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DEPARTMENT OF COMMERCE

Bureau of Standards

HMR:EGH
II-8

REPORT

January 16, 1933

Letter
Circular
LC 353

RAILROAD TRACK SCALE TESTING SERVICE

OF THE

NATIONAL BUREAU OF STANDARDS

FISCAL YEAR JULY 1, 1931 TO JUNE 30, 1932.

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RAILROAD TRACK SCALE TESTING SERVICE OF THE NATIONAL BUREAU OF STANDARDS FISCAL YEAR, 1932

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C O N T E N T S

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RAILROAD TRACK SCALE TESTING SERVICE

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NATIONAL BUREAU OF STANDARDS

FISCAL YEAR 1932.

INTRODUCTION

The primary object of this report is to review the results of the railway track scale tests conducted by the National Bureau of Standards in the fiscal year ended June 30, 1932. Analysis and discussion of the data collected during such tests or obtained through incidental related activities are included. A summary of the results of all tests made by the Bureau since 1913 showing the consistent progress which has been made in improving carload freight weighing facilities since that year concludes the report.

In previous reports of this character issued after the close of each fiscal year since 1924, the general subject of freight car weighing has been thoroughly treated and the responsibility of the Bureau as a federal agency concerned with the investigation and improvement of carload freight weighing practices and facilities has been fully explained. Readers not familiar with the manner in which the Bureau acts to maintain a uniform standard of weighing practice throughout the extensive channels of rail transportation and wholesale interstate trade in the United States may consult the afore-mentioned letter circulars.

FIELD ACTIVITIES

The major part of the work performed in the field during the fiscal year 1932 consisted of 959 tests of railway track scales, and 21 tests of master track scales not used for weighing freight. The testing service was distributed throughout 41 States and the District of Columbia and involved transportation of three separate test units over approximately 25,000 miles on 76 railways. A formal report of the test results on each scale, including a statement of construction faults or maintenance deficiencies observed during inspection of the scale and submitting recommendations for necessary corrections, was transmitted to the owner and to parties or agencies at interest.

The 21 tests made of master scales not used for weighing freight will be discussed separately in another section of this report.

The 959 tests made of track scales employed in weighing carload traffic were applied to 606 scales owned by railways, 344 scales owned by industries, and 9 scales owned by City, State or Federal Government Departments.

SUMMARY OF FIELD OPERATION

On the accompanying map are shown (1) the itineraries of the testing equipment for the past fiscal year, (2) the location of 19 master track scales which the Bureau has permanently designated as being satisfactory for establishing or verifying the weight values of track scale test weight cars, and (3) boundaries of the three major districts which are referred to throughout succeeding pages of the report.

Table No. 1 comprises a summary of field operation, including a study of the field time distribution and an abstract of the work completed in the field during the year.

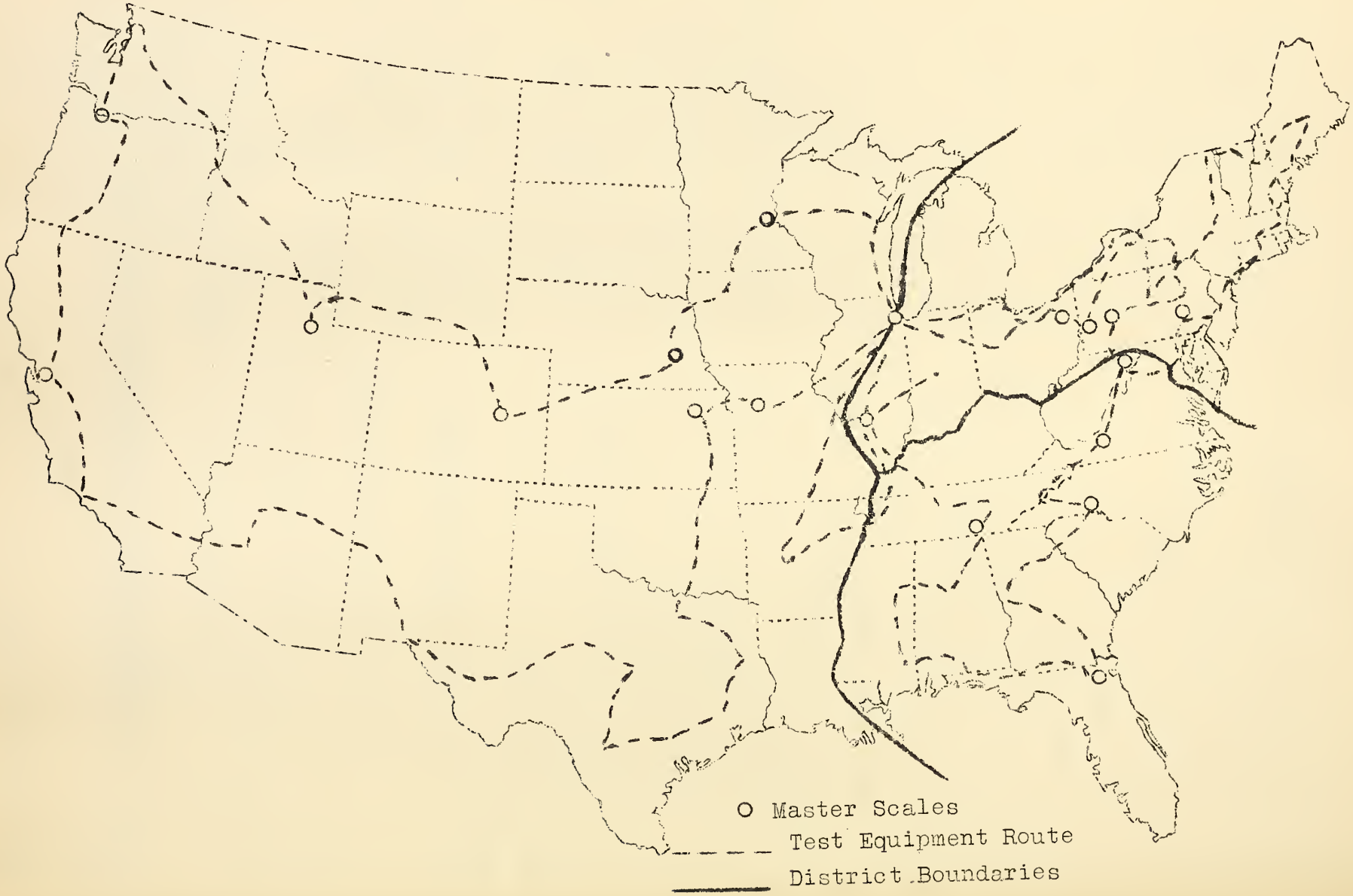
Master Scales
Test Equipment Route
District Boundaries

TABLE 1

SUMMARY OF FIELD OPERATION OF RAILROAD TRACK SCALE TESTING UNITS, NATIONAL BUREAU OF STANDARDS, FISCAL YEAR, 1932

Item	Field Equipments			
	No. 1	No. 2	No. 3	All*
1. Days in the field	165	266	316	747
2. Days in operation testing master scales	16 9.7%	16 6.0%		32 4.3%
3. Days in operation testing track scales	93 56.4%	162 60.9%	233 73.7%	488 65.3%
4. Days no tests, all causes (See Note following)	56 33.9%	88 33.1%	83 26.3%	227 30.4%
5. Master scale tests	12	9		21
6. Track scale tests	164	328	467	959
7. Tests per day testing track scales	1.76	2.02	2.0	1.97
8. Test cars calibrated	14	11	16	41
9. Track scales adjusted	3	23	30	56
10. Miles travelled	6100	11180	7500	24780
11. Miles per day in field	37.0	42.0	23.7	33.2
12. Miles per track scale test	37.2	34.1	16.1	25.8
13. Number of stations**	72	102	149	323
14. Track scale tests per station	2.28	3.22	3.13	2.97
15. Stations per day testing track scales	0.77	0.63	0.64	0.66
16. Days at terminals***	7	61	92	160
17. Tests at terminals	20	154	213	387
18. Tests per day at terminals	2.86	2.52	2.32	2.42
19. Days outside terminals	86	101	141	328
20. Tests outside terminals	144	174	254	572
21. Tests per day outside terminals	1.67	1.72	1.80	1.74

TABLE 1 (Continued)

Item	Field Equipments			
	No. 1	No. 2	No. 3	All*
22. Stations outside terminals	70	91	140	301
23. Stations per day outside terminals	0.81	0.90	0.99	0.92
24. Ratio of tests outside terminals to total tests	0.88	0.53	0.54	0.60
25. Ratio of time outside terminals to total testing time	0.92	0.62	0.61	0.67
26. Ratio of tests of other than railroad owned scales to total tests	0.29	0.41	0.37	0.37
27. Ratio of tests of other than railroad owned scales outside terminals to total tests outside terminals	0.25	0.30	0.26	0.27

* Totals or averages.

** A station is a locality where testing was done. If the movement of the equipment between consecutive tests was a "switching" movement as distinguished from a "road" movement, the tests are considered as being at the same station, that is, all tests within the switching or yard limits of the same locality are considered as being at the same station.

*** A terminal is a station where 8 or more tests were made.

Note.- Item 4, "Days no tests, all causes", may be subdivided as follows: (percentages are of total days in field)

Due to	No. 1	No. 2	No. 3	Totals
a. Repairs, maintenance	1 0.6%	17 6.4%	8 2.5%	26 3.5%
b. Bad weather	2 1.2%	1 0.4%	4 1.3%	7 0.9%
c. Sundays, holidays	26 15.8%	35 13.2%	47 14.9%	108 14.5%
d. Moving, schedule arrangements	4 2.4%	24 9.0%	22 7.0%	50 6.7%
e. Waiting master scale modifications	21 12.7%	11 4.1%		32 4.3%
f. Other causes	2 1.2%		2 0.6%	4 0.5%

RAILROAD TRACK SCALE TEST DATA

The results of the 959 tests made on railway track scales are presented in Table 2, the scales tested being grouped according to geographical location and class of ownership.

The performance criterion according to which scales were classified as correct or incorrect is a tolerance, or allowable indicated weighing error, equivalent to two-tenths of one per cent (0.20%) of the applied test load, this allowable error being the mean of the two greatest errors developed with a test load at positions which may be assumed by the trucks of a freight car. Standard weight test loads of 40,000 pounds and 80,000 pounds are ordinarily applied by the Bureau; the allowable maximum mean errors are thus respectively 80 pounds and 160 pounds.

TABLE 2. - SUMMARY OF TRACK SCALE TEST DATA, NATIONAL BUREAU OF STANDARDS, FISCAL YEAR, 1932

District and Scale Ownership	Number of scales tested	Within Tolerance		Not Within Tolerance		Mean Numerical error % of applied Load	Analysis of Errors of Incorrect Scales					
							Errors in excess			Errors in deficiency		
		Number	Per cent	Number	Per cent		Number of scales	Per cent of incorrect scales	Mean error	Number of scales	Per cent of incorrect scales	Mean error
EASTERN												
Railroad	284	227	79.9	57	20.1	0.15	37	64.9	0.34	20	35.1	0.50
Industrial	122	97	79.5	25	20.5	0.22	14	56.0	0.59	11	44.0	0.72
Government	4	3	75.0	1	25.0	0.12	1	100.0	0.25	--	----	----
State or Municipality	---	---	----	--	----	----	--	-----	----	--	----	----
Total	410	327	79.8	83	20.2	0.17	52	62.7	0.41	31	37.3	0.58
SOUTHERN												
Railroad	86	59	68.6	27	31.4	0.18	22	81.5	0.35	5	18.5	0.36
Industrial	50	37	74.0	13	26.0	0.18	6	46.2	0.35	7	53.8	0.44
Government	--	--	----	--	----	----	--	----	----	--	----	----
State or Municipality	1	1	100.0	--	----	0.08	--	----	----	--	----	----
Total	137	97	70.8	40	29.2	0.18	28	70.0	0.35	12	30.0	0.41
WESTERN												
Railroad	236	207	87.7	29	12.3	0.13	19	65.5	0.32	10	34.5	0.66
Industrial	172	133	77.3	39	22.7	0.20	23	59.0	0.31	16	41.0	0.80
Government	2	2	100.0	--	----	0.07	--	----	----	--	----	----
State or Municipality	2	2	100.0	--	----	0.10	--	----	----	--	----	----
Total	412	344	83.5	68	16.5	0.16	42	61.8	0.31	26	38.2	0.75
ALL DISTRICTS												
Railroad	606	493	81.4	113	18.6	0.15	78	69.0	0.34	35	31.0	0.53
Industrial	344	267	77.6	77	22.4	0.20	43	55.8	0.41	34	44.2	0.70
Government	6	5	83.3	1	16.7	0.10	1	100.0	0.25	--	----	----
State or Municipality	3	3	100.0	---	----	0.09	--	-----	----	--	----	----
GRAND TOTAL	959	768	80.1	191	19.9	0.17	122	63.9	0.36	69	36.1	0.61
1931 totals	1030	782	75.9	248	24.1	0.21	133	53.6	0.40	115	46.4	0.71

Discussion of Test Results. In Table 2 the critical data by which the performance of any particular group of scales may best be judged or compared with the performance of some other group are (1) the proportion of scales found to be correct within tolerance, and (2) the average mean maximum weighing error for the group. These data occupy the third and sixth columns of the table.

Thus it is seen that the proportions of scales found correct in the Eastern, Southern and Western districts were respectively 79.8 per cent, 70.8 per cent and 83.5 per cent. In the same order the average errors for the three districts were, respectively, 0.17%, 0.18% and 0.16%. These averages indicate comparative inferiority of weighing equipment in the Southern district, a fact in accordance with the usual findings of previous years.

A comparison of the results in each of the two major classes of scale ownership for all districts combined shows that 81.4 per cent of railway owned scales were correct as compared with 77.6 per cent of the industry owned scales, the average errors for the two classes being, respectively, 0.15% and 0.20%. These figures represent the usual comparative performance standing for the two classes of ownership.

At the foot of the table where totals for this past year and the preceding year are compared, appreciable recent progress in improvement is indicated. It may be emphasized that the total percentage of scales found correct this year (80.1%) and the total average error (0.17%) represent a better general grade of test performance than has heretofore been observed. It is worthy of special note, too, that the total average error of all scales tested during the year was materially less than the allowable error tolerance (0.20%) which is applied to railway track scales.

Especially commendable was the average test performance exhibited by the railroad-owned scales tested in the Western district, 87.7 per cent of them being correct within tolerance and the average error for all being 0.13%.

Improvement of results over those of the preceding year was most noticeable in the Southern district although the tests made in that area during the past year were too few to justify an assumption that the data are representative of the entire district.

The right hand portion of Table 2 is composed of a study of the performance of those scales found to be incorrect. Separate tabulation was made for errors representing "over-weight indications" and errors representing "under-weight" indications. As shown by the total figures, 63.9 per cent of

the incorrect scales were yielding "over-weight" indications and 36.1 per cent were yielding "under-weight" indications. As fixed by these two values, the ratio of "over-weighing" scales to "under-weighing" scales is rather at variance with the results of previous years' tests when an approximately equal division of "over-weighing" and "under-weighing" scales has been usual. Two factors which may be mentioned as, perhaps, contributing to the preponderance of "over-weighing" scales are (1) a general instinctive tendency for scale inspectors employed by railways to regard "over-weight" errors as less objectionable than "under-weight" errors and therefore to correct the latter more frequently, and (2) the inherent tendency of track scale test weight cars to lose mass and thus in instances where verification control is inadequate, to introduce "over-weight" errors when used for adjustment or test of a scale.

The generally higher value for the average error in deficiency is attributed to the influence of some errors of considerable magnitude in a few scales subject to interferences which caused gross errors in deficiency.

ERROR FREQUENCY DISTRIBUTION

The frequency distribution of the various weighing errors of the track scales tested this year is shown in Table 3. Nine track scales used by State, City and Federal governments have been excluded from this study. The average error for the scales in each ownership and location group are shown at the foot of the table and may be compared with corresponding data for the two preceding years.

TABLE 3. - FREQUENCY DISTRIBUTION OF TRACK SCALE ERRORS - FISCAL YEAR 1932

ERRORS	EASTERN DISTRICT		SOUTHERN DISTRICT		WESTERN DISTRICT		ALL DISTRICTS	
	Railroad 284 tests	Industrial 122 tests	Railroad 86 tests	Industrial 50 tests	Railroad 236 tests	Industrial 172 tests	Railroad 606 tests	Industrial 344 tests
Percentage 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.	22.5	15.6	14.0	16.0	34.7	19.2	26.1	17.4
0.06 to 0.10 "	26.4	24.6	23.3	30.0	26.3	26.7	25.9	26.4
0.11 to 0.15 "	21.5	26.2	24.4	12.0	19.5	17.4	21.1	19.8
0.16 to 0.20 "	9.5	13.1	6.9	16.0	7.2	14.0	8.3	14.0
0.21 to 0.25 "	6.7	3.3	11.6	4.0	3.4	6.4	6.0	4.9
0.26 to 0.30 "	2.5	4.9	5.8	4.0	3.4	3.5	3.3	4.1
0.31 to 0.35 "	1.8	1.6	4.6	8.0	1.3	4.1	2.0	3.8
0.36 to 0.40 "	2.1	3.3	1.2	4.0	1.3	2.9	1.6	3.2
0.41 to 0.45 "	2.8	0.8	1.2	4.0	1.3	---	2.0	0.9
0.46 to 0.50 "	0.7	0.8	2.4	---	---	1.2	0.7	0.9
0.51 to 1.00 "	2.8	3.3	4.6	---	0.8	2.3	2.3	2.3
Over 1.00	0.7	2.5	----	2.0	0.8	2.3	0.7	2.3
Mean Error % of applied load	0.15	0.22	0.18	0.18	0.13	0.20	0.15	0.20
Mean Error Fiscal year 1931	0.13	0.22	0.21	0.27	0.14	0.26	0.16	0.25
Mean Error Fiscal year 1930	0.17	0.24	0.25	0.24	0.15	0.18	0.19	0.22

Discussion of Table 3. The data in Table 3 to which special attention is directed are the figures in the two final columns. They represent that more than 25 per cent of the railway owned scales tested throughout the nation had a mean maximum weighing error of five one-hundredths of one per cent (0.05%) or less, and that more than half the scales in that class of ownership were correct within one-half the adopted tolerance. In both respects the industry owned scales were inferior. The values at the foot of the final two columns denote moderate improvement over the results for the two preceding years.

SPECIFICATION SCALES

Since the year 1920 the accepted standard of design and construction for railroad track scales in revenue freight weighing service or in commercial weighing service where the volume of traffic or the tonnage of individual cars is considerable, has been what is known as the "Specification Type Track Scale." These are scales designed and installed according to specifications published in 1920 through joint action of the Bureau and associated organizations in response to demands for scales which should be adequate for modern traffic conditions. Intended originally for installation by the carriers, scales of this type have also been adopted generally by industrial and commercial organizations of major importance.

A survey of all the scales tested this year by the Bureau shows that approximately one-third of the number conformed in essential respects to those specifications. Comparative study of the general performance qualities for specification and non-specification types has been made and is summarized in Table 4.

(Note: Several scales of the plate fulcrum style of lever construction, not covered by specifications, have been included in the number of specification scales. A number of scales installed prior to adoption of the specifications but embodying structural and design features required in the specifications have also been included.)

TABLE 4

COMPARATIVE TEST PERFORMANCE -SPECIFICATION TYPE VS. NON-SPECIFICATION TYPE SCALES

FISCAL YEAR 1932

Type and ownership	Scales tested	Within Tolerance		Not Within Tolerance		Average Error
		Number	%	Number	%	
Specification type or equivalent:						
Railroad owned	230	214	93.0	16	7.0	0.09
Industry owned	85	74	87.0	11	13.0	0.12
Total	315	288	91.4	27	8.6	0.10
Non-specification type:						
Railroad owned	376	279	74.2	97	25.8	0.19
Industry owned	259	193	74.5	66	25.5	0.22
Total	635	472	74.3	163	25.7	0.20
GRAND TOTAL	950	760	80.0	190	20.0	0.17

Of all scales tested 33.2% were specification type scales; of these 73% were railroad owned.

Discussion of Table 4. The significant fact illustrated by the data in Table 4 is that of scales designed and constructed according to approved specifications and tested in the past year, less than 10 per cent failed to meet the required performance standard. Moreover, it will be noted that the average error of all specification type scales tested was one-tenth of one per cent (0.10%) or within one-half the allowable error limit. This was in marked contrast to the performance record for track scales not designed and constructed in accordance with specifications, more than 25 per cent of the latter being incorrect and the average error for the group being 0.20% or twice that of the specification type equipment.

When it is considered that weighing equipment of the specification class is now concentrated at the principal railway weighing stations where the volume of weighed traffic is relatively great and at some few industrial plants where particularly severe demands upon equipment are the rule, the superior reliability and accuracy of specification type scales, as represented by their performance under test, is even more forcefully demonstrated.

As stated in a footnote to the tabulated data, approximately one-third of the scales tested in 1932 were of the specification type group and of these 73 per cent were owned by railways. There is valid reason to assume that these ratios denote substantially the general proportion and distribution of all specification type scales now in use. A conclusion which may properly be drawn from these circumstances and one which betrays existence of an economically unsound principle is that notwithstanding that the charges levied by railways for transporting materials in carload lots represent a fraction of the materials' intrinsic value, the equipment maintained by the carriers for revenue freight weighing is, in general, of better quality than that employed by industry to weigh the same materials for sale or purchase. In other words that class of weighing service in which modern adequate weighing facilities are most essential is the one in which least progress in modernization has been effected. (A limited group of industries, in which steel mills are foremost, forms an exception to the general case.)

STATUS OF INDUSTRIAL WEIGHING

It has been explained in a previous exposition of the anomalous situation outlined above that a majority of the railway track scales in industrial weighing service are in use at plants of minor size and small capital investment. Failure of these numerous plants to absorb the original specification type track scales which were intended primarily for heavy duty railway weighing points has been due to the disproportionate investment which the purchase and installation of such equipment would entail. In consequence several thousand

obsolete and unreliable track scales in current industrial weighing service have been continued in use beyond the time when their deterioration or inadequacy rendered them unfit for satisfactory weighing service.

Evidence of the restraint which a general deficiency of proper weighing equipment has imposed upon progress in industrial weighing standards is observed in the annual summaries of tests conducted by the Bureau in recent past years. Since the year 1923 when replacement of deficient scales with modern specification type installations became a noticeable factor in improving freight weighing conditions, railroad owned facilities have, in general, shown greater improvement than those owned by industry, judged by the results of the Bureau's tests. The following table summarizes statistically the comparative rates of progress effected in the two major classes of weighing service. Similar comparison in graphic form and for the entire period of Bureau investigation is made in Figures I and II at the end of this report.

TABLE 5. RELATIVE QUALITY OF PERFORMANCE OF RAILROAD OWNED AND INDUSTRY OWNED TRACK SCALES.

1	2	3	4	5	6	7
Year	Percentage of Scales Tested that passed the Tolerance		Difference (2)-(3)	Average Error in Per Cent of Applied Load		Difference (6)-(5)
	Railroad owned	Industry owned		Railroad owned	Industry owned	
1924	57.9	54.3	3.6	0.36	0.36	0.00
1925	67.2	63.3	3.9	0.28	0.25	-0.03
1926	66.9	64.1	2.8	0.26	0.22	-0.04
1927	72.0	68.1	3.9	0.20	0.22	+0.02
1928	73.9	63.5	10.4	0.23	0.24	+0.01
1929	74.0	68.4	5.6	0.19	0.21	+0.02
1930	76.2	67.6	8.6	0.19	0.22	+0.03
1931	79.9	72.3	7.6	0.16	0.25	+0.09
1932	81.4	77.6	3.8	0.15	0.20	+0.05

To provide practical measures whereby the underlying weakness of the industrial weighing system might be removed has been for several years the object of cooperative action by the Bureau and those agencies concerned with problems of weighing in the wholesale and transportation field. Two years since, through joint action of these interests, there was prepared and promulgated a code of specifications for a new type of railroad track scale designated as the "Light Industrial Service Track Scale". This type is well adapted for use at industrial plants where comparatively few cars are weighed and is procurable at a cost approximately one-half that of the original specification type scale designed for heavy duty. Track scales designed and constructed according to the new specifications are in production and on the market but their adoption in the intended field of use has not become general as yet, probably because of the present general demoralization in the buying market.

TRACK SCALES IN GRAIN WEIGHING SERVICE

The industry-owned scales tested by the Bureau in the past year included 72 railway track scales used for weighing carload shipments of grain. For scales in this special class of service, the required standard of test performance, adopted pursuant to recommendation of the Interstate Commerce Commission (Docket 9009), is an allowable mean maximum indicated error equivalent to one-tenth of one per cent (0.10%) to be computed from the two greatest errors developed with a test load at positions which may be assumed by the trucks of a freight car used for transporting bulk grain.

Of the 72 grain weighing track scales tested, 64 per cent were correct within the adopted tolerance and the average error for all was 0.13%. It may be said that these figures, taken in connection with the results of tests made in recent years, indicate that apparently commendable improvement in the general grade of performance by grain weighing scales is in progress. Factors to which such progress must be attributed, however, are increased vigilance of maintenance measures and more accurate and frequent adjustments, rather than replacement of inadequate equipment. Thus it is found that but 18 per cent of the grain scales tested in the past year were of the modern type recommended for use in weighing grain. In this latter connection, it should be understood that the exacting performance requirements for grain weighing scales contemplate use of the original specification type scale and that the newer light industrial service track scale is not intended for grain weighing service.

At the major terminal markets where grain deliveries are weighed under supervision of some responsible agency, the routine system of scale tests and inspections enforced by those agencies have, to some extent, compensated for the deficiency of the scales in use.

TRACK SCALES AT STEEL MILLS

To accommodate a specific request that data on the performance of track scales in use at steel mills be segregated there has been prepared the following summary of test results in that particular field of industrial weighing service.

Tests were made of 49 track scales used for weighing steel mill products at their source. Of that number 43 scales or 87.8 per cent were correct within tolerance. The average error for all scales was 0.13%.

The extent to which original specification type scales have been adopted in the steel production industry is shown by the fact that specification scales comprised 61 per cent of the scales tested at steel mills. Their general ability to yield accurate performance under test despite the comparatively rigorous and heavy service demands is indicated by the fact that all were correct within tolerance and their average error was 0.09%.

TRACK SCALES AT COAL MINES

A series of tests made in the coal fields of Southern Illinois in the spring of 1932 affords opportunity for a review of the performance qualities common to scales in the coal mining industry in that particular locality. The scales tested were owned by coal mine operators and used for determining the weights of loaded coal cars, these weights being the basis upon which invoices of sale are established.

Tests were made of 31 scales at 27 mines. Twenty-two scales or 71 per cent were correct within tolerance and the average error for all the scales was 0.19%. Ten of the scales or 32.3 per cent were of the original specification type and the average error of the ten was 0.10%.

MASTER SCALE CALIBRATIONS

Each of the 19 master track scales whose location is shown on the map on page 3 and which has been designated by this Bureau as a permanent master scale suitable for determining the weight values of track scale test weight cars was calibrated during the year. A second calibration of two of these master scales was conducted following completion of some extensive modifications which had been recommended on the occasion of the first calibration. On final calibration, each master scale proved to be accurate within the required tolerance (approximately 0.01%).

TEST CAR CALIBRATIONS IN THE FIELD

In certain sections distant from designated master scales or in the case of railway track scale test weight cars so constructed that transportation to or accommodation on such master scales is not practicable, it has become customary for test car operators to depend upon the services of the Bureau field equipment for annual verification of the test car weight values. Determination of the weight values is by a modified form of substitution weighing whereby the test car is compared with the field standards of the Bureau upon some track scale deemed satisfactory for the purpose.

In the past fiscal year, 41 cars were weighed in the above described fashion. Twenty-six cars were deficient in weight, six weighed more than the nominal weight value and 9 were correct within the margin of accuracy which this field method of calibration involves, ordinarily 10 pounds.

Test car weight verification by substitution weighing against standards is conceded to be of a secondary quality and is performed only when the preferred method of calibration on a designated master scale is obviously impracticable.

TEST CAR CALIBRATIONS AT HEADQUARTERS

Table 6 contains statistical data relating to the calibration of railway track scale test weight cars on the Bureau master scale at the Bureau of Standards Master Scale Depot, Clearing, Illinois.

Individual cars are indicated by the letters A, B, C, etc. Results of successive calibrations are shown in chronological order. Letters inclosed with a parenthesis, thus, (B), indicate that the corresponding cars are "self-contained" test weight cars.*

The symbol, °, attached to some of the error values in the last two columns indicates that when the corresponding values were obtained there was positive evidence that repairs or alterations had been made previously to calibration, or that the errors found were for some other reason not representative of variations resulting from normal use. Absence of the symbol does not necessarily mean that the errors found represent variations resulting from normal use, but that evidence to the contrary at the time of calibration was not positive.

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* Note: According to construction, test weight cars are designated as being of one or the other of two types: (1) "Self-contained" cars in which the body is essentially a one or two piece casting; and (2) "Compartment" cars in which the body consists of a steel plate shell in one or more compartments loaded with billets or other form of permanently fixed weight.

TABLE 6.- TRACK SCALE TEST WEIGHT CAR CALIBRATIONS
NATIONAL BUREAU OF STANDARDS MASTER SCALE DEPOT, CLEARING, ILLINOIS
FISCAL YEAR 1932

Car	Report No.	Nominal Weight (lb.)	Air Brakes		Errors in Pounds	
			(Yes)	(No)	(Plus)	(Minus)
A	166	60,000	X			26°
(B)	167	80,000		X		414°
	195					43°
	208				8°	
C	168	50,000	X		6°	
	170				93°	
D	169	61,400	X		4°	
	200				69°	
E	171	75,000	X			69°
	188				84°	
	224				219°	
(F)	172	80,000		X		56°
	199					49°
(G)	173	80,000		X		76°
H	174	60,600	X			39°
	205				42	
(I)	175	30,000		X		12°
	181					6
	194					5
	203				3	
	210					4°
	221					2
(J)	176	80,000		X		12°
	180				1	
	193					5
	204				10	
	209					17°
	222					8
(K)	177	30,000		X		12°
	191				6	
	207				1	
	218					4

TABLE 6 (Continued)

Car	Report No.	Nominal Weight (lb.)	Air Brakes (Yes)	Air Brakes (No)	Errors in Pounds (Plus)	Errors in Pounds (Minus)
(L)	178	80,000		X	925°	
	184				6	
	202				7	
	215					11
(M)	179	80,000		X		15
	211				14	
N	182	50,000	X		28°	
	214					6
O	183	60,000	X			44
(P)	185	40,000		X	4	
	201					3
	216				3	
(Q)	186	80,000	X			7°
(R)	187	80,000	X			15
(S)	189	80,000	X			2
	212					5
(T)	190	80,000	X		202°	
(U)	192	80,000		X		9
	206					8
	219					12
V	196	96,500	X		50°	
(W)	197	40,000		X		2
(X)	198	80,000		X		4
(Y)	213	83,000		X	71°	
	217				10°	
	225				10°	
(Z)	220	61,600	X			2
(AA)	223	80,000		X		15°
		TOTALS				
27 cars	60 calibrations		13 cars with air brakes	14 cars without air brakes	25 too light	35 too heavy

Review of Calibration Results. Fifteen different organizations, of which 13 are railroads, are represented in the ownership of the 27 cars to which calibration service was furnished. Five of the 22 major railroad systems entering Chicago operate master scales but with one exception none of those to whom calibration service was furnished do so.

Nineteen of the 27 cars calibrated were the self-contained type. The remainder were the compartment type.

Forty-six calibrations, or 2.4 calibrations per car, were made on self-contained cars, and 14 calibrations, or 1.8 calibrations per car, were made on compartment type cars.

In 28 calibrations on 12 different self-contained cars, no evidence was discovered that the errors did not result from normal use. In these the cars were heavy in 10 cases and light in 18 cases. The average error was 6.2 pounds.* The instances of compartment cars appearing for calibration without previous shop treatment were too few to justify a statement of an average.

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*(Note: The average just given is calculated from the "absolute" errors, that is, no distinction is made between plus and minus errors.)

RESEARCH

There was brought to conclusion during the year a program of investigation and service test begun in 1930 and designed to test the properties of various protective coatings applied to fifty-pound test weights. Throughout this investigation some two hundred test weights treated with ten varieties of paints and employed in eight distinct classes of testing service were under observation. The results of this research, now being prepared for publication, indicate that depending upon circumstances of their routine use and the normal frequency of their readjustment, weights treated with paints of light body vehicle such as varnishes (plain or pigmented) are least susceptible to variation in weight. An incidental fact revealed on analysis of the data collected during these tests is that test weights subjected to moderate use, not regularly exposed to weather, and ordinarily verified at intervals of twelve months, may be expected to remain constant within required tolerances without paint protection on their surfaces.

Other investigations prosecuted during the year included experiments with various forms of sealing cavities and sealing caps for fifty pound test weights and a study of the practicability of producing slotted cylindrical test weights by machining from cold rolled steel stock and subsequently plating with chromium.

COOPERATION WITH TECHNICAL GROUPS

Bureau representatives serving on committees of the American Railway Engineering Association and the National Scale Men's Association cooperated with those organizations to provide needed codes of rules and specifications relating to problems of heavy duty scale maintenance.

The chief projects completed in cooperation with the two previously named organizations were (1) Code of rules for the transportation and maintenance of track scale test weight cars, and (2) Definition of a standard test of a railway track scale. Both codes have been adopted by the National Scale Men's Association, and both, with some modifications, are now under consideration by the American Railway Engineering Association.

PUBLICATIONS

Letter Circular No. 315, published and distributed early in the fiscal year reviewed the results of track scale tests made during the 1931 fiscal year and the progress which has been made in advancing standards of freight weighing.

An abstract of the master track scale calibrations performed during the preceding year and a graphic record of the calibration results for each master scale were compiled and supplied to a limited number of agencies responsible for supervision over weighing on railways.

A supplement to the previously compiled catalogue of industry-owned scales was prepared and distributed to interested parties or organizations.

A code of specifications for the repair of scales of large capacity, formally adopted by the National Scale Men's Association, was published as Letter Circular No. 309.

GENERAL REVIEW OF PROGRESS TO DATE

The results of railway track scale tests made by the Bureau demonstrate a remarkable improvement in conditions since the testing service was inaugurated in 1913 and this improvement is reasonably consistent throughout the period. The progress record is depicted graphically in Figures 1 and 2, the former recording the proportions of scales found to be correct and the latter the values of the average errors. Results for railway owned scales and industry owned scales are plotted separately. Scales tested in the fiscal year 1914 have been excluded since they were too few in number to be representative, and scales owned by Federal, State and municipal governments also are not included. The total number of tests represented is approximately 12,600.

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Figure 1

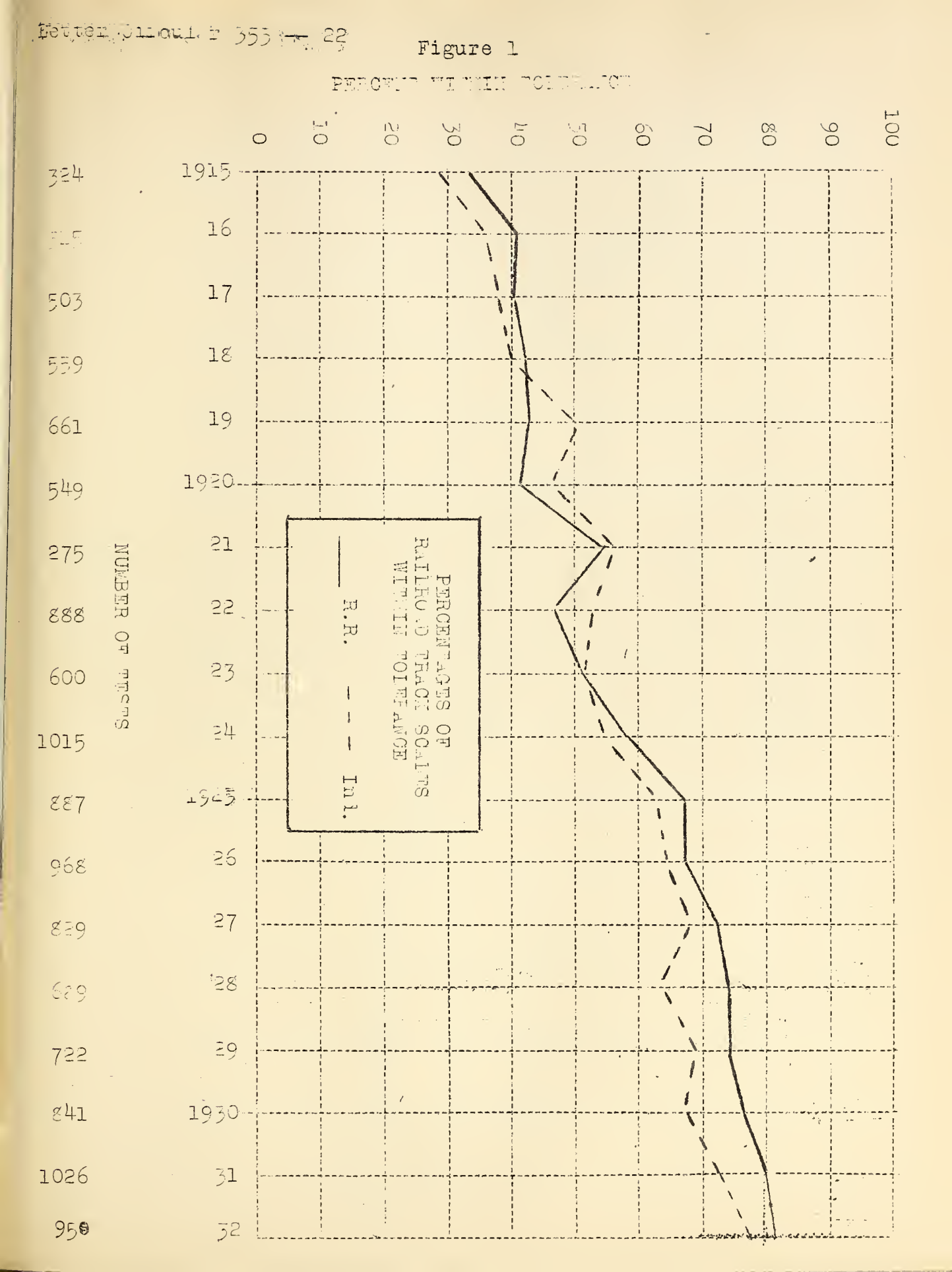
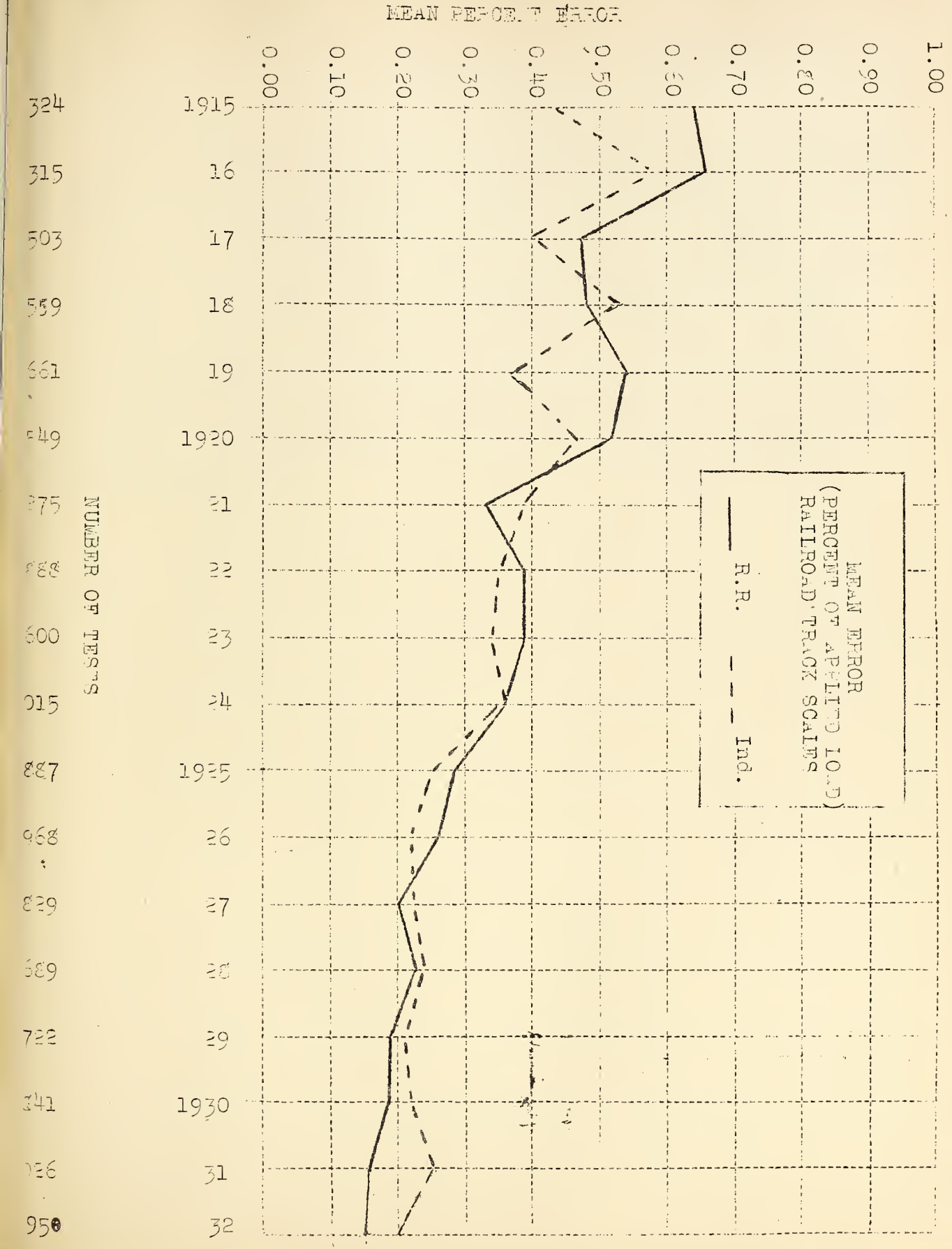


Figure 2


MEAN PERCENT ERROR
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
NUMBER OF TESTS
324
315
503
559
661
649
675
688
600
615
887
968
839
689
722
341
336
950
1915
16
17
18
19
1920
21
22
23
24
1925
26
27
28
29
1930
31
32
MEAN ERROR
(PERCENT OF APPLIED LOAD)
RAILROAD TRACK SCALES
R.R.
Ind.

CONCLUSION

Consideration of the various factors which have contributed to the advancement of freight car weighing accuracy in American transportation and industry justifies the assertion that modernization of weighing equipment to meet increasing demands of traffic and lading conditions has been the most effective single factor. Its benefits have been noticeable in increasing degree since 1922 and as stated in foregoing pages, have been most apparent on railways. Future progress in industrial weighing will also depend largely upon the extent to which defective equipment now in use may be replaced with equipment suitable for the conditions of service. Restoration of normal buying power should bring about widespread adoption of approved specification type scales in industry. In the meantime, it is to the interest of all that there be no lowering of the standards previously established for the design and construction of adequate equipment.