Form 259

DEPARTMENT OF COMMERCE

HMR:RDM
II-8

Bureau of Standards

REPORT

Letter
Circular
LC 259

RAILROAD TRACK SCALE TESTING SERVICE OF THE U. S. BUREAU OF STANDARDS DURING THE FISCAL YEAR JULY 1, 1927 to JUNE 30, 1928.

INTRODUCTION

The Bureau of Standards publishes herein a review of the work accomplished by the Railroad Track Scale Testing Section during the fiscal year ended June 30, 1928. The report includes a summary of the year's test results, an account of miscellaneous related activities, and a tabular and graphic recapitulation of the results of all track scale tests conducted by the Bureau since inauguration of the testing service in 1913.

The interest of the Bureau in car load freight weighing facilities, the manner in which it maintains correct mass standards in circulation over the Nation's transportation network, and the policies which govern the testing service have been the subjects of detailed explanation in previous reports for the fiscal years 1924, 1925, 1926, and 1927. For descriptions of routine test procedure, error calculation methods and accuracy requirements, reference may be had to form No. 566, attached to this report.

RAILROAD TRACK SCALE TESTS IN 1928

Fewer track scale tests were made during the fiscal year 1928 than in any recent year for the reason that field testing operations were discontinued early in 1928 in order that the field personnel and a part of the field equipment might be employed on the Bureau master scale project at Clearing, Illinois. This latter activity will be reviewed later in this report.

703 railroad track scales were tested during the year. 459 of these were owned by railroads, 230 by industries, 10 by the Federal Government, and 4 by states or municipalities. 54 scales were adjusted to improve their weighing accuracy. The testing equipment operated on 68 different railroad systems and tested scales located in the District of Columbia and in the 34 states listed below.

Alabama
Arkansas
California
Colorado
Delaware
Florida
Georgia
Idaho
Illinois
Indiana
Iowa
Kentucky
Louisiana
Maryland
Minnesota
Mississippi
Missouri
Montana
Nebraska
Nevada
North Carolina
North Dakota
Ohio
Oregon
Pennsylvania
South Carolina
South Dakota
Tennessee
Texas
Utah
Virginia
Washington
West Virginia
Wisconsin

TEST RESULTS

Data representing a summary of the test results for the fiscal year appear in table No. 1. The scales tested were grouped according to their geographical location and by class of ownership. The district partition scheme corresponds to that adopted by the Interstate Commerce Commission for reporting railway statistics and the district boundaries have been defined in previous annual reports.

The tolerance by reference to which the accuracy of scales has been classified as correct or incorrect is quoted on the attached form No. 566. It is, in effect, a requirement that the greatest average of any two weighing errors observed with the test load at positions which the trucks of a freight car may occupy shall not exceed two-tenths of one per cent (0.2%) of the value of the test load. The standard procedure of the Bureau contemplates the use of test loads weighing 40 000 lb. and 80 000 lb.

TABLE I. RESULTS OF TRACK SCALE TESTS FISCAL YEAR 1928.

District and Scale Ownership	No. of scales tested	Passed Tol. No.	Passed Tol. %	Failed Tol. No.	Failed Tol. %	Mean Numerical error % of applied load	Analysis of Error of Incorrect Scales: Errors in excess: No. of scales	Errors in excess: % of incorrect scales	Errors in excess: Mean error	Errors in deficiency: No. of scales	Errors in deficiency: % of incorrect scales	Errors in deficiency: Mean error
EASTERN												
Railroad	49	38	77.6	11	22.4	0.17	5	45.4	0.26	6	54.6	0.48
Industrial	9	8	88.9	1	11.1	0.14	1	100.0	0.36	0	0.0	
Government	4	2	50.0	2	50.0	0.17	2	100.0	0.26	0	0.0	
State or Municipality	0	-	----	-	----	----	-	-----	----	-	----	----
Total	62	48	77.4	14	22.6	0.16	8	57.1	0.27	6	42.9	0.48
SOUTHERN												
Railroad	216	148	68.5	68	31.5	0.31	26	38.2	0.53	42	61.8	0.79
Industrial	92	50	54.4	42	45.6	0.29	17	40.5	0.32	25	59.5	0.59
Government	5	2	40.0	3	60.0	0.24	2	66.7	0.33	1	33.3	0.29
State or Municipality	3	1	33.3	2	66.7	0.23	0	0.0	----	2	100.0	0.32
Total	316	201	63.6	115	36.4	0.30	45	39.1	0.44	70	60.9	0.70
WESTERN												
Railroad	194	153	78.9	41	21.1	0.16	25	60.9	0.30	16	39.1	0.51
Industrial	129	88	68.2	41	31.8	0.20	22	53.7	0.37	19	46.3	0.45
Government	1	1	100.0	0	0.0	0.10	0	----	----	--	----	----
State or Municipality	1	1	100.0	0	0.0	0.08	0	----	----	--	----	----
Total	325	243	74.8	82	25.2	0.17	47	57.3	0.33	35	42.7	0.48
ALL DISTRICTS												
Railroad	459	339	73.9	120	26.1	0.23	56	46.7	0.40	64	53.3	0.69
Industrial	230	146	63.5	84	36.5	0.24	40	47.6	0.35	44	52.4	0.53
Government	10	5	50.0	5	50.0	0.20	4	80.0	0.30	1	20.0	0.29
State or Municipality	4	2	50.0	2	50.0	0.19	0	0.0	----	2	100.0	0.32
GRAND TOTAL	703	492	70.0	211	30.0	0.23	100	47.4	0.38	111	52.6	0.62
For - - 1927	840	589	70.1	251	29.9	0.21	125	49.8	0.34	126	50.2	0.54

Attention is here directed to table No. 1 and to the third and sixth columns of figures which represent respectively the proportion of scales found within tolerance and the average weighing error magnitudes. At the foot of the table are shown the totals for the year and for the preceding year.

DISCUSSION OF RESULTS

Considering first the results for the Eastern District, it will be apparent that the data were derived from comparatively few tests. The Bureau is not inclined to consider the data as a correct index to the general grade of accuracy obtainable on track scales throughout the Eastern District. It is hoped that circumstances will favor more prolonged and more widespread testing operations in the district during the current year.

In the Southern District, the total percentage of correct scales shows a very slight increase over the figure for last year and the average error value is greater than last year's value by a small margin. The latter circumstance was due to the influence of a certain few weighing errors of large magnitude. As in preceding years the Southern District is not in as satisfactory condition as the others and this condition is now improving only very slowly. It is necessary to compare the figures of this year with those of several years ago in order to demonstrate that a material improvement has taken place. The reasons for this state of affairs have been cited in former reports. In the case of a large number of scales the use is seasonable and intermittent, and there is also a high proportion of light capacity scales. It is also true that in general the maintenance standards are not as high as in other sections.

The results of tests conducted in the Western District this year indicate a nominal increase in the proportion of correct scales and some reduction of the average weighing error. A variety of contributing factors may be credited with responsibility for the invariably higher quality of test results observed in the Western District. They are an increasing preponderance of new installations, generally lighter traffic, more adequate standards of test and maintenance practice and vigilant supervision of equipment and weighing by responsible agencies.

The total results for all districts show no significant variation from total results for the preceding year.

WEIGHING ERROR MAGNITUDES

Table No. 2 illustrates the range and the frequency of weighing errors recorded for all tests of railroad owned and industry owned scales. Scales owned by the federal government, the states and the municipalities have been omitted from this analysis in order that the table might afford a conception of the accuracy of which track scales used in transportation and commerce are capable. The mean errors for the year and for each of the two last preceding years are shown at the bottom of the table. It should be noted that, excepting only the scales of the Southern district, the average error for all scales tested during the year was appreciably less than two-tenths of one per cent (0.2%) which is the figure this Bureau has adopted as an allowable tolerance for error.

RAILROAD TRACK SCALES FOR WEIGHING GRAIN

The industry owned scales tested during the year included 54 scales used for weighing bulk grain in car load lots. Of this number, 32 scales or 59.2 per cent were correct within the special tolerance which has been established for track scales in grain weighing service. The percentage is considerably higher than for recent preceding years. The increased percentage is attributed not to improved equipment but to the accident that a majority of the scales tested were located at grain terminal markets where they received frequent test, adjustment or repair by competent experts.

It seems pertinent, in reviewing this subject, to comment on a rather anomalous general condition which prevails in connection with the use of track scales for weighing grain at mills and elevators. In consideration of the value of the commodity, tolerances of an especially exacting standard were established for grain weighing scales. Notwithstanding this fact, the grain trade has been slow to acquire scales of improved type. Specification type scales which are admirably adapted to the requirements of grain weighing are available and should be more generally adopted for use.

TABLE II. SHOWING DISTRIBUTION OF TRACK SCALE ERRORS - FISCAL YEAR 1928

ERRORS	EASTERN		SOUTHERN		WESTERN		ALL DISTRICTS	
	Railroad 49 tests	Industrial 9 tests	Railroad 216 tests	Industrial 92 tests	Railroad 194 tests	Industrial 129 tests	Railroad 459 tests	Industrial 230 tests
Percent of Applied Load	% of scales tested	% of scales tested	% of scales tested	% of scales tested	% of scales tested	% of scales tested	% of scales tested	% of scales tested
0.00 to 0.05 incl.	16.3	11.1	12.5	4.3	22.7	7.7	17.2	6.5
0.06 to 0.10 "	20.4	22.2	21.7	19.6	22.1	32.7	21.8	26.9
0.11 to 0.15 "	20.4	33.3	16.7	15.2	24.7	17.0	20.5	17.0
0.16 to 0.20 "	20.4	22.2	17.6	15.2	9.3	10.9	14.4	13.0
0.21 to 0.25 "	6.1	----	6.0	6.5	6.2	8.5	6.1	7.4
0.26 to 0.30 "	8.2	----	4.6	9.8	4.6	8.5	5.0	8.7
0.31 to 0.35 "	2.0	----	3.7	8.7	4.1	5.4	3.7	6.5
0.36 to 0.40 "	----	11.1	2.8	5.4	2.1	2.3	2.2	3.9
0.41 to 0.45 "	2.0	----	2.3	1.1	0.5	1.5	1.5	1.3
0.46 to 0.50 "	----	----	0.5	2.2	----	0.8	0.2	1.3
0.51 to 1.00 "	2.0	----	7.4	9.8	3.1	3.1	5.0	5.6
Over 1.00	2.0	----	4.2	2.2	0.5	1.5	2.4	1.7
Mean Error % of applied load	0.17	0.14	0.31	0.29	0.16	0.20	0.23	0.24
Mean Error Fiscal year 1927	0.16	0.16	0.24	0.29	0.18	0.20	0.20	0.22
Mean Error Fiscal year 1926	0.29	0.26	0.34	0.24	0.21	0.18	0.26	0.31

MASTER SCALE CALIBRATIONS

At the close of the year on June 30, 1928, 18 master scales had been calibrated. Sixteen were found to be correct within the master scale tolerances which limit weighing errors to approximately one one-hundredth of one per cent (0.01%). One scale exhibiting excessive errors has been withdrawn from service and one in which certain installation faults were discovered is being reconstructed.

A new master scale installed by the Atlantic Coast Line Railroad at Jacksonville, Florida, was calibrated by the Bureau and subsequently placed in service.

Early cessation of field testing left two master scales uncalibrated at the close of the year. These will be visited when the Bureau resumes testing operations in their localities.

Periodic calibration of the master scales in the United States is a primary function of the Bureau since it is through these well distributed control centers that correct standards of mass are kept in circulation over the transportation systems.

FIELD CALIBRATIONS OF TEST CARS

In connection with field testing schedules, the Bureau equipment re-established the standard weight value of 18 test cars which did not have access to master scales for periodic calibrations. The accuracy of the results which may be derived by field calibration methods are necessarily controlled by the accuracy and sensitivity characteristics of the scale utilized and the Bureau recommends calibration on a master scale when transportation of a test car to and from some master scale is practicable.

BUREAU TEST CAR DEPOT AND MASTER SCALE

The Bureau accomplished during the fiscal year the construction of a station at Clearing, Illinois on the Belt Railway of Chicago. The station comprises a focus from which the railroad track scale investigation of the Bureau will henceforth be directed, a repair depot for the testing equipment of the Bureau and a master track scale of high precision qualities which is accessible to all test cars operated in the Chicago district or by lines entering the Chicago terminal.

The address of the station is U. S. BUREAU OF STANDARDS MASTER SCALE DEPOT, 5800 West 69th Street, Clearing Station, Chicago, Illinois. The building, containing the offices, repair facilities and master scale is a well-lighted and substantial brick structure with approximately 3,000 square feet of floor space. The site was provided by the General Managers Association of the railroads entering Chicago. The station was constructed and will be maintained by the Bureau of Standards.

At the close of the fiscal year, twelve test cars had been calibrated on the master scale. Fees for the service have been fixed at $7.50 per car. Test cars of less than twelve feet wheel base can be accomodated on the master scale.

SPECIAL INVESTIGATION

In August, 1927, this Bureau, at the request of the Western Weighing & Inspection Bureau and with the cooperation of certain railroads serving the Omaha, Nebraska district, conducted a series of special tests intended to demonstrate the adequacy of track scale test results as a proper criterion of commercial freight weighing accuracy. The details and results of these tests were reported to parties at direct interest. It will suffice to announce here that the suitability of current methods of test and error calculation was amply confirmed and that sporadic agitation for modification of these methods was proven to be without apparent justification.

NEW EQUIPMENT

Information derived from diverse sources is that a considerable number of new track scales were installed during the year. There is apparently a trend toward adoption of two-section scales designed for use without dead rail tracks and this is attributed to present day demands for rapidity in the weighing of traffic at classification yards and similar congested areas on transportation systems. Plate fulcrum scales of lengths extending to 75 feet have lately been placed in service for manual weighing of cars in motion at "hump" yards. Specifications for two-section scales of the knife edge type were prepared by the Yards and Terminals Committee of the American Railway Engineering Association, in 1926. The Bureau was represented on this Committee and has published these specifications.

RECAPITULATION OF 9200 TESTS

The Bureau of Standards first undertook the investigation and improvement of car load freight weighing conditions in 1913. To date more than 9200 tests of track scales have been made. A recapitulation of the general test results for each year since 1913 is presented in tables III and IV. The tabulated data are reproduced graphically on plates No. 1 and No. 2.

Table III and plate No. 1 indicate the proportion of scales which were tested and found correct within tolerance each year.

Table IV and plate No. 2 show the average error magnitudes for the scales tested each year.

(In table IV, for the year 1926, the values in parentheses represent the average errors computed after excluding one scale having the exceptionally large error of -37.94%).

TABLE III. Percent of Scales Within Tolerance.

	EASTERN DISTRICT		SOUTHERN DISTRICT		WESTERN DISTRICT		ALL DISTRICTS		ALL SCALES
	R.R.	Ind.	R.R.	Ind.	R.R.	Ind.	R.R.	Ind.	
1914	26.7	66.7	----	----	----	----	26.7	66.7	32.5
1915	35.5	28.6	20.2	18.5	48.2	35.4	33.7	29.2	32.8
1916	3.7	16.7	36.4	15.4	62.2	100.0	41.3	36.1	39.5
1917	44.5	31.2	34.5	37.5	39.1	27.0	40.2	38.1	40.4
1918	33.0	29.3	47.5	20.8	48.4	51.8	42.1	40.1	39.2
1919	34.2	39.9	34.0	41.4	58.8	67.2	42.6	50.5	45.7
1920	51.4	29.0	30.9	0.0	42.6	45.6	41.5	46.0	40.7
1921	45.1	20.0	46.4	66.7	69.5	63.6	54.7	56.7	53.7
1922	46.5	58.1	27.5	33.3	60.6	53.8	46.6	53.0	48.5
1923	45.9	48.3	39.1	30.8	66.2	58.9	51.6	51.9	51.5
1924	58.3	49.2	43.5	45.2	62.7	56.8	57.9	54.3	56.9
1925	65.2	59.1	49.6	42.4	74.6	68.2	67.2	63.3	65.2
1926	64.6	58.7	63.7	59.5	69.5	69.9	66.9	64.1	65.4
1927	75.3	76.2	62.3	61.7	77.8	69.9	72.0	68.1	70.1
1928	77.6	88.9	68.5	54.4	78.9	68.2	73.9	63.5	70.0

TABLE IV. Average Error - Percent of Applied Load.

1914	0.62	0.39	----	----	----	----	0.62	0.39	0.56
1915	0.63	0.38	0.78	0.48	0.47	0.41	0.64	0.43	0.57
1916	1.80	1.23	0.77	0.51	0.20	0.12	0.66	0.58	0.63
1917	0.50	0.39	0.37	0.35	0.43	0.46	0.47	0.40	0.44
1918	0.45	0.72	1.02	0.54	0.35	0.32	0.48	0.53	0.51
1919	0.51	0.46	0.89	0.48	0.46	0.22	0.54	0.37	0.47
1920	0.39	0.44	0.58	0.49	0.53	0.34	0.52	0.47	0.51
1921	0.37	0.75	0.49	0.35	0.25	0.31	0.33	0.39	0.35
1922	0.44	0.40	0.43	0.32	0.30	0.30	0.39	0.35	0.38
1923	0.44	0.42	0.45	0.26	0.30	0.29	0.39	0.34	0.39
1924	0.32	0.52	0.45	0.41	0.35	0.31	0.36	0.36	0.36
1925	0.36	0.36	0.46	0.34	0.19	0.23	0.28	0.25	0.27
1926	0.29	0.26	0.34	0.69 (0.24)	0.21	0.18	0.26	0.31 (0.22)	0.29 (0.25)
1927	0.16	0.16	0.24	0.29	0.18	0.20	0.20	0.22	0.21
1928	0.17	0.14	0.31	0.29	0.16	0.20	0.23	0.24	0.23

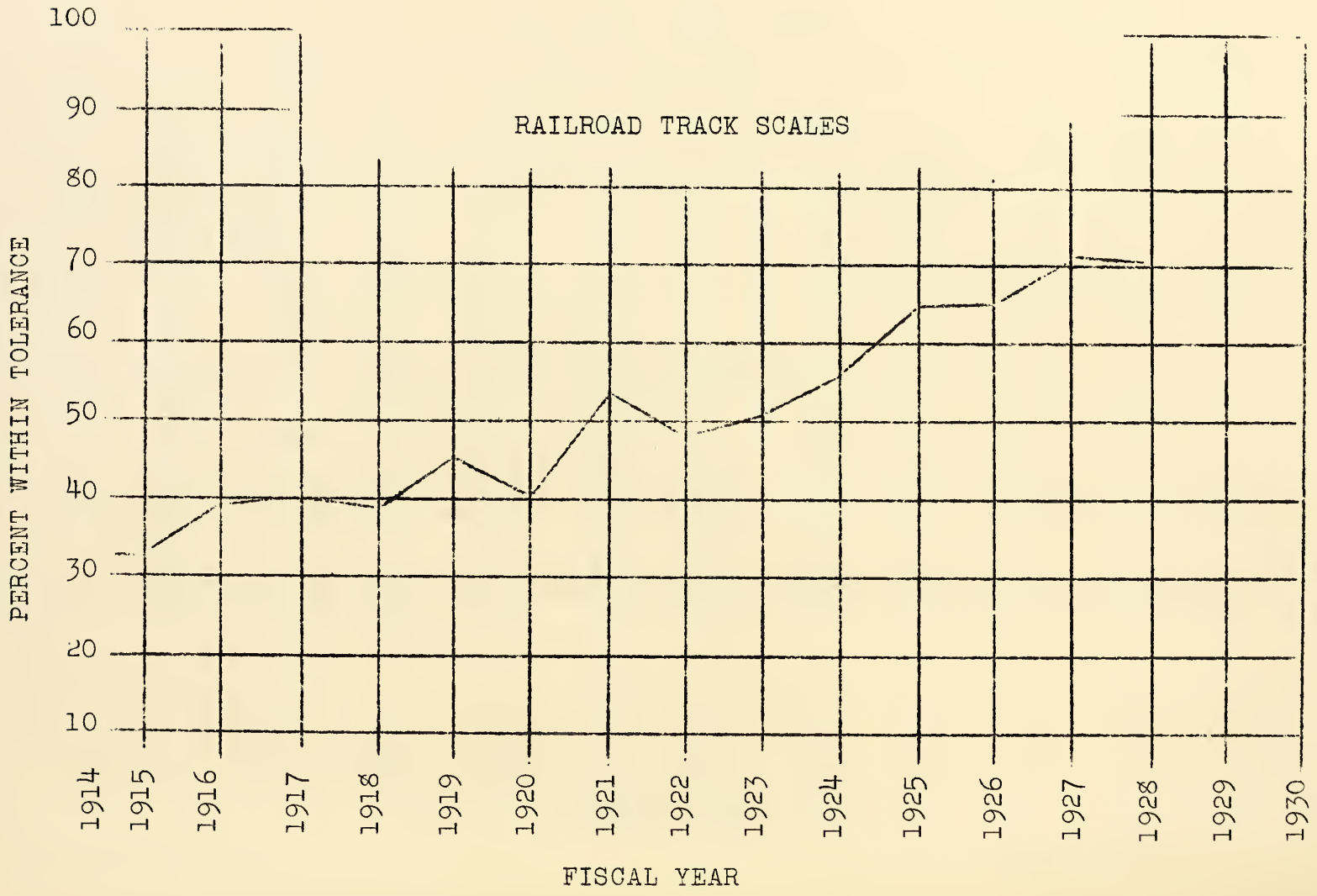
RAILROAD TRACK SCALES
PERCENT WITHIN TOLERANCE
100
90
80
70
60
50
40
30
20
10
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
FISCAL YEAR

PLATE 1.

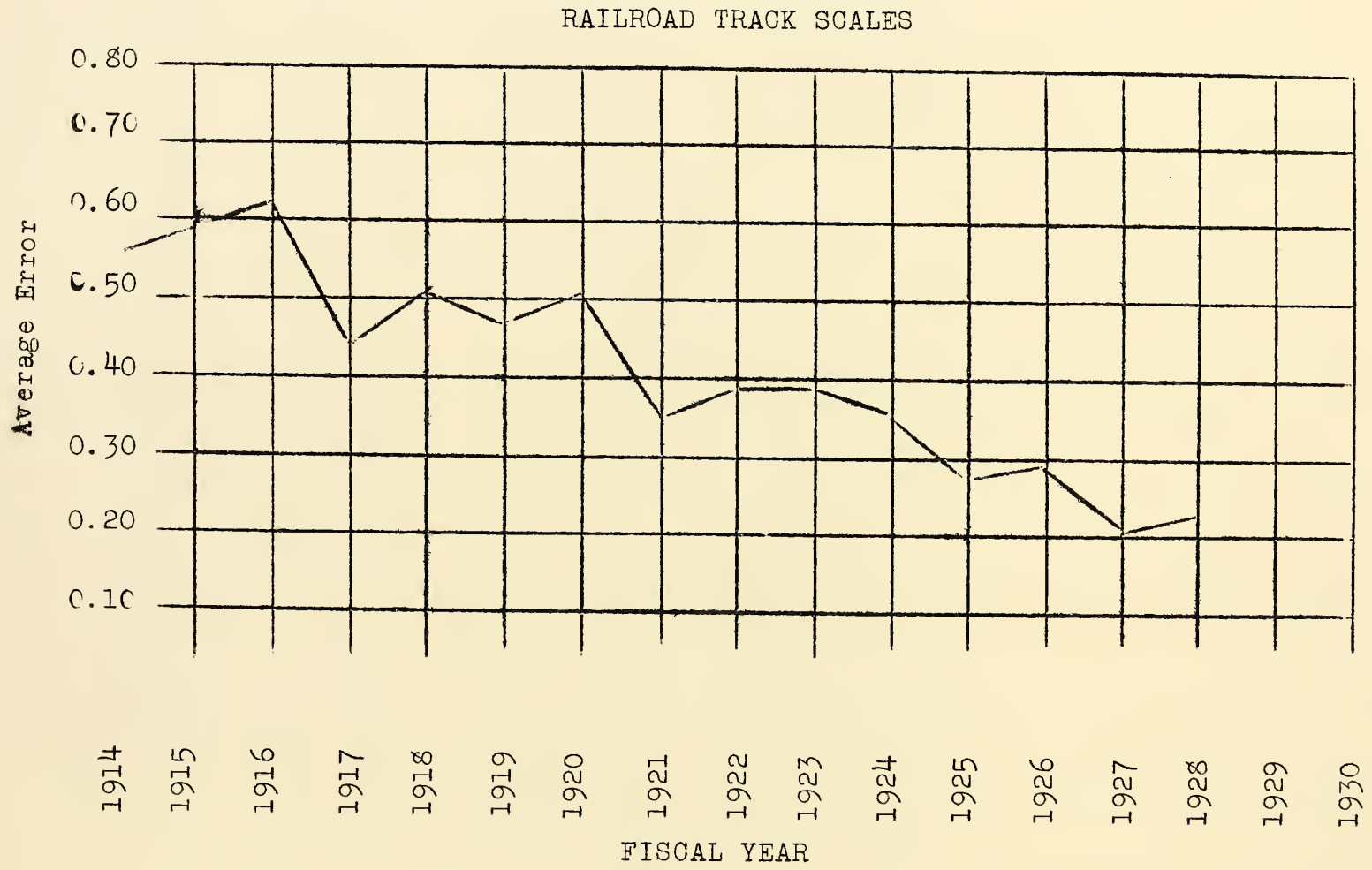
RAILROAD TRACK SCALES
Average Error
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
FISCAL YEAR

PLATE 2.

GENERAL SUMMARY

In reviewing the progress which has been made in improving equipment for weighing car load traffic during the past fifteen years, the Bureau of Standards is inclined to regard the rate of advancement as generally satisfactory.

Assuming that the current and well correlated systems for promoting improvement in this vital phase of transportation and commerce are continued and allowed normal development, increased weighing accuracy will inevitably result as defective and inadequate equipment is retired or replaced with track scales of approved types.

Expectation of future improvement is also based upon the presumption that gradually increasing concentration of improved type scales will render "check-weighing practices" more efficacious as a means of identifying inaccurate scales and eliminating them from weighing service. It is also believed that the testing and advisory service extended by railroad scale maintenance departments to industries on their lines may eventually create higher maintenance standards for industry owned track scales.

In conclusion, the Bureau takes occasion to urge upon transportation system officials and industrial plant managers the necessity for providing substantial specification type track scales for weighing the increased tonnage of present-day traffic. Scales of inadequate length and light construction invariably cause interruption of plant operation, are undependable as weight measuring machines, form a source of controversy and litigation respecting claims and require expensive maintenance or repair measures.

Form 566.

DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
Washington, D. C.

SUPPLEMENT TO REPORT OF TRACK SCALE TEST

(Track Scale Testing Equipments, Nos. 1 and 2)

Nature of Test Load.—The test load applied to the scale consists of standardized test weights mounted on a four-wheel truck of known weight. The wheel base of the truck is 5 feet in length, which corresponds closely to the truck of a freight car. The truck is driven by an electric motor at a slow and uniform speed, so that its movement is practically without impact, and therefore there is little tendency for the scale parts to shift during the operation of the load across the scale.

Position of Test Loads.—The sections of the scale are designated as 1, 2, 3, etc., numbered from left to right when standing at the beam and facing the scale platform. Each pair of main levers constitutes a section.

The Bureau's method of testing a railroad track scale differs from the method used by many railroads in that the test truck is not centered over each section but it is placed at the extreme ends of each span by setting each pair of wheels in turn directly over each section. The advantage of this method is that the load is carried entirely on one span and is thus supported by only two sections, while, on the other hand, when the load is centered over the section, it is carried on two spans and is thus supported by three sections. The former method has been selected because it gives more nearly exact information in regard to the individual sections.

The positions of the test truck are designated in order from left to right as 1R, 2L, 2R, 3L, 3R, etc., the numbers referring to the section and the letters indicating that the body of the truck lies to the left or right of the section. These are known and hereafter referred to as the normal positions of the test truck.

If for any reason the test truck can not be placed in one of its normal positions, then its position is designated as a certain distance to the left (−) or right (+) of its nearest normal position. Thus, a position of the truck 25 inches to the right of the normal position known as 1R, is designated as 1R+25″; if it is 25 inches to the left of the normal position known as 4L, it is designated as 4L−25″.

Character of Error.—The amount by which the beam indication differs from the actual value of the load applied is called the "error" of the scale for the given position of the test truck. A plus (+) error signifies that the indication of the beam is in excess of the load on the platform; a minus (−) error signifies the opposite condition.

Maximum Indicated Error of Weighing.—Since the errors found with the test truck in general correspond to those that would be produced by one truck of a freight car, it is apparent that the largest algebraic sum of any two errors found that may be duplicated by the two trucks of a freight car corresponds to a possible error of weighing a freight car whose gross weight is twice the weight of the test load, or instead, the mean of these two errors may be used if the weight of the freight car is considered equal to the weight of the test load.

Since the distances between the two trucks of freight cars of various types differ greatly, any two of the normal positions of the test truck on the scale except those which are at the same section, such as 2R and 2L, etc., may be duplicated by the trucks of some car, but on account of the improbability that the two trucks of a car can assume a position on the same span of the scale the Bureau does not use in the computation of the maximum error two errors found on opposite ends of the same span.

Therefore, in computing the maximum indicated error of weighing of the scale for the load applied, the largest mean of any two errors corresponding to normal positions of the test truck not closer together than similar points on adjacent spans is used.

Tolerance.—A tolerance of two-tenths of 1 per cent (0.20 per cent) on the "maximum indicated error of weighing" for any test load applied to the scale has been adopted by the Bureau. A tolerance of 0.20 per cent applied to a load of 100,000 pounds amounts to 200 pounds. The test loads used by the Bureau are in no case less than 40,000 pounds.

Sensibility Reciprocal.—The term "sensibility reciprocal" is defined as the change of weight indication required to be made upon the beam or the weight required to be added to or subtracted from the platform to turn the beam from a horizontal position of equilibrium at the middle of the loop to a position of equilibrium at the top or at the bottom of the loop.

GOVERNMENT PRINTING OFFICE

Form 566.

DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
Washington, D. C.

SUPPLEMENT TO REPORT OF TRACK SCALE TEST

(Track Scale Testing Equipments, Nos. 1 and 2)

Nature of Test Load.—The test load applied to the scale consists of standardized test weights mounted on a four-wheel truck of known weight. The wheel base of the truck is 5 feet in length, which corresponds closely to the truck of a freight car. The truck is driven by an electric motor at a slow and uniform speed, so that its movement is practically without impact, and therefore there is little tendency for the scale parts to shift during the operation of the load across the scale.

Position of Test Loads.—The sections of the scale are designated as 1, 2, 3, etc., numbered from left to right when standing at the beam and facing the scale platform. Each pair of main levers constitutes a section.

The Bureau's method of testing a railroad track scale differs from the method used by many railroads in that the test truck is not centered over each section but it is placed at the extreme ends of each span by setting each pair of wheels in turn directly over each section. The advantage of this method is that the load is carried entirely on one span and is thus supported by only two sections, while, on the other hand, when the load is centered over the section, it is carried on two spans and is thus supported by three sections. The former method has been selected because it gives more nearly exact information in regard to the individual sections.

The positions of the test truck are designated in order from left to right as 1R, 2L, 2R, 3L, 3R, etc., the numbers referring to the section and the letters indicating that the body of the truck lies to the left or right of the section. These are known and hereafter referred to as the normal positions of the test truck.

If for any reason the test truck can not be placed in one of its normal positions, then its position is designated as a certain distance to the left (−) or right (+) of its nearest normal position. Thus, a position of the truck 25 inches to the right of the normal position known as 1R, is designated as 1R+25″; if it is 25 inches to the left of the normal position known as 4L, it is designated as 4L−25″.

Character of Error.—The amount by which the beam indication differs from the actual value of the load applied is called the "error" of the scale for the given position of the test truck. A plus (+) error signifies that the indication of the beam is in excess of the load on the platform; a minus (−) error signifies the opposite condition.

Maximum Indicated Error of Weighing.—Since the errors found with the test truck in general correspond to those that would be produced by one truck of a freight car, it is apparent that the largest algebraic sum of any two errors found that may be duplicated by the two trucks of a freight car corresponds to a possible error of weighing a freight car whose gross weight is twice the weight of the test load, or instead, the mean of these two errors may be used if the weight of the freight car is considered equal to the weight of the test load.

Since the distances between the two trucks of freight cars of various types differ greatly, any two of the normal positions of the test truck on the scale except those which are at the same section, such as 2R and 2L, etc., may be duplicated by the trucks of some car, but on account of the improbability that the two trucks of a car can assume a position on the same span of the scale the Bureau does not use in the computation of the maximum error two errors found on opposite ends of the same span.

Therefore, in computing the maximum indicated error of weighing of the scale for the load applied, the largest mean of any two errors corresponding to normal positions of the test truck not closer together than similar points on adjacent spans is used.

Tolerance.—A tolerance of two-tenths of 1 per cent (0.20 per cent) on the "maximum indicated error of weighing" for any test load applied to the scale has been adopted by the Bureau. A tolerance of 0.20 per cent applied to a load of 100,000 pounds amounts to 200 pounds. The test loads used by the Bureau are in no case less than 40,000 pounds.

Sensibility Reciprocal.—The term "sensibility reciprocal" is defined as the change of weight indication required to be made upon the beam or the weight required to be added to or subtracted from the platform to turn the beam from a horizontal position of equilibrium at the middle of the loop to a position of equilibrium at the top or at the bottom of the loop.

GOVERNMENT PRINTING OFFICE