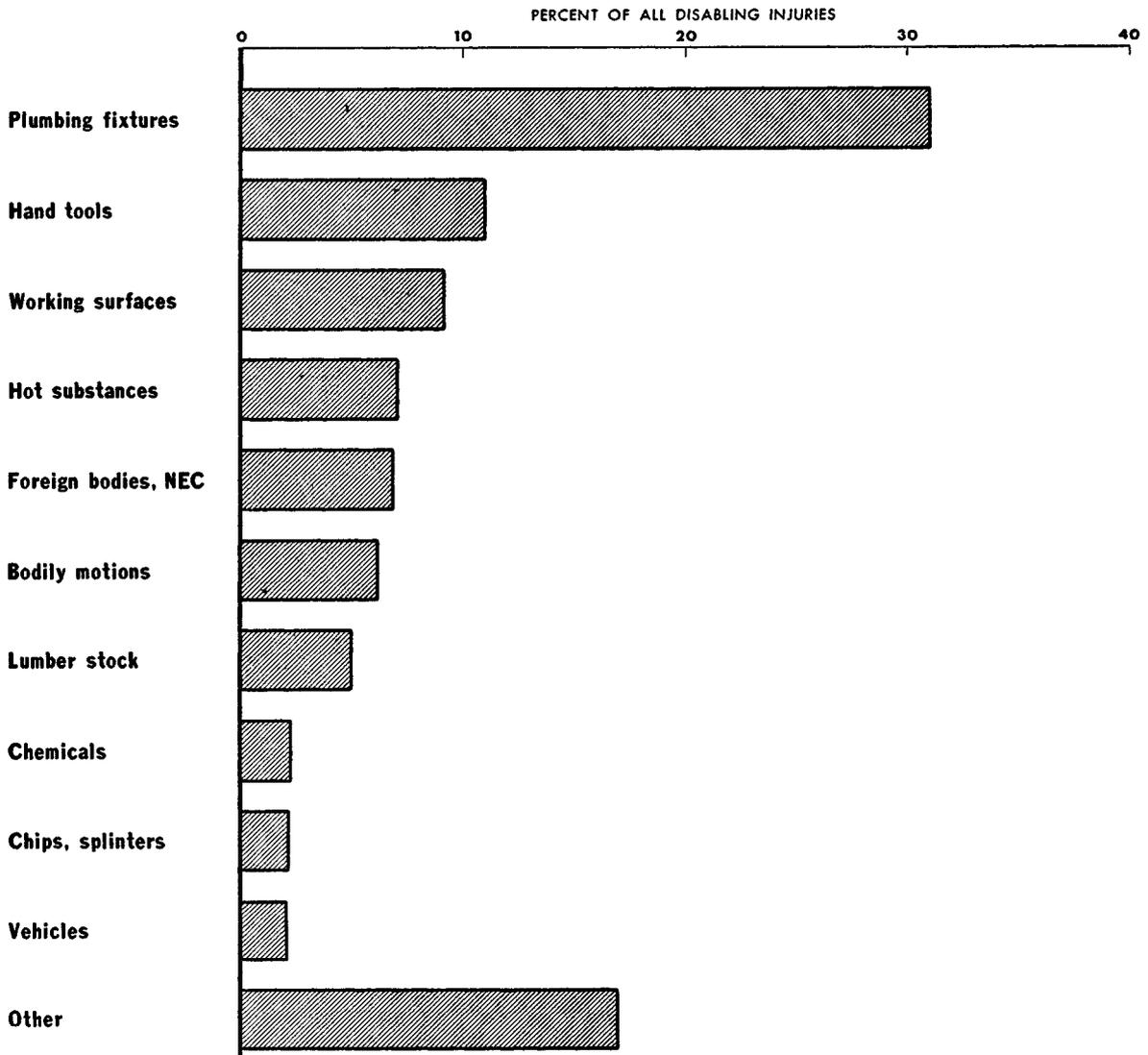
Nearly a third of the injuries resulted from contact with the materials of the trade, such as pipes, tubs, heaters, and sinks. About half these cases were strains or sprains experienced in handling of materials. Bruises and cuts from bumping into, rubbing against, or being struck by the fixtures were common.

About 11 percent of the injuries were inflicted by hand tools, mostly wrenches and hammers. The most common injuries in this category were bruises, resulting from the injured person's striking himself with his own hand tool, followed by strains and sprains due to overexertion in applying the tools.

Contact with working surfaces produced about 9 percent of the injuries. Most commonly these contacts resulted from falls, causing, in many instances, severe bruises, contusions, or fractures.

Surprisingly, about 7 percent of the injuries were burns resulting from contact with hot substances such as molten lead, soldering irons, the flame or heated parts of plumbers' furnaces, steam or hot water, and pipes carrying

CHART 1. AGENCIES OF INJURY IN PLUMBING OPERATIONS



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hot liquids. These generally were not serious injuries, but in the aggregate they accounted for a substantial amount of lost time.

Flying particles produced another 7 percent of the injuries, and came mostly from the use of impact tools such as hammers, chisels, picks, and jackhammers, or high-speed power tools such as saws, buffers, or drills. Wind-borne particles of unknown origin, however, were

relatively common sources of injury. Practically all the injuries inflicted by flying particles were eye injuries, none of which was serious. The possibility of permanent disability from this source, however, should not be minimized. Impact goggles undoubtedly would have prevented practically all of these injuries. Wider use of these protective devices in operations which produce flying particles is indicated.

About 6 percent of the injuries were strains or sprains resulting from bodily reactions rather than from contact with any particular object or substance. These occurred most frequently when the injured person slipped or lost his balance on an irregular surface and overexerted himself in trying to avoid a fall.

Lumber, chemicals, chips, splinters, and vehicles separately were responsible for relatively few injuries, but in the aggregate they were the agencies of injury in about 10 percent of the cases.

### Accident Types

The great majority of the reported accidents fell into four general categories. Accidents in which the injured persons were struck by moving objects accounted for over 28 percent of the injuries; overexertion accidents were responsible for 22 percent. Accidents in which the injured person bumped into or struck against objects produced 14 percent of the injuries, and falls accounted for another 12 percent. (See appendix tables 9, 10, and 11.)

In about half the accidents in the "struck-by" group, pipes, tubs, radiators, and other plumbing fixtures, hand tools, and lumber were the agencies of injury. In a majority of instances the injury-producing objects were dropped by the injured person himself. These accidents usually resulted in crushing injuries to the feet or hands. In proportion, helpers and apprentices experienced more accidents of this type than the journeymen plumbers.

Another important segment of the "struck-by" group consisted of cases involving flying objects, i. e., objects propelled by a force other than gravity. Most of these objects were small particles thrown off by hand tools and most of the injuries affected the eyes. In a number of cases, however, the agencies of injury were wind-blown particles or dusts or larger objects dislodged and carried by the wind. Apprentices appeared to be particularly susceptible to injury by flying particles originating in hand-tool operations.

The third major group of struck-by accidents consisted of cases in which the workers were struck by their own hand tools. Many of these

occurred when the tools slipped from the object to which they were being applied; others were simply cases in which the tools were misdirected. Here again the apprentices experienced more than their proportionate share of these accidents.

Overexertion accidents occurred primarily in the course of lifting, carrying, pulling, or pushing heavy objects, and secondly, in exerting pressure on wrenches or other hand tools. A high proportion of these accidents occurred on steps or stairways—they were even more common than falls at these locations. Accidents in this category were frequently experienced by all classes of plumbing workers, but were the leading source of injury for plumbing superintendents and foremen.

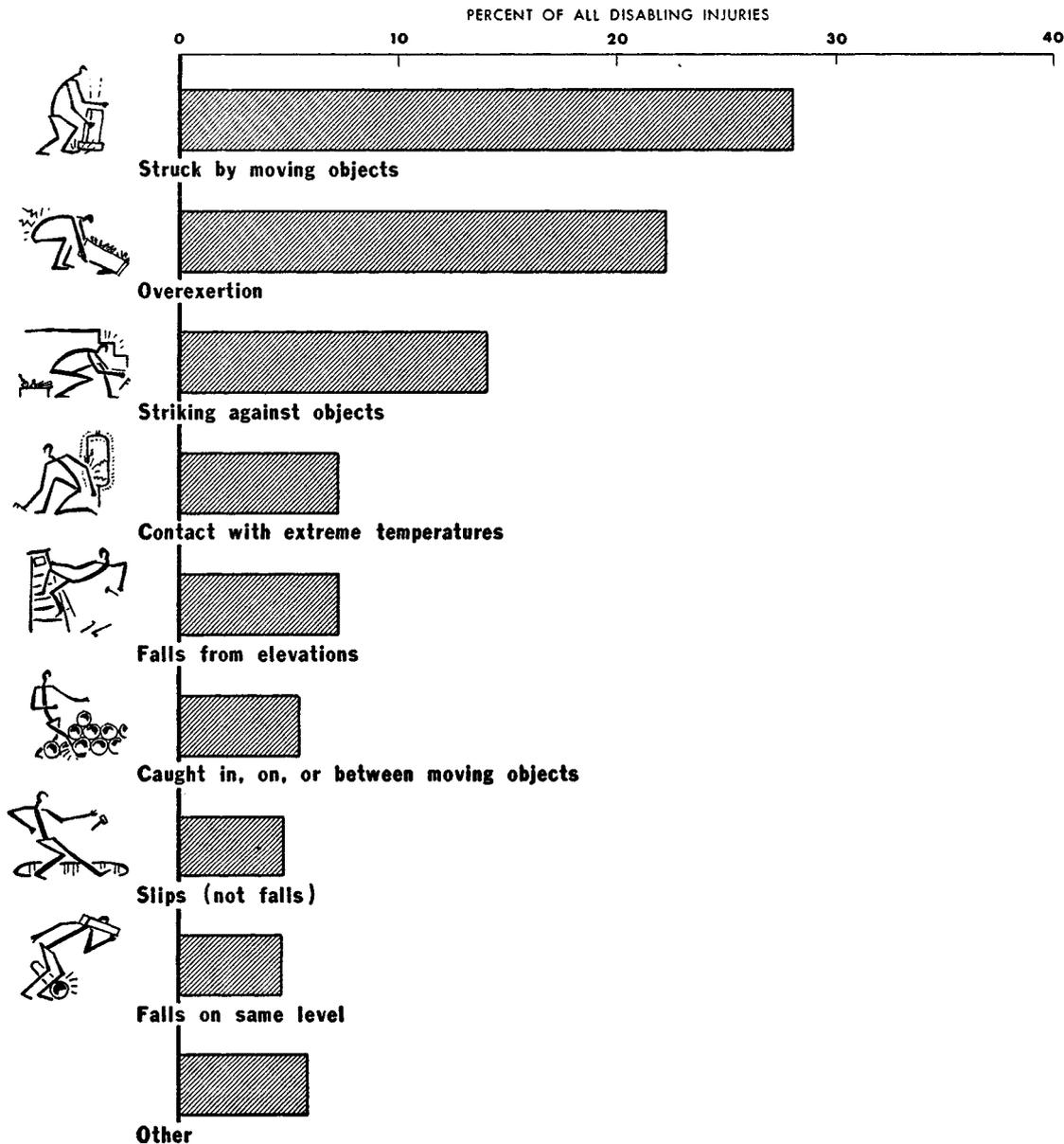
Accidents of the "striking against" type accounted for one in every seven of the reported injuries. About half of these were simple cases of workers bumping against machines, working surfaces, lumber, or hand tools. Poor house-keeping and cramped working spaces led to many of these accidents. Most of the other cases in the group were accidents in which workers stepped on nails or wires, or rubbed against rough or sharp objects. Many of the latter accidents occurred in the course of handling burred pipe, plumbing fixtures, or hand tools. Knee abrasions resulting from kneeling on rough surfaces were common.

Falls produced a wide range of relatively serious injuries. In about a third of these accidents the injured person slipped or tripped and fell to the surface on which he had been walking or standing. Wet, muddy, or icy surfaces, inadequate plank walkways, and loose materials or scrap contributed to many of these accidents. In many instances the workers were carrying bulky or heavy objects when they fell, which not only helped to bring about the fall but also tended to increase the severity of the resulting injuries.

Many falls were from elevations such as ladders, joists, or other open structural members; from regular or makeshift scaffolds or platforms; and on roughed-in stairways. Journeymen and supervisory plumbers had a higher ratio of falls than did helpers or apprentices.

Among the less prominent types of accidents,

Chart 2. MAJOR TYPES OF ACCIDENTS IN PLUMBING OPERATIONS



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the most important were: Those involving contact with hot substances; those in which the injured person was caught and crushed between

two objects; and those in which the worker slipped or stumbled and strained himself in avoiding a fall. The "hot substances" cases

consisted primarily of burns inflicted by molten lead, soldering irons, and hot liquids.

The "caught in, on, or between" cases consisted largely of finger and toe injuries while setting down or moving heavy objects. However, a number of accidents occurred in which the injured person was crushed between moving materials or moving vehicles and fixed objects. The most common trench accidents

were those in which workers were caught under sliding dirt when unsupported trench walls collapsed.

Injury-producing slips and stumbles most commonly were attributed to poor housekeeping or to the use of makeshift working surfaces. They occurred most frequently on the grounds outside buildings under construction, and on stairways and ladders inside buildings.

## Accident Causes

Modern accident prevention is based upon two premises—first, that there is an identifiable cause for every accident; and, second, that when an accident cause is known, it is generally possible to eliminate or to counteract that particular cause as the probable source of future accidents of the same character. In many instances, a variety of circumstances contributes to the occurrence of an accident, and the most desirable accident prevention procedure may be in question because of the many possible alternatives. Generally, however, every accident is traceable to some unsafe working condition, to the commission of an unsafe act by some individual, or to a combination of these accident-producing factors. For the purpose of establishing an effective safety program, therefore, it is essential to identify those elements in the chain of circumstances leading to the accidents. Concentration and emphasis upon the elimination of the unsafe conditions and practices identified by such analysis, will almost invariably result in improved safety records.

The correction of unsafe working conditions generally is entirely within management's powers. The avoidance of unsafe acts, on the other hand, requires cooperation and understanding by both management and workers. Management must take the lead, however, by providing safety-minded supervisors and by making certain that all workers know the hazards of their operations and are familiar with the means for overcoming them.

### Hazardous Working Conditions

Three general groups of hazardous conditions were found to be responsible for most of

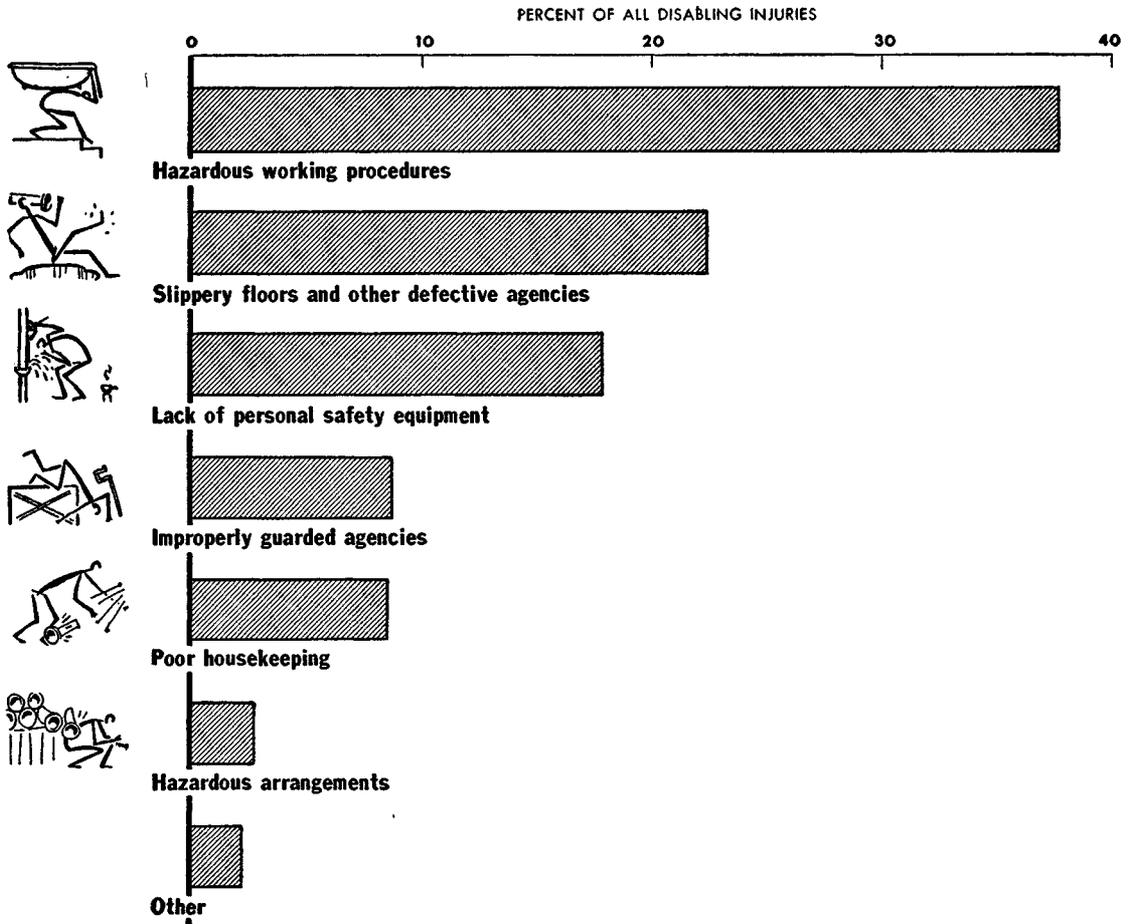
the plumbing accidents: Hazardous working procedures, 38 percent; defective agencies, 22 percent; and the lack of personal safety equipment, 18 percent. Two other groups — inadequately guarded agencies and poor housekeeping—each accounted for approximately 9 percent of the accidents. (See appendix tables 14, 15, and 16.)

*Hazardous working procedures.*—The principal hazard of this group—inadequate help in lifting—grows out of the heavy and bulky nature of many plumbing fixtures, and from the impracticability of using mechanical equipment to move materials on most plumbing jobs. The necessary manual lifting and carrying of materials, moreover, frequently must be performed under very adverse conditions. On new construction the surfaces over which the materials must be moved are usually rough and irregular and may be slippery or littered with debris. On both new construction and repair work the materials frequently must be maneuvered through or into very tight quarters where it is difficult for more than one or two men to participate in the operation.

This combination of circumstances, which make up the general hazard designation—inadequate help in lifting—produced a very high proportion of the overexertion accidents, most of which resulted in strains, sprains, and hernias. A considerable number of "struck-by" accidents, in which the workers dropped materials on their feet while lifting or carrying them, were also attributable to this hazard.

Inadequate help in lifting was the most common accident cause for all classes of plumbing workers. It was the basic cause of 37 percent

**CHART 3. MAJOR TYPES OF UNSAFE WORKING CONDITIONS IN PLUMBING OPERATIONS**



UNITED STATES DEPARTMENT OF LABOR  
BUREAU OF LABOR STATISTICS

of the accidents involving supervisors, 35 percent of those involving helpers, 32 percent of the apprentices' accidents, and 27 percent of the accidents involving journeymen.

The hazardous condition of working without adequate scaffolds or walkways was of less importance in terms of the number of accidents, but was of great importance in terms of the seriousness of the accidents. Specifically, the

principal hazards lay in the lack of scaffolds or platforms for overhead work and in the lack of adequate walkways across open joists, floor openings, and ditches. Most of the accidents resulting from these hazardous conditions were falls.

Inadequate planning or lay-out of work, requiring men to operate in unnecessarily crowded quarters, also resulted in many accidents in

most of which the workers bumped into objects or overexerted themselves in moving materials or equipment while in cramped positions.

*Defective agencies.*— Nearly half the accidents attributed to defects in materials and equipment arose from internal defects which might have been detected during thorough inspection, but which were not of such nature as to be obvious to the workers in normal operations. Ranking high among these hidden defects were: Crystallized metal in chisels, hammers, or other impact tools, which threw off particles when struck; structurally defective ladders and scaffolds, which collapsed under normal loads; weak pipes, which burst under pressure; hot surfaces or flames in unexpected places; internally defective hand tools which broke in normal use; and defective electrical connections in power equipment. The most serious accidents resulting from these unsafe conditions were the falls precipitated by defects in ladders and scaffolds.

Among the more obviously defective agencies found to be responsible for accidents, the most important were slippery surfaces, rough or uneven surfaces, sharp-edged materials, and protruding wires and nails.

Most of the accidents ascribed to slippery, rough, or uneven surfaces were slips or falls—mainly on the grounds adjacent to new buildings rather than inside the structures. In a number of these accidents, however, workers dropped or lost control of materials which were slippery with oil.

The accidents attributed to sharp-edged materials were mostly those in which workers bumped into or rubbed against the edges of fixtures or pieces of metal which they were handling or around which they were working.

Projecting nails, wires, and sharp slivers of wood constituted an extensive hazard for plumbers. A great many accidents were attributed to projecting nails in scrap lumber, particularly to pieces of scrap which had been discarded and left lying about the working premises. For purposes of analysis, these cases were classified in the poor housekeeping category, although they merit consideration along

with other cases that fall in the general group of defective agencies.

Most of the accidents in the latter group were those in which the plumbers bumped into or rubbed against nails projecting through the joists or other framing lumber of the buildings in which they were working. Although the injury possibilities of projecting nails and wires are generally recognized and avoided in spaces of ready access, many workers assume that no hazard exists when the nails or wires project into spaces which are normally inaccessible. Plumbers, however, must run their pipes between the joists under the floors and between the studding in partitions, spaces which are ordinarily considered inaccessible. Many of the accidents attributed to projecting nails or wires occurred while the plumbers were installing or repairing pipes in these areas.

*Lack of personal protective equipment.*—The use of personal protective equipment is not common in the plumbing industry, although the record is replete with cases in which the use of protective devices, such as safety shoes, impact goggles, gloves, safety hats, or knee pads, would have prevented or minimized injuries. Wider use of these devices is unquestionably desirable. In a great majority of cases, however, the use or nonuse of these devices bears no relation to the accident itself. Therefore, because accident analysis is primarily concerned with determining the factors which led to the accident as contrasted with the injury which resulted from the accident, the absence of personal protective devices is seldom indicated as a hazardous working condition.

There are, however, certain operations performed by plumbers involving inherent hazards which can be overcome only through the use of proper protective equipment. Typical of such operations are the breaking, chipping, drilling, or hammering of concrete, stone, or metal. These operations frequently throw off fast-flying chips or particles capable of inflicting serious eye injuries unless the eyes are protected by a face shield or goggles. Similarly, burns are inevitable unless proper gloves and other protective clothing are worn while handling

hot substances, particularly when those substances are liquid or molten and can spill or splash onto the person. Plumbers frequently find it necessary to assume a kneeling position and as a result get cuts and abrasions on their knees from contact with rough surfaces. Knee pads probably would prevent most of these injuries.

Most of the accidents ascribed to the lack of personal protective equipment in this analysis occurred in operations of the types described above. In more than half the cases the deficiency was a lack of goggles or face shields. In most of the other cases it was the lack of gloves, knee pads, or protective boots. It was recognized that steel-toed safety shoes would have prevented many toe injuries, but their non-use was not considered an accident cause.

*Inadequately guarded agencies.* — Because plumbers do not customarily work at great heights, the scaffolds and platforms which they use for overhead work are frequently without railings or toeboards. Also, their ladders frequently have neither safety shoes nor any means by which they can be anchored to prevent slippage. These factors were directly responsible for many accidents in which plumbers fell from scaffolds, platforms, or ladders, and for many others in which materials fell from scaffolds or platforms and struck workers below. A high proportion of all accidents experienced in trench work resulted from inadequate shoring.

*Poor housekeeping.* — Poor housekeeping at the job site was a major source of slips and falls and was the direct cause of many injuries resulting from stepping on projecting nails in scrap lumber. Haphazardly placed materials and scattered debris lying about the workplace present serious hazards to all persons entering the area. These hazards, moreover, are greatly intensified when it is necessary to carry heavy or bulky materials through the area.

About half the accidents ascribed to poor housekeeping occurred when workers stepped on projecting nails and most of the remainder were slips or falls resulting from stepping on or stumbling over loose materials or scrap.

## Unsafe Acts

For the purpose of this analysis an unsafe act was defined as that "violation of a commonly accepted safe procedure which occasioned or permitted the occurrence of the injury-producing accident." Literally, this definition means that no personal action should be designated as unsafe unless there is a reasonable and less hazardous alternative procedure. For example, the use of a ladder which was not equipped with safety shoes when a properly equipped ladder was not provided was classified as a hazardous condition and not as an unsafe act. On the other hand, the use of a nail keg or other makeshift platform as a working surface was classified as an unsafe act because other safe means of reaching overhead work are generally available.

The analysis, however, does not imply that the alternative safe procedure was known to the person who acted in an unsafe manner, nor that his act was the result of a considered choice between two possible procedures. In some instances the individual knew the safe procedure, but consciously decided not to follow it; in others the person acted unsafely simply because he did not know the alternative safe method. There are, therefore, two essential steps in any program designed to eliminate unsafe acts. The first is educational—to make sure that all workers are thoroughly instructed in the safe methods of performing their duties and that they are familiar with the hazards connected with deviations from them. The second step is enforcement—to exercise strict supervision to see that safe procedures are followed.

Generally speaking, the accident reports available for this study were inadequate for a satisfactory unsafe-act analysis. Only about one in every five reports contained sufficient details to permit accurate conclusions regarding the possible commission of an unsafe act. The results of the analysis, therefore, cannot be considered as establishing the general pattern of unsafe acts in plumbing operations. The fact that 80 percent of the reports contained no information pointing to the commission of an unsafe act does not mean that unsafe acts are

a factor in the occurrence of only 20 percent of plumbing accidents.

Despite the limitations of the data, which prevent quantitative conclusions, it is possible to draw from the material a generalized picture of some of the most common types of unsafe acts which lead to plumbing accidents. In broad categories the most prominent unsafe acts consisted of: Gripping objects insecurely; inattention to footing; inattention to surroundings; taking an unsafe position; exerting excessive pressure; and failing to secure materials or warn others of material movement. (See appendix table 17.)

*Gripping objects insecurely.*—Reflecting the preponderance of manual operations in the plumbing field, a large proportion of the accidents were directly related to improper methods of handling tools and materials. In many instances, workers dropped objects on their own toes or set objects down on their fingers simply because they had not taken or maintained a proper grip on the materials. In other instances, workers were struck by their own hand tools because they were not holding the tools properly to keep them under control. In some cases, the fault lay in attempting to lift too many objects at one time or in using one hand instead of two. In still other cases, workmen attempted to lift irregular, slippery, or hot objects by grasping only a small section and found it impossible to hold them because they were unbalanced.

*Inattention to footing.*—Because of the irregular surfaces and poor housekeeping conditions so frequently encountered in the areas where plumbers must work, the primary safety admonition "Watch your step" should have special significance to these workers. The number of missteps into openings and stumbles over misplaced materials which should have been quite visible, however, indicates that this precept is frequently forgotten. Cases in which workmen stepped on loose objects and fell

while getting down from ladders or descending stairs were quite common.

*Inattention to surroundings.*—Many reports indicated that the injured workers had simply walked into piled materials, posts, or parts of the buildings in which they were working. Others apparently forgot where they were and walked over the edge of platforms. Still others swung their tools too widely or raised their heads too sharply while working in confined spaces, and were injured when they struck obstructions. Unsafe conditions contributed to most of these accidents, but they generally resulted from the combination of a hazardous condition and an unsafe act.

*Assuming an unsafe position.*—The unsafe acts in this group consisted primarily of applying hand tools in such a manner that a slip would direct the tool against the user's body or against the person of another worker. Also included were cases of working or standing directly under overhead operations; jumping from platforms or other elevations instead of climbing down; working or standing in the line of moving objects; working from makeshift supports; and climbing on open structural members or walking on open joists.

*Exerting excessive pressure.*—Most of the cases in this group are workers who attempted to perform alone, heavy tasks in which they obviously should have had assistance. These accidents frequently occurred in the use of wrenches to tighten fittings, or in the use of pry bars to move heavy equipment.

*Failure to secure or warn.*—A high proportion of these accidents resulted in injury to persons other than those who committed the unsafe acts. These included cases in which workers started machines or vehicles, or moved heavy materials without first making sure that every one in the vicinity was in the clear, as well as cases in which materials were placed in positions from which they could roll or fall, and were left without proper blocking.

## Accident Prevention Suggestions

To illustrate the general hazards encountered by plumbers, a number of typical accidents were selected for specific comment. These accidents were analyzed by a member of the Division of Safety Standards in the Bureau of Labor Standards of the United States Department of Labor and suggestions were made as to how they might have been prevented.

The purpose of this portion of the report is not to make all-inclusive recommendations, nor to make authoritative safety rules for the industry, but rather to point to a simple approach in the prevention of nearly every type of accident. Many safety engineers, no doubt, would attack the problems involved in these accidents in different ways and would achieve equally good results. The method of prevention is of little importance as long as it accomplishes its purpose.

Brief descriptions of the selected accidents accompanied by the comments and recommendations of the Bureau of Labor Standards' safety specialist are given on the following pages.

### Case Descriptions and Recommendations

1. A plumber was installing pipes in a cellar. As he entered an unlighted area under a stairway, he stepped on a rusty nail protruding from a piece of lumber.

(a) *Before starting work, a plumber should inspect the area in which he will work. He should make a note of all existing hazards and, where possible, correct or eliminate them. Workmen should never enter unlighted areas without flashlights or other lighting equipment.*

(b) *Good housekeeping is essential for safety, not only for plumbers but also for all other construction workers and for householders as well. Loose lumber should never be left lying on floors or walkways.*

(c) *A basic safety rule is that all nails in scrap lumber should be removed or bent into the wood before the piece is discarded.*

2. A helper was loading used lumber onto a truck. A nail projecting from one of the boards punctured his hand.

*Projecting nails should be removed or bent into the lumber as it is removed from service.*

3. A plumber was installing pipe in a bathroom. While he was crawling on the rough concrete, he bruised his knee and infection developed.

*Knee pads probably would have prevented this injury.*

4. A helper was using a snake to free a clogged sewer. The cable broke and cut his thumb. Investigation disclosed that the cable was frayed because of extended use.

*All equipment should be inspected before it is placed in service. In this case, an inspection should have disclosed the frayed cable and it should have been replaced.*

5. A plumber was riding on top of a load of pipe. During transit, the load shifted, throwing him to the ground. Part of the load then fell on him, striking his shoulder and arm. Investigation disclosed that the load had not been secured against unexpected movements.

(a) *Truckloads should be tied or otherwise secured against unexpected movements during transit.*

(b) *Employees should never ride on top of the load. Instead, they should ride in the cab of the truck or, if there is not sufficient room, in a second vehicle.*

6. A plumber was working in a ditch. A stone fell from the bank and struck his arm. Investigation disclosed that the stone had been removed from the ditch and placed on the bank. The weight of the stone gradually loosened the dirt under it, permitting the stone to fall.

*Material removed from a ditch should be piled at least 18 inches from the edge of the ditch.*

7. A plumber was using an electric drill on a piece of metal which he was holding in his hand. When the drill pierced the metal it lacerated his hand.

*A drill should never be applied to hand-held material. The material should be held in a clamp or vise.*

8. A plumber was using a portable vise fas-

tened to a joist. When he removed a fitting from the vise, the vise pulled loose from the joist and fell on his toes. Investigation disclosed that the plumber had neglected to fasten the vise securely.

(a) *Obviously the vise should have been clamped securely. The basic training of any worker should develop an ability to recognize hazards of this nature and emphasize the need for proper precautions.*

(b) *Steel-toed safety shoes would have prevented the injury.*

9. A truck driver and a plumber's helper were carrying a bathtub from the stockroom in a warehouse to a truck. When the tub slipped from the truck driver's hands, the helper lost his grip and the tub fell, striking the helper's knee.

(a) *Mechanical equipment should be used for heavy or large loads wherever practicable. In this case, the use of a hand truck to move the tub would have been feasible.*

(b) *Training in material-handling operations should emphasize taking and maintaining a firm grip on the materials handled.*

10. A plumber was working under a scaffold being used by a brick mason. When a load of concrete blocks was placed on the scaffold, the scaffold collapsed, pinning the plumber under it. Investigation disclosed that the scaffold had been overloaded.

(a) *Load limits should be determined for every scaffold. Adequate supervision should be provided to assure that the limit is not exceeded.*

(b) *Whenever practicable, work assignments should be planned to avoid anyone's having to work in unprotected areas while other operations are being performed overhead.*

11. A plumber was moving a piece of pipe. It slipped through his hands, which were covered with oil, and fell on his foot.

(a) *Employees should be carefully instructed in the safe method of lifting heavy and large objects. When their hands are oily or greasy, they should never attempt to lift objects.*

(b) *Workmen handling heavy objects should wear steel-toed safety shoes.*

12. A plumber was working on the ground floor of a building while a carpenter was laying subflooring on the second floor. A board slipped from the carpenter's hands, fell through the joists, and struck the plumber on the head.

(a) *Whenever practicable, assignments should be planned to avoid work in unprotected areas while other operations are being performed overhead. In this case, the plumbing should have been delayed until the subflooring on the second floor was completed.*

(b) *All construction workers should be encouraged to wear safety hats while they are on the job.*

13. A plumber attempted to lift a piece of pipe which had a thin coating of oil on it. The pipe slipped from his hands and dropped on his foot. Investigation disclosed that the oil had been placed on the pipe to prevent rusting.

(a) *This is a particularly difficult hazard to overcome. Gloves generally are not the answer, because they become slippery when they absorb oil. A common and fairly successful practice in operations other than the piling of pipe is to use a clean wiping rag as a hand pad in taking a grip on the oily material.*

(b) *Employees engaged in this work should wear steel-toed safety shoes.*

14. A workman was using a hammer and chisel to cut a length of cast-iron pipe. A section of the pipe shattered and a small piece of the pipe lodged in his eye.

*Cast iron is brittle and very likely to break or shatter when struck. For this type of work, goggles or protective face shields are necessary.*

15. An apprentice was using a hammer and chisel to remove scale from a boiler. A piece of rust from the boiler lodged in his eye.

*For this type of work, goggles or other suitable eye protective devices are necessary.*

16. A plumber was using a hammer and chisel to cut through a concrete wall. A piece of the chisel broke off and punctured the workman's knee. Investigation disclosed that the head of the chisel was badly mushroomed and the metal had crystallized.

(a) *All tools should be inspected frequently on a regular schedule. Chisels with mushroomed heads should be removed from service and should not be returned to service until they are properly dressed.*

(b) *Employees engaged in this work should be provided with, and required to wear, impact goggles.*

17. An employee was using an electric drill on a pipe. A small piece of steel flew from the pipe and lodged in his eye.

*Power drills, both fixed and portable, frequently throw off chips or sharp particles when used on metal. Goggles or face shields should always be worn while drilling metal.*

18. A plumber was using a wrench to tighten a pipe on a water heater. A piece of rust flew from the pipe and lodged in his eye.

(a) *Rust should be removed from any pipe before the jaws of a wrench are placed over it.*

(b) *Safe practice demands eye protection on all work of this type.*

19. A plumber's helper was using a sledge hammer to break a large stone so that it could be removed from a ditch. A small piece of the stone flew from the rock and lodged in the helper's eye.

*Employees engaged in this work should be furnished with, and required to wear, protective goggles.*

20. An apprentice was using a pocket knife to cut linoleum. The blade of the knife closed suddenly, cutting his finger.

*Apprentices should be carefully instructed in the safe performance of their duties. A spring-blade knife should never be used in this work; instead, a one-piece knife, properly guarded, should be used.*

21. A plumber was operating a threading machine. While he was adjusting a short piece of pipe in the jaws of the machine, the front of his overalls caught the switch, closing it. As a result, the automatic jaws of the machine closed and mashed his fingers.

*The switch should be located or protected so as to prevent unintentional contact with it.*

22. A plumber pulled the belt of a well pump to start it. When the pump started, his fingers were caught between the belt and the pulley.

(a) *This illustrates the need for guarding all nip points, even on small belts of this type. Had this pulley been properly guarded, nothing more than a slight bruise or scratch would have resulted.*

(b) *In any event, no belt should ever be moved manually when the power is on. If the motor will not start it, the power should be cut off and an inspection made to determine the trouble.*

23. A plumber was using an electric drill to remove a stud. The leg of his trousers caught in the drill and, before he could open the switch, the drill had lacerated his leg.

*All power drills should be equipped with "dead-man controls," which will automatically cut the power when the operator relaxes his grip.*

24. An apprentice was shoveling dirt from a ditch which was 12 feet deep. The brace holding the sides of the ditch broke, and the ditch caved in, causing the employee a sprained shoulder.

*Investigation disclosed that the ditch was in filled ground and that the soil was unstable. The ditch was shored and braced, but in this kind of soil it should have been sheet-piled for maximum protection. The shoring probably would have been inadequate to hold the soil even if the brace had not failed.*

25. A worker was helping to carry a bathtub up a stairway. His fingers were squeezed between the wall and the tub and badly lacerated. Infection developed. Investigation disclosed that he grasped the tub at the sides instead of the end.

*Careful instruction and close supervision are necessary to prevent accidents of this type. Workmen who are required to lift heavy or large objects should be instructed in working as a team. In this case, the workman should have grasped the tub at the end instead of at the sides.*

26. A plumber was descending a ladder. As

he stepped to the floor, he slipped on some small pieces of wood near the foot of the ladder and fell against the wall, bruising his shoulder. Investigation disclosed that the small pieces of wood were waste material from carpentry operations and that the working surface had not been cleaned when the carpenters completed their work.

*A case of poor housekeeping and inattention to footing. All working crews should be required to clean up their own scrap. The plumbing supervisor should have made certain the working surface was clear before his man started work. Furthermore, anyone using a ladder should make certain the surface at the base of the ladder is clear before going up. In descending a ladder the handhold should never be released nor the full weight shifted from one foot to the other until a firm footing, for the foot taking the weight, is assured.*

27. An apprentice was carrying a box of supplies from a truck when he stepped in a hole in the ground and fell, spraining his ankle. Investigation disclosed that the workman could not see the hole because he was carrying the box in front of him.

*(a) All plumbers should be carefully instructed in the safe method of handling materials. In this case, the workman should have carried the box in such a position that he could observe the surface on which he was walking.*

*(b) Before engaging in this work, an inspection should have been made of the surface. Holes should have been filled in or covered by an adequate walkway.*

28. A plumbing superintendent stood on a steel girder to direct the moving of a tank. He fell from the girder and struck a pump 13 feet below, experiencing multiple contusions and lacerations.

*A girder is not a safe working platform. In this case, the superintendent probably could have selected a safer position from which to direct the operation or, if it was necessary to stand on the girder, a lifeline could have been used for his protection.*

29. A plumber stood on a chair to hang a one-half-inch pipe. When he stepped to the

edge of the chair, it tipped, throwing him to the floor.

*Chairs should never be used as working surfaces. A properly constructed scaffold or a working platform should have been provided for this work.*

30. A plumber was sitting on the floor joists installing copper pipe. He slipped and fell between the joists, cutting his arm on an electric receptacle as he fell.

*Employees should not be permitted to work from floor joists. Planks laid across the floor joists would provide a suitable working surface.*

31. An apprentice plumber was working on the third floor of a house under construction. He stepped backward and fell through an opening which had been made for a stairway. He fell to the basement and suffered multiple bruises.

*Any temporary opening in the floor of a building under construction should be enclosed by a guardrail and toeboard or should be covered until it is to be used.*

32. A sewer was being installed for a new home. A 10-inch plank had been placed between the ground and the doorstep to permit construction workers to cross the ditch which had been dug for the sewer. As a plumber's helper was walking on the plank, a strong wind caused him to lose his balance and he fell into the ditch.

*The walkway was entirely too narrow. Two or more planks, cleated together, should be provided for the walkway.*

33. An apprentice was standing on a ladder installing a pipe. The ladder slipped and the employee fell against a wall. Investigation disclosed that the ladder was neither equipped with safety treads nor anchored at the top.

*(a) All ladders should be equipped with safety treads and, if possible, anchored at the top.*

*(b) This accident emphasizes the importance of training all workers to do their work safely. Unless the journeyman practices safety in his work, the apprentices assigned to him are likely to adopt his unsafe habits.*

34. A plumber was standing on a nail keg "roughing in" plumbing. He fell from the keg and fractured his wrist.

*Nail kegs should never be used as working surfaces. A properly constructed scaffold or a working platform should have been provided for this work.*

35. A plumber stood on a sawhorse to solder an overhead pipe. His foot slipped from the sawhorse and he fell.

*Sawhorses should never be used as working surfaces. A properly constructed scaffold or a working platform should be provided for this type of work.*

36. A plumber stepped on joists to reach a ladder. He lost his balance and fell through the joists to the floor below.

*Workmen should not walk on joists. Adequate walkways should be constructed by laying planks across the joists.*

37. A helper tripped and fell down the stairs in a new house. Investigation disclosed that the steps had been covered with paper held in place by fiberboard. A strip of paper near the top of the stairs had not been fastened. It rolled up and tripped the helper.

*Temporary treads should always be fastened in place. A regular and systematic inspection of the premises would probably have revealed this unsafe condition.*

38. A plumber stepped on the rail of a stock bin to get a piece of pipe from the top of the bin. The rail loosened and the employee fell, spraining his ankle.

(a) *Stock bins should be located so they can be reached from the floor.*

(b) *Where stock bins cannot be reached from the floor, a working platform or a step ladder should be provided.*

39. A plumber was checking floor measurements with the superintendent. He stepped from a soil pipe to a nail keg which overturned and threw him to the floor. Investigation disclosed that the area was littered with plumbing supplies.

(a) *Good housekeeping is essential to safety*

*in any operation. Plumbing supplies should be safely stored in an orderly manner. Periodic inspections and adequate supervision should be maintained to enforce this rule.*

(b) *Construction workers should not use soil pipes, nail kegs, boxes, sawhorses, chairs, or other makeshifts as substitutes for adequate ladders or working platforms.*

*In this case, the superintendent should have ordered the place cleaned up and should have stopped the plumber from climbing on the soil pipe and keg. Supervisory indifference to hazardous conditions encourages workmen to take unnecessary chances.*

40. A plumber erected a scaffold from used lumber which he found at the job site. When he mounted it, one of the planks broke and he fell to the ground. Investigation disclosed the plank to be badly split.

*Lumber used in the construction of scaffolds should be sound and straight-grained. Periodic inspections and close supervision should be provided to enforce this rule.*

41. As an apprentice was climbing a ladder, a rung broke and he fell to the ground, bruising his heel. Infection developed. Investigation disclosed that the ladder had been made at the job site and the rung had split through a knot.

*Lumber used in the construction of ladders should be sound, straight-grained, and free from knots. Regular inspections and adequate supervision should be provided to enforce this rule.*

42. A plumber was on a scaffold installing pipes, when he misstepped off the end, and fell to the ground. Investigation showed no guard-rail or toeboard on the scaffold.

*Scaffolds should be constructed with guard-rails and toeboards.*

43. While walking across the floor of the shop, a plumber stepped on a short piece of pipe. The pipe rolled and the employee twisted his back trying to maintain his balance. Investigation disclosed that a helper had cut the end from a pipe and dropped it on the floor. It had then rolled into the passageway.

*All employees should be carefully instructed*

*in the need for good housekeeping. In this case a scrap box placed near the work table might had led to better housekeeping and might have prevented the accident.*

44. A plumber was using a pipe wrench to remove a union from a section of pipe. While pulling on the wrench he placed his foot on a second wrench which he was using to steady the pipe. His foot slipped off the second wrench and he strained his back.

*Workmen should be carefully instructed in the safe method of using hand tools. In this case the plumber should have grasped a wrench in each hand. If additional force was necessary, a second employee should have been assigned to hold the second wrench.*

45. While he was kneeling, a plumber lifted a cast-iron soil pipe and strained his back. Investigation disclosed that the section of pipe weighed 120 pounds.

*Thorough instruction in the safe handling of materials should be a part of the training given every plumber. Even under the best conditions a 120-pound lift generally should be a 2-man operation; from a kneeling position, 120 pounds is obviously too heavy for any man to lift.*

46. A plumber on a scaffold attempted to lift a section of soil pipe being handed up to him. The section weighed approximately 120 pounds. As he was pulling the pipe onto the scaffold, he twisted his back.

*Thorough instruction in safe handling of materials should be a part of the training given every plumber. In this case a block and fall probably should have been used to lift the heavy pipe.*

47. A plumber and his helper were lifting a bathtub onto a truck. The helper set his end down without warning, throwing the weight onto the plumber. As a result, the plumber strained his back.

*Coordination of effort is essential for safety whenever two or more persons are lifting together. One person in the team should signal each move and the others should carefully follow his instructions. Supervisors should make*

*sure all workers know and follow safe-lifting procedures.*

48. A plumber walked across the floor joists to deliver a pot of hot lead. When he stepped on a loose joist, it turned and he dropped the pot. The lead splashed and burned his eye. Investigation disclosed that the carpenters had overlooked nailing the joist.

*Workmen should never walk on floor joists. A properly constructed walkway should be provided.*

49. A plumber was running a lead joint in a soil pipe. Water in the pipe caused the molten lead to explode and the employee's face and head were severely burned.

*All water and moisture should be removed from the pipe before this work is started. Supervisors should be responsible for determining when the operation can be safely undertaken.*

50. A plumber was using a wrench to tighten a bolt on a hanger. When the wrench slipped, the workman brushed against a hot valve and burned his arm. Investigation disclosed that the employee had not adjusted the jaws of the wrench properly.

*Thorough instruction in the safe method of using hand tools should be a part of the training given every plumber. Wrenches should be properly adjusted before any pressure is applied.*

51. While a plumber was engaged in wiping a joint, some hot solder fell from it and burned his arm.

*Sleeves of leather or fireproof duck should be worn in this work.*

52. A plumber was adjusting the gas burners on a steam table. When he struck a match and opened the gas line, an explosion occurred. Investigation disclosed that the manufacturer of the steam table had neglected to place a cap on the end of the gas line.

*All new equipment should be carefully inspected before it is placed in service.*

53. A plumber's helper was carrying hot lead in a ladle. He tripped over a piece of

lumber and fell, spilling the lead into his shoes. Investigation disclosed that the lumber was left by carpenters who had just completed laying the floor.

(a) *Good housekeeping is essential to safety in any operation. The piece of lumber should have been removed from the working surface before the helper engaged in this work.*

(b) *The use of personal protective devices such as gloves, goggles, etc., is desirable for workmen handling hot lead.*

54. A plumber was melting lead. When he dropped a piece of cold lead into the pot, hot lead splashed from the melting pot into his eye.

*Employees engaged in this work should wear protective goggles or face shields.*

55. A plumber was carrying a can of hot tar up a ladder. He tipped the can and spilled the hot tar on both hands.

*Employees should never attempt to carry objects up ladders. A hand line should have been used to raise the hot tar.*

56. A plumber poured molten lead into a ladle which had small beads of moisture on it. An explosion resulted and the plumber's face was burned.

*To eliminate moisture, ladles should be preheated before molten metal is poured into them.*

57. When a foreman plumber entered a well to set a pump, he was overcome by gas fumes. Two men attempted to rescue him but during the rescue they dropped him back into the well. The foreman suffered a sprained and bruised back.

*A test for gas should be made before any workman enters a well or other confined space. Safe practice dictates that a supplied-air respirator should be used in any contaminated*

*area or in any confined space which has not been tested for the presence of gas.*

58. An apprentice was working in the basement of a new house. Fumes from an open salamander caused congestion of his respiratory passages. Investigation disclosed that the basement was closed and no ventilation had been provided.

*Salamanders should never be used in closed or unventilated areas.*

59. An employee was using a hammer to fasten a pipe hanger into place in the basement. While he was doing this, the hammer jarred several pieces of plaster loose from cracks in the subflooring. The plaster fell, burning the workman's eyes.

*Goggles are desirable for eye protection in any form of construction work and are particularly important on overhead construction work.*

60. A plumber suffered flash burns of both eyes while working near arc welding operations.

(a) *Welding operations should be properly shielded or enclosed.*

(b) *Employees working near arc welding operations should be provided with, and required to wear, protective goggles.*

61. A plumber received a slight shock while using an electric hammer in an overhead position. This shock caused him to relax his grip, and the hammer fell, striking him on the head. Subsequent inspection of the tool revealed a short in the wiring.

(a) *All electrical tools should be effectively grounded.*

(b) *All tools, electrical or not, should be given periodic inspections on a regular schedule and should be withdrawn from service if they are defective in any way.*

## Appendix—Statistical Tables

TABLE 1.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by nature of injury and occupation of injured

Nature of injury	All workers		Journeyman		Apprentices		Helpers		Superintendents, foremen	
	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>
Total .....	2,719	100.0	2,040	100.0	245	100.0	402	100.0	32	100.0
Amputations, enucleations.....	12	.4	11	.5	49	20.3	1	.3	5	16.7
Bruises, contusions.....	467	17.4	343	17.0	42	17.4	61	15.3	5	16.7
Without infection.....	404	15.1	296	14.7	7	2.9	9	2.3	2	6.7
With infection.....	63	2.3	47	2.3	1	.4	7	1.8	3	10.0
Burns, scalds.....	195	7.3	151	7.5	18	7.4	24	6.0	3	10.0
Chemical burns.....	30	1.1	22	1.1	1	.4	7	1.8	1	3.3
Cuts, lacerations.....	527	19.6	386	19.1	43	17.8	95	23.9	2	6.7
Without infection.....	405	15.1	289	14.3	36	14.9	77	19.4	3	10.0
With infection.....	122	4.5	97	4.8	7	2.9	18	4.5	1	3.3
Foreign bodies, not elsewhere classified.....	170	6.3	132	6.5	18	7.4	19	4.8	2	6.7
Fractures.....	268	10.0	206	10.2	23	9.5	37	9.3	2	6.7
Hernias.....	78	2.9	53	2.6	10	4.1	13	3.3	2	6.7
Industrial diseases.....	40	1.5	29	1.4	3	1.2	7	1.8	1	3.3
Strains, sprains.....	880	32.7	668	33.2	75	31.1	123	30.9	14	46.6
Other.....	22	.8	19	.9	2	.8	1	.3	2	6.7
Unclassified; insufficient data.....	30	.....	20	.....	3	.....	5	.....	2	.....

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.<sup>2</sup> Percents are based on classified cases only.TABLE 2.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by nature of injury and location of accident

Nature of injury	Number of accidents occurring—											
	On floors		On ground (except excavations)		On ladders		In ditches or other excavations		Under houses		On steps or stairs	
	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>
Total .....	246	100.0	112	100.0	102	100.0	101	100.0	97	100.0	77	100.0
Amputations, enucleations.....							1	1.0				
Bruises, contusions.....	54	22.3	17	15.2	27	26.5	19	18.8	18	18.6	11	14.5
Without infection.....	43	17.8	15	13.4	24	23.6	17	16.8	11	11.4	11	14.5
With infection.....	11	4.5	2	1.8	3	2.9	2	2.0	7	7.2		
Burns, scalds.....	7	2.9			4	3.9	6	5.9	3	3.1		
Chemical burns.....	2	.8							2	2.1		
Cuts, lacerations.....	85	35.1	26	23.2	6	5.9	14	13.9	14	14.4	4	5.3
Without infection.....	69	28.5	24	21.4	5	4.9	11	10.9	6	6.2	2	2.7
With infection.....	16	6.6	2	1.8	1	1.0	3	3.0	8	8.2	2	2.6
Foreign bodies, not elsewhere classified.....	4	1.7					1	1.0	10	10.3		
Fractures.....	10	4.1	12	10.7	21	20.6	17	16.8	2	2.1	6	7.9
Hernias.....	6	2.5	1	.9	2	2.0	1	1.0			3	3.9
Industrial diseases.....							2	2.0	16	16.5		
Strains, sprains.....	74	30.6	56	50.0	42	41.1	40	39.5	30	30.8	52	68.4
Other.....									2	2.1		
Unclassified; insufficient data.....	4	.....									1	.....

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.<sup>2</sup> Percents are based on classified cases only.

TABLE 3.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by nature of injury and activity of injured

Nature of injury	Activity when injured											
	Using hand tools		Walking, stepping, etc.		Lifting objects		Carrying objects		Placing objects		Other	
	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>
Total .....	623	100.0	239	100.0	481	100.0	245	100.0	118	100.0	345	100.0
Amputations, enucleations.....	4	.6			1	.2			1	.9	3	9.0
Bruises, contusions.....	110	17.8	47	19.8	48	10.1	43	17.8	32	27.6	55	16.1
Without infection.....	95	15.4	38	16.0	46	9.7	38	15.7	29	25.0	52	15.2
With infection.....	15	2.4	9	3.8	2	.4	5	2.1	3	2.6	3	.9
Burns, scalds.....	47	7.6	2	.8	4	.8	2	.8	2	1.7	85	24.8
Chemical burns.....	9	1.5									15	4.4
Cuts, lacerations.....	150	24.2	60	25.4	35	7.4	21	8.7	17	14.7	59	17.3
Without infection.....	123	19.8	52	22.0	30	6.3	16	6.6	14	12.1	42	12.3
With infection.....	27	4.4	8	3.4	5	1.1	5	2.1	3	2.6	17	5.0
Foreign bodies, not elsewhere classified.....	108	17.4	1	.4	2	.4			2	1.7	20	5.9
Fractures.....	54	8.7	23	9.7	38	8.0	26	10.7	24	20.7	34	10.0
Hernias.....	6	1.0			44	9.2	16	6.6	3	2.6	4	1.2
Industrial diseases.....	1	.2	2	.8					1	.9	7	2.1
Strains, sprains.....	126	20.4	102	43.1	304	63.9	184	55.4	34	29.2	55	16.1
Other.....	4	.6									4	1.2
Unclassified; insufficient data.....	4		2		5		3		2		4	

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.<sup>2</sup> Percents are based on classified cases only.TABLE 4.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by part of body injured and occupation of injured

Part of body injured	All workers		Journeyman		Apprentices		Helpers		Superintendents, foremen	
	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>
Total .....	2,719	100.0	2,040	100.0	245	100.0	402	100.0	32	100.0
Head.....	401	14.8	300	14.8	42	17.2	58	14.6	1	3.2
Eye.....	274	10.1	206	10.2	29	11.9	38	9.5	1	3.2
Brain or skull.....	32	1.2	25	1.2	2	.8	5	1.3		
Other.....	95	3.5	69	3.4	11	4.5	15	3.8		
Trunk.....	802	29.7	606	29.7	70	28.7	112	28.2	14	45.2
Chest, lungs, ribs, etc.....	107	4.0	85	4.1	9	3.7	11	2.8	2	6.5
Back.....	504	18.6	385	18.8	40	16.5	72	18.0	7	22.6
Abdomen.....	96	3.6	64	3.2	13	5.3	15	3.8	4	12.9
Shoulder.....	66	2.4	52	2.6	5	2.0	9	2.3		
Other.....	29	1.1	20	1.0	3	1.2	5	1.3	1	3.2
Upper extremities.....	671	24.8	509	25.1	59	24.2	98	24.7	5	16.1
Arm.....	138	5.1	110	5.4	5	2.0	20	5.0	3	9.6
Hand.....	262	9.7	201	10.0	25	10.2	34	8.6	2	6.5
Finger.....	271	10.0	198	9.7	29	12.0	44	11.1		
Lower extremities.....	706	26.1	523	25.8	63	25.8	112	28.2	8	25.8
Leg.....	284	10.5	218	10.7	19	7.8	42	10.6	5	16.1
Foot.....	310	11.5	230	11.4	31	12.7	47	11.8	2	6.5
Toe.....	112	4.1	75	3.7	13	5.3	23	5.8	1	3.2
Body—general.....	123	4.6	93	4.6	10	4.1	17	4.3	3	9.7
Unclassified; insufficient data.....	16		9		1		5		1	

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.<sup>2</sup> Percents are based on classified cases only.

TABLE 5.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by part of body injured and location of accident

Part of body injured	Number of accidents occurring—											
	On floors		On ground (except excavations)		On ladders		In ditches or other excavations		Under houses		On steps or stairs	
	Number	Per- cent <sup>2</sup>	Number	Per- cent <sup>2</sup>	Number	Per- cent <sup>2</sup>	Number	Per- cent <sup>2</sup>	Number	Per- cent <sup>2</sup>	Number	Per- cent <sup>2</sup>
Total	246	100.0	112	100.0	102	100.0	101	100.0	97	100.0	77	100.0
Head	15	6.1	2	1.8	2	2.0	8	7.9	19	19.8	1	1.3
Eye	7	2.9					2	2.0	12	12.5		
Brain or skull	2	.8				1	1.0		2	2.1		
Other	6	2.4	2	1.8	1	1.0	6	5.9	5	5.2	1	1.3
Trunk	62	25.2	32	28.6	33	32.7	40	39.7	28	29.2	32	42.0
Chest, lungs, ribs, etc.	14	5.7	4	3.6	6	5.9	5	5.0	2	2.1	2	2.6
Back	34	13.9	22	19.6	16	15.9	24	23.8	23	24.0	20	26.3
Abdomen	6	2.4	2	1.8	2	2.0	2	2.0			3	3.9
Shoulder	3	1.2	2	1.8	7	6.9	7	6.9	3	3.1	5	6.6
Other	5	2.0	2	1.8	2	2.0	2	2.0			2	2.6
Upper extremities	37	15.0	11	9.8	23	22.8	18	17.8	14	14.6	10	13.2
Arm	12	4.9	2	1.8	14	13.9	3	3.0	7	7.4	3	3.9
Hand	14	5.6	5	4.4	8	7.9	7	6.9	6	6.2	3	3.9
Finger	11	4.5	4	3.6	1	1.0	8	7.9	1	1.0	4	5.4
Lower extremities	126	51.3	65	58.0	37	36.6	28	27.7	22	22.9	20	26.3
Leg	52	21.1	19	17.0	17	16.8	13	12.8	20	2.8	9	11.8
Foot	74	30.2	45	40.1	20	19.8	12	11.9	2	2.1	19	25.1
Toe			1	.9			3	3.0			1	1.3
Body—general	6	2.4	2	1.8	6	5.9	7	6.9	13	13.5	4	5.3
Unclassified; insufficient data					1				1		1	

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.<sup>2</sup> Percents are based on classified cases only.TABLE 6.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by part of body injured and activity of injured

Part of body injured	Activity when injured—											
	Using hand tools		Walking, stepping, etc.		Lifting objects		Carrying objects		Placing objects		Other	
	Number	Per- cent <sup>2</sup>	Number	Per- cent <sup>2</sup>	Number	Per- cent <sup>2</sup>	Number	Per- cent <sup>2</sup>	Number	Per- cent <sup>2</sup>	Number	Per- cent <sup>2</sup>
Total	623	100.0	239	100.0	481	100.0	245	100.0	118	100.0	345	100.0
Head	183	29.5	9	3.8	11	2.3	6	2.5	5	4.3	79	23.0
Eye	161	25.9	1	.4	4	.8	1	.4	2	1.7	49	14.2
Brain or skull	3	.5	4	1.7	2	.4			2	1.7	1	.3
Other	19	3.1	4	1.7	5	1.1	5	2.1	1	.9	29	8.5
Trunk	110	17.7	43	18.0	315	66.0	127	52.5	35	29.9	55	16.0
Chest, lungs, ribs, etc.	25	4.0	12	5.0	14	2.9	11	4.5	10	8.5	11	3.2
Back	63	10.1	19	8.0	225	47.2	79	32.8	19	16.2	35	10.2
Abdomen	8	1.3	1	.4	52	10.9	18	7.4	4	3.4	6	1.7
Shoulder	11	1.8	4	1.7	16	3.3	16	6.6	1	.9	3	.9
Other	3	.5	7	2.9	8	1.7	3	1.2	1	.9		
Upper extremities	229	36.8	15	6.3	70	14.6	26	10.7	36	30.8	107	31.2
Arm	40	6.4	8	3.3	15	3.1	3	1.2	7	6.0	16	4.7
Hand	82	13.2	4	1.7	27	5.6	14	5.8	11	9.4	53	15.4
Finger	107	17.2	3	1.3	28	5.9	9	3.7	18	15.4	38	11.1
Lower extremities	88	14.2	156	65.2	80	16.7	81	33.5	37	31.6	65	19.0
Leg	48	7.8	49	20.5	28	5.8	23	9.5	12	10.3	23	6.7
Foot	25	4.0	105	43.9	24	5.0	37	15.3	8	6.8	31	9.1
Toe	15	2.4	2	.8	28	5.9	21	8.7	17	14.5	11	3.2
Body—general	11	1.8	16	6.7	2	.4	2	.8	4	3.4	37	10.8
Unclassified; insufficient data	2				3		3		1		2	

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.<sup>2</sup> Percents are based on classified cases only.

TABLE 7.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by part of body injured and nature of injury

Part of body injured	Nature of injury												
	Total number of injuries	Amputations, enucleations	Bruises, contusions	Burns, scalds	Chemical burns	Cuts, lacerations	Foreign bodies, not elsewhere classified	Fractures	Hernias	Industrial diseases	Strains, sprains	Other	Unclassified, insufficient data
Total .....	2,719	12	467	195	30	527	170	268	78	40	880	22	30
Head .....	401	1	35	59	25	76	170	6		3	16	7	3
Eye .....	274	1	12	35	23	25	170			1		6	1
Brain or skull .....	32		8			20		3					1
Other .....	95		15	24	2	31				2	16	1	1
Trunk .....	802		68	2		10		47	78	6	585	3	3
Chest, lungs, ribs, etc. ....	107		38			4		30		4	28	2	1
Back .....	504		16	1		2		6		1	478		
Abdomen .....	96		2	1		1			78		13	1	
Shoulder .....	66		8			1		7		1	49		
Other .....	29		4			2		4			17		2
Upper extremities .....	671	10	133	62	4	297		85		5	68	2	5
Arm .....	138		36	16		42		20			24		
Hand .....	262		48	39	3	99		23		4	42	2	2
Finger .....	271	10	49	7	1	156		42		1	2		3
Lower extremities .....	706	1	195	30		142		125		3	202		8
Leg .....	284	1	117	5		47		18		3	92		1
Foot .....	310		45	25		90		36			109		5
Toe .....	112		33			5		71			1		2
Body—general .....	123		36	41	1	2		5		23	4	10	1
Unclassified; insufficient data .....	16			1							5		10

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.

TABLE 8.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by type of accident and agency of injury

Accident type	Total number of accidents	Agency of injury																			Unclassified; insufficient data			
		Plumbing fixtures						Hand tools				Working surfaces				Hot substances	Foreign bodies not elsewhere classified	Bodily motion	Lumber stock	Chemicals		Chips, splinters	Vehicles	Other
		Total	Pipes	Bathtubs	Heaters	Sinks	Other	Total	Wrenches	Hammers	Other	Total	Floors	Ground	Other									
Total.....	2,719	828	387	115	101	51	174	294	101	70	123	245	146	80	19	188	183	164	132	60	58	57	454	56
Striking against objects.....	375	100	66	1	5	7	21	16	6	1	9	44	24	15	5				90		2	6	117	
Bumping against.....	190	62	39	1	5	4	13	8	5		3	14	8	5	1				13			6	87	
Sharp-edged or rough objects.....	97	30	18	1		3	8	5	2		3	4	2	1	1				9			2	47	
Other objects.....	93	32	21		5	1	5	3	3		3	10	6	4					4			4	40	
Rubbing against objects.....	90	34	24			3	7	3	1	1	6	22	13	7	2				1		2		23	
Stepping on nails, wires, etc.....	88	4	3				1					4	2	1	1				74				6	
Other.....	7											4	1	2	1				2				1	
Struck by moving objects.....	751	215	132	12	23	8	40	163	31	62	70						183		32		56	9	93	
Falling objects.....	335	198	117	12	23	8	38	29	6	3	20						11		27			2	68	
From hands of workers.....	185	125	67	12	14	7	25	25	6	2	17								7			1	27	
From other sources.....	150	73	50		9	1	13	4		1	3											1	41	
Flying objects.....	247	6	5				1	3		1	2												8	
Small particles.....	232																						4	
Other.....	15	6	5				1	3		1	2											2	4	
Hand-operated or -wielded objects.....	150	9	8				1	129	24	58	47											2	8	
Other.....	19	2	2					2	1		1											2	8	
Other.....																						5	9	
Caught in, on, or between.....	147	45	22	4	8		11	17	8		9											33	52	
Moving parts of equipment.....	25	1			1			3			3												21	
Rolling or falling objects.....	39	14	7		3		4																25	
Moving equipment and other objects.....	32																						32	
Objects being handled.....	44	26	11	4	4		7	13	8		5											1	4	
Other objects.....	7	4	4					1			1												2	
Falls—on same level.....	125	18	7	5	1	1	4	1	1			64	37	19	8								3	34
Due to slips.....	59	8	4	2		1	1					32	16	13	3								2	14
Other.....	66	10	3	3	1		3	1	1			32	21	6	5								1	20
Falls—from elevations.....	194	6	4		1		1					132	82	45	5								3	51
From ladders.....	68	1	1									57	41	15	1								1	9
From scaffolds, stagings, etc.....	29	1	1									20	8	12									1	7
From other elevations.....	97	4	2		1		1					55	33	18	4								2	35
Slips and stumbles (not falls).....	127	7	6	1								4	3		1			105						9
Overexertion due to.....	593	435	149	92	63	35	96	93	55	7	31												3	61
Carrying objects.....	111	105	18	33	17	7	30																	6
Lifting objects.....	328	276	105	48	40	26	57	4	1		3												1	46
Pulling or pushing objects.....	103	23	15	1	2		5	73	54	7	12												2	5
Other operations.....	51	31	11	10	4	2	4	16			16													4
Contact with extreme temperatures.....	194	2	1				1	1			1							188						3
Hot liquids.....	118																	118						
Flames.....	71							1			1							70						
Other.....	5	2	1				1																	3
Other types.....	157							3			3	1		1					59		60			34
Unclassified; insufficient data.....	56																							56

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.

TABLE 9.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by type of accident and occupation of injured

Accident type	All workers		Journeymen		Apprentices		Helpers		Superintendents, foremen	
	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>
Total	2,719	100.0	2,040	100.0	245	100.0	402	100.0	32	100.0
Striking against objects	375	14.1	294	14.7	23	9.5	56	14.2	2	6.7
Bumping against	190	7.1	159	7.9	7	2.9	24	6.1		
Sharp-edged or rough objects	97	3.6	80	3.9	2	.8	15	3.8		
Other objects	93	3.5	79	4.0	5	2.1	9	2.3		
Rubbing against objects	90	3.4	72	3.6	5	2.1	12	3.0	1	3.4
Stepping on nails, wires, etc.	88	3.3	58	2.9	10	4.1	20	5.1		
Other	7	.3	5	.3	1	.4			1	3.3
Struck by moving objects	751	28.1	536	26.7	85	35.3	125	31.5	5	16.7
Falling objects	335	12.5	280	11.4	38	15.8	63	15.8	4	13.4
From hands of workers	185	6.9	127	6.3	19	7.9	37	9.3	2	6.7
From other sources	150	5.6	103	5.1	19	7.9	26	6.5	2	6.7
Flying objects	247	9.3	183	9.1	27	11.2	36	9.1	1	3.3
Small particles	232	8.7	173	8.6	25	10.4	33	8.3	1	3.3
Other	15	.6	10	.5	2	.8	3	.8		
Hand-operated or -wielded objects	150	5.6	109	5.5	18	7.5	23	5.8		
Other	19	.7	14	.7	2	.8	3	.8		
Caught in, on, or between	147	5.5	105	5.3	14	5.8	26	6.6	2	6.7
Moving parts of equipment	25	.9	20	1.0	1	.4	4	1.0		
Rolling or falling objects	39	1.5	28	1.4	3	1.2	7	1.8	1	3.4
Moving equipment and other objects	32	1.2	22	1.1	5	2.1	4	1.0	1	3.3
Objects being handled	44	1.6	29	1.5	5	2.1	10	2.5		
Other objects	7	.3	6	.3			1	.3		
Falls on same level	125	4.7	107	5.4	6	2.5	11	2.8	1	3.3
Due to slips	59	2.2	50	2.5	3	1.2	5	1.3	1	3.3
Other	66	2.5	57	2.9	3	1.3	6	1.5		
Falls from elevations	194	7.3	157	7.9	15	6.2	16	4.1	6	20.0
From ladders	68	2.6	55	2.8	5	2.1	7	1.8	1	3.3
From scaffolds, stagings, etc.	29	1.1	25	1.3	1	.4	2	.5	1	3.3
From other elevations	97	3.6	77	3.8	9	3.7	7	1.8	4	13.4
Slips and stumbles (not falls)	127	4.8	101	5.1	7	2.9	18	4.6	1	3.3
Overexertion due to	593	22.3	434	21.7	56	23.2	94	23.8	9	29.9
Carrying objects	111	4.2	70	3.5	11	4.6	29	7.3	1	3.3
Lifting objects	328	12.3	247	12.3	31	12.8	44	11.2	6	20.0
Pulling or pushing objects	103	3.9	84	4.2	7	2.9	11	2.8	1	3.3
Other operations	51	1.9	33	1.7	7	2.9	10	2.5	1	3.3
Contact with extreme temperatures	194	7.3	150	7.5	18	7.5	24	6.1	2	6.7
Hot liquids	118	4.4	89	4.4	12	5.0	15	3.8	2	6.7
Flames	71	2.7	57	2.9	5	2.1	9	2.3		
Other	5	.2	4	.2	1	.4				
Other types	157	5.9	113	5.7	17	7.1	25	6.3	2	6.7
Unclassified; insufficient data	56		43		4		7		2	

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.<sup>2</sup> Percents are based on classified cases only.

TABLE 10.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by type of accident and location of accident

Accident type	Number of accidents occurring—											
	On floors		On ground (except excavations)		On ladders		In ditches or other excavations		Under houses		On steps or stairs	
	Number	Per- cent <sup>2</sup>	Number	Per- cent <sup>2</sup>	Number	Per- cent <sup>2</sup>	Number	Per- cent <sup>2</sup>	Number	Per- cent <sup>2</sup>	Number	Per- cent <sup>2</sup>
Total .....	246	100.0	112	100.0	102	100.0	101	100.0	97	100.0	77	100.0
Striking against objects .....	88	36.2	29	26.1	7	6.9	9	9.1	25	26.1	2	2.6
Bumping against .....	20	8.2	7	6.3	3	2.9	5	5.1	20	20.9	2	2.6
Sharp-edged or rough objects .....	11	4.5	4	3.6	—	—	3	3.1	7	7.3	—	—
Other objects .....	19	3.7	3	2.7	3	2.9	2	2.0	13	13.6	2	2.6
Rubbing against objects .....	15	6.1	4	3.6	—	—	2	2.0	5	5.2	—	—
Stepping on nails, wires, etc. ....	51	21.1	18	16.2	4	4.0	2	2.0	—	—	—	—
Other .....	2	.8	—	—	—	—	—	—	—	—	—	—
Struck by moving objects .....	23	9.4	8	7.2	—	—	17	17.2	15	15.6	6	7.9
Falling objects .....	9	3.7	4	3.6	—	—	10	10.2	6	6.2	6	7.9
From hands of workers .....	7	2.9	2	1.8	—	—	2	2.0	2	2.1	4	5.3
From other sources .....	2	.8	2	1.8	—	—	8	8.2	4	4.1	2	2.6
Flying objects .....	10	4.1	—	—	—	—	4	4.0	7	7.4	—	—
Small particles .....	9	3.7	—	—	—	—	3	3.0	7	7.4	—	—
Other .....	1	.4	—	—	—	—	1	1.0	—	—	—	—
Hand-operated or -wielded objects ..	4	1.6	1	.9	—	—	2	2.0	1	1.0	—	—
Other .....	1	.4	3	2.7	—	—	1	1.0	1	1.0	—	—
Caught in, on, or between .....	3	1.2	1	.9	—	—	22	22.1	2	2.1	1	1.3
Moving parts of equipment .....	—	—	—	—	—	—	2	2.0	1	1.1	—	—
Rolling or falling objects .....	—	—	—	—	—	—	19	19.1	—	—	—	—
Moving equipment and other objects ..	1	.4	—	—	—	—	—	—	—	—	—	—
Objects being handled .....	1	.4	1	.9	—	—	1	1.0	—	—	1	1.3
Other objects .....	1	.4	—	—	—	—	—	—	1	1.0	—	—
Falls on same level .....	43	17.6	19	17.1	2	2.0	5	5.1	1	1.0	3	3.9
Due to slips .....	15	6.1	12	10.8	2	2.0	2	2.0	1	1.0	2	2.6
Other .....	28	11.5	7	6.3	—	—	3	3.1	—	—	1	1.3
Falls from elevations .....	20	8.2	7	6.3	68	66.7	3	3.0	1	1.0	18	23.7
From ladders .....	—	—	—	—	68	66.7	—	—	—	—	—	—
From other elevations .....	20	8.2	7	6.3	—	—	3	3.0	1	1.0	18	23.7
Slips and stumbles (not falls) .....	32	13.1	35	31.6	14	13.7	9	9.1	1	1.0	14	18.4
Overexertion due to .....	16	6.6	12	10.8	4	3.9	21	21.2	14	14.6	28	36.9
Carrying objects .....	2	.8	3	2.7	1	1.0	1	1.0	—	—	24	31.7
Lifting objects .....	6	2.6	1	.9	—	—	8	8.1	5	5.2	2	2.6
Pulling or pushing objects .....	5	2.0	3	2.7	—	—	—	—	8	8.4	2	2.6
Other operations .....	3	1.2	5	4.5	3	2.9	12	12.1	1	1.0	—	—
Contact with extreme temperatures .....	5	2.0	—	—	4	3.9	6	6.1	3	3.1	—	—
Hot liquids .....	4	1.6	—	—	4	3.9	4	4.1	2	2.1	—	—
Flames .....	1	.4	—	—	—	—	2	2.0	1	1.0	—	—
Other types .....	14	5.7	—	—	3	2.9	7	7.1	34	35.5	4	5.3
Unclassified; insufficient data .....	2	—	1	—	—	—	2	—	1	—	1	—

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.<sup>2</sup> Percents are based on classified cases only.

TABLE 11.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by type of accident and activity of injured

Accident type	Activity when injured—											
	Using hand tools		Walking, stepping, etc.		Lifting objects		Carrying objects		Placing objects		Other	
	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>
Total.....	623	100.0	239	100.0	481	100.0	245	100.0	118	100.0	345	100.0
Striking against objects.....	68	11.1	78	33.1	22	4.6	18	7.4	12	10.2	40	11.8
Bumping against.....	53	8.6	23	9.7	13	2.7	6	2.5	4	3.4	16	4.7
Sharp-edged or rough objects.....	26	4.2	9	3.8	7	1.4	2	.8	2	1.7	13	3.8
Other objects.....	27	4.4	14	5.9	6	1.3	4	1.7	2	1.7	3	.9
Rubbing against objects.....	15	2.5	4	1.7	6	1.3	5	2.1	7	6.0	19	5.6
Stepping on nails, wires, etc.....			46	19.6	3	.6	7	2.8	1	.8	3	.9
Other.....			5	2.1							2	.6
Struck by moving objects.....	332	54.2	11	4.7	86	18.0	56	23.0	40	34.0	74	21.8
Falling objects.....	42	6.9	5	2.2	75	15.8	52	21.4	37	31.5	34	10.0
From hands of workers.....	20	3.3			62	13.1	49	20.2	28	23.9	7	2.1
From other sources.....	22	3.6	5	2.2	13	2.7	3	1.2	9	7.6	27	7.9
Flying objects.....	161	26.2	1	.4	4	.8			2	1.7	30	8.8
Small particles.....	158	25.7	1	.4	3	.6			2	1.7	24	7.0
Other.....	3	.5			1	.2					6	1.8
Hand-operated or -wielded objects.....	126	20.6	1	.4	4	.8	3	1.2	1	.8	7	2.1
Other.....	3	.5	4	1.7	3	.6	1	.4			3	.9
Caught in, on, or between.....	25	4.1	2	.8	17	3.6	7	2.9	17	14.4	51	15.0
Moving parts of equipment.....	5	.8			2	.4			2	1.7	13	3.8
Rolling or falling objects.....	5	.8			4	.8	2	.8	7	5.9	5	1.5
Moving equipment and other objects.....					1	.2					28	8.2
Objects being handled.....	13	2.2			10	2.2	5	2.1	8	6.8	4	1.2
Other objects.....	2	.3	2	.8							1	.3
Falls—on same level.....	13	2.1	25	10.6	8	1.7	15	6.2	5	4.2	10	2.9
Due to slips.....	6	1.0	17	7.2	3	.6	6	2.5	1	.8	3	.9
Other.....	7	1.1	8	3.4	5	1.1	9	3.7	4	3.4	7	2.0
Falls—from elevations.....	11	1.8	48	20.3	5	1.0	7	2.9	7	5.9	23	6.8
From ladders.....	4	.7	11	4.7					2	1.7	5	1.5
From scaffolds, stagings, etc.....			7	3.0					3	2.5	2	.6
From other elevations.....	7	1.1	30	12.6	5	1.0	7	2.9	2	1.7	16	4.7
Slips and stumbles (not falls).....	4	.7	45	19.1	8	1.7	26	10.7	4	3.4	9	2.6
Overexertion.....	95	15.5			324	67.8	111	45.7	28	23.7	19	5.6
Contact with extreme temperatures.....	45	7.4	2	.8	4	.8	2	.8	2	1.7	87	25.6
Hot liquids.....	28	4.6	2	.8	1	.2	2	.8	1	.9	54	15.9
Flames.....	16	2.6			3	.6			1	.8	32	9.4
Other.....	1	.2									1	.3
Other types.....	19	3.1	25	10.6	4	.8	1	.4	3	2.5	27	7.9
Unclassified; insufficient data.....	11		3		3		2				5	

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.<sup>2</sup> Percents are based on classified cases only.

TABLE 12.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by type of accident and hazardous working condition

Accident type	Total number of accidents	Hazardous working condition																							
		Hazardous working procedures					Defective agencies					Lack of personal safety equipment					Improperly guarded agencies	Poor housekeeping	Hazardous arrangement	Other	Unclassified; insufficient data				
		Total	Lack of adequate help in lifting	Lack of scaffolds, walkways, etc.	Congested or confined working areas	Other	Total	Hidden defects	Slippery	Sharp-edged	Projecting nails, wires, or slivers	Rough or uneven	Other	Total	Goggles	Gloves						Knee pads	Boots	Other	
Total	2,719	706	547	65	41	53	420	203	63	60	42	27	25	333	181	44	36	24	48	162	160	50	41	847	
Striking against objects	375	21	2	2	14	3	104	5	1	55	38	3	2	49		12	36		1	3	90	3		105	
Bumping against	190	18		2	14	2	60	4	1	35	17	2	1	15		1	14		1	1	9	3		84	
Sharp-edged or rough objects	97	4			3	1	57	3		35	17	2		2		1	1			1	8	1		24	
Other objects	93	14		2	11	1	3		1	1			1	13			13				1	2		60	
Rubbing against objects	90	3	2			1	40	1		20	19			34		11	22		1					13	
Stepping on nails, wires, etc.	88						3				2		1						2		80			3	
Other	7						1					1									1			5	
Struck by moving objects	751	99	63	1	2	33	103	83	4	5	2		9	129	123	4			2	38	1	39		342	
Falling objects	335	74	61			13	35	21	4	2	1		7							32		38		156	
From hands of workers	185	66	59			7	13	6	4	2	1													106	
From other sources	150	8	2			6	22	15					7								32		38	50	
Flying objects	247						46	46						129	123	4			2	1	1			70	
Small particles	232						38	38						129	123	4			2					65	
Other	15						8	8											2	1	1			5	
Hand-operated or -wielded objects	150	21	1		1	19	18	13		3			2							1		1		109	
Other	19	4	1	1	1	1	4	3			1									4				7	
Caught in, on, or between	147	25	19		2	4	19	10	7				2								36	1	5		61
Moving parts of equipment	25	1				1	1														16				8
Rolling or falling objects	39	5	4			1	6	5					1								19		5		4
Moving equipment and other objects	32	2				2	9	1	7				1												21
Objects being handled	44	16	15		1		4	4																	24
Other objects	7	1			1																1	1			4
Falls—on same level	125	14	3	10	1		39	4	23		1	5	6								3	21			48
Due to slips	59	4	2	2			25	1	23				1								1	10			19
Other	66	10	1	8	1		14	3		1	5	5									2	11			29
Falls—from elevations	194	42	2	40			42	33	4		1	2	2	10					10		67	4			29
From ladders	68	17		17			9	8			1			1					1		32				9
From scaffolds, stagings, etc.	29						16	15						1							13				
From other elevations	97	25	2	23			17	10	4			2	1	9					9		22	4			20
Slips and stumbles (not falls)	127	6	1	5			41		23			17	1								6	40	2		32
Overexertion due to	593	471	457	2	10	2	2		1				1								2				118
Carrying objects	111	109					1		1																1
Lifting objects	328	311	309		1	1																			17
Pulling or pushing objects	103	23	13		9	1																			80
Other operations	51	28	26	2			1						1								2				20
Contact with extreme temperatures	194	8				8	67	65					2	103	35	21		23	24	6		1			9
Hot liquids	118	3				3	5	4					1	102	35	20		23	24	4					4
Flames	71	3				3	61	60					1	1		1						1			5
Other	5	2				2	1	1													2				
Other types	157	20		5	12	3	3	3						42	23	7		1	11	1	3		41		47
Unclassified; insufficient data	56																								56

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.

TABLE 13.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by hazardous working condition and agency of accident

Hazardous working condition	Agencies of accident																				
	Total number of accidents	Plumbing fixtures						Working surfaces				Hand tools			Hot substances	Ladders	Chemicals	Excavations	Lumber	Other	Unclassified
		Total	Pipes	Bath-tubs	Heat-ers	Sinks	Other	Total	Floors	Ground	Other	Total	Chis-els	Other							
Total	2,719	620	220	111	99	48	142	357	191	102	64	230	88	142	103	75	54	48	35	344	853
Hazardous working procedures	706	497	149	111	82	43	112	22	17	1	4	21	16	5	2	30	3	4	8	113	6
Lack of adequate help in lifting	547	481	139	110	80	42	110									3			1	56	6
Lack of scaffolds, walkways, etc.	65	2			2			20	17		3					27		3		13	
Congested or confined working areas	41	9	6	1		1	1					1		1				1		30	
Other	53	5	4			1	1	2		1	1	20	16	4	2		3		7	14	
Defective agencies	420	77	37		13	4	23	100	35	41	24	71	15	56		8		7	19	138	
Hidden defects	203	35	14		12	1	8	19	4		15	66	15	51		7		2	8	66	
Slippery	63	1	1					42	18	19	5							5	2	13	
Sharp-edged	60	30	18			2	10	1			1	4		4						25	
Projecting nails, wires, slivers	42	8	4			1	3	6	5		1	1		1		1			9	17	
Rough or uneven	27							23	1	21	1									4	
Other	25	3			1		2	9	7	1	1									13	
Lack of personal safety equipment	333	5	5					44	15	16	13	132	57	75	101		32			19	
Goggles	181											122	54	68	34		14			11	
Gloves	44	5	5									9	2	7	20		7			3	
Knee pads	36							33	15	15	3									3	
Boots	24														23		1				
Other	48							11		1	10	1	1		24		10			2	
Improperly guarded agencies	162	13	6		3		4	43	24		19	3		3		36		29		38	
Poor housekeeping	160							148	100	44	4							8		4	
Hazardous arrangement	50	28	23		1	1	3					3		3		1	1		8	9	
Other	41																18			23	
Unclassified; insufficient data	847																				847

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.

TABLE 14.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by hazardous working condition and occupation of injured

Hazardous working condition	All workers		Journeymen		Apprentices		Helpers		Superintendents, foremen	
	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>
Total .....	2,719	100.0	2,040	100.0	245	100.0	402	100.0	32	100.0
Hazardous working procedures .....	706	37.7	501	36.0	68	41.2	127	43.7	10	41.7
Lack of adequate help in lifting .....	547	29.2	384	27.5	52	31.6	102	35.1	9	37.5
Lack of scaffolds, walkways, etc. ....	65	3.5	51	3.7	5	3.0	8	2.7	1	4.2
Congested or confined working area .....	41	2.2	29	2.1	6	3.6	6	2.1	—	—
Other .....	53	2.8	37	2.7	5	3.0	11	3.8	—	—
Defective agencies .....	420	22.4	323	23.2	33	20.0	59	20.3	5	20.8
Hidden defects .....	203	10.9	150	10.7	23	14.0	29	10.0	1	4.2
Slippery .....	63	3.4	50	3.6	2	1.2	8	2.7	3	12.4
Sharp-edged .....	60	3.2	50	3.6	—	—	10	3.4	—	—
Projecting nails, wires, slivers .....	42	2.2	32	2.3	4	2.4	6	2.1	—	—
Rough or uneven .....	27	1.4	19	1.4	3	1.8	4	1.4	1	4.2
Other .....	25	1.3	22	1.6	1	.6	2	.7	—	—
Lack of personal safety equipment .....	333	17.8	259	18.6	29	17.6	40	13.7	5	20.8
Goggles .....	181	9.6	135	9.7	20	12.2	25	8.6	1	4.2
Gloves .....	44	2.4	32	2.3	3	1.8	7	2.4	2	8.2
Knee pads .....	36	1.9	34	2.4	—	—	1	.3	1	4.2
Boots .....	24	1.3	19	1.4	3	1.8	1	.3	1	4.2
Other .....	48	2.6	39	2.8	3	1.8	6	2.1	—	—
Improperly guarded agencies .....	162	8.7	122	8.8	14	8.5	23	7.9	3	12.5
Poor housekeeping .....	160	8.5	119	8.5	13	7.9	28	9.6	—	—
Hazardous arrangement .....	50	2.7	37	2.7	5	3.0	7	2.4	1	4.2
Other .....	41	2.2	31	2.2	3	1.8	7	2.4	—	—
Unclassified; insufficient data .....	847	—	648	—	80	—	111	—	8	—

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.<sup>2</sup> Percents are based on classified cases only.TABLE 15.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by hazardous working condition and location of accident

Hazardous working condition	Number of accidents occurring—											
	On floors		On ground (except excavations)		On ladders		In ditches or other excavations		Under houses		On steps or stairs	
	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>	Number	Percent <sup>2</sup>
Total .....	246	100.0	112	100.0	102	100.0	101	100.0	97	100.0	77	100.0
Hazardous working procedures .....	38	18.1	8	9.0	28	33.3	18	25.4	28	36.3	32	61.5
Lack of adequate help in lifting .....	15	7.1	7	7.9	1	1.2	10	14.2	5	6.5	31	59.6
Lack of scaffolds, walkways, etc. ....	16	7.7	—	—	27	32.1	3	4.2	1	1.3	—	—
Congested or confined working areas .....	3	1.4	—	—	—	—	1	1.4	22	28.5	—	—
Other .....	4	1.9	1	1.1	—	—	4	5.6	—	—	1	1.9
Defective agencies .....	41	19.5	40	45.0	10	11.9	10	14.1	6	7.8	12	23.1
Hidden defects .....	10	4.8	—	—	8	9.5	4	5.6	1	1.3	2	3.8
Slippery .....	17	8.0	18	20.3	—	—	5	7.1	—	—	4	7.8
Sharp-edged .....	5	2.4	—	—	—	—	1	1.4	1	1.3	—	—
Projecting nails, wires, slivers .....	4	1.9	2	2.2	1	1.2	—	—	2	2.6	—	—
Rough or uneven .....	1	.5	19	21.4	—	—	—	—	1	1.3	4	7.7
Other .....	4	1.9	1	1.1	1	1.2	—	—	1	1.3	2	3.8
Lack of personal safety equipment .....	21	10.0	3	3.4	5	6.0	6	8.5	18	23.4	—	—
Goggles .....	3	1.4	—	—	—	—	1	1.4	4	5.2	—	—
Gloves .....	1	.5	—	—	2	2.4	1	1.4	—	—	—	—
Knee pads .....	15	7.1	3	3.4	—	—	—	—	13	16.9	—	—
Boots .....	1	.5	—	—	1	1.2	4	5.7	—	—	—	—
Other .....	1	.5	—	—	2	2.4	—	—	1	1.3	—	—
Improperly guarded agencies .....	16	7.6	2	2.2	35	41.7	26	36.5	—	—	3	5.8
Poor housekeeping .....	93	44.3	35	39.3	6	7.1	8	11.3	2	2.6	4	7.7
Hazardous arrangement .....	1	.5	1	1.1	—	—	2	2.8	1	1.3	—	—
Other .....	—	—	—	—	—	—	1	1.4	22	28.6	1	1.9
Unclassified; insufficient data .....	36	—	23	—	18	—	30	—	20	—	25	—

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.<sup>2</sup> Percents are based on classified cases only.

TABLE 16.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by hazardous working condition and activity of injured

Hazardous working condition	Activity when injured—											
	Using hand tools		Walking, stepping, etc		Lifting objects		Carrying objects		Placing objects		Other	
	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>	Number	Per-cent <sup>2</sup>
Total.....	623	100.0	239	100.0	481	100.0	245	100.0	118	100.0	345	100.0
Hazardous working procedures.....	40	12.5	23	12.8	347	88.0	150	73.1	47	55.3	31	12.7
Lack of adequate help in lifting.....	4	1.3	—	—	339	85.9	147	71.6	41	48.1	10	4.1
Lack of scaffolds, walkways, etc.....	12	3.8	16	8.8	1	.3	2	1.0	2	2.4	8	3.3
Congested or confined working areas.....	8	2.5	6	3.4	2	.5	—	—	2	2.4	4	1.6
Other.....	16	4.9	1	.6	5	1.3	1	.5	2	2.4	9	3.7
Defective agencies.....	93	29.2	41	22.9	27	6.9	27	13.2	16	18.8	85	34.8
Hidden defects.....	72	22.6	9	5.0	9	2.3	4	2.0	7	8.2	45	18.4
Slippery.....	2	.6	11	6.2	6	1.5	7	3.4	—	—	13	5.3
Sharp-edged.....	10	3.2	2	1.1	8	2.0	2	1.0	7	8.2	7	2.9
Projecting nails, wires, slivers.....	8	2.5	2	1.1	2	.5	1	.5	1	1.2	12	4.9
Rough or uneven.....	1	.3	10	5.6	1	.3	11	5.3	1	1.2	1	.4
Other.....	—	—	7	3.9	1	.3	2	1.0	—	—	7	2.9
Lack of personal safety equipment.....	162	50.8	16	8.9	2	.5	1	.5	3	3.5	87	35.8
Goggles.....	141	44.3	—	—	—	—	—	—	—	—	33	13.6
Gloves.....	11	3.4	—	—	1	.3	—	—	1	1.2	14	5.8
Knee pads.....	3	.9	12	6.6	—	—	—	—	1	1.2	4	1.6
Boots.....	3	.9	1	.6	—	—	—	—	—	—	11	4.5
Other.....	4	1.3	3	1.7	1	.2	1	.5	1	1.1	25	10.3
Improperly guarded agencies.....	16	5.0	20	11.2	6	1.5	5	2.4	8	9.4	24	9.8
Poor housekeeping.....	3	.9	74	41.4	5	1.3	20	9.8	4	4.7	7	2.9
Hazardous arrangement.....	5	1.6	2	1.1	7	1.8	2	1.0	6	7.1	5	2.0
Other.....	—	—	3	1.7	—	—	—	—	1	1.2	5	2.0
Unclassified; insufficient data.....	304	—	60	—	87	—	40	—	33	—	101	—

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.<sup>2</sup> Percents are based on classified cases only.

TABLE 17.—Disabling work injuries reported by plumbers in 13 States,<sup>1</sup> 1949, classified by type of accident and unsafe act

Accident type	Unsafe acts																	Un- classified; insuffi- cient data	
	Total number of acci- dents	Gripping objects insecurely				Inattention to footing							In- atten- tion to sur- round- ings	Taking unsafe posi- tions	Exert- ing ex- ces- sive pres- sures	Failure to secure or warn	Work- ing at unsafe speeds		Other
		Total	Pipes	Hand tools	Other	Total	While stepping to or from				On floors	Other							
							Total	Stairs	Lad- ders	Other sur- faces									
Total.....	2,719	189	78	61	50	93	60	20	19	21	16	17	54	44	41	31	14	60	2,193
Striking against objects.....	375	23	8	7	8	7	3			3	1	3	40	2	2		6	4	291
Bumping against.....	190	11	2	6	3	3	1			1		2	40	2	2		1	2	129
Sharp-edged or rough objects.....	97	9	2	5	2	1						1	9	1			1	1	75
Other objects.....	93	2		1	1	2	1			1		1	31	1	2			1	54
Rubbing against objects.....	90	12	6	1	5														78
Stepping on nails, wires, etc.....	88					4	2			2	1	1						1	83
Other.....	7																5	1	1
Struck by moving objects.....	751	133	63	41	29								2	24		17		10	565
Falling objects.....	335	107	63	20	24									3		17		5	203
From hands of workers.....	185	107	63	20	24											1			77
From other sources.....	150													3		16		5	126
Flying objects.....	247	2		1	1													2	243
Small particles.....	232	1			1													2	229
Other.....	15	1		1															14
Hand-operated or -wielded objects.....	150	23		20	3								2	21				2	102
Other.....	19	1			1													1	17
Caught in, on, or between.....	147	14	6	6	2	1						1	3	4		3		7	115
Moving parts of equipment.....	25	2		2												2		2	19
Rolling or falling objects.....	39	2	1		1									1					36
Moving equipment and other objects.....	32													3					29
Objects being handled.....	44	10	5	4	1								2			1		5	26
Other objects.....	7					1						1							5
Falls—on same level.....	125					12	4	1	1	2	4	4		2	1	1	1		108
Due to slips.....	59					4	1		1		2	1							55
Other.....	66					8	3	1		2	2	3		2	1	1	1		53
Falls—from elevations.....	194	1			1	22	22	8	10	4			9	1		1			160
From ladders.....	68					10	10		10							1			57
From scaffolds, stagings, etc.....	29					1	1												28
From other elevations.....	97	1			1	11	11	8		3			9	1					75
Slips and stumbles (not falls).....	127					36	20	8	8	4	9	7		1		1	1		88
Overexertion due to.....	593	7	1	4	2									9	38			28	511
Carrying objects.....	111	1	1															1	110
Lifting objects.....	328													7				14	313
Pulling or pushing objects.....	103	4		2	2									1	38			1	53
Other operations.....	51	2		2										7				13	35
Contact with extreme temperatures.....	194	11		3	8											7		4	172
Hot liquids.....	118	10		2	8											5		4	99
Flames.....	71	1		1												2			68
Other.....	5																		5
Other types.....	157					15	11	3		8	2	2		1		1	5	7	128
Unclassified; insufficient data.....	56																1		55

<sup>1</sup> Arkansas, California, Colorado, Florida, Georgia, Kentucky, Maine, Massachusetts, Missouri, Ohio, Pennsylvania, Vermont, and West Virginia.

INJURY AND ACCIDENT CAUSES IN PLUMBING OPERATIONS