SCHEDULE RATING BY FORMULA.

BY

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It is the purpose of this paper to call attention to a method of rating compensation risks, which has already had some discussion and has been practically applied to several groups of classifications.

A more or less general discussion of this method took place at the joint Manual Committee meeting in the Hotel Manhattan, the latter part of September. It was pointed out that in certain classifications, there were inherent differences of degree of hazard within the same trade arising out of the organization of the particular risk; that these differences must be treated to avoid discrimination; that the making of further sub-classifications would lead to a very great increase in the size of the manual, and an undesirable subdivision of statistical data, and that a possible solution of the difficulty lay in an extension of the schedule rating plan along the lines indicated by the treatment of " Metal Goods, N.O.C."

A word of explanation regarding this method is not amiss at this point, as the subject is one which is not generally understood outside of the various committees that have been responsible for the innovation. Considerable complaint had been made by manufacturers over assignment to classification, "Metal Goods, N.O.C." The Manual rate was made high in order to furnish an adequate premium for certain risks involving a large stamping payroll. The application of the classification to risks of lesser hazard has produced some injustice, the tendency has been to avoid the use of the classification, and many risks have been forced into other classifications in order to escape the high rate. The committee found upon investigation that the essential difference between these risks lay in the percentage of stamping payroll as compared with the percentage of non-stamping payroll, the hazard increasing directly with the percentage of stamping payroll. In many of these plants, however, it is very difficult to keep a separation of stamping payroll, as employes work interchangeably on stamping presses and on other machines.

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The inspection department of the Workmen's Compensation Bureau, after an extended investigation, proposed the following:

"First: Risks assigned to 'Metal Goods Mfrs.—N.O.C.' are subject to a special inspection for the purpose of determining:

    (a) Percentage of machine workers.

    (b) Number of hand fed stamping presses.

    (c) The total number of working machines.

Second: The following formula is applied as a method for determining the basic rate for such risks:

$$1.36 + 1.36 \left(13.3 \times \text{M.W.} \times \frac{\text{S.P.}}{\text{W.M.}} \right),$$

where

    M.W. = machine workers.

    S.P. = number of hand-fed stamping presses.

    W.M. = total number of working machines.

The resulting rate will be the basic rate for the risk, subject to the usual modification, in accordance with the Universal Analytic Schedule and experience valuation.

The practical application of this formula has produced on the whole a very satisfactory result in the opinion both of the General Reference Committee of the Bureau and the Classification and Rating Committee of the Compensation Inspection Rating Board.

The general subject of "Container" hazard which was discussed at the Manhattan Hotel Conference has led Professor Whitney to work out the following method of treatment:

1. The average percentage of employes engaged in 'Container' work should be determined for each classification. Designate this percentage by the symbol 'A.'

2. The relationship between the "Container" rate and the governing rate should be determined for each classification. If, for example, the basic rate for a governing classification is .50 and the base rate for the "Container" classification is $2.00, this relationship would be expressed by the multiplier 4. Designate this factor by the symbol "X." This factor can be determined from a consideration of the basic pure premiums. A statistical investigation need not be made.

3. On a given inspection, let the actual percentage of employes engaged in "Container" work to the total number of employes in the plant be "E."

4. Let "Y" equal the adjusted rate.

5. Let "R" equal the governing rate.

6. Let "R'" equal the container rate.

7. Let "Ro" equal the theoretical rate which would apply if no Container work were carried on.

Professor Whitney assumes that the base rate for classifications of this character must be predicated upon a certain average condition which contemplates a certain degree of "Container" hazard, and obtains,

$$1. \quad (1-A)R_0 + AR' = R$$
$$2. \quad (1-E)R_0 + ER' = Y$$

The first forumla is a special case of the second.

Formula 1 states that the average governing rate for a given classification of the character is made up as follows:

One portion is based upon the theoretical rate which should apply to the classification, if no "Container" work is carried on (R_0). This part of the rate is weighted by the average percentage of workers, not "Container" workers; the remaining portion of the rate is based upon the rate for "Container" manufacturing (R'). This portion is weighted by the average percentage of "Container" workers. In an average plant, the sum of the foregoing rates properly weighted is the governing rate for the classification. This formula is a special case of the general formula which we desire to use in properly distinguishing between risks presenting various degrees of "Container" hazard.

In the actual case (not average), E is substituted for A and the rate Y must be determined. To determine the rate Y, it is necessary to substitute for R_0, the value obtained by solving Equation 1 for R_0. This substitution gives the following formula:

$$Y = \frac{(1-E)(R-AR') + ER'(1-A)}{1-A}$$
$$= \frac{(1-E)(1-AX) + EX(1-A)}{1-A} R$$
$$= \frac{(1-E) + (E-A)X}{1-A} R$$
$$= R + \frac{(E-A)(X-1)}{1-A} R.$$

The inspection departments have been asked to make a further investigation of the practical application of this formula, and the Rating Committees will gather as much experience as possible, in order to test its practicability. It is the general opinion of those who have made some examinations of the subject, that there are a large number of other classifications which, from a mathematical standpoint, present no difficulties under this method of treatment. The practical difficulties are: First, the derivation of a fair set of values for the elements of each formula by inspection of risks in the class; and, second, the evolution of a statistical method for testing these elements by experience. This latter proposition is a difficult one, and so far, has not been treated with any elaboration.

The fire companies, however, have recently found a statistical method for attacking a similar problem in their rating formulas, and our problem is one which will yield to a serious attack. A general application of the method by the inspection and rating board of a locality would, in the ultimate analysis, supersede the present rating by manual. In other words, the manual rate for a classification would bear a decreasingly important part in the final rate, and the elements of the schedule would largely determine the rate of the particular plant. This rate would be worked out by the inspection board, and filed with all companies for each risk, similar to the general method of rating adopted by the fire insurance companies.

We believe that this plan of rating has many possibilities as well as some difficulties, and the object of this paper is to bring the matter before the Society in order that a number of investigations along these lines may be started, and the whole subject receive the attention which the needs of the present manual will justify.

It is agreed by all that a further extension of the number of classifications is unwise, and some further method of rating must be devised in order to avoid obvious discriminations. The schedule method is one of the best solutions which has been offered up to the present time, and follows the experience of the fire insurance companies in their solution of the similar problem.

ORAL DISCUSSION

MR. SENIOR: The application of the metal-goods formula has resulted in developing individual rates, in what appears to be an equitable manner, for a great many risks which prior to the adop-

tion of the formula were given a class rate of $5.67. In practice, of course, every company and every employer who succeeded through the application of the formula in reducing the rate in a given case from $5.67 to a lower figure, was satisfied with the result. On the other hand, serious protests have come from companies and assured who were formerly rated under related classifications such as " brass goods mfg." or " copper and zinc goods mfg." or " sheet metal workers."

The main difficulties which we have encountered were due largely to the fact that with the adoption of the metal-goods formula, nothing has been done to eliminate present classifications which include metal stamping as part of the operations.

The reasons which have influenced the underwriters to rate metal goods on the basis of a mathematical formula developing an individual rate for each risk, were due to the fact that the rate for metal stamping is extremely high and that it is difficult to secure a reliable and accurate division of pay roll from employers for stamping operations. It was, therefore, primarily a practical necessity that induced the rating board committees to adopt that formula.

Whether it is possible to defend its adoption upon any scientific grounds is another question.

If it were possible to secure an accurate division of pay roll for stamping operations, it would be far preferable to write metal risks subject to a divided pay roll for stamping work. From the standpoint of the statistician, the experience results secured from the underwriting of a mixed classification like metal goods, n. o. c. are not satisfactory, for that experience does not bring out clearly the necessary data and basis for rate-making.

With reference to plants that manufacture containers for their product, the suggestion that an individual rate be developed for each plant upon the basis of a mathematical formula is open to several objections. It is quite true that the present method of rating such plants is not satisfactory and is perhaps illogical and inconsistent. For instance, for plants that manufacture containers for the use of their own products exclusively, a flat rate is applied, the container portion of the plant being rated under the governing classification. On the other hand, for plants that manufacture containers for their own product and also sell such containers to outside trade, a division of pay roll for the container portion of the risk is allowed. The investigation which we have made indicates that it is practical to divide the container pay roll in all plants. It would, therefore, seem to be doubtful as to whether it is advisable to rate such plants upon any other basis than upon a divided pay roll. The application of a given formula upon an inspection will not, obviously, develop an absolute and accurate rate. There must enter into such formula items relating to average number of employees or pay roll. Such items are necessarily speculative in character.

Furthermore, we meet with the serious statistical objection that the experience produced on risks of this character will not develop any correct basis for rate-making. It would, therefore, seem that where we are confronted with the type of risks conducting separate operations, which are subject to fairly accurate pay roll returns for each separate classification, the most equitable results may be obtained by creating separate rates for the separate classifications and not by the development of a flat rate for the entire risk.

MR. MOWBRAY: Mr. Forbes's paper presents some ingeniously worked formulæ for differentiating between risks in the " Metal goods, n. o. c." classification according to the extent of stamping involved and for differentiating between risks similarly classified, in other cases according to the amount of container manufacturing done, without separating the pay roll in either case.

At first glance the formulæ seem to fill a real need but deeper analysis seems to show their use would not be an unmixed good, if good at all. The formulæ for the " Metal goods, n. o. c." classification bring out as the rate the result of a theoretical but not actual division of pay roll between " Sheet metal works" and " Metal stamping" but quote the rate under "Metal goods, n. o. c." under which classification presumably the experience would be reported. This experience would be of no value for rate-making and the rates for the classification will depend upon the experience with other types of risks, viz., " Sheet metal works " and " Stamping," in lines where pay roll division is followed. This to my mind is a serious objection. A similar but slightly different objection lies against the use of the second formula.

Having previously indicated my belief in the soundness of Dr. Downey's views on classification I cannot but look upon the introduction and use of such formulæ as a step in the opposite direction. To my mind it is much better policy to face the issue squarely, divide the pay roll where possible (I believe it can always be done for container work) and in other cases refuse to differentiate until the system of classification is so changed that differentiation naturally follows.