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DEPARTMENT OF COMMERCE
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GENERAL REPORT OF THE WORK OF THE RAILROAD TRACK SCALE TESTING SERVICE OF THE U. S. BUREAU OF STANDARDS DURING THE FISCAL YEAR, 1925, JULY 1, 1924 TO JUNE 30, 1925.

INTRODUCTION

The Bureau of Standards receives inquiries from time to time regarding its activities in the testing of railroad track scales and investigation of freight weighing conditions throughout the country. In response to this demand, there was prepared at the close of the 1924 fiscal year a general resume covering the work during that year, and this served the intended purpose so effectively that it has been concluded to continue such reports annually provided other circumstances permit. This report which covers the work of the 1925 fiscal year contains all pertinent information that consistently can be furnished to the general public.

In order to make the investigation of the greatest utility and to secure the maximum improvement in weighing conditions, an individual report on each test is made which details the performance found and contains recommendations for necessary improvements. These reports are furnished to owners and sometimes to other parties in direct interest and are very frequently made the basis for the adjustment, correction, and replacement of scales. The general policy of the Bureau is not to furnish these individual reports to parties of outside interest, this policy having been formulated as the only one which can be consistently followed in view of the circumstances under which the work is done. One of the strongest reasons dictating this course is that there can be tested each year with the present equipment and personnel, only a relatively small percentage of the scales in use. The scales to be tested therefore must be selected from among the requests received, or at random, in such a way that the general conditions can be most accurately gauged.

In arranging schedules for each of the Bureau's three testing equipments, attempts are made to accomodate as many requests for the service that have been previously filed as far as it is at all possible. The Bureau charges no fee for this service and therefore no expense is connected with the test with the possible exception of switching charges which may be assessed by carriers for handling the outfits. Schedules are ordinarily laid out a year in advance. It is required that each master scale in the United States, about twenty in number, be visted each year, and this circumscribes the territory which can be visited to some extent. This and other demands upon the service make it inefficient to attempt to reach outlying points, or the schedule trips where the outfits cannot be kept reasonably busy at actual testing work. These facts should be borne in mind when making requests for the service, and they will help to explain many cases in which service cannot be given in accordance with such requests.

INVESTIGATION OF RAILROAD TRACK SCALES

Considerable progress was made during the year ending June 30, 1925 in the investigation of the condition of railroad track scales used for weighing revenue freight. As in past years it was found necessary to tie up one or more of the equipments for more or less extended periods as a result of shortage of funds and personnel, and for necessary repairs. The idle time during this year consumed about 30 percent of the total working time. The idle testing periods were utilized in the repair and overhauling of equipment.

Railroad master scale schedules were completed in regular order, with the exception of one master scale. Eighteen master scales were tested and 898 railroad track scales. Tests were made in the following 35 states and the District of Columbia.

Alabama	Maryland	Oklahoma
Arkansas	Michigan	Oregon
California	Minnesota	Pennsylvania
Colorado	Mississippi	South Carolina
Georgia	Missouri	Tennessee
Idaho	Montana	Texas
Illinois	Nebraska	Utah
Indiana	New Mexico	Virginia
Iowa	New York	West Virginia
Kansas	North Carolina	Wisconsin
Kentucky	North Dakota	Wyoming
Louisiana	Ohio	

The testing work is planned to make the results as representative as possible. Tests were made on 70 railroads and at approximately 250 industrial plants.

A resume of the results of the tests of railroad track scales is shown in Table I below. Master scale test results are shown elsewhere. The data are arranged geographically, the country being divided into three districts corresponding generally with the territorial divisions adopted by the Interstate Commerce Commission in its "Report on the Statistics of Railways" which are designated as Eastern, Southern, and Western. (The Eastern District includes territory east of the Mississippi, and north of the Ohio and Potomac Rivers and a line connecting Parkersburg, West Virginia and the Southwestern corner of Maryland. The Southern district includes territory south of the Eastern District and east of the Mississippi). For practical purposes there has been some modification of this territorial arrangement in that the Western District includes also territory east of the Mississippi and west of a line from East St. Louis to Peoria and Chicago, inclusive. The data are classified to indicate ownership by railroads, industries, Federal government, and states and municipalities. A brief analysis of the errors on incorrect scales is also given.

Table I RESULTS OF TRACK SCALES TESTS

FISCAL YEAR 1925

District	Ownership	Number of Scales Tested	Passed		Failed		Mean Numerical Error Per cent of Applied Load	Analysis of Errors of Incorrect Scales					
								Scales Weighing Heavy			Scales Weighing Light		
			Number	Per cent	Number	Per cent		Number	Per cent of Incorrect Scales	Mean Error Per cent of Applied Load	Number	Per cent of Incorrect Scales	Mean Error Per cent of Applied Load
EASTERN	Railroad	46	30	65.2	16	34.8	0.36	10	62.5	0.47	6	37.5	1.38
	Industrial	22	13	59.1	9	40.9	0.36	4	44.4	0.62	5	56.6	.98
	Government	3	2	66.7	1	33.3	0.19	1	100.0	0.44	0	0	
	State or Municipality	0											
	Total	71	45	63.4	26	36.6	0.34	15	57.7	0.51	11	42.3	1.01
SOUTHERN	Railroad	131	65	49.6	66	50.4	0.46	25	37.9	0.65	41	52.1	0.88
	Industrial	66	28	42.4	38	57.6	0.34	16	42.1	0.36	22	57.9	0.58
	Government	2	1	50.0	1	50.0	0.26	1	100.	0.40	0	0	
	State or Municipality	1	0	0	1	100.0	0.81	1	100.	0.81	0	0	
	Total	200	94	47.0	106	53.0	0.42	43	40.6	0.54	63	59.4	0.78
WESTERN	Railroad	323	241	74.6	82	25.4	0.19	52	63.4	0.39	30	36.6	0.54
	Industrial	299	204	68.2	95	31.8	0.23	54	56.8	0.42	41	43.2	0.54
	Government	3	2	66.7	1	33.3	0.20	1	100.	0.31	0	0	
	State or Municipality	2	0	0	2	100.0	1.84	1	50.0	0.53	1	50.0	3.16
	Total	627	447	71.3	180	28.7	0.22	108	60.0	0.40	72	40.0	0.58
ALL DISTRICTS	Railroad	500	336	67.2	164	32.8	0.28	87	53.0	0.47	77	47.0	0.79
	Industrial	387	245	63.3	142	37.7	0.25	74	52.1	0.42	68	47.9	0.56
	Government	8	5	62.5	3	37.5	0.21	3	100.	0.38	0	0	
	State or Municipality	3	0	0	3	100.0	1.50	2	66.7	0.67	1	33.3	3.16
	Grand Total	898	586	65.2	312	34.8	0.27	166	53.2	0.45	146	46.8	0.70

The figure of outstanding importance in Table I is that at the foot of the third column which indicates that 64.2 % of all the track scales tested passed the tolerance prescribed by the Bureau for good performance, namely 0.20 % of the applied load, or 200 pounds per 100 000 pounds of load. This figure has never heretofore been attained. Last year the figure was 56.9 % and the year previous 51.6 %. A figure that shows conclusively the beneficial results of concentration upon freight weighing conditions is the mean numerical error of all railroad owned scales tested in the Western District, namely, 0.19 % which is a figure inside the tolerance, and is the mean of 323 tests. The fact should not be overlooked however, that the mean numerical error of all scales tested was only 0.27 %, a figure slightly outside the tolerance, and even though it may be regarded as something of a statistical accident yet it is gratifying to note that conditions have, by effective concentration, been brought to such a pass that such accidents are possible.

In Table I it is found that by geographical divisions 63.4 % of scales tested in the Eastern District passed the tolerance, 47.0 % in the Southern District and 71.3 % in the Western District. These figures are greater than those found last year, the most notable increase being in the Western District. Last year the figures were 56.7 %, 43.8 %, and 60.2 % respectively. The mean errors of the scales in these districts are 0.34 % in the Eastern district, 0.42 in the Southern district, and 0.22 in the Western district. Last year the corresponding figures were 0.40 %, 0.44 %, and 0.33 % respectively. Of the incorrect scales it is seen that the number weighing heavy is somewhat in excess of those weighing light. This is a manifestation of a fact that seems well established by statistical studies over a number of years, namely, that the tendency in practical maintenance of track scales is to adjust them to weigh slightly heavy. The mean error of scales weighing light is greater than that of scales weighing heavy, but this reflects a few extremely large errors due to interference or obstruction with the weighing mechanism generally caused by neglectful maintenance.

Table II below purposes to show what is called in statistical theroy the "frequency distribution" of track scale errors in the different territorial districts and in the country as a whole. This table shows rather strikingly that the existing tolerance of 0.20% accommodates existing maintenance conditions very well, and a study of it seems to indicate that agitation for changing the tolerance which has cropped up occasionally in recent years has little basis in fact. For instance, suppose the tolerance were cut from 0.20 to 0.15 %. The Table shows that the

effect of this would be to reject from the class "good scales" a comparatively large number of scales which are not as far as weighing performance goes, in a very much worse condition that the tolerance prescribes. If on the other hand the tolerance were increased, say, to 0.25 %, the number of scales passed that are rejected by the existing tolerance would be relatively small. This reasoning together with consideration of the practical capabilities of the modern track scale shows rather impressively that the existing tolerance, fortuitous as it may be, is well adapted to the requirements of a tolerance.

Table II

FISCAL YEAR 1925
TABLE SHOWING DISTRIBUTION OF TRACK SCALE ERRORS

ERRORS Percent of Applied Load	EASTERN DISTRICT		SOUTHERN DISTRICT		WESTERN DISTRICT		ALL DISTRICTS	
	Railroad owned 46 Tests	Industrial owned 22 Tests	Railroad owned 131 Tests	Industrial owned 66 Tests	Railroad owned 323 Tests	Industrial owned 299 Tests	Railroad owned 500 Tests	Industrial owned 387 Tests
	Percent of Scales tested	Percent of Scales tested	Percent of Scales tested	Percent of Scales tested	Percent of Scales tested	Percent of Scales tested	Percent of Scales tested	Percent of Scales tested
0.00 to 0.05 Inclusive	8.7	4.5	3.1	1.5	16.4	7.7	12.2	6.5
0.06 to 0.10 "	23.9	27.3	19.8	6.1	29.1	21.4	26.2	19.1
0.11 to 0.15 "	19.6	9.1	16.8	13.6	17.0	21.1	19.2	19.1
0.16 to 0.20 "	13.0	18.2	9.9	21.2	12.1	18.0	9.6	18.6
0.21 to 0.25 "	4.4	9.1	10.7	10.6	5.6	7.0	6.8	7.8
0.26 to 0.30 "	6.5	4.5	8.4	12.1	5.9	4.7	6.4	5.9
0.31 to 0.35 "	4.4	9.1	6.1	10.6	3.1	3.3	4.2	4.9
0.36 to 0.40 "	2.2	0.0	2.3	4.6	1.5	2.7	1.8	2.8
0.41 to 0.45 "	6.5	0.0	1.5	3.0	2.5	5.0	2.6	4.4
0.46 to 0.50 "	2.2	0.0	1.5	1.5	0.3	1.3	0.8	1.3
0.51 to 1.00 "	2.2	9.1	9.2	10.6	5.0	6.0	5.8	7.0
Over 1.00 "	6.5	9.1	10.7	4.6	1.5	1.8	4.4	2.6
MEAN ERROR Percent of Applied Load	0.36	0.36	0.46	0.34	0.19	0.23	0.28	0.25

ADJUSTMENT OF INCORRECT SCALES

During the past year corrective adjustments were made on 79 track scales. This service is extended to owners whenever the condition of the equipment justifies it, and when it can be done without utilizing time that can be spent in making other tests.

CALIBRATION OF PRIVATELY OWNED TEST CARS

During the past year 35 test cars belonging to railroads and industrial plants were calibrated. This service is considered a very important function of the Bureau's testing work since it assures a correct standard of weight to the owners in maintaining their own weighing equipment.

CALIBRATION OF MASTER SCALES

The annual program of test and calibration of all the master scales maintained by railroads and industrial plants for the purpose of calibrating their own test cars used as standard weights in testing track scales was carried out in regular order. These were generally found to be in good weighing condition and receiving a commendable amount of attention to maintenance. A factory test of a new master scale for the Minnesota Railroad and Warehouse Commission was also made.

The Bureau holds this work to be its most responsible activity in the field, and the great amount of attention that is being given to this phase of weight control all over the country has much to do with the remarkable improvement in revenue freight weighing conditions that has come to pass in recent years.

TRACK SCALES USED FOR WEIGHING GRAIN

Interstate Commerce Commission Docket 9009 (56 I.C.C.,347) decided January 13, 1920, and American Railway Association Grain Circular No. 1, effective January 1921, published pursuant to the recommendations in the above mentioned decision, require, among other things that track scales used for weighing grain shall comply with a tolerance of 0.10 % of the applied load. A verbatim statement of the tolerance requirement is as follows:

"Railroad track scales used for weighing grain shall be maintained so that when a test load, consisting of a one-truck short wheel base test car standardized on a master scale, is used, the largest mean of any two errors found for different positions of the test truck shall not exceed one-tenth of one percent, or one pound per thousand pounds test load applied; provided, however, that no two errors shall be selected corresponding to positions of the test truck equal to or closer together than the distance between the sections of the scale.

Moreover, the scale shall be corrected when it is found on test, that the error exceeds one-tenth of 1 % of the test load applied for any position of the test load on the scale. The manufacturers tolerances on new scales shall be one half the above values".

During the past fiscal year in connection with its regular track scale testing service, the Bureau tested 82 track scales used for weighing grain. Of these, 34 scales, or 41.5 %, passed the above-mentioned tolerance, and 48, or 58.5 % failed to pass. Corrective adjustments were made on 20 scales. During the preceding year, 34.8 % of the grain scales tested were found to pass the prescribed tolerance. Improvement in grain weighing conditions is coming to pass, chiefly as a result of the publicity given to the Docket 9009 tolerance, and to the great amount of attention being given to the elimination of unreasonable discrepancies between origin and destination weights.

Generally speaking, the class of track scales used for weighing grain is not remarkably good, and while much better weighing conditions than have heretofore obtained, can and will undoubtedly come to pass, yet the degree of improvement is limited by the grade of equipment in service, and will almost certainly fall short of practical requirements. The fundamental need in this kind of weighing is better weighing equipment.

Table III shows the "frequency distribution" of errors in track scales used for weighing grain during the past fiscal year.

TABLE III

FISCAL YEAR 1925

DISTRIBUTION OF ERRORS IN TRACK SCALES

USED FOR WEIGHING GRAIN

ERRORS	82 SCALES TESTED
Percent of Applied Load	Percent of Scales Tested
0.00 to 0.05 Inclusive	9.8
0.06 to 0.10 "	31.7
0.11 to 0.15 "	18.3
0.16 to 0.20 "	13.4
0.21 to 0.25 "	6.1
0.26 to 0.30 "	6.1
0.31 to 0.35 "	3.7
0.36 to 0.40 "	2.4
0.40 to 0.45 "	2.4
0.46 to 0.50 "	0.0
0.51 to 1.00 "	4.9
Over 1.00 "	1.2
MEAN ERROR Percent of Applied Load	0.19

CONCLUSION

The data in this report generally show improved weighing conditions over those of recent years. A study of collateral facts to determine the cause for this and the possibility of further improvement indicates that it is chiefly due to a greater amount of concentration upon maintenance conditions than has heretofore obtained. Nose iron adjustments have become a common feature of tests, and the demand for new and heavier equipment is insistently voiced from every quarter. These things are commendable but their possibilities of accomplishment are limited to results short of practical requirements. The fundamental need is better installation and still more intelligent attention to maintenance. To be sure new equipment is needed at many points, and nose iron adjustments can often be made to cover up minor installation or maintenance faults, however, weighing conditions at a great majority of points can be improved if each scale be given something like the amount of attention and care that would be given any other piece of machinery representing the same capital outlay.

That the greatest bane to track scale maintenance is one least susceptible to correction is extremely unfortunate. Others are found perhaps with the same frequency but their effects generally speaking dwindle into comparative insignificance compared to the detrimental effects of wet, foul, or dirty pit conditions. Corrosion due to these destroys pivot edges and bearings, weakens structural members, and inhibits manual attention except of a casual nature. A wet pit is usually due to inattention to waterproofing and drainage at the time of building, or cracking of the pit walls after the pit is built, and in any case cannot be corrected without great difficulty and expense. Consequently scales at a majority of weighing points in the country are operated under a handicap whose effects must be alleviated if the desired improvement in freight weighing conditions is to continue to a remarkable extent.

Comments in the above paragraphs do not generally apply to scales used in grain weighing service. As pointed out elsewhere in the report, maintenence conditions at grain weighing points is reasonably good. The need in this case is new and heavier equipment.