UNITED STATES DEPARTMENT OF LABOR
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BUREAU OF LABOR STATISTICS
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Accident-Record Manual for Industrial Plants

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Prepared by
DIVISION OF INDUSTRIAL HAZARDS
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Bulletin No. 772

Letter of Transmittal

UNITED STATES DEPARTMENT OF LABOR,
BUREAU OF LABOR STATISTICS,
Washington, D. C., March 10, 1944.

THE SECRETARY OF LABOR:

I have the honor to transmit herewith an accident-record manual for industrial plants. This manual was prepared in the Division of Industrial Hazards by Max D. Kossoris.

The Bureau of Labor Statistics gratefully acknowledges the criticisms and suggestions of the following safety engineers: H. W. Heinrich, Assistant Superintendent, Engineering and Inspection Division, The Travellers; Col. E. R. Granniss, Chief, Safety and Health Branch, Internal Security Division, War Department; and R. P. Blake, Senior Safety Engineer, Division of Labor Standards, United States Department of Labor.

A. F. HINRICHS, *Acting Commissioner.*

Hon. FRANCES PERKINS,
Secretary of Labor.

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Purpose of This Bulletin

During the last year the Bureau of Labor Statistics received many requests for information on the methods of computing industrial-injury rates, and how accident facts generally might be used to best advantage for accident prevention.

The occupational-accident toll for the war year 1943 has been estimated at about 2,400,000, and the consequent economic time loss at about 274 million days—the equivalent of a year's work for over 900,000 workers. Strong efforts to reduce this impediment to our production program were made by the Committee for the Conservation of Manpower in War Industries of the United States Department of Labor, the Safety and Health Branch of the Office of the Provost Marshal General of the Army Service Forces, the National Safety Council, and many other Federal, State, and private organizations. Through their efforts the message that most of these accidents could be prevented simply and practically was carried to literally thousands of plants, many of which had not been familiar with scientific accident prevention until then. Such plants generally knew little or nothing about the analysis and recording of accident facts and the uses of such data for accident prevention.

The purpose of this bulletin is to assist such plants to set up and use effective accident records. It is not a primer on methods of preventing accidents. Its function is to suggest simple and useful methods of accident recording and the uses of such data for accident prevention. It is also hoped that plants having good accident records may find useful suggestions in this manual to expand and utilize more fully the data they already have.

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Contents

Bulletin No. 772 of the
United States Bureau of Labor Statistics

Accident-Record Manual for Industrial Plants

Industrial Accidents Are Preventable

The time loss because of industrial accidents during 1943 is conservatively estimated at nearly 57 million man-days. This figure contains no allowance for the economic losses extending beyond the year and attributable to fatalities and permanent impairments. If allowances are made for these items, the total time-loss figure rises to 274 million man-days. But even this figure, which represents a year's work for 914,000 workers, does not take into account the millions of days lost because of time taken out for first-aid treatments and the decreased efficiency on the job after the injured's return to work. Nor does it include the time required by supervisors to investigate the accident, to provide care for the injured, and, frequently, to break in new men to replace those injured or killed. Further, the figure does not reflect the time necessary to replace or repair equipment or materials which frequently are damaged in industrial accidents. Large as the estimates are, they tell but a fraction of the total story.

Disabling injuries during 1943 have been estimated at 2,400,000. In manufacturing alone about 63,000 persons are disabled each month, or about 2,000 per day.

Most of these accidents could have been prevented. Competent safety engineers agree that at least 50 percent of all industrial accidents are preventable *practically* and *cheaply*, provided attention is directed to two factors—unsafe working conditions and unsafe acts. Prevention of these accidents not only would have been tremendously helpful to the war effort, but would have benefited individual plants greatly by insuring a smoother production flow, greater attention to production by supervisors, less labor turnover, less waste, and lower workmen's compensation costs.

In the process of accident prevention, accident reports and records are extremely useful tools. The determination of the proper preventive measures, in each instance can be made only after an accurate and adequate analysis of the conditions or practices which resulted in the accident. Similarly, the safety man wants certain information to guide his policies, information which can best be obtained from records. Specifically, he wants to know:

1. How serious is the accident problem?
2. Where do the accidents occur?
3. What are the causes of these accidents?

4. What remedial action is necessary to prevent recurrences of such accidents?
5. How effective are the remedial measures?

Accident records can provide specific answers to all of these questions. The only question which records may not answer directly is item 4—the remedial action necessary. But, if the analysis is accurate and adequate, the statement of why the accident occurred frequently will point directly to the remedy, or, at least, will be very helpful in the determination of the remedy.

How To Evaluate the Accident Problem

Form 1 is suggested for recording the frequency rates for each month as well as the cumulative rates throughout the year. It provides for the entry of the data necessary for the computation of these rates for each department as well as for the plant as a whole. The severity-rate computation is suggested on an annual basis only.

The frequency rate is the most important single measure of both the accident trend and the size of the accident problem—whether in an industry, plant, or department of a plant. A mere knowledge of the number of work injuries is not enough. Is the accident experience bad because a plant had 25 disabling injuries last month? Is the situation getting worse because there were only 15 disabling injuries the month before, and only 10 the month before that? Obviously it is necessary to know not only the number of injuries, but also the number of workers and the total time during which they were exposed to the hazard of being injured through work accidents. An increase in the number of injuries may, nevertheless, represent an improvement if employee-hours increased more sharply than did injuries. Conversely, a smaller number of injuries represents an improvement only if the decrease in injuries is not matched by a comparable or larger decrease in total employee-hours worked.

The accepted standard for measuring the frequency of industrial injury occurrence is the *frequency rate.* It is defined as *the number of disabling injuries per million employee-hours of exposure.* It may easily be computed by the following formula:

$$\text{Frequency rate} = \frac{\text{Number of disabling injuries} \times 1{,}000{,}000}{\text{Total number of employee-hours worked}}$$

By adding injuries and by totaling employee-hours worked (usually referred to by the single term "exposure") cumulative totals can be computed. For instance, the cumulative rate for January through June can be obtained by adding all disabling injuries for this 6-month period, multiplying the sum by 1,000,000, and dividing this result by the total employee-hours worked during the period. The form provides for the entry of the cumulative totals which are obtained simply by adding the figures for the last month to the sum of the preceding months.

By using the million employee-hour yardstick, the measurement of disabling work injuries is reduced to a uniform base, a base which is not affected by either the number of workers or the daily or weekly hours they work.

FORM 1

Monthly Industrial–Injury Frequency Summary

Month of _____, 19__

Name of Plant:_____ Compiled by _____

Department	Average number of employees	Employee-hours worked		Disabling injuries					Frequency rate		Severity rate
		This month	Year to date	Death	Permanent impairment	Temporary total	Total		This month	Year to date	For entire year
							This month	Year to date			
All departments:											
Department A											
B											
C											
D											
etc.											

Example of Use of Formula

Monthly rate.—Plant "A" had 500 employees during July. Employee-hours worked during the month totaled 108,000. There were 5 disabling injuries. What is the frequency rate?

To compute the frequency rate, the formula is applied as follows:

$$\text{Frequency rate}=\frac{5\times 1{,}000{,}000}{108{,}000}=\frac{5{,}000{,}000}{108{,}000}=46.3$$

Cumulative rate.—Plant "B" worked 103,000 employee-hours during January, 95,000 during February, and 131,000 during March. Disabling injuries totaled 7 for January, 4 for February, and 5 for March. What is the cumulative rate for the 3 months?

By application of the formula, the cumulative rate would be:

$$\frac{(7+4+5)\times 1{,}000{,}000}{103{,}000+95{,}000+131{,}000}=\frac{16\times 1{,}000{,}000}{329{,}000}=\frac{16{,}000{,}000}{329{,}000}=48.6$$

The individual rates for January, February, and March in this example are 69.9, 42.1, and 38.2. It should be noted that the cumulative rate is not computed by averaging the 3 frequency rates, which would result in an average of 50.1.

What Injuries to Count

The frequency rate is based on a consideration of *disabling injuries.* A disabling injury is defined briefly as *one which results in some permanent bodily impairment or prevents a worker from resuming work at the beginning of the next day or shift or at some later date.* The first part of the definition includes fatalities and all permanent impairments, whether major or minor. The second includes all temporary disabilities.

Permanent impairments may be of two kinds: (1) Those resulting in the complete loss of a member, such as by amputation, or (2) those which, without amputation, impair the usual function of the body or any part of it. Thus, a permanent impairment of an arm may result either from an amputation above the elbow, or from a limitation of the motion of the arm.

Temporary total disabilities include all *disabling* injuries which do not involve death or permanent impairment. They do not include first-aid cases. For example, if a worker loses 1 or more days because of an injury but returns to his job thereafter without any permanent impairment, his case is counted as a temporary total disability.

Unless indicated to the contrary, the disabling injuries included in the computation of the frequency rate consist of the following four types:

1. Fatalities.
2. Permanent total disabilities } Permanent impairments.
3. Permanent partial disabilities }
4. Temporary total disabilities.

In the procedure proposed here, permanent total disabilities are combined with permanent partial disabilities into the single group of permanent impairments. As the names suggest, the difference is one of degree. Under permanent total disabilities are classed all impair-

ments which render a worker totally unfit for industrial employment. By definition, this group also includes all injuries resulting in the loss or total loss of use of both arms or hands, both legs or feet, both eyes, or any combination of these, such as one hand and one foot. The permanent partial disability group includes all lesser permanent impairments.[1]

Although first-aid cases are not included in the frequency rate, they are well worth recording and analyzing, especially in small establishments where the number of disabling injuries often is too small to provide a comprehensive picture of accident causes. Attention to these injuries will reveal accident-causation factors which frequently lead to more serious disabling injuries. Often the difference between a minor injury and a major one is merely a fraction of a second or a fraction of an inch. A falling box can crush a skull as easily as it bruises knuckles, and a fall can result in a broken neck or leg as easily as in a bruised shin. If it can be managed to record and analyze minor injuries, it is recommended that this be done. If the volume of such injuries is so large as to make a regular analysis too burdensome, it may be advantageous to analyze a cross section, or to make only an occasional analysis. If a count of these cases is wanted, the proposed form can be modified easily to accommodate this additional item. It is suggested, however, that the total of these cases be excluded from the total for disabling injuries, which is to be used in the computation of the frequency rate.

The principal reason for keeping a separate count of first-aid cases is that the frequency rate based on disabling injuries is the measure used for comparison with other plants or industries. There is no reason, however, why a frequency rate should not be computed separately for first-aid cases. Many industrial establishments do that because of the conviction that the elimination of the causes of first-aid cases also means the prevention of disabling injuries.

How to Obtain Exposure Data

Obtaining employee-hour data present no great problem for the small plant, as it can simply add together the hours shown on the time cards. It is not often difficult for the medium-sized or the large plant to obtain such data; either the plant computes departmental totals which in turn can be added together to give the exposure for the entire plant, or it has the information on tabulating cards which may be totaled by tabulating machines. Plants which have no time cards, or in which the accounting or pay-roll department cannot readily furnish the exposure data when wanted for the computation of the frequency rate, can come very close to the actual rate by estimating the employee-hours worked. For instance, if 500 employees worked an average of 9 hours a day, and there are 25 working days in the month, the estimated employee-hours worked would be $500 \times 9 \times 25 = 112{,}500$. If there were 5 disabling injuries during the month, the frequency rate would be $\frac{5 \times 1{,}000{,}000}{112{,}500} = 44.4$. If absentee-

[1] For detailed definitions see either of the following: (a) American Standards Association, Code Z16.1: American Standard Method of Compiling Industrial Injury Rates, 1937; or (b) U. S. Bureau of Labor Statistics, Bulletin No. 667: Manual on Industrial Injury Statistics, 1940.

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ism records are available, a correction can be introduced by deducting the employee-days lost. Suppose 20 employees lost a total of 95 days during the month. The time lost would be $95 \times 9 = 855$ employee-hours. Deducting this from the total estimate of 112,500, leaves 111,645 hours worked. The corrected frequency rate would then be $\frac{5 \times 1{,}000{,}000}{111{,}645} = 44.8$. If it were possible to count the number of hours worked, the total might actually be somewhat below 111,645 because of absences of less than a full day. The correct frequency rate may actually be about 45.0.

It will be noted, however, that these corrections do not affect the *level or the trend of the rate* to any appreciable extent. The difference between the rough estimate of the total employee-hours exposure and the refined method of allowing for all absences in this illustration changes the frequency rate from 44.4 to 44.8 or 45.0, or less than 1 percent. Such an error is negligible, and would remain negligible for practical purposes even if it were several times 1 percent.

For practical purposes, therefore, the estimated total of the employee-hours worked is sufficiently accurate in the computation of the frequency rate. Obviously, if a frequency rate remains high or consistently increases, urgent attention is called for. The frequency rate may be considered as the fever thermometer reading for disabling industrial injuries.

How the Frequency Rate Can Be Used

The frequency rate can be used (1) to determine where accidents are occurring within the plant (if records are kept by departments) and (2) to determine how the experience of a department or of a plant compares with similar departments or plants. If the frequency rate for a plant is 45 while the average rate for the industry is 29, obviously there is something wrong with the plant situation.[2] That is not to say, however, that the rate of 29 indicates a good safety performance. It does not. But it does afford some measure of the relative standing of the plant. On the other hand, if the plant rate is 5 against an industry average of 29, the plant may justly be proud of its safety record.

A third use of the rate is to indicate whether the safety program is keeping step with the changes in the plant, whether in type of activity or changing character of the composition of the employee force. With the present activities in war production and the employment of greater proportions of women and older and younger persons, the established safety procedures may require revision. The trend of the frequency rate is a good gauge for this purpose.

Fourth, the frequency rate is a measure of the effectiveness of the corrective methods used. If certain corrective methods are followed by a decreasing frequency rate, the conclusion is permissible that they are accomplishing this result. If the rate stays at the same level or goes up, it is a clear indication that the steps taken have not remedied the situation and that more effective methods are needed.

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[2] Monthly frequency rates for selected manufacturing industries are published by the U. S. Bureau of Labor Statistics and are obtainable by request. Yearly rates are computed annually and cover a larger number of industries.

How To Measure Injury Severity

The frequency rate, based on all disabling injuries, gives no clue as to whether these injuries are serious ones or not. A fatality is given no more weight in the computation of this rate than the loss of 1 day's time for a temporary total disability.

The *severity rate* is used as *a measure of the relative time lost because of disabling injuries.* It is defined briefly as *the average time loss* (measured in days) *per 1,000 hours worked.* Convenience is the major reason for using 1,000 hours as a base rather than 1,000,000 hours, as in the computation of the frequency rate.

For all but temporary disabilities, time charges are arrived at by means of a standard scale. For temporary disabilities, the calendar days are counted by beginning with the first day the worker was disabled, and ending with the last day of his disability. No deductions are made for Sundays, holidays, shutdowns, or other days during which the worker normally would not be required to work. If he was hurt on April 10, and was off continuously until his return on April 25, the disability count begins on April 11 and ends on April 24, for a total of 14 days.

For deaths and permanent impairments, the figures given in the scale of time charges are used. *The actual days of disability are disregarded.* If the impairment is only partial, the same percentage is applied against the time charge as the extent of the injury bears to the total loss or loss of use of the member involved. Thus, if a worker suffers a 33-percent impairment of an arm below the elbow, the time charge is one-third of 3,600 days, or 1,200 days.

SCALE OF TIME CHARGES	*Days*
Death	6,000
Permanent total disability	6,000
Arm at or above elbow	4,500
Arm below elbow	3,600
Hand	3,000
Thumb	600
Any one finger	300
Two fingers, same hand	750
Three fingers, same hand	1,200
Four fingers, same hand	1,800
Thumb, and one finger, same hand	1,200
Thumb and two fingers, same hand	1,500
Thumb and three fingers, same hand	2,000
Thumb and four fingers, same hand	2,400
Leg, at or above knee	4,500
Leg, below knee	3,000
Foot	2,400
Great toe or any two or more toes, same foot	300
Two great toes	600
One toe, other than great toe	[1]
One eye, loss of sight	1,800
Both eyes, loss of sight	6,000
One ear, loss of hearing	600
Both ears, loss of hearing	3,000

[1] Hernia, loss of teeth, and loss of any toe other than great toe, are considered temporary disabilities only.

The formula for the computation of the severity rate is as follows:

$$\text{Severity rate} = \frac{\text{Total days lost} \times 1{,}000}{\text{Total number of employee-hours worked}}$$

EXAMPLE OF USE OF FORMULA

Plant "A" worked a total of 900,000 employee-hours during the first 6 months of 1943. During this period it had the following injuries:

1 loss of vision of one eye	time charge	1,800 days
1 loss of one thumb	time charge	600 days
1 loss of use of hand—25 percent	time charge	750 days
12 temporary disabilities	time lost	150 days
15 injuries	Total time loss	3,300 days

$$\text{Severity rate} = \frac{3{,}300 \times 1{,}000}{900{,}000} = 3.7$$

The frequency rate for this period would be computed as follows:

$$\text{Frequency rate} = \frac{15 \times 1{,}000{,}000}{900{,}000} = 16.7$$

Because it is difficult to evaluate many injuries, particularly the more serious ones, at the end of each month, it is suggested that the severity rate be computed for a period of not less than 6 months, and preferably for an entire year.

Even then the problem is encountered of evaluating the severity of injuries for which the extent of impairment is undetermined at the time of the computation. A worker, for instance, may have an injury to his leg, but the exact extent of the impairment may not be measurable until months later. In such instances the opinion of the attending physician must be used as the basis for the time-charge estimate.

If the severity rate is computed for the entire year, then obviously these estimates need to be made only for such cases as are undetermined at the end of the year. For most cases the exact degree of impairment will have become definitely settled during the course of the year. A recently suggested modification of the American Standard provides that the necessary estimates be made within 1 month after the close of the year so as to permit an earlier severity determination for plants interested in safety contests. A more accurate measure usually requires that a somewhat longer period elapse after the end of the year before making final severity estimates.

The frequency rate, and to a lesser extent the severity rate, are useful in answering the first two of the five questions of the safety man: (1) How serious is the accident problem? and (2) Where do the accidents occur? The frequency rates by departments tell him where most accidents occur. A comparison with the rates of other departments or other plants in the same industry, or with rates for the entire industry, reveals quickly the relative measure of the department's or plant's performance.

What Causes Accidents?

Any analysis of accident causes must necessarily begin with the investigation of individual accidents. As safety is an integral part of the production process, and because safety is management's responsibility, the foreman is the key man in accident prevention. He is responsible for the production and for the safety of his workers. He must see that working conditions are safe, that the workers under his supervision know how to work safely, and that they do so. Conse-

quently the basic approach to accident prevention is through the foreman. Form 2, the Supervisor's Report of Accident Investigation has been drawn with two purposes in mind: (1) To assist the supervisor in the analysis of accidents in his department, and (2) to require him to think in terms of causes and remedial measures. The trained safety man can tell quickly from the completed reports whether or not a foreman understands his accident problems. Through discussion with the foreman, his attention can be directed to significant omissions or errors in judgment. In addition to serving as a record for each accident, the form therefore serves also as a useful educational tool.

In a few States the agencies administering the workmen's compensation acts have prescribed report forms which not only serve the administrative needs of these bodies but also provide them with basic material for accident prevention. Such forms readily serve the employer's needs for accident-cause analysis and make unnecessary the use of a form along the lines suggested here. The form required by the Arkansas Workmen's Compensation Commission is reproduced, by way of example, on page 11.

FORM 2

Name of Company:_____

Supervisor's Report of Accident Investigation

(NOTE.—The term "Supervisor" refers to any individual who acts as immediate foreman, leader, headman, or gang boss)

Department:_____

Name of injured worker:_____ Badge or clock no._____

Occupation:_____

Date of accident:_____ Hour of day: —— a. m. —— p. m. Shift: 1, 2, 3 (circle one)

Description of injury (name also body parts affected and resulting type of disability):_____

Full description of how accident happened:_____

What unguarded, defective, or otherwise unsafe machine, tool, or other object, substance, or condition, contributed to the accident?_____

What was wrong with it?_____

What unsafe act was committed?_____

Why was the unsafe act committed?_____

What has been done to prevent similar accidents?_____

What do you recommend to prevent similar accidents?_____

Signature:_____ Position:_____ Date:_____

NOTE: The size suggested for this form is 8½" x 11".

THE USE OF THIS FORM IS REQUIRED UNDER THE PROVISIONS OF THE ARKANSAS WORKMEN'S COMPENSATION LAW

Form A-8—Second Revise
DALVEY-MORRIS PRINTING CO., FT. SMITH, ARK.

EMPLOYER'S FIRST REPORT OF INDUSTRIAL INJURY

State's Number For:	File: ..... Carrier: ..... Employer: .....
Carrier's File No.	

(The spaces above not to be filled in by Employer)

EMPLOYER

(1) Name ..... (2) Corporation ..... Partnership ..... Individual .....
(Give name under which concern does business)

(3) Office Address: No. and Street ..... City ..... State .....

(4) Nature of business .....
(List principal product or service of the concern)

ACCIDENT

(5) (a) Accident occurred where? ..... (b) On employer's premises? .....
(City and State) (Yes or No)

(6) Date of accident: ..... 19..... Hour: ..... A. M. ..... P. M.

(7) Date disability began: ..... (8) Was injured paid in full for this day? .....
(Yes or No)

(9) When did Foreman or Employer know of injury? .....

(10) Name of Foreman .....

INJURED EMPLOYEE

(11) Name ..... (First Name) (Middle Initial) (Last Name)

(12) Address: No. and Street ..... City ..... State .....

(13) Race ..... (14) Check: Single ..... Married ..... Divorced ..... Widowed ..... Female ..... Male ..... (15) Age .....

(16) Occupation .....

(17) (a) How long employed by you at this occupation? ..... (b) Piece or time worker? .....

(18) (a) Number of hours worked per day ..... (b) Number of days worked per week .....

(19) Wages: Per hour $..... per day $..... per week $..... If board, lodging, fares or other advantages were furnished in addition to wages, give estimated value per week $..... per month $.....

CAUSE OF ACCIDENT

(20) What was the employee doing when the accident occurred? .....
(Describe briefly, such as: loading truck; operating a drill press; shoveling dirt; etc.)

(21) (a) What machine, tool, substance or object was most closely connected with the accident? .....
(Name the machine, tool, appliance, gas liquid, etc., involved)

(21) (b) If machine or vehicle, what part of it? .....
(State if gears, pulley, motor, etc.)

(22) (a) Were mechanical guards, or other necessary safeguards (such as goggles) provided? .....

(22) (b) Was injured using them? .....

(23) In what way was the machine, tool or object defective? .....

(24) (a) How did the accident happen? .....
(Describe the accident fully, stating whether the injured person fell or was struck, etc., and all the factors contributing to the accident. Use other side of report for additional space.)

(24) (b) How can you prevent this type of accident? .....
(Specify the remedial measure, such as: better illumination, better ventilation, providing goggles, providing a better guard, better supervision, etc.)

(25) (a) Name and address of witness .....

(25) (b) How could the injured have prevented the accident? .....
(Do not say "by being more careful," but specify what employee should or should not have done. For instance: should not have used defective ladder; should not have oiled machinery in motion, etc.)

NATURE AND LOCATION OF INJURY

(26) .....
(Describe in detail the nature of the injury and the part of the body affected. For instance: amputation of right arm.)

(27) Probable length of disability .....

(28) Has employee returned to work? ..... If so, give date ..... (29) At what weekly wage $.....

(30) (a) Name and address of physician .....

(30) (b) Name and address of hospital .....

(31) Did injury result in death? ..... If so, give date .....

(32) In case of death, give name and address of nearest relative .....

INSURANCE

(33) Name and address of workmen's compensation insurance carrier .....

(34) Date of this report ..... Made out by .....
Official position .....

DO NOT WRITE IN THIS COLUMN

CASE NO.

EMPLOYER NO.

PLACE OF ACCIDENT

INDUSTRY

DATE OF ACCIDENT

AGE

RACE

CONJUG. COND. AND SEX

TIME EMPLOYED

WEEKLY WAGE

OCCUPATION

AGENCY

AGENCY PART

ACCIDENT TYPE

UNSAFE ACT

MECHANICAL DEFECT

PERSONAL DEFECT

NATURE

LOCATION

INSURANCE

REPORT LAG

CODED BY

NOTE: The actual size of this form is 8½" x 11".

Accident Cause Summary

From time to time, and preferably for specified periods, it will be desirable to summarize the facts obtained from the supervisors' reports. If accidents have been few in number, a simple chronological record of the type suggested in Form 3 may suffice. If accidents have been numerous, Form 4 is preferable.

Before entering into a discussion of these forms, however, it is desirable to sketch briefly the method of accident cause analysis which underlies these forms.

The purpose of accident cause analysis is to determine the factors which brought about accidents. These factors fall into 2 classes: (1) Unsafe working conditions, and (2) unsafe acts. It is important to watch both of these factors, even though in any given accident one may appear to be the more important. Unsafe working conditions frequently lead to unsafe acts, and vice versa. In most accidents, both factors will be found.

It is not intended here to go into great detail on the classification of accident factors. There are several sources which adequately cover this subject.[3] It is sufficient to indicate that the accident factors to be recorded are the factors which appear during any properly conducted accident investigation, and which can be obtained directly from an analysis of either the supervisor's report or a workmen's compensation report form of the type used in Arkansas.

To describe an unsafe working condition adequately, it is necessary to identify both the unsafe object or condition and to specify in what respect it is or was unsafe. Frequently it is desirable to go even farther and to identify a particular part of the unsafe object. It is more meaningful, for instance, to specify the faulty safety lock on the elevator door or the frayed elevator cable rather than to name the elevator as the unsafe object. In describing the unsafe working condition, then, it is necessary to identify three accident factors:

(1) The object, substance, or condition which is or was unsafe.
(2) The particular unsafe part of the named object.
(3) The defective condition.

In the standard method of accident cause analysis, these three factors are labeled, respectively—(1) agency, (2) agency part, and (3) agency defect. A fourth factor, called accident type, identifies the type of accident which resulted from the unsafe condition or unsafe act. This accident type may be a fall on a level surface, a fall from one level to another, struck by, caught in, on or between, etc.

The unsafe act involved may have been committed by the worker who was injured, or by a co-worker, or by some other person. An unsafe act may be described briefly as the violation of an accepted safe practice rule, such as oiling gears which are in motion, placing a lad-

[3] American Standards Association Code Z16.2: American Recommended Practice for Compiling Industrial Accident Causes, 1941; U. S. Bureau of Labor Statistics, Bulletin No. 667: Manual on Industrial Injury Statistics, 1940; and H. W. Heinrich: Industrial Accident Prevention, 1941.

der at an improper angle, climbing over a moving belt or conveyor, and similar acts. The question to be answered is: What was done unsafely and thereby contributed to the occurrence of the accident? The determination of the unsafe act furnishes the fifth accident factor.

If possible, it is worth while to determine *why* the unsafe act was committed (personal fault). The determination of this sixth factor may help greatly in the selection of the proper remedial measures. This is particularly true if workers are unaware of the proper safe practices, or have some physical deficiency, such as poor vision, which requires attention.

Briefly, the accident cause factors may be summarized as follows:[4]

1. The agency involved—i. e., the object or substance.
2. The agency part—such as the gears of a press.
3. The defective condition of the agency or agency part.
4. The accident type.
5. The unsafe act.
6. The reason for the unsafe act—i. e., personal fault.

An example may serve to illustrate this method of accident-factor classification. An inexperienced oiler removes the guard on the gears of a punch press in order to oil them. The guard was so constructed as to make access to the oil cup difficult without the removal of the guard. The oiler's fingers were mashed between the gears. The accident factors in this case are:

Agency	Punch press.
Agency part	Gears.
Agency defect	Improperly guarded.
Accident type	Caught between.
Unsafe act	Removal of guard.
Reason for unsafe act	Inexperience.

This type of analysis is factual, and it does not attempt to assess blame. The remedial measures, however, are not difficult to determine: (1) The substitution of a guard, or the modification of the present guard, which will provide easy access to the oil cup; (2) proper supervision and training of the oiler in the safe way of doing his work.

This method of analysis is simple and follows the steps which an investigator of accidents usually follows.

The Accident Report Summary

As already indicated, Form 3 is suggested for plants with few disabling injuries. It provides a chronological record which can be compiled readily from an analysis of the accident investigation report. In addition to the six accident factors, the form also provides for a record of the remedial action taken.

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[4] For the rules governing the selection of cause factors when there is a choice, see any of the sources named in footnote 3 (p. 12).

Form 3

Name of company: _____

Accident Report Summary

Period covered: _____ to _____

Department: _____ Prepared by _____

Name of injured	Accident date	Nature of injury	Agency and part	Agency defect	Accident type	Unsafe act	Reason for unsafe act	Remedial action taken
Walter Ryan	3-5-43	Broken leg	Conveyor	None	Caught between	Climbing over moving conveyor	In a hurry	Employees instructed never to climb over moving conveyor
John Walters	3-8-43	Punctured eye	Chisel	Burred	Struck by	Not wearing goggles—using unsafe tool	Not sold on safety	Wearing of goggles made mandatory; frequent inspection and conditioning of tools

The Accident Cause Analysis Summary

In summarizing the accident factors of a large number of accidents, best results will be obtained by so arranging the summary form that it will point toward hazards of particular concern to the specific department or plant. Although there are many unsafe acts, relatively few are of important significance at any one time in any one unit of industrial operation. It is advisable, therefore, for each plant or department or type of operation—depending on how these records are to be kept—to provide itself with a few selected items in the category of each of the accident factors. These selected items should constitute the items of special importance to the operation or department or plant, and should be assigned simple code numbers or symbols. Classification and summarization by such numbers or symbols is very much simpler than by the use of the actual terminology on the summary form. All other items, deemed of lesser significance, can be assigned to a miscellaneous heading. This procedure permits the summary sheet to be expanded or contracted. New items may be added, old ones dropped, and variations introduced to suit the need.

Form 4 can be prepared directly from Form 1. Under the agency column should be listed the specific agencies involved in the work injuries—such as saw, multiple drill press, ladder, loading platform, wrench, etc. If the summary is for a plant, the departments can next be shown, also by code symbol. The number of injuries shown for each department will then be those in which the listed agency was involved. Next are shown the type of disability, unsafe condition, accident type, unsafe act, and reason for unsafe act.

In a department or plant in which operations consist of machining with some assembling, for illustration, the agencies may tend to fall into two major categories: Machines and hand tools. Under the heading of "machines" can be listed the specific machines involved: Lathe, drill press, grinder, etc. The category of tools can be divided into power-driven tools and hand-operated tools, with the specific tools listed under each.

For the purpose of this system, there are essentially three types of disability: Fatalities, permanent impairments, and temporary total disabilities. These have already been defined and can be shown on the form simply as types 1, 2, and 3.

Unsafe conditions can be summarized by selecting those which seem important—from Form 1—and assigning a number to each. The number of cases shown within each space indicates the number of times an accident occurred because of this particular defect of the agency. In case of machines, the selected unsafe conditions conceivably may be (1) unguarded, (2) improperly guarded, and (3) miscellaneous. For hand tools, they may be (4) worn, (5) mushroomed, and (6) miscellaneous.

The standard accident-cause classification recognizes 10 accident types. For a particular department or plant, however, only 3 of these may be important: (1) Struck by, (2) caught in, on, or between, and (3) falls—on same level. A miscellaneous group (4) will provide for all others.

As is true of unsafe conditions, the number of unsafe acts are legion. But again certain of these will stand out from an analysis of Form 2. Suppose in the department under consideration, the following stand out: (1) Improper methods of lifting, (2) failure to wear goggles, and (3) using hands instead of hand tools. All other unsafe acts can then be combined into (4) miscellaneous.

Although some of the reasons for unsafe acts are hard to determine objectively, many of them lend themselves readily to analysis and classification. Such reasons are not difficult to identify, as for example: Disregard of instructions, violent temper, nervous, excitable. failure to understand instructions, lack of skill, unawareness of safe practice, and various bodily defects—such as poor eyesight or defective hearing. Form 2 will indicate that some of these recur much more frequently than others. If, for example, these numerically significant reasons are then identified as 1, 2, 3, 4, and 5 (miscellaneous), they too can be summarized very simply.

The general outline of Form 4 can remain essentially unchanged from month to month, or year to year. But the detail to be recorded on it will change, depending on the results of the review of Form 2. The detail shown on Form 4 serves primarily as an example for the hypothetical department used in the illustration. Each department or plant will want to substitute detailed classification of its own. based on its specific accident experience. Each form, however, should either show or have appended to it a listing of the cause factors represented by each code symbol.

Form 4

Name of company:_____

Accident Cause Summary

For period from _____ to _____

Department (or plant)_____ Summary prepared by _____

Agency	Type of disability			Unsafe condition						Accident type				Unsafe act				Reason for unsafe act				
	1	2	3	1	2	3	4	5	6	1	2	3	4	1	2	3	4	1	2	3	4	5
Machines:																						
Lathe																						
Drill press																						
Grinder																						
All others																						
Hand tools—power driven:																						
Pneumatic drill																						
Hammer																						
Chisel																						
All others																						
—hand powered:																						
Wrench																						
Hammer																						
All others																						
Etc.																						

Other Types of Summaries or Detailed Analyses

Form 4 by no means exhausts the possible types of summaries which may be found valuable. It does, however, include the more obvious facts which are important for a recording of accident cause data. Other information which may be found worth while may contain such items as occupation, sex, race, shift, day of week, hour of shift, and, possibly, the age or length of experience. The form can be expanded to include any or all of these, should that be desirable.

Various types of detailed analyses may also be found of value. For instance, what types of unsafe acts are characteristic of certain types of operations or occupations? To what extent do unsafe acts differ for men and women, or between employees on different shifts? What types of accidents follow from certain types of unsafe acts? How do certain types of remedial action affect the recurrence of accident types or unsafe acts? To this may be added data on the time losses involved as well as compensation and medical costs.

An important aspect of accident investigation and record keeping is that *detailed information is important.* The better the record keeping, the easier it will be to see accident trends, and the more adequately can the records be used to prevent recurrences of similar accidents. Records are no substitute for accident prevention, nor should accident prevention stand inactive until records are compiled. But accident records are indispensable aids toward accident prevention. Their important function is *to use the past as a guide for the future.*