

UNITED STATES DEPARTMENT OF COMMERCE  
WASHINGTON

**National Bureau of Standards**

**REPORT**

FSH:HER  
II-8

Letter  
Circular  
LC 450

October 31, 1935

RAILWAY TRACK SCALE TESTING SERVICE  
OF THE  
NATIONAL BUREAU OF STANDARDS  
FISCAL YEAR 1935 (JULY 1, 1934 to JUNE 30, 1935)



RAILWAY TRACK SCALE TESTING SERVICE  
OF THE  
NATIONAL BUREAU OF STANDARDS  
FISCAL YEAR, 1935

---

C O N T E N T S

	Page
Introduction .....	1
Résumé of Testing Activities .....	2
Master Track Scale Calibrations .....	2
Railway Track Scale Tests .....	3
Discussion of Test Results .....	6
Analysis of Errors of Incorrect Scales .....	8
Discussion of Errors .....	10
Error Frequency Distribution .....	10
Discussion of Data .....	12
Scales in Grain-Weighing Service .....	12
Standardization of Railway Track Scale Test Weight Cars on Bureau Master Track Scale .....	14
Discussion of Standardization Results .....	17
Weighing of Railway Track Scale Test Weight Cars in the Field .....	18
Publications and Special Reports .....	18
Scales Tested Classified on Basis of Last Former Test by National Bureau of Standards Equipments .....	19
Conclusion .....	20



## INTRODUCTION

This report is one of an annual series setting forth the work accomplished by the Railway Track Scale Testing Service of the National Bureau of Standards, and the conditions existing throughout the United States in respect to railway master track scales, railway track scales and weighing, and railway track scale testing equipment. This report covers the period of the Government fiscal year, 1935 (July 1, 1934 - June 30, 1935). It is issued for the information of persons and agencies owning or using scales of these classes, or concerned with the accuracy of weights determined by these facilities.

The activities of this service have been described and discussed in detail in former reports. Briefly they consist of:

(a) Calibration of all master track scales owned by railroads and governmental agencies, and located at points widely distributed throughout the United States. These scales are employed for calibrating the railway track scale test weight cars used by railroads and industries in testing and adjusting railway track scales. The master scales are calibrated annually by the Bureau in accordance with an agreement with the Association of American Railroads to insure a uniform standard of weight for scales utilized in the assessment of charges for freight shipped, and in the purchase and sale of commodities, in carload lots.

(b) Operation of the Master Scale Depot of the National Bureau of Standards at Clearing, Ill., at which depot is located the Bureau master track scale. This master scale serves as the standard of the Federal Government, for heavy weights and weighing. It is utilized in standardizing the weights of test weight cars belonging to railroads, industries, and the Bureau, which are brought to the depot for that purpose. The depot serves as headquarters for the track scale testing service and here the heavy weights carried by the Bureau master track scale testing equipments are annually calibrated, the equipments are overhauled, scales and weights submitted for that purpose are tested, and related work is done.

(c) Investigation and improvement of the condition and accuracy of railway track scales throughout the United States. The Bureau track scale testing equipments travel on itineraries arranged in cooperation with the Association of American Railroads. Tests of scales are made on these routes in connection with the calibrations of master track scales. Tests are widely distributed throughout the various sections of the country and among the various railroad companies and industries, to the end that the results may be representative of general conditions existing throughout the United States.

(d) Research, testing, and other work, necessary to the carrying out of the above objects, or along related lines.



## RÉSUMÉ OF TESTING ACTIVITIES

Thirteen master track scales were calibrated during the year. Fifty-five standardizations of railway track scale test weight cars were made on the National Bureau of Standards Master Track Scale, and 26 such cars were weighed in the field. A total of 1240 railway track scales were tested. The latter number very considerably exceeds the number tested in any previous year, with the single exception of last year, when 1309 scales were tested. The scales tested were located in 38 States, and the District of Columbia, on the lines of 123 railroads. It is considered that this is an excellent distribution throughout the country as a whole and by railroad companies. Thirty-seven and one-half percent of the tests were made in the Eastern District, 17.5 percent in the Southern District, and 45 percent in the Western District. These figures may be compared with the distribution of total scales in service; it is estimated that about 43 percent are in the Eastern District, 20 percent in the Southern District, and 37 percent in the Western District. Fifty-five and six-tenths percent of the scales tested were owned by railroads, the remaining 44.4 percent were classified as industry-owned scales.

The routes followed by the three Bureau testing equipments and the location of the 19 railway master track scales, are shown on the map on the following page. There are also shown the boundaries of the districts -- Eastern, Southern, Western -- into which the country is divided for the purpose of analysis of the test data. The districts are those adopted by the Interstate Commerce Commission in its "Reports on the Statistics of Railways in the United States"; also in the assignment of roads to territorial groups the methods of the Commission have been followed.

## MASTER TRACK SCALE CALIBRATIONS

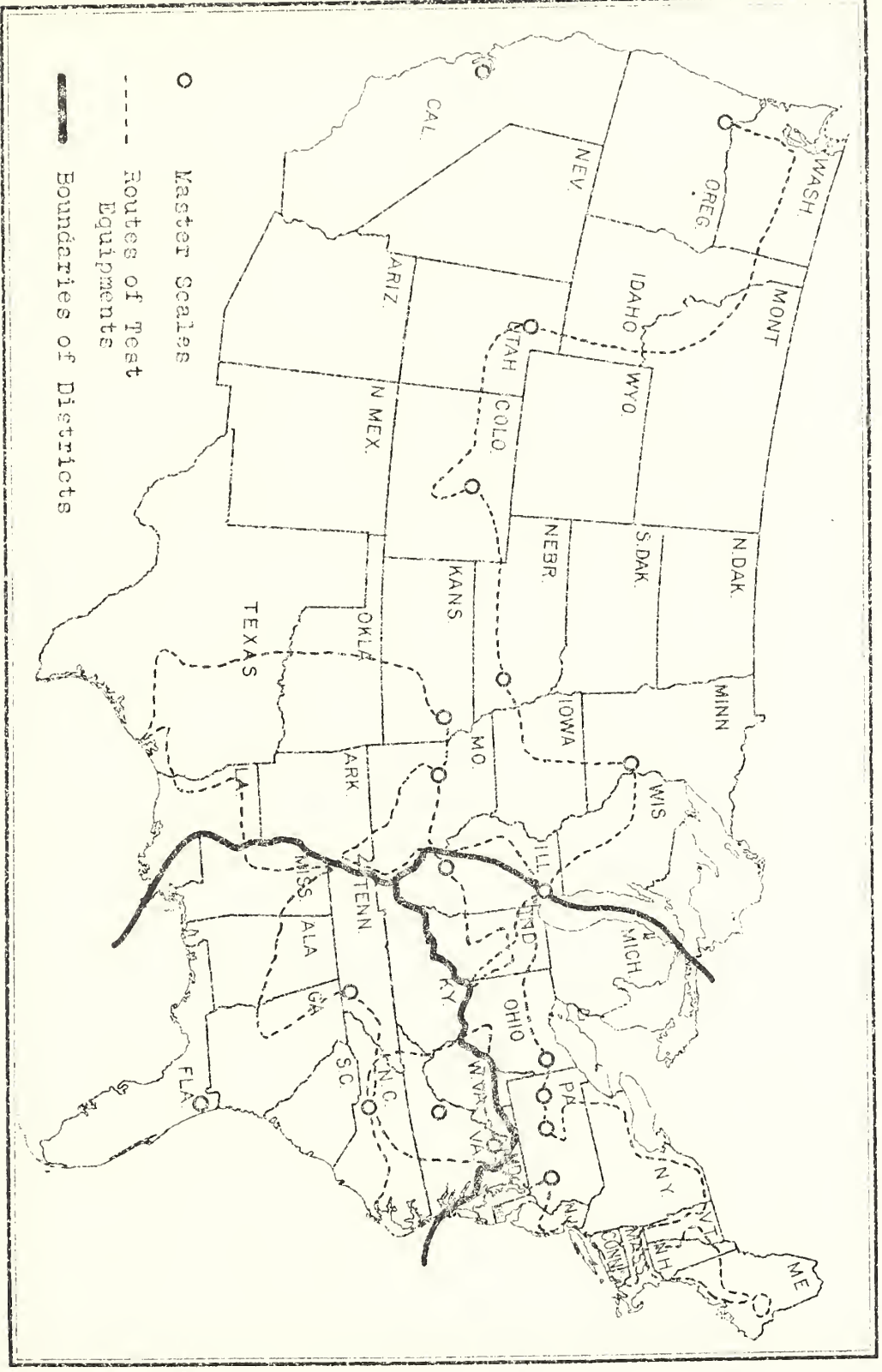
There are nineteen master track scales in the United States. These should be calibrated at approximate twelve-month intervals, and ordinarily it is found possible to calibrate each of these within the period of the fiscal year. As mentioned above thirteen of these were tested during the fiscal year 1935. The fact that all were not tested was due to two main causes:

(a) In preparing the itineraries these were so arranged that the equipments would travel over roads not recently traversed by our equipments to the end that the work would be better distributed over the lines of the various roads. This resulted in the master scales being encountered in a different order than last year.

(b) Attention was given to the testing of a greater proportion of scales located on the itineraries since this results in more efficient operation, reducing the number of miles









of travel per test. Also in some instances there was a considerable amount of travel off the route laid down in order to accommodate railroads which were particularly desirous of having additional scales tested. These factors resulted in slowing down the progress of the equipments.

As a result of the above causes some master scales which would normally have been calibrated during the fiscal year, had not been reached at the conclusion of the year. This situation will rapidly correct itself, since all master scales not tested during the twelve-month period are included in uncompleted itineraries upon which the equipments were travelling at the close of the year. Consequently these scales will be tested early in the fiscal year 1936; for instance, one such test was begun on July 2, 1935.

The test of a master scale usually comprises three separate tests: (1) A preliminary maintenance test to ascertain to what degree the accuracy exhibited during the last preceding calibration has been maintained. (2) An adjustment test to determine the accuracy attained after the scale has been adjusted or modified, if the condition of the scale as found renders such steps advisable; otherwise the maintenance test is made part of the adjustment test. (3) A test of the counterpoise weights. The tolerance applied on the maintenance test is approximately two one-hundredths of one percent (0.02%) of the applied test load; the tolerance on the adjustment test is one-half of this amount.

All of the master scales tested were within the maintenance tolerance of approximately 0.02 percent, and in the case of 10 of these, no error exceeded the adjustment tolerance of approximately 0.01 percent. Adjustments or other modifications were made in the case of 7 scales, to reduce weighing errors or to effect other improvements in weighing performance. The numerical mean of the maximum percent errors on final test of all scales was 0.006 percent; maximum percent errors usually occurred at the smaller loads, and the mean figure quoted is reduced to 0.003 percent when consideration is limited to loads of 60,000 pounds and over.

#### RAILWAY TRACK SCALE TESTS

For the information of those readers of this report who are not thoroughly conversant with the methods adopted by the Bureau in the test of a railway track scale, a brief outline may be of interest:

The test consists essentially in determining the indications of the scale when standard test loads are placed at certain specified positions on the scale rails. The loads utilized are 40,000 pounds and 80,000 pounds. Repeat observations are made



for each position. In the case of one equipment an added test is conducted with a distributed load of 120,000 pounds. The sensitiveness of the scale and the performance with respect to the zero balance condition are also determined.

Following the test a thorough inspection of the scale parts is made. When it is found that the character of error and the condition of the scale parts justify an adjustment, this may be made to improve the weighing accuracy.

In the case of each test an individual report is issued to the owner of the scale. This report states the accuracy of the scale, and in the case of scales not performing within tolerance, gives the detailed results of all observations. The report also includes the results of the inspection, detailing any faulty conditions found, and, when indicated, making recommendations in relation to repair and to maintenance measures.

Railway track scales are considered to be correct or incorrect according to the requirements of the tolerance adopted by the Bureau. Substantially it is required that the maximum indicated percent error of weighing, computed in accordance with methods detailed on the reverse of the report forms issued, shall not exceed two-tenths of one percent (0.20%) in the case of all scales except those used in grain-weighing service, and one-tenth of one percent (0.10%) for scales in this special class. For the statistical purposes served by table 1 of this report, each scale is listed as "within tolerance" or "not within tolerance" on the basis of the tolerance of two-tenths of one percent whether or not the scale is in grain-weighing service. In a subsequent section of the report the accuracy of grain scales is analyzed on the basis of the tolerance of one-tenth of one percent.

The results of the railway track scale tests are summarized statistically in table 1, which follows. Classification of the scales tested is on the basis of location and class of ownership. The districts referred to have been described earlier in this report. Scales in the "Railroad" group are those owned by the carriers and used by them to weigh revenue car-load freight. Scales in the "Industry" group comprise those ordinarily utilized at commercial or industrial establishments for establishing or verifying weights for the purchase or sale of materials; by agreement these weights are often accepted by the carriers as a basis for freight-haul charges, also. There are also included in the industry group a few scales owned by the Federal Government, States, or cities.



TABLE 1. SUMMARY OF RAILWAY TRACK SCALE TEST DATA

FISCAL YEAR 1935

District and scale ownership	Number of scales tested	Within tolerance		Not within tolerance		Mean numerical error -- percent of applied load
		Num-ber	Per-cent	Num-ber	Per-cent	
EASTERN						
Railroad	250	181	72.4	69	27.6	0.25
Industry	215	148	68.8	67	31.2	0.22 <sup>1</sup>
Totals	465	329	70.8	136	29.2	0.23 <sup>1</sup>
SOUTHERN						
Railroad	131	96	73.3	35	26.7	0.19
Industry	86	57	66.3	29	33.7	0.20
Totals	217	153	70.5	64	29.5	0.20
WESTERN						
Railroad	309	279	90.3	30	9.7	0.11
Industry	249	202	81.1	47	18.9	0.20
Totals	558	481	86.2	77	13.8	0.15
ALL DISTRICTS						
Railroad	690	556	80.6	134	19.4	0.18
Industry	550	407	74.0	143	26.0	0.20 <sup>1</sup>
GRAND TOTALS	1240	963	77.7	277	22.3	0.19 <sup>1</sup>
1934 Totals	1309	1020	77.9	289	22.1	0.17 <sup>2</sup>

<sup>1</sup> Excluding one scale having abnormal error.<sup>2</sup> Excluding two scales having abnormal errors.





Discussion of Test Results. The percentage of scales tested found accurate within tolerance, is 77.7 percent, this figure being practically identical with the figure for the fiscal year, 1934, when 77.9 percent were found accurate. Last year's figure was 2.7 percent lower than the figure for the preceding year (1933) at which time the percentage of scales found accurate was at its peak, following a series of years of continuous improvement. Thus it may be said that while it is again indicated that there has been a small decrease in the percentage of scales within tolerance, it is not indicated that the decline in percentage of scales found accurate is continuing. Indeed there are some indications to the contrary.

The percentage of railroad-owned scales found accurate is still considerably higher than the figure for industry-owned scales, the figures being 80.6 percent and 74.0 percent, respectively. The difference is considerably smaller than was the case last year when the comparable figures were 84.4 percent and 71.1 percent, respectively. It will be noted that the decrease in this difference is contributed to by both groups, the figure for railroad-owned scales having fallen 3.8 percent from 84.4 percent, while the figure for industry-owned scales has risen 2.9 percent from 71.1 percent.

The conditions in the Western District are still very considerably better than elsewhere. The general percentage of scales found accurate is 86.2 percent, only slightly different from last year's figure of 87.0 percent. The percentage for railroad-owned scales is 90.3 percent, 2.6 percent lower than last year's figure of 92.9 percent; for industry-owned scales, it is 81.1 percent, an improvement of 1.2 percent. In the case of the Western District the general percentage of scales found accurate is not considerably below the peak figure of 87.6 percent attained in 1933.

The general percentages of scales found within tolerance in the Eastern District and in the Southern District, on the basis of this year's figures, are almost identical, the difference being entirely negligible, 0.3 percent. The figures for railroad-owned and industry-owned scales are also strikingly similar, the difference being only 0.9 percent (in favor of the South), and 2.5 percent (in favor of the East), respectively.

In the Eastern District there is a marked decline in the percentage of scales found within tolerance. This figure is 70.8 percent, to be compared with last year's figure of 74.1 percent, a decrease of 3.3 percent. This falling off is to be attributed to the railroad-owned group which has a percentage of scales found accurate of 72.4 percent, as compared with 81.7 percent, a decrease of 9.3 percent. In the case of industry-owned scales an increase of one percent is noted from 67.8 percent to 68.8 percent.



The decline in the figure denoting percentage of all scales found accurate noted above (3.3 percent) follows upon a decrease of 7.6 percent between 1933 and 1934, which in turn followed two successive years in which only small increases were noted. As a result the percentage found is considerably lower than at any time during the period represented by fiscal years 1931 to 1934 inclusive, and the figure for the fiscal year 1929 is the only one since 1926 which is lower than the figure now found. Approximately the same condition is found when the percentages of the railroad-owned group alone, are considered.

The Southern District has a general percentage of scales found within tolerance of 70.5 percent, not materially different from the figure of 71.3 percent found last year, which was the year in which this figure reached its highest point. As was the case in the other districts, the percentage for railroad-owned scales decreases, the drop in this case being 3.0 percent, from 76.3 to 73.3. Also as in the other districts the percentage for industry-owned scales increased somewhat; in this instance the improvement noted is from 64.9 percent to 66.3 percent.

Turning now to the mean numerical errors of scales expressed in terms of percentages of applied loads, we find that the general figure for all scales for the country as a whole is 0.19 percent, 0.02 percent greater than the corresponding figure developed last year. It is noteworthy that this slight variation is the first which has occurred for four years, since 1931. As in the case of the analysis of percentages of scales within tolerance, it is again indicated that the railroad-owned group and the industry-owned group are not as markedly different as was the case last year, there being a decrease of average accuracy in the case of the first class of 0.05 percent, the mean numerical error rising from 0.13 percent to 0.18 percent, and an increase of average accuracy in the case of the second class of 0.02 percent, from 0.22 percent to 0.20 percent. Thus the railroad-owned scales have lost the improvement noted last year and now have a slightly greater average percent error than in 1933; industry-owned scales, on the contrary, have regained part of the loss suffered last year.

The Western District again easily leads, with the smallest mean numerical error for all scales, 0.15 percent.

The figures for the Southern District are 0.20 percent for all scales, 0.19 percent for railroad-owned, and 0.20 percent for industry-owned scales; in the Eastern District the figures are 0.23 percent, 0.25 percent, and 0.22 percent, respectively.

The figures representing the mean numerical error on railroad-owned scales increase in each district, very slightly in the Western (0.01 percent), moderately in the Southern (0.04 percent), and seriously in the Eastern District (0.11 percent).



The corresponding figures for industry-owned scales decrease in the Eastern and Southern Districts, while in the Western District the figure is unchanged. (In computing the mean numerical errors -- percent of applied load -- given in this discussion and elsewhere in this report, an abnormal error has been omitted, since its inclusion would too greatly have influenced the averages; these would have been made non-representative and their significance would have been destroyed; the scale in question was an industry-owned scale in the Eastern District, in error by 15.25 percent. The rejection of the error follows a practice established in former reports.)

All of the figures given above, of course, refer to the condition of scales as they were encountered. It is the policy of the service upon occasion to make adjustments and retests on scales found out of tolerance or where adjustment is requested. It is the practice to do this when time is available and when the scale is in good enough mechanical condition to justify the adjustment, or when minor faulty conditions adversely affecting accuracy, can be corrected at the time of test. This year faulty conditions were corrected and/or adjustments made on 153 of the scales encountered. As a result of this the average error of these scales was reduced from 0.24 percent to 0.07 percent.

#### ANALYSIS OF ERRORS OF INCORRECT SCALES

In table 2, following, is contained the usual analysis of errors on scales not within tolerance.



TABLE 2. ANALYSIS OF ERRORS OF INCORRECT SCALES

FISCAL YEAR 1935

District and scale ownership	Total number of in-correct scales	Mean numerical error-- of percent of applied load	Errors in excess(+)			Errors in deficiency(-)		
			Number of scales	Percent of in-correct scales	Mean error-- of percent of applied load	Number of scales	Percent of in-correct scales	Mean error-- of percent of applied load
EASTERN								
Railroad	69	0.59	41	59.4	0.39	28	40.6	0.89
Industry	67	0.46 <sup>1</sup>	29	43.3	0.35	38	56.7	0.55 <sup>1</sup>
Totals	136	0.53 <sup>1</sup>	70	51.5	0.37	66	48.5	0.70 <sup>1</sup>
SOUTHERN								
Railroad	35	0.43	16	45.7	0.33	19	54.3	0.52
Industry	29	0.38	16	55.2	0.35	13	44.8	0.41
Totals	64	0.41	32	50.0	0.34	32	50.0	0.47
WESTERN								
Railroad	30	0.35	17	56.7	0.31	13	43.3	0.39
Industry	47	0.63	19	40.4	0.35	28	59.6	0.81
Totals	77	0.52	36	46.8	0.34	41	53.2	0.68
ALL DISTRICTS								
Railroad	134	0.50	74	55.2	0.36	60	44.8	0.77
Industry	143	0.50 <sup>1</sup>	64	44.8	0.35	79	55.2	0.62 <sup>1</sup>
GRAND TOTALS	277	0.50 <sup>1</sup>	138	49.8	0.36	139	50.2	0.69 <sup>1</sup>
1934 Totals	289	0.45 <sup>2</sup>	137	47.4	0.36	152	52.6	0.53 <sup>2</sup>

<sup>1</sup> Excluding one scale having abnormal error.<sup>2</sup> Excluding two scales having abnormal errors.





Discussion of Errors. The mean numerical error -- percent of applied load -- for 277 scales found to have an error in excess of tolerance, is 0.50 percent. This figure is somewhat larger than that found last year, 0.45 percent. This year the general figures for railroad-owned and industry-owned scales are identical, 0.50 percent. Last year a difference was noted in the equivalent figures, 0.36 percent and 0.50 percent, respectively.

As in former years there is no marked discrepancy between the percentage of scales in error in excess and in error in deficiency. Actually this year 138 scales fall in the first category and 139 scales in the latter, 49.8 percent and 50.2 percent, respectively. Over a period of 14 years, 1987 of a total of 3931 scales found incorrect or 50.5 percent have been found to have errors in excess, while 49.5 percent have been in deficiency.

As in former years also, the mean error in excess (0.36 percent) is very considerably smaller than the average error in deficiency (0.69 percent). Again this year there is no significant difference between the mean error in excess of railroad-owned and industry-owned scales, 0.36 percent and 0.35 percent, respectively. However this year the mean error in deficiency on railroad-owned scales (0.77 percent) is larger than the equivalent figure for industry scales (0.62 percent).

In the table, the above figures are also given by districts for the reader who is particularly interested in one district, or in a comparison between districts.

#### ERROR FREQUENCY DISTRIBUTION

Table 3 showing the frequency distribution of errors on railway track scales follows:



TABLE 3. FREQUENCY DISTRIBUTION OF RAILWAY TRACK SCALE ERRORS - FISCAL YEAR 1935

Errors -- percent of applied load	EASTERN DISTRICT		SOUTHERN DISTRICT		WESTERN DISTRICT		ALL DISTRICTS	
	Rail- road 250 scales Percent of scales tested	Indus- try 215 scales Percent of scales tested	Rail- road 131 scales Percent of scales tested	Indus- try 86 scales Percent of scales tested	Rail- road 309 scales Percent of scales tested	Indus- try 249 scales Percent of scales tested	Rail- road 690 scales Percent of scales tested	Indus- try 550 scales Percent of scales tested
0.00 to 0.05 incl.	10.4	13.9	17.6	8.1	36.6	18.9	23.5	15.3
0.06 to 0.10 "	25.6	21.9	25.2	20.9	29.4	37.0	27.3	28.6
0.11 to 0.15 "	20.4	24.2	14.5	24.4	16.5	15.7	17.5	20.3
0.16 to 0.20 "	16.0	8.8	16.0	12.8	7.8	9.6	12.3	9.8

Incorrect scales	EASTERN DISTRICT		SOUTHERN DISTRICT		WESTERN DISTRICT		ALL DISTRICTS	
	Rail- road 250 scales Percent of scales tested	Indus- try 215 scales Percent of scales tested	Rail- road 131 scales Percent of scales tested	Indus- try 86 scales Percent of scales tested	Rail- road 309 scales Percent of scales tested	Indus- try 249 scales Percent of scales tested	Rail- road 690 scales Percent of scales tested	Indus- try 550 scales Percent of scales tested
0.21 to 0.25 incl.	6.8	5.6	9.2	7.0	3.6	5.6	5.8	8.8
0.26 to 0.30 "	5.2	7.9	3.8	8.1	1.6	1.6	3.3	5.1
0.31 to 0.35 "	2.8	4.2	5.3	7.0	2.0	4.4	2.9	4.7
0.36 to 0.40 "	2.0	4.2	0.8	3.5	0.6	0.8	1.1	2.5
0.41 to 0.45 "	1.2	0.9	1.5	3.5	0.6	1.2	1.0	1.5
0.46 to 0.50 "	0.8	2.8	0.8	1.2	-	-	0.5	1.3
0.51 to 1.00 "	5.2	4.2	3.0	2.3	1.3	3.2	3.1	3.5
Over 1.00	3.6	1.4	2.3	1.2	-	2.0	1.7	1.6

Mean numerical errors		Correct scales		Incorrect scales		All scales	
Correct scales	0.12	0.11	0.11	0.12	0.08	0.10	0.10
Incorrect scales	0.59	0.46	0.43	0.38	0.35	0.53	0.50
All scales	0.25	0.22	0.19	0.20	0.11	0.20	0.20
Mean errors, 1934	0.14	0.23	0.15	0.23	0.10	0.20	0.13
All scales	0.14	0.23	0.15	0.23	0.10	0.20	0.22

<sup>1</sup> Excluding scales having abnormal errors, as in Table 2.

# 1. The end of the world

.....

.....

.....

.....

.....

.....

.....

.....

.....

Discussion of Data. It is disclosed by the data in the above table that of 690 railroad-owned scales tested in all districts 23.5 percent were within one-quarter of the tolerance allowed and 50.8 percent were within one-half the tolerance. This record is not as good as that of last year. Every district shows a falling off but the most serious decline is in the Eastern District. Industry-owned scales are not as good as railroad-owned scales in respect to error distribution. However, except in the Eastern District, the figures for industry-owned scales for the country as a whole and for each district do not differ materially from the figures for last year.

There is a decided increase in the percentage of railroad-owned scales having large errors, this tendency being most pronounced in the Eastern and Southern Districts. In the former district 8.8 percent and in the latter 5.3 percent of the railroad-owned scales tested have errors of more than 0.50 percent. In the case of the industry-owned scales the percentages in this range are smaller than last year.

It is noteworthy that in the Western District 66.0 percent of the railroad-owned scales and 55.9 percent of the industry-owned scales tested are within one-half the tolerance.

#### SCALES IN GRAIN-WEIGHING SERVICE

Included among the railway track scales tested were a number which were employed in grain-weighing service. In table 1 preceding, these scales have, in accordance with usual practice, been rated along with the others, according to the usual commercial tolerance of 0.20 percent. However the performance of these scales is also to be considered in relation to a tolerance of 0.10 percent since this latter tolerance is recommended for this class of scales by the Interstate Commerce Commission as a result of the proceedings in I. C. C. Docket 9009.

The number of scales in this category was 122; this is greater than has been the case in any year heretofore, 97 having been tested in the best previous years.

The percentage of grain scales found accurate within the special tolerance applicable, is 72.1 percent. This is to be compared with 57.3 percent, last year's figure; also it is considerably higher than the best percentage found heretofore, 63.9 percent in fiscal year 1932. The mean numerical error -- percent of applied load -- is 0.12 percent which equals the former smallest mean error of record. It will be noted that this average error is 0.07 percent less than the average for all scales, and is 0.08 percent better than the average error for all industry-owned scales -- the group in which grain scales are classified.

Table 4 follows, which contains data on scales used in grain-weighing service from 1923 to date.



TABLE 4. RAILWAY TRACK SCALES IN GRAIN-WEIGHING SERVICE

Fiscal year	Number of scales tested	Within special grain scale tolerance		Not within special grain scale tolerance		Mean numerical error -- percent of applied load
		Number	Percent	Number	Percent	
1923	32	2	6.2	30	93.8	0.40
1924	89	31	34.8	58	65.2	(a)
1925	82	34	41.5	48	58.5	(a)
1926	90	37	41.1	53	58.9	(a)
1927	67	26	38.8	41	61.2	(a)
1928	54	32	59.2	22	40.8	(a)
1929	97	54	55.7	43	44.3	0.15
1930	47	22	46.8	25	53.2	0.15
1931	97	51	52.6	46	47.4	0.12
1932	72	46	63.9	26	36.1	0.13
1933	58	34	58.6	24	41.4	0.13
1934	96	55	57.3	41	42.7	0.15
1935	122	88	72.1	34	27.9	0.12

(a) Values of the mean errors for the years 1924 to 1928, inclusive, are not available.





STANDARDIZATION OF RAILWAY TRACK SCALE TEST WEIGHT CARS ON  
BUREAU MASTER TRACK SCALE

National Bureau of Standards Master Scale Depot at Clearing, Ill., was open continuously throughout the year. Fifty-five standardizations were made of railway track scale test weight cars, five fewer than last year.

The results of all determinations are summarized in table 5. Individual cars are designated by letter. Those conforming in essential particulars to recommended specifications for test weight car design are identified by inclosing the letter in a parenthesis ( ). In the tabulation of errors found, a "plus" (+) error indicates that the actual weight of the car was found to be greater than the nominal weight value, a "minus" (-) error the converse. The symbol ° appears in instances where there was record or evidence of repairs or alterations having been made since the last preceding standardization. It should be understood that absence of the symbol ° does not necessarily mean that the corresponding deviation from nominal weight value is attributable entirely to normal causes, but signifies that there was no definite record or indication of other causes.

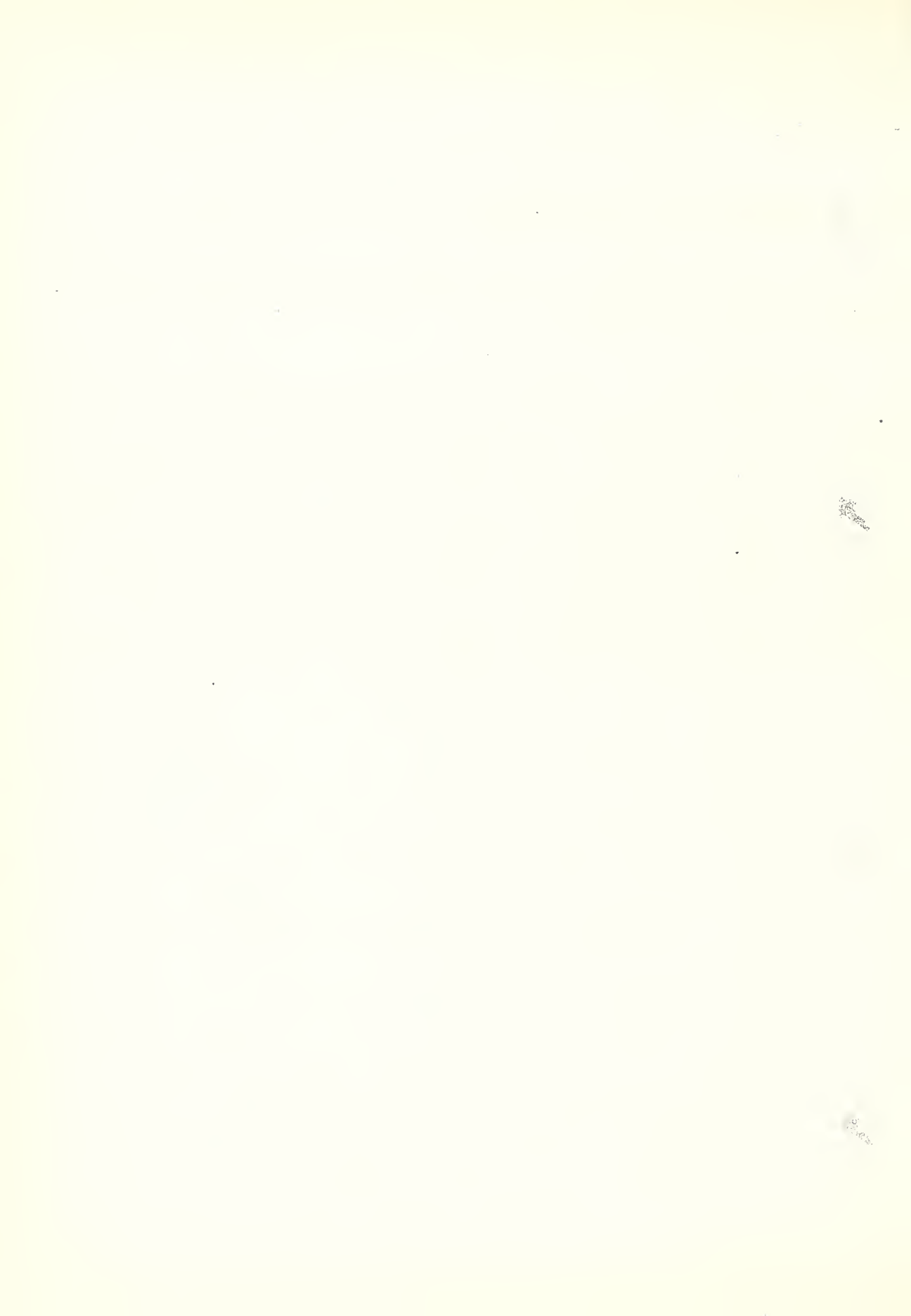


TABLE 5. STANDARDIZATIONS OF RAILWAY TRACK SCALE TEST WEIGHT CARS ON NATIONAL BUREAU OF STANDARDS MASTER TRACK SCALE, CLEARING, ILLINOIS -- FISCAL YEAR 1935

Designation	Report No.	Nominal weight in pounds	Period since last preceding standardization in months	Error in pounds	
				(Plus)	(Minus)
(A)	329	80,000	4		53°
	343		4		264°
	355		3	25°	
	373		4	14°	
(B)	330	80,000	9		137°
	365		8		5
C	331	61,400	3		20°
	342		3	25°	
	354		3	8	
	372		4		17°
D	332	50,600	3		0°
	339		3		0
	356		4	5	
	371		3		8°
	383		2		56°
E	333	75,000	3	8°	
	349		3		5
	363		4	244°	
	378		3		9
(F)	334	80,000	7		169°
	360		6	18	
G	335	60,000	8	98°	
	374		9		319°
H	336	53,600	14		34°
I	337	80,000	6		46°
	367		6		528°
(J)	338	80,300	1st test	9	
K	340	60,000	6		24°
	369		6	48	
L	341	80,000	6	212°	
	370		6		6
(M)	344	61,600	8	9°	
	357		3	42°	



TABLE 5 (Continued)

Designation	Report No.	Nominal weight in pounds	Period since last preceding standardization in months	Error in pounds	
				(Plus)	(Minus)
(N)	345	80,000	13		127
(O)	346	80,000	12		158
P	347	60,000	12	32	
Q	348	50,000	13	10°	
R	350	60,000	13	111°	
(S)	351	80,000	11	3	17
	382		6		
T	352	92,500	6	58	37
	366		3		
(U)	353	80,000	7		188°
	379		6		
(V)	358	80,000	12		4°
(W)	359	83,000	10		369°
(X)	361	80,000	8		2°
	381		4		
(Y)	362	40,000	8	2°	5
	380		4		
(Z)	364	80,000	24	28°	
AA	368	80,000	12	334°	
(BB)	375	40,000	22		4
(CC)	376	80,000	22		4
DD	377	92,500	1st test	109°	

30 cars

55  
standardi-  
zations

23 2 30  
heavy zero light



Discussion of Standardization Results. The fifty-five standardizations made during the year involved thirty cars belonging to 17 owners. Two units were standardized for the first time. Twenty-three cars were heavier and 30 were lighter than their nominal weight; in the case of two standardizations no departure from nominal weight was noted. In the case of thirty-two standardizations on cars formerly standardized by the Bureau on its master scale, it was determined that repairs or alterations had been made since the last standardization. Thus, this year there are but 21 standardizations made upon cars which show no record of repairs or alterations since the last preceding standardization. Seven of these were heavy, one was correct, and thirteen were light. Eleven of them were on cars which essentially conformed to the main requirements of specification cars, while ten were on cars departing from specifications in important particulars of design and construction believed to have a tendency to make the weight less reliable. Detail requirements not believed to have this effect are disregarded for the purposes of the classification.

The data on cars not modified or repaired since previous standardization are probably too few to permit conclusions to be drawn as to reliability between types. Also, as has been pointed out in previous reports, it is always difficult accurately to determine that changes have not been made. However, for what the figures may be worth and for comparison with figures given in previous reports, it may be said that of the 11 standardizations on cars generally conforming with specifications and not known to have been repaired or modified, 2 were found heavy for an average of 10 pounds and 9 were found light for an average of 37 pounds; disregarding the sign of the error the average departure from nominal weight was 32 pounds. For cars not conforming, 5 standardizations on heavy cars produced an average error of 30 pounds, 4 standardizations on light cars resulted in an average error of 14 pounds, and on one standardization a zero error was reported. Thus the average error without regard to sign was 21 pounds for all standardizations on cars of this classification. Combining these figures we have standardizations on 7 cars averaging 25 pounds heavy, 13 standardizations on cars averaging 30 pounds light, one standardization producing zero error, and a discrepancy of 27 pounds for a total of the 21 standardizations.

Fifty-three standardizations were made on cars previously standardized by the Bureau on its master scale. The average period of time elapsing since the next prior standardization was 7.4 months. In the following tabulation there is shown the number of standardizations falling into each of several periods, and for each period the condition of the cars on the basis of their nominal weights and the average numerical errors.





Period in months	Number of Standardizations		Unrepaired and unmodified cars			
	Total	On unrepaired and unmodified cars	Weight Condi- tions			Mean numerical error in pounds
			Heavy	Zero	Light	
3	13	5	1	1	3	12
6	18	9	4	-	5	19
12	15	4	2	-	2	50
18	4	1	-	-	1	127
24	3	2	-	-	2	4
	53	21	7	1	13	27

It will be well to keep in mind the limitations expressed heretofore in regard to the data, in attempting to draw any conclusions from them. In a general way the advisability of frequent standardizations of this character of equipment seems to be indicated.

#### WEIGHING OF RAILWAY TRACK SCALE TEST WEIGHT CARS IN THE FIELD

In connection with the testing of track scales the Bureau units are accustomed to weigh railway track scale test weight cars in the field, this being deemed to be a very important contribution to the maintenance of the standard throughout the country. Many of these cars are not standardized periodically on master track scales, either because they operate in a territory remote from such a facility or because their wheelbase is too long to permit of such weighing. The weighings in the field are conducted in connection with the test of a track scale deemed suitable for such a comparison by substitution methods.

During the year 26 test weight cars were weighed in the field, for 19 railroad owners and one industry owner. Four of these were found to be heavier, and seventeen were lighter, than their nominal weight; five were reported as having zero error within the limits of accuracy attainable by field weighing.

The average error of the four heavy cars was 35 pounds, of the seventeen light cars was 45 pounds; the average numerical error of the 26 cars was 35 pounds.

#### PUBLICATIONS AND SPECIAL REPORTS

A report on the railway track scale testing service of the National Bureau of Standards for the fiscal year 1934, Letter Circular No. 431, was issued and circulated to the various parties in interest, including each railroad and industrial concern for which one or more tests were made during the year.



In last year's report it was noted that at the suggestion of a railroad official a special report for the fiscal year 1933, had been prepared for each railroad upon the lines of which ten or more scales were tested during the year, detailing and summarizing the results of the tests made on the road in question. The data were arranged in the same form as the general summary contained in the annual report, and the special reports were sent out with the annual report, so that interested officials would be able directly to compare the results obtained on their line with the general results obtained in the district in which their tracks were located and in the country as a whole. These special reports were so very well received and appeared to perform so useful a function that they were again issued in 1934 and it is the intention to continue to issue them in the future.

An abstract of master track scale calibrations for the fiscal year 1934 was prepared and distributed to a limited number of agencies entitled to receive this character of information.

#### SCALES TESTED CLASSIFIED ON BASIS OF LAST FORMER TEST BY NATIONAL BUREAU OF STANDARDS EQUIPMENTS

In the last preceding report of this series, National Bureau of Standards Letter Circular LC 431, there were discussed briefly the factors governing distribution and selection of Bureau tests of railway track scales. It was pointed out that in any one year the Bureau was able to test only a small percentage of the total number of track scales in use in the United States. In view of this it appeared that special efforts should be made to prevent the service from becoming routine in its nature. Particularly was it emphasized that a scale owner could in no case rely upon tests by Bureau equipments to keep him advised as to the condition of his scale; that routine testing service, which is deemed to be vitally necessary to keep scales accurate, should be arranged for elsewhere. It was announced that in drafting itineraries thoughtful attention would be given to the inclusion of scales not formerly tested, or not recently tested by Bureau equipments, and that preference would ordinarily be given to the selection of such scales for test, where a selection had to be exercised.

Current itineraries for the three testing equipments have been drafted with the above principles in mind. All of the testing done this year has not been in pursuance of such itineraries, however, since during the fiscal year two of the equipments proceeded partially on itineraries not so drafted. It may be said that only some 43 percent of the tests this year were made while travelling on itineraries drafted in accordance with these principles. It is therefore too early definitely to determine to what extent the period elapsing since last prior test by the Bureau may be affected by the continued preparation of itineraries such as are now being drafted. However, from incomplete figures, it is demonstrated that improvement has already been effected. This year, 20.6 percent of all railroad-owned scales tested by Bureau equipments had never been tested by the Bureau heretofore, 14.3



percent were last tested 10 years or more ago, and 14.1 percent were last tested in a period of from 5 years to 9 years ago. Fifty-one percent had last been tested within 5 years. This represents an increase in the percentage of scales in each of the first three classes mentioned and a consequent marked decrease in the last class.

The figures for industry-owned scales are still more favorable. In the case of this class of scales our record of former tests is complete only from fiscal year 1929 to date. Forty-eight and seven-tenths percent of the scales tested this year are listed as not having been formerly tested, 10.4 percent were tested 5 or more years ago, and the remainder, comprising 40.9 percent of the total, had been tested less than five years ago.

It is believed that further improvement may be shown in the fiscal year 1936. With intensive attention being given to this phase of the testing program, scales will rapidly be transferred from the class of scales not tested, and from the class of scales not recently tested. Therefore the percentage of scales in the first mentioned class, and to a lesser extent the not-recently tested classes, also, will continually decrease. However continued efforts will be made so to distribute tests that each year a considerable proportion of the tests made will be on scales not theretofore tested by our equipments for a considerable period. If this can be accomplished it seems that the distribution by sections, roads, and agencies will be equitable and that the service will benefit a very large proportion of the owners of railway track scales.

## CONCLUSION

In October, 1913, the National Bureau of Standards inaugurated its Railway Track Scale Testing Service. The objects of its program were the furnishing of a uniform standard of weight throughout the country for the testing of railway track and other large capacity scales, the determination of conditions existing with respect to such scales and weighing, and the improvement of such conditions through cooperation with owners and users of these scales and with agencies charged with the maintenance and testing of them.

Originally one track scale testing equipment was put into service. At later dates two additional equipments were added. Finally a master track scale housed in a depot erected at Clearing, Ill., was added to these facilities.

Throughout the period during which the railway track scale testing service has functioned, the primary objects of the service have continuously been kept in mind. The activities described in this report -- the calibration of master track scales widely distributed throughout the United States, the standardizations and weighings of railway track scale test weight cars at the Bureau



master track scale and in the field, the testing of railway track scales owned by railroads and industries, and related work -- are all well designed to effectuate the primary objects described.

The early reports of the service revealed that facilities available for the weighing of commodities in carload lots were susceptible of very great improvement. When measured by present-day standards, conditions twenty years ago were deplorable. In fiscal years, 1914-15, the percentage of scales tested which were within tolerance was only about 33 percent; the mean error was found to be about 0.57 percent. During the first four years, the annual reports revealed reasonably satisfactory improvement. A hesitant period between 1920 and 1922 was followed by a period of years in which rapid and continuous progress was made. Competent specifications were prepared and circulated and better types of scales became available. Maintenance and adjustment measures and facilities greatly improved. The percentages of correct scales steadily mounted; mean errors of scales steadily decreased. This period of improvement culminated in 1933. The percentage of scales within tolerance as shown in the Bureau report for that year reached the all time high of 80.6 percent; the mean error of scales was 0.17 percent. This was a far cry from the conditions disclosed by the early reports.

In 1934 and 1935 a retrogression is noted. Certainly as yet it can not be said to be serious in character. It is doubtless not as great as might reasonably have been expected in view of the business conditions existing during the last five years.

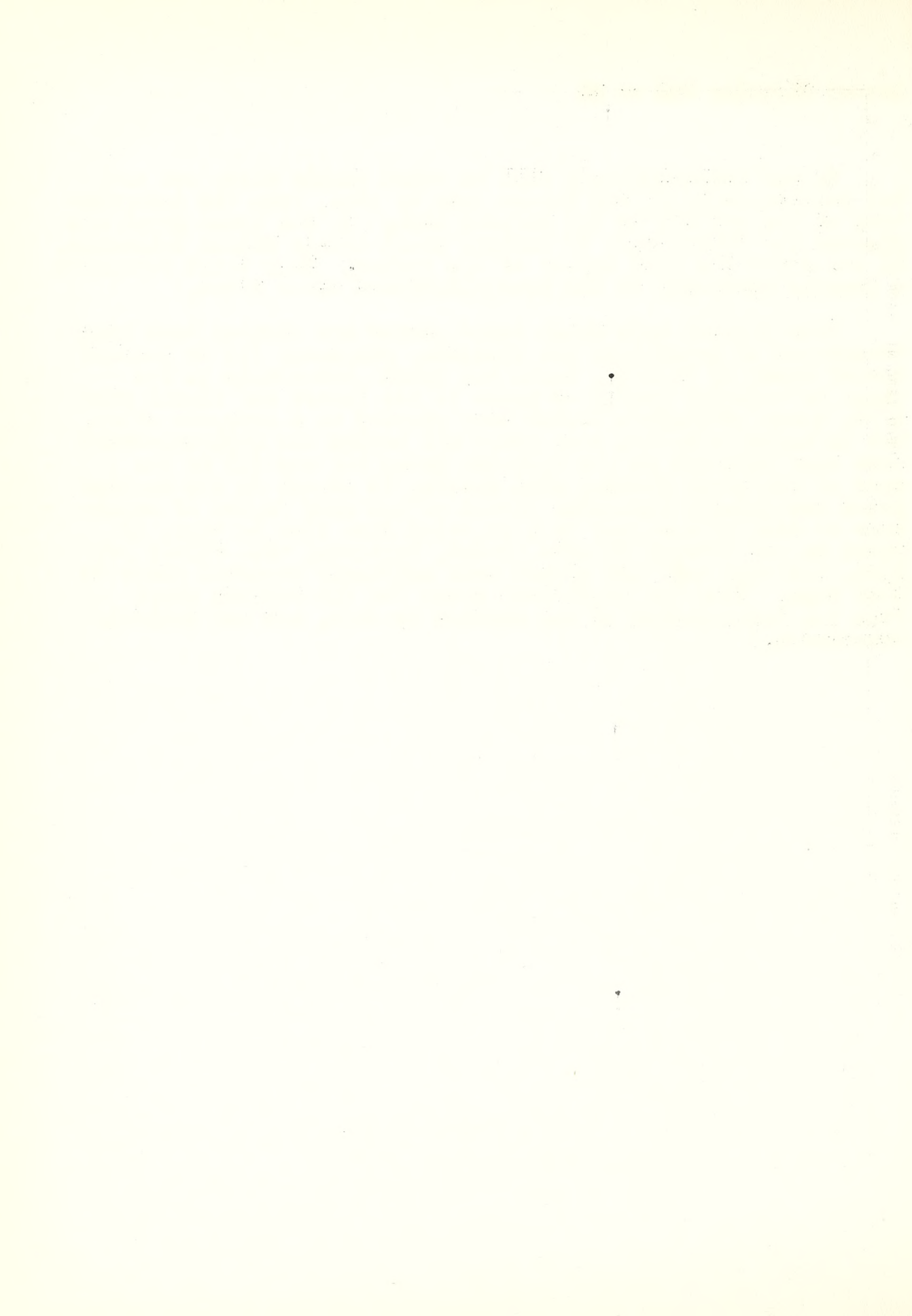
It has been pointed out that the National Bureau of Standards entered the railway track scale testing field as a cooperating agency. The policy of cooperation with all interested groups has steadily been kept in mind. The Bureau has received hearty support. The improvements made have been too notable and too wide spread to be attributed to any one agency. Many have contributed to the common end and are entitled to credit for results achieved. The Bureau is proud to have played a part. It is confidently expected that the united efforts of all concerned, coupled with improvement in general business conditions, will serve to consolidate the tremendous gains already made and to make possible continued improvement in the accuracy of railway track scales and weighing.





On the following page will be found graphs which set out the results found by the Bureau year by year, from the inauguration of the service to the present time. In the lower graph are plotted the percentages of railway track scales within tolerance, in the upper the mean errors of the scales. This chart furnishes a graphic portrayal of the accomplishments cited above.

(The figures upon which these graphs are plotted have been recomputed to accomplish the following purposes: (1) To include scales owned by Federal, State and local governments in the class of industry scales -- prior to the report for fiscal year 1934, these government scales were carried as a separate class, but beginning with the year noted all scales not railroad-owned have been included in the industry group --; and (2) in the case of the graph showing mean errors, to reject in the various years any grossly excessive errors of the same degree of magnitude -- such errors have been rejected from time to time, as noted in the several reports issued, beginning with fiscal year 1922, but they had not always been uniformly rejected prior to that time. Thus the conditions shown for the various years from the inauguration of the service to date, are now entirely comparable.)



# RAILWAY TRACK SCALES



