

## 1922 REVISION OF THE INDUSTRIAL COMPENSATION RATING SCHEDULE

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A schedule rating plan as an instrument of rating a risk for workmen's compensation insurance should establish the relativity of hazard between individual risks of the same manual classification to the extent that the physical condition of the risk influences its experience. How far the Industrial Compensation Rating Schedule does accomplish this purpose is a matter of conjecture. It seems fair to state, however, that even if the present schedule does produce in many instances the correct rate for the individual plant, this is probably due largely to chance, for, while the present schedule has many good points, the fact remains that none of them have been based upon experience. A correct rate under the present schedule might be accomplished by the offsetting of excessive charges on some items and inadequate charges on others. The absence of experience for determining the item values of the present schedule necessitated the use of considerable judgment—sometimes excellent and other times subject to criticism. Therefore, the problem of establishing a new and simplified schedule rating plan was undertaken with the avowed purpose of assigning to accident producing causes charges commensurate with the costs of accidents arising therefrom with due consideration to the industry involved.

The first questions which naturally presented themselves for solution were as to what constituted accident producing causes. Were conditions out of which accidents could have been demonstrated to have arisen in one industry necessarily the source of a corresponding number of accidents in other industries and to what detail should a schedule attempt to measure the presence of these causes? It so happened that a number of companies, members of the now National Bureau of Casualty and Surety Underwriters, had been keeping their accident data in accordance with the Workmen's Compensation Statistical Plan which provided an individual analysis card for each accident. For the policy year 1919 there were available about 340,000 of these individual

accident reports. This mass of experience was accepted as being not only the largest volume but the most dependable experience available for the purpose of establishing a new industrial schedule.

The Workmen's Compensation Statistical Plan contains something over 500 causes of accidents. Engineering judgment concurred before any tabulation of statistics was made in two respects, namely, that the value of particular causes of accidents would vary between industries, and, secondly, that the vast majority of the number of accidents as well as the cost would be found to relate to comparatively few causes. As a preliminary step, therefore, the manual classifications were divided into 19 groups as follows:

#### INDUSTRIAL DIVISIONS

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|----------------------------------|---|
| 1. Stone Products                | 11. Rubber and Composition Goods        |
| 2. Clay Products                 | 12. Chemicals and Allied Products       |
| 3. Glass Products                | 13. Paper and Paper Products            |
| 4. Ore Reduction and Smelting    | 14. Printing and Publishing             |
| 5. Rolling Mills and Steel Works | 15. Textiles                            |
| 6. Metal Products                | 16. Clothing and Furnishings            |
| 7. Machinery and Instruments     | 17. Laundering, Cleaning and Dyeing     |
| 8. Vehicles                      | 18. Foods, Beverages, and Tobacco       |
| 9. Lumber and Wood               | 19. Miscellaneous Manufactured Products |
| 10. Leather                      |   |

Even as a preliminary measure it was not a simple matter to determine what the most important causes of accidents might be. With regard to manual classifications there were certain definite analogies between industrial hazards and the vast majority of classifications clearly belonged in one or the other of the industrial groups. Of course there were border line cases. With regard to causes of accidents, however, there were causes of all grades and importance. The two or three causes of major importance were clearly recognizable, but from there on the causes graded down so gradually that it was exceedingly difficult to place them in the order of their importance on the basis of judgment. Statistics were then relied upon to determine the answer. The first step in the actual tabulation was of course to sort out the accidents which arose out of classifications not subject to schedule rating. The costs of fatalities and permanent total disability cases were excluded in this preliminary tabulation because the occurrence

of an occasional loss of such magnitude would distort beyond justification the indications of the less important causes of injury. The death and permanent total cases were distributed over the various causes by number only in order that the frequency of their occurrence in any one cause might be checked against the indications on the cost basis of all other kinds of injury. In the actual determination of partial pure premiums which ultimately went into the schedule the total experience was used, average values being assigned to the permanent total disability cases. The result of the compilation was extremely instructive as it verified both major assumptions heretofore mentioned. A review of the compilation will verify this statement.

An analysis of the above tabulation gave rise to the first important decision with regard to the establishment of a new schedule, namely, that a schedule which included charges for machines, transmission, elevators, molten metal and eye protection and which reflected properly the presence of safety organizations and hospitals would produce results which would substantially satisfy the function of schedule rating. This decision with regard to machines, transmission and elevators would seem to require no further justification. With regard to molten metal, it is apparent that the hazard exists to a material degree, where it exists at all, and that is to be expected. In the industrial divisions five, six and seven, which constitute rolling mills, steel works, metal products, machinery and instruments, it is apparent that there will be a great deal of foundry hazard and, therefore, serious molten metal hazard, and a schedule to be satisfactorily complete for these divisions must needs include a treatment of this hazard.

With regard to eye protection, the same general argument would apply. It is unfortunate that in the Workmen's Compensation Statistical Code the great majority of accidents occurring to eyes were assigned to particular machines, the original thought probably being that all accidents arising out of the operation of a machine could be charged to it and that the proper guarding of the machine would be the remedy, whereas the wearing of goggles by the operator, entirely independent of the guarding of the machine itself, would in a great majority of cases have been the most effective preventative. As in the case of the molten metal hazard, the eye hazard, too, is primarily a local one, and

**PERCENTAGE OF TOTAL ALL OTHER AND MEDICAL LOSSES  
DUE TO VARIOUS ACCIDENT CAUSES**

Schedule	Toe Boards	Handrails	Openings	Explosions	Electricity	Molten Metals	Caustic Burns	Boilers	Prime Movers	Power Transmission	Cranes			Conveyors	Machines					All Other Causes	Total All Causes	Total Losses		
											Elevators	Traveling	All Other		Total	Point of Operation	Belts & Pulleys	Machine Explosions	Flying Objects				A. O. Machine Items	Total
1. Stone Products.....	..	.1	..	..	.1	..	..	.4	1.5	1.2	.4	.1	2.2	2.3	1.0	6.7	.2	..	.3	1.5	8.7	84.4	100.0	32,388
2. Clay Products.....	..	.1	.1	..	..	..	..	..	..	3.1	.7	..	..	..	.6	12.7	.5	..	2.2	7.8	23.2	72.1	100.0	146,784
3. Glass Products.....	..	.3	.1	..	.1	..	..	.9	..	2.3	3.7	.6	..	..	.3	6.8	.4	..	1.4	2.0	10.6	81.2	100.0	60,344
4. Ore Reduction & Smelting..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	100.0	100.0	..
5. Rolling Mills & Steel Wks...	..	.3	.3	..	.2	10.0	.3	..	.1	.6	.7	.8	1.1	1.9	.3	14.1	.5	..	2.9	2.9	20.4	64.9	100.0	14,728,119
6. Metal Products.....	..	.1	.1	..	.1	2.4	.8	..	.1	.8	.6	.5	1.1	1.6	.4	29.4	.7	.1	5.3	3.3	38.8	54.2	100.0	1,222,221
7. Machinery & Instruments.	..	.1	.1	.1	.2	3.8	.7	..	.1	.5	.7	.1	.2	.3	..	28.3	.9	.1	5.8	3.3	38.4	55.0	100.0	556,620
8. Vehicles.....	..	..	..	1.1	.4	.1	.2	.1	..	.6	.5	.2	.5	.7	..	22.9	.1	.1	4.3	3.9	31.3	65.0	100.0	570,874
9. Lumber and Wood.....	..	.8	..	..	..	.3	.6	.2	.7	2.6	1.2	..	..	..	.8	42.6	1.3	..	3.9	5.1	52.9	39.7	100.0	757,596
10. Leather.....	..	.6	.1	..	.1	..	1.0	.1	..	2.1	1.0	..	..	..	..	36.9	1.8	..	2.2	1.8	42.7	52.3	100.0	174,112
11. Rubber and Comp. Goods..	..	.2	..	.1	.4	.1	.4	.2	..	.3	.2	..	..	..	..	35.6	.8	.2	3.1	7.3	47.0	51.1	100.0	86,667
12. Chemical & Allied Products.....	..	.3	1.9	..	1.3	.2	3.6	.2	.1	.9	2.4	..	.3	.3	2.9	14.5	.4	..	1.4	3.8	20.1	65.9	100.0	271,400
13. Paper & Paper Products....	.2	.2	.1	..	.1	..	1.3	.1	..	1.0	6.4	..	.1	.1	.1	34.0	1.2	..	1.8	3.5	40.5	49.9	100.0	417,259
14. Printing & Publishing.....	..	.1	..	..	.1	.5	.2	..	..	1.8	5.5	..	..	..	..	40.9	.2	.1	3.3	9.0	50.5	41.3	100.0	244,567
15. Textiles.....	..	.4	.2	..	.3	..	.2	.1	.2	3.1	1.0	..	..	..	..	29.9	2.4	..	2.3	9.1	43.7	50.8	100.0	332,918
16. Clothing & Furnishings.....	..	.4	1.2	..	.1	..	.2	..	..	1.0	1.1	..	..	..	..	20.5	2.5	..	1.4	7.1	31.5	64.5	100.0	208,587
17. Laundering, Cleaning & Dyeing.....	..	..	..	6.0	.4	..	.4	.4	.5	7.1	1.9	..	..	..	..	33.6	.1	.1	.1	13.3	47.2	36.1	100.0	79,962
18. Foods, Beverages & Tobacco.....	..	.6	.2	.1	.1	.1	.4	.4	.3	1.1	2.1	.1	..	.1	1.2	19.4	.8	..	1.2	5.8	27.2	66.1	100.0	732,954
19. Miscellaneous.....	.4	.2	.1	..	.2	..	.1	.6	..	.6	1.7	.1	.6	.7	..	14.3	1.9	..	1.9	4.6	22.7	72.4	100.0	212,312
<b>TOTAL ALL SCHEDULES</b>	..	.3	.3	.2	.2	1.9	.6	.1	.2	1.3	1.5	.2	.4	.6	.5	26.5	.9	.1	3.2	4.7	35.4	56.9	100.0	6,835,698
<b>PERCENTAGE OF CASES</b>																								
D. & P. T. D.....	..	.3	.9	.3	2.2	.9	.3	.9	1.2	3.4	6.5	.6	2.8	3.4	.3	8.6	.6	..	1.2	3.4	13.6	64.2	100.0	944,242

where it exists at all it is very apt to exist to a marked degree. Safety organizations, hospitals, etc. find their defense in the portion of accidents which are not assignable to schedule items or physical equipment of any sort.

Up to this point no definite decision had been reached with regard to the actual subdivision of classifications, the tentative grouping being used only in the proof of the theory that accident causes did vary in importance between industries. At this point the whole matter of classification grouping was reviewed. The experience had originally been tabulated by individual classifications and was reviewed on the individual classification basis. In many classifications there was experience enough to determine their own relative accident cause weights. The remaining classifications had to be treated on the basis of analogy. Eventually all of the classifications were divided into 97 groups, each group purporting to be homogeneous with regard to the distribution of accident hazards.

How to measure the accident hazard of an individual risk and how to apply the data obtained in an inspection report then became the all important question. Mr. A. W. Whitney, in his paper appearing in Volume VII, Part II of the PROCEEDINGS, developed the theory which should underlie a schedule rating plan. In effect he brought out in the course of his development that the pure premium for any classification could be divided into two component parts, the one representing the anticipated cost due to non-schedule ratable causes to be called the residue, and the other representing the anticipated cost due to schedule ratable causes and that each of these component parts may be further subdivided into partial pure premiums which represent the anticipated cost due to particular causes. A partial premium relating to any particular accident cause must, therefore, represent the average cost per \$100 payroll exposed to that hazard. In rating an individual risk the point to be considered is the condition of that risk compared to the average condition of all risks exposed to the hazard under consideration. Roughly, therefore, if the index of a given hazard condition for the average risk or for the average exposure to hazard were unity and an individual risk could be shown to present a hazard 10% worse than the average, its index would be 110 and the pure premium to be charged against that individual risk for that

hazard would be 110/100 of the pure premium chargeable to the average risk. The particular problem consequently became how to determine the average condition and how to measure the departure of the individual risk from the average condition. It was necessary at this point to establish units of measure.

It is apparent that the pure premium for the machine hazard should vary directly with the ratio of total units of machine hazard present to total \$100 units of payroll exposed. If every machine presented the same hazard and every employee in a plant were constantly exposed to the hazard of one machine, there would be no need of schedule rating that particular hazard because it would be identical in every plant. In the first place all machines do not present the same hazard and, further, the hazard presented by any individual machine depends upon whether it is guarded or not. The first of these variables is subject to statistical determination. It was not sufficient to determine the amount of losses assignable to the various machines, which was readily done, but it was necessary also to determine the frequency with which the individual machines occurred and up to this time no method had presented itself of determining those very vital facts. The inspectors' reports for every plant, the experience of which had been included in the loss data, would have furnished the answer but the possibility of obtaining this correlation was absolutely out of the question. It was possible, however, to obtain from the various inspection boards and bureaus copies of current inspection reports as they were made. A call was issued for these inspection reports in July, 1921, and they were collected continuously until January 1, 1922, approximately 30,000 being obtained. If it had been necessary to determine an actual pure premium for each kind of machine, it would have been impossible to have used the loss data and the inspection reports of two differing periods or even of any but the same identical risks. However, what was desirable and necessary was a relative weight and, on the assumption that the distribution of machines had not varied materially between periods over which the loss data and the inspection reports were assembled, the results obtainable from these two masses of data, which were each large enough to avoid the stigma of selection, were deemed sufficiently indicative to be used as a schedule basis. Ratios were then developed between the actual

losses assignable to individual machines and the numbers of the machines present, and the weights based upon the relative values of these ratios were established for each kind of machine appearing with any degree of frequency in industry. All machines which did not appear with a sufficient degree of frequency to determine for themselves a weight, were thrown into a miscellaneous group.

It was thus found possible to meet the first condition, namely, that all machines do not present the same hazard. During the development of the machine weighting a refinement was injected into the procedure. The general hazard of the machine was divided into two parts—the point of operation hazard and the all other moving part hazard. It might not have been necessary to make this division except for the fact that the hazard presented by any one machine is not constant inasmuch as there are various conditions of guarding and it was recognized that the guarding at the point of operation on some types of machines reduced the hazard by a greater percentage amount than a guarding of the all other moving part. In fact, it was the hazard at the point of operation that established the difference in hazard from machine to machine and therefore it was for that part of the hazard that the weight was determined—the hazard of the all other moving part of each machine being sufficiently constant for schedule purposes.

As to the question of reduction of machine hazard by virtue of guarding, it was, of course, impossible to distribute the losses to individual machines or to groups of machines representing guarded and unguarded conditions. The judgment of various engineers, both those affiliated with the National Council on Workmen's Compensation Insurance under whose supervision the schedule was being constructed and those of the member companies who were taking an active part in its construction, was called into play. A questionnaire was submitted to each of these engineers asking their opinion as to (1) what percentage of the total hazard due to driving mechanism and dangerous moving parts of machines could be removed by guarding in accordance with the standards in the schedule; (2) whether there was any substantial difference in the above percentages as between machines of different types; (3) the percentage of total hazard due to unguarded points of operation of various individual

machines which could be removed by the installation of guards as provided in the schedule. Under this last question ninety-six individual machines were listed. As a result of the amalgamation of the various individual estimates, a series of differential values as between guarded and unguarded machines was obtained. The percentage of point of operation hazard removed by guarding was varied from 0 to 80% for the various machines, the average being about 40%, while the percentage of hazard of other moving parts removed by guarding was considered as constant at 80% for all machines. The inspection reports divulged the average condition of machines of any given type with regard to guarding both at the point of operation and all other moving parts, and these were related to the partial pure premiums which were subsequently assigned to these particular causes of accident.

With regard to the second premise, the condition that every employee in every plant be constantly exposed to the hazard of one machine is of course not realized in practice. In some plants there are fewer men than machines. It is possible, therefore, in such an instance, that every man is working on some machine all of the time, although he alternates from one kind of machine to another with no degree of regularity. It would not be unfair in such a situation to assume that every man in the plant were subject to the average machine hazard, this average machine hazard being determined by weighting each individual machine in accordance with the values heretofore determined and dividing by the number of machines. Opposed to this, however, is the condition that the plant may have more men than machines, in which case it would be obviously impossible for every man to be employed on a machine all of the time. The premium returned to the insurance carrier by the application of the partial pure premium assigned to the machine hazard would, of course, increase with the addition of the payroll for each additional employee, while the actual machine hazard might not increase at all. Obviously the payroll subject to hazard of machine operation would be determined by ratio of machine operators to total employees if such a factor could be ascertained for each individual plant. It has been suggested that this be determined by the simple expedient of asking the foreman, but it must be remembered at this point that the satisfactory application of any rating plan depends upon the inability of anyone to alter the result



of its application by the use of discretionary judgment. Criticism may possibly be offered at this point that judgment has played some part in the establishment of the schedule itself but the answer is clearly that once such judgment has been exercised the application of the schedule and this same judgment to every individual plant coming within the scope of the plan at least gives every individual operator the same kind of treatment and does not discriminate unfairly between them. A solution to this particular part of the problem presented itself provided that one assumption could be made, namely, that the classification system provided for the grouping of individual risks of sufficient homogeneity that the variation in the ratio of machines to employees in individual plants falling under one classification should not be material enough to jeopardize the validity of the rates produced by the application of the schedule itself founded upon such an assumption. This assumption was accordingly made and as a result the average hazard per machine, with due regard for its type and condition of guarding, gave the index of the machine hazard for the individual plant.

A treatment somewhat similar to that accorded to the machine hazard was also necessary in the case of power transmission. In this case it was not possible to obtain the total units of power transmission because the inspection reports under the present schedule give only the unguarded transmission units. It was, therefore, necessary to assume that all accidents occurred from unguarded units. It is true, however, that accidents do happen on fully guarded power transmission but in view of the small size of the partial pure premium assignable to this cause very little error would result from making the above assumption. At this point it should be noted that the number of units to be considered under the general heading of Transmission has been cut down to three general items,—gears, belts and shafting. Also, the occurrence of an unguarded belt has been given only one half the weight assigned to each of the other two items. The omission of the other items such as fly wheel and set screws, which appeared under the Transmission section in the 1918 Schedule was made because it was found that these causes produced too few accidents, comparatively, to warrant their inclusion in the Schedule.

When it came to relating these units of hazard to the exposure, considerable difficulty was found in determining a true index of

the payroll exposure. It was not possible as in the case of the machine hazard to combine both parts of the problem, hazard and exposure by using the average hazard per power transmission unit because the total number of power transmission units was not available. It was finally decided to relate the unguarded units to the number of machines present in the risk. This cannot be justified by as cogent reasoning as in the treatment of the machine hazard, but in view of the small percentage of total losses due to transmission items it was felt that any error involved in assuming such a relation would be negligible. Therefore, to obtain the risk index for the Transmission element it is simply necessary to divide the weighted sum of the unguarded units by the total number of machines in the risk.

The elevator hazard more closely parallels the treatment of machines than does power transmission, because in this instance it was assumed that the hazard of the risk could be measured by the average hazard per elevator. No weight was given to different types and sizes of elevators, although it should be noted that the revised Schedule does not apply to dumbwaiters, hand hoists and sidewalk elevators. Also, the number of units under this Section was reduced to four general items,—entrances or gates, shaftway enclosures, sides of car, and controlling mechanism. The amount of hazard removed by guarding was determined on the basis of engineering judgment as statistics were not available for this purpose, greatest weight being given to the most hazardous items. In this way, it is seen that a premium is placed upon the guarding of the most dangerous parts of the elevator, and of course this is to be desired inasmuch as it exerts an influence for the elimination of such danger points. The average elevator condition also included those risks which had no elevators for the reason that it was not possible to distinguish from the accident statistics those risks which had elevators and those risks which did not have them. The effect of this is that, as a general rule, the presence of an elevator, even though fully guarded, will produce a higher risk pure premium than the average, since a considerable proportion of risks are without elevators altogether. However, the index on the basis of average hazard per elevator is applied on the same basis as it was derived and gives, therefore, substantially correct results.

The treatment of those classifications where recognition is given to eye protectors and foot and leg protectors was to charge the full partial pure premium where there were no protectors used and to allow a reduction of 50% where eye protectors were used and 55% where foot and leg protectors were used, these percentages being determined on the basis of engineering judgment.

As has been already pointed out, the presence of such items as safety organization, inspection service, first aid, hospital, etc., in the Schedule is justified by the large percentage of losses due to accident causes which are not assignable to other schedule items. From the tabulation which has been presented, it will be seen that about 60% of the total losses fall in this group. It seems reasonable to believe that a reduction in the percentage of losses due to various miscellaneous causes,—in many instances sheer carelessness,—will produce a marked improvement in the total loss experience of the risk. The factor which should, therefore, be considered as of marked importance, is the morale factor, comprising as it does the various items which have a direct influence in cutting down losses of the miscellaneous type,—either by prevention due to safety education and inspection service, or by reduction in cost due to immediate and capable medical aid. Whereas it was recognized that the morale factor should be used to measure comparatively the condition of the individual risk against that of the average risk in the classification, it was deemed inadvisable, at the present time, to follow this procedure until more definite information was obtained as to the relative importance of the various items. They will, therefore, be entered in the proposed Schedule in the same manner as heretofore,—namely, as a percentage reduction of the manual rate.

In general it is fair to state that a great deal has been accomplished in the proposed Schedule toward building up a rating instrument on the basis of actual statistics. This is true particularly with regard to the machine hazard which fortunately, for this purpose, represents by far the greatest ratable hazard existent in industrial risks. With regard to the minor and more or less supplementary hazards, even the proposed Schedule has to depend upon a great deal of engineering judgment. This, therefore, represents the field which must be covered more thoroughly in future Schedule revisions, and, accordingly, the

necessary steps toward compiling the statistical data required should be taken with as little delay as possible. It is felt, however, that because the proposed Schedule eliminates some of the weaknesses of the Schedule in use at the present time, it is well worth the labor involved in its construction and the confusion which invariably accompanies the substitution of one rating mechanism for another.