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DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
WASHINGTON

Letter
Circular
LC 179.

September 15, 1925.

PORTABLE MACHINES FOR MEASURING THE WHEEL LOADS OF VEHICLES.

Based upon the necessity of protecting highways and streets from premature failure, state and municipal regulation of the degree to which vehicular traffic may be loaded has in recent years become quite general. In the practical enforcement of these regulations policing agencies have felt the need of a portable weighing device which can be depended upon to indicate rapidly and accurately whether or not a vehicle is loaded in excess of prescribed limits. To meet this demand machines have been developed for weighing single wheel loads of vehicles and are ordinarily used in pairs, one machine under each wheel on an axle. The weight of a vehicle is thus presumably established if a machine is placed under each front wheel, and then under each rear wheel, and the sum of the two pairs of readings taken.

The formal practice in courts handling cases in which overloading of vehicles is charged requires that testimony concerning the actual weight of the vehicle be of unquestionable accuracy. Other design requirements of the weighing machines from which such testimony is secured inevitably places mechanical limitations upon the degree of accuracy that may be obtained. Again the conditions of use are severe, and the mechanical limitations of the design are such that rough usage is likely to result in variations in the weighing performance. Apparently, however, the machines in common use show as much promise as can be expected when all the circumstances are considered, and since the protection of highways from destruction is a vital economic necessity, it is incumbent upon all concerned to follow the dictates of common sense and engineering experience in the enforcement of vehicular weight regulation. In short, a weighing machine need not be absolutely accurate, if it in fact be accurate enough. Neither need it be immutable in performance if its variations are reasonably convenient to determine and correct. Treatment of these phases is the particular purpose of this paper.

The Possibility of Accuracy.

The accuracy obtainable in machines for weighing individual wheel loads is limited by the requirements of portability and compactness. The substantial foundation and combination of levers that would be required in an ordinary commercial scale to weigh loads of 10 000 to 20 000 pounds must be reduced to a form of size and weight that can be conveniently carried about and this practically eliminates the reducing lever principle of force measurement entirely. In fact, it is necessary to work into the design principles of force measurement that could not be considered in commercial weighing machinery and these principles are the accuracy limiting agents.

The end sought in the design of all measuring machinery is that measurement shall be done close enough for the intended purpose. Absolute accuracy of measurement of wheel loads of vehicles is no more necessary than it is in any form of commercial measurement where it is never hoped to be attained. As a matter of fact, it is less necessary because the consequences of inaccuracies are less. A five percent overweight on a bill of goods would be unconscionable not only because of the economic hardship upon the ~~buyer~~ seller, but because in the present state of development of commercial weighing machinery there is no excuse for it. Whereas aside from the fact that a five percent overload on a motor truck may be considered only a technical violation of a police regulation, its destructive effect on highways in excess of the weight limit set by the regulation is undoubtedly comparatively slight.

The opinion of the Bureau after a number of tests of these machines under various conditions and a rather complete study of the design, manufacture, and quality of workmanship is that under ordinary conditions of use, the machines can be depended upon to yield a degree of accuracy better than five percent and probably better than three percent. However, it is advised that the conditions of use be rigidly and competently supervised, and that the performance be frequently checked in the manner described below.

Methods of Test.

Owing to their compactness the customary method of testing scales by placing standard weights on the load receiving

element is impractical to apply to portable wheel load weighers. A not unusual method of checking the performance of these machines is to place them in an ordinary materials testing machine of suitable capacity. This sort of test is considered by the Bureau to be unsatisfactory for the general reason that the errors or variations in the testing machines are likely to be of the same order or greater than those in the weighers, and, further, because perceptible variations can be produced by different methods of operating the testing machines.

A simple, convenient, and extremely practical method of test is here described, and it is not believed that the possibilities of elimination of variations due to testing technique can be improved. This consists simply in laying a pair of weighers on the deck of a motor truck scale whose accuracy has previously been authentically established, balancing them out on the weigh beam, driving a pair of wheels on the weighers, and comparing the weight indications of the weighers with that indicated by the scale beam. This procedure can be carried out with both the front and rear wheels of a truck which will check the machines at two points in the capacity range. Other points can be checked by varying the load on the motor truck, or by weighing different trucks. For a daily or weekly test, checking two points in the weighing range will probably be sufficient.

In this connection it may be added that as far as accuracy, or dependability of performance is concerned, a well designed, modern motor truck scale as a force measuring machine is capable of producing superior results to machines used in engineering laboratories for testing the strength of materials. Further, when using a motor truck scale as described above, the factor of making tests under practical conditions of loading is involved, which, as a matter of principle, is much desired.

Methods of Use.

Care should be exercised in the use of portable wheel load weighers that they be laid on a surface as nearly level as possible, and aligned so that the wheel loads are applied in the center of the platforms. They should be protected from falls and in fact generally treated with extreme care. The gage indicator is susceptible to damage from rough treatment, and the whole machine should be returned for repairs at any sign of failure in the gage or elsewhere.

It is emphasized that the practice of establishing corrections to be applied to the weight indications of portable weighers should not be followed. A sensible, or reasonable range of variation should be established and the manufacturers required to maintain the machines within these limits. The Bureau has often suggested that five percent of the applied load is large enough for a maximum allowance and small enough to be considered reasonable for the practical purposes of enforcing overweight regulation. This matter, however, might be left to the manufacturers to establish, and provided the allowable variation established is five percent or less, the Bureau can see no objection to it. This policy is desirable from the point of view of administering over weight regulations, and modern business standards are such that the manufacturers of the machines should not object to providing reasonable and competent maintenance service. In order to guard against possible misunderstanding the rather obvious point might be interjected here that in following the policy just outlined in the event of an indicated overload in any case less than the established allowance for variation there can be no positive assumption that the vehicle is overloaded at all.

Finally, let it be said that the common tendency to expect these machines to compare in performance with commercial weighing machines has no justification. They are not commercial weighing machines nor are they used for any of the purposes for which commercial weighing machines are used. Their intended function is to establish a degree of probability as nearly certainty as may be that a vehicle is or is not loaded in excess of prescribed limits, and to do this there is no essential reason why they should compare in performance with commercial weighing machinery. In cases where the evidence of overloading shown by the weighers is unlikely to stand the test of court procedure, the vehicle should be sent to a platform scale and weighed.