NOTES ON THE ROYAL AUTOMOBILE CLUB OF VICTORIA RELIABILITY TRIALS.

By Mr. J. Hugh Grice, B.Sc.

The basic idea underlying these tests was to ascertain the reliability of the modern car over 1,000 miles of road—good, bad or indifferent—without neglecting the questions of economy of petrol consumption and hill-climbing power as being of interest to the motor-owner, actual or prospective. The first point to be dealt with is the evolution of the formulae used in the petrol consumption test and hill climbs; and, as regards the 1922 trials, the speed test (with flying start) over a measured mile, and the acceleration test over two-tenths of a mile.

Dealing first with the petrol consumption, neither the actual mileage per gallon nor the ton miles per gallon can give a fair comparison of the relative merits of cars of various weights and horse power, and it was considered advisable to adopt a combination of the two values in some definite ratio. From the meagre information available, some English tests seemed to prove that \( \frac{3\text{TM} + 3\text{RM}}{4} \) would be a suitable formula where \( \text{RM} \) = road miles per gallon.

\( \text{TM} \) = ton miles per gallon.

Applying this formula to results of previous trials it was found to unduly favour cars with small engines and low weights. After several modifications, the formula adopted for the 1922 trials, which seemed to answer very well, was \( \frac{3\text{TM} + \text{RM}}{4} \).

Cars were rated in three classes, viz.:

(a) Small cars with engines of under 2,200 cc. total cylinder capacity.
(b) Medium cars with 2,200 to 3,300 cc
(c) Single cars with over 3,300 cc.
This is a purely arbitrary classification used by the R.A.C.V., and it was a condition of the tests that the large cars should average from 2 to 6 miles per hour more than the small ones, the set averages varying according to the nature of the road. Because of its simplicity the R.A.C.V. rates the H.P. (for competition purposes) as equal to the cylinder capacity cc. divided by 150. The cylinder capacity being generally available from makers’ lists.

The hill climbing contests also caused considerable thought in evolving a formula which would present a true index of merit. The formula \( \frac{HP \times t}{w} \) where \( t \) = time in seconds, \( w \) = the total weight; in general use assumes that the power consumed is proportional to the weight. This is not true in practice, and the less steep the hill the less accurate the formula. An attempt was made to obtain a rational formula which would involve the following factors:—

(a) Difference in height between start and finish of the hill.
(b) Rolling resistance (depends on length of hill).
(c) Air resistance.

The horse power necessary to overcome the three factors are respectively

\[
\frac{hw}{33,000t} \quad \frac{lr}{33,000t} \quad \frac{1Pa}{33,000t}
\]

\( h \) = height; \( w \) = weight in pounds; \( t \) = time in minutes; \( l \) = length of hill in feet; \( r \) = rolling resistance in pounds depending on nature of road surface; \( P \) = air pressure in pounds per square foot; and \( a \) = area acted upon by air pressure.

By addition the total horse power required would be

\[
\frac{hw + l (r + Pa)}{33,000t}
\]

This formula was simplified down to:

\[
HP = \left( h \times \text{constant} \right) \frac{w + H}{t}
\]

by following three assumptions, viz.:—

(1) That the average rolling resistance would be about 60 lbs., and be taken as constant.
(2) That the area exposed to air pressure be taken at 12 sq ft.
(3) That for the purpose and estimating \( P \) an average speed of 25 m.p.h. be assumed.

So as not to depart too much from the form of the old
formula, this was inverted, and the performance of a car in the 1921 trial was based on \[ \frac{HP \times t}{W + \frac{1}{h}} \]

It was seen upon working out results that the light cars seemed to have undue advantage on hills with sharp turns. On a straight hill the above formula should give a very fair comparison. However, after consideration, the committee adopted for the 1922 trials the formula \[ \frac{HP \times t}{W + \frac{1}{3h}} \] This formula will probably be retained for future events as it does not unduly penalise the heavier cars.

The formulae for the speed and acceleration tests were similarly based on first principles and kept as simple as possible. They were as follows:—Acceleration test: \[ HP \times \frac{t^2}{100w} \] taking time in seconds, weight in tons, no account being taken of wind resistance. Speed test: \[ HP \times \frac{t^3}{(2wt^2 + 3)} \] time in minutes. It will be seen from these formulae that the lowest numerical result connotes the highest performance. The leading car in each event was awarded the maximum number of points for that event, and the other cars obtained points pro rata according to their formula result.

Contrary to expectations only one car obtained a speed of one mile per minute. Of course, in order to get a really accurate comparison of car performance the question of gear ratio and size of wheels should be taken into consideration, but this is impracticable in trials of this kind. In this connection reference may be made to the "K" equation, published some years ago in the "Automobile Engineer," by means of which, together with a set of tables, the gradient that a car should climb on its various gears and its petrol consumption on various surfaces could be estimated. With the increased efficiency of the modern motor these tables would have to be modified.

The President moved a hearty vote of thanks to Mr. Grice for his lecture. Mr. Grice had confined his remarks principally—and correctly—to the different efficiency formulae, for most of which he was responsible. Mr. Grice deserved the greatest credit for the care he had given to that most important subject.

The vote was carried by acclamation.
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