HMR:MAO
II-8

DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
WASHINGTON

Letter
Circular
LC 152
Revised

(July 10, 1928)

SPECIFICATIONS FOR THE MANUFACTURE AND INSTALLATION OF MOTOR TRUCK, BUILT-IN, SELF-CONTAINED, AND PORTABLE SCALES FOR RAILROAD SERVICE.

(Revised to include amendment of Section II-4, Section VIII-1-(c) and Section XX-3, March 1927).

INTRODUCTION

The specifications herein published were prepared by the Sub-Committee on Scales of the American Railway Engineering Association Yards and Terminals Committee. This committee with which the Bureau cooperates through the medium of a staff member on the committee took up preparation of these specifications in the course of its regular work. They were first published in Volume 25, No. 257, July 23 number of the American Railway Engineering Association Bulletin. They are also published in Circular IV-39 of the American Railway Association. Subsequent amendments are shown in Volume 28, 1927, pp. 612-615, Proceedings of the American Railway Engineering Association.

These specifications are intended to apply to knife edge scales of the straight and torsion lever types equipped with beams for weighing less than carload freight. They do not apply to scales now in service, except that reinstallation of old scales should be governed as nearly as practicable by the provisions of the specifications relating to installation of new scales. They are intended, except in special cases, to secure a reasonable uniformity in scales for similar service, but without preventing improvements in types of scales or in scale parts. Requests for proposals for scales to conform to these specifications should specify the type and capacity of scales, and the size of the platform required, together with such other information as will insure complete and uniform proposals.

(1) TYPES OF SCALES

1. The types of scales covered by these specifications are as follows:

(a) Motor Truck Scale -- A scale especially designed for weighing motor trucks.

(b) Built-In Scale -- A scale whose lever mechanism is erected upon a pit foundation or equivalent structure built in the field, and whose superstructure, including the weighing platform, is of a character not fabricated in scale manufacturing plants and not generally secured from or through the scale manufacturer.

(c) Self-Contained Scale -- A scale in which the lever system is enclosed in a box frame equipped to receive it and provided with platform, all comprising a complete weighing unit furnished by the scale manufacturer for installation in a fixed location.

(d) Portable Scale -- A scale mounted on wheels or otherwise designed for easy movement from place to place.

(II) CAPACITIES AND SIZES

1. Capacity Defined. -- The capacity of a scale is the weight of the heaviest load it will weigh under certain specified application of the load, without developing stresses in the members in excess of those hereinafter specified.

2. Size Defined. -- The size of the scale is the width and length of the platform on which the load is applied.

3. Capacities and Sizes Standardized. -- The capacities and sizes of the different types of scales, except for special cases, shall be as follows, with the understanding that the term size has reference to the dimensions of the platform and that in stating these dimensions the dimension first given is that of the side adjacent to the beam:

(a) Motor Truck Scales.

Capacity	Sizes
40 000 lbs. (for 7 1/2 Ton Trucks)	20'x 9', 22'x 9' and 24'x 9'
30 000 lbs. (for 5 Ton Trucks)	18'x 9' and 20'x 9'
20 000 lbs. (for 3 1/2 Ton Trucks)	16'x 8' and 22' x 8'

(b) Built-In Scales.

Capacity	Sizes
5 Tons	6'x5', 8'x6' and 9'x7'
10 Tons	8'x6' and 9'x7'

(c) Self-Contained Scales.

Capacity	Sizes
2 500 lbs.	46" x 38"
4 000 lbs.	48" x 48"
10 000 lbs.	72" x 54"

(d) Portable Scales.

Capacity	Size
1 000 lbs.	18" x 27"
2 000 lbs.	25" x 32"

4. Corner and End Loading..--

(a) Motor Truck Scales. -- They shall be designed for loads on any corner as follows:

20 000 lb. capacity scale, 75 per cent of the beam capacity; 30 000 lb. capacity scale, 65 per cent of the beam capacity; 40 000 lb. capacity scale, 62 1/2 per cent of the beam capacity; and for all scales, 100 per cent of the beam capacity of the scale on either end. The above percentages of the capacity include the weight of the weigh-bridge and deck.

(b) Built-In Scales. -- They shall be designed for 75 per cent of the rated capacity on any corner or 100 per cent of the rated capacity on any two corners together with the entire weight of the platform.

(c) Self-Contained and Portable Scales. -- They shall be designed for 25 per cent of the rated capacity on any corner or 50 per cent of the rated capacity on any two corners together with the entire weight of the platform.

(III) PLANS

1. For motor truck and built-in scales the manufacturer shall furnish to the purchaser plans showing the material of which the scale is to be fabricated, stresses, and sufficient dimensions to permit the purchaser to check the stresses; also assembly plans showing location and size of all open holes for field connections necessary for assembly and installation, and all information necessary for the purchaser to design and construct any pit or parts required and not designed or furnished by the scale manufacturer.

(IV) WORKING STRESSES

1. General. -- The following unit stresses shall not be exceeded when the scale is loaded with its platform and to its capacity as defined above. These stresses include an allowance for impact.

3. Iron and Steel, Working Stresses in Pounds Per Square Inch.

Material	Transverse Bending		Direct Stresses		Shear and Torsion
	Tension	Compression	Tension	Compression	
Steel castings.....	8000	10000	8000	10000	5000
Machinery steel.....	12000	12000	12000	12000	7500
Structural steel.....	16000	16000	16000	16000	10000
Steel for pivots and bearings:					
High carbon.....	24000	24000	24000	24000	.....
Special alloy.....	30000	30000	30000	30000	.....
Cast iron:					
Thickness of section					
0.25"	5000	8500	3500	10000	5000
0.3	4780	8130	3350	9560	4780
0.35	4600	7820	3220	9200	4600
0.4	4450	7560	3110	8900	4450
0.45	4320	7340	3020	8640	4320
0.5	4200	7140	2940	8400	4200
0.6	4020	6830	2814	8040	4020
0.7	3870	6580	2710	7740	3870
0.8	3740	6360	2620	7480	3740
0.9	3630	6170	2540	7260	3630
1.0	3540	6020	2480	7080	3540
1.1	3450	5860	2410	6900	3450
1.2	3380	5750	2370	6760	3380
1.3	3310	5620	2320	6620	3310
1.4	3250	5520	2270	6500	3250
1.5	3190	5420	2230	6380	3190
1.6	3140	5340	2200	6280	3140
1.8	3050	5180	2130	6100	3050
2.0	2970	5050	2080	5940	2970
2.5	2810	4780	1970	5620	2810
3.0	2690	4570	1880	5380	2690
3.5	2580	4390	1810	5160	2580
4.0	2500	4250	1750	5000	2500

The maximum allowable unit stress of any character used for designing cast iron members of a scale shall be determined for any section of such member by the greatest thickness used in the section, exclusive of fillets. In the main portion of a beam the thickness of the web or flange shall be used, whichever is the greater. The thickness of the flange shall be considered as either the average depth of the outstanding portion of the flange or the breadth of flange, out to out, whichever is the less.

The bearing stress on steel pins shall not exceed 15,000 pounds per square inch.

3. Knife Edge Bearing Stresses. -- The load per linear inch of knife edge shall not exceed 5,000 pounds.

4. Concrete Bearing Stresses. -- Stresses to be allowed for bearing on concrete shall not exceed 300 pounds per square inch.

5. Loops, Formula for Stresses. -- Considering the end of the loop as a simple beam, its section at the point of maximum bending shall be determined by the formula $\frac{W}{4}(L - 1/2\ d)$

wherein W equals the maximum load applied to the loop, L equals the distance between the center lines of the depending sides, and d equals the distance over which the load is distributed.

6. Projecting Pivots, Formula for Stresses. -- Where practicable, the pivots shall be supported their full length by integral parts of the lever. Where impracticable to so support the pivots, the bending moments shall be determined as follows:

Let W equal the total load on both ends of pivot, in pounds.
L equal the moment arm, in inches.
d equal the length of bearing in loop, in inches.
T equal distance between friction faces of loop, in inches.
B equal the width of boss or sustaining member enveloping pivot, in inches
M equal bending moment in pivot, in inch pounds.

Then:

L equals 1/2 D + (T - B) + 1/4 in.

and:

$$M \text{ equals } \frac{W\ L}{2} = \frac{W}{2}(1/4\ d + (T - B) + 1/4 \text{ in.})$$

7. Tests. -- Before acceptance of a scale the purchaser may, if he so desires, test by customary approved methods any scale part or parts with a load equal to three times the rated capacity for the part, provided the manufacturer is given opportunity of having a representative present during the test, which shall be made within sixty (60) days after delivery and before installation of the scale. Upon failure of any part so tested the purchaser may reject either the part or parts which failed or the entire scale and return same to the manufacturer at the latter's expense.

(V) SCALE LEVERS

1. Type. -- All levers of motor truck and built-in scales shall be of the solid lever type without truss rods.

2. Qualities of Castings. -- The finished levers shall not be unduly warped; they shall be free from blisters, large holes or other imperfections, and shall be brought to a reasonably smooth finish.

3. Machined Ways for Nose Irons. -- In motor truck scales, levers that are to be equipped with nose irons shall have those portions of the lever ends receiving them machined for the full distance over which the nose irons are to move.

The guides for all nose irons shall be of such construction that, when one is moved for the purpose of adjusting, the knife edge will always be held parallel to its normal position.

4. Leveling Lugs. -- In motor truck scales and built-in scales of the straight lever type each lever shall be provided with leveling lugs for longitudinal alinement.

In scales of like classes of the torsion lever type, leveling lugs shall be provided on the pipe or torsion member for transverse alinement and on the extension arm for longitudinal alinement. Each pair of lugs shall be spaced eleven (11) inches. The leveling surfaces of each pair of lugs shall be finished to a common plane which shall be parallel to the plane established by the knife edges of the end pivots.

5. Marking of Levers. -- In motor truck and built-in scales figures denoting the multiple of each lever shall be cast or otherwise permanently marked in plain figures thereon.

6. Length, Allowable Variation. -- In motor truck and built-in scales, levers shall be true to their nominal length between end knife edges within a tolerance of one-sixty-fourth (1/64) inch per foot.

(VI) PIVOTS AND KNIFE EDGES

1. Material. -- In motor truck scales and built-in scales the requirements for physical properties of the steel used for pivots shall be as follows:

(a) Special Alloy Steel in the Annealed State:

Elastic limit.....Not over 75,000 lb. per sq. in.
Tensile strength.....Not over 110,000 lb. per sq. in.
Elongation in 2 in.....Not less than 20 per cent.
Reduction in area.....Not less than 35 per cent.

(b) Special Alloy Steel Hardened:

Elastic limit.....Not less than 160,000 lb.per sq. in.
Tensile strength.....Not less than 200,000 lb.per sq. in.
Elongation in 2 in.....Not less than 5 per cent.
Reduction in area.....Not less than 25 per cent.
Shore hardness.....Not less than 75.

(c) High Carbon Steel in the Annealed State:

Elastic limit.....Not over 55,000 lb. per sq. in.
Tensile strength.....Not over 117,000 lb. per sq. in.
Elongation in 2 in.....Not less than 15 per cent.
Reduction in area.....Not less than 25 per cent.

(d) High Carbon Steel Hardened:

Elastic limit.....Not less than 135,000 lb. per sq.in.
Tensile strength.....Not less than 180,000 lb. per sq.in.
Elongation in 2 in.....Not less than 6 per cent.
Reduction in area.....Not less than 12 per cent.
Shore hardness.....Not less than 65

2. Design. -- In motor truck scales and built-in scales all pivots shall be designed and manufactured so that the two sides joining to form the knife edge shall make an angle that will not exceed 90 degrees; that the tolerance for offset of the knife edge of the pivots, as figured from the center line of the pivot at its base, shall be within 10 per cent. of the width of the pivot for "machined in" pivots, and 15 per cent. of the width of the pivot for "cast in" pivots.

3. Mounting:

(a) Fastening. -- All pivots shall be firmly fastened in position, without swedging or caulking.

(b) Continuous Contact. -- All pivots shall be mounted so as to secure equal and continuous contact of the knife edges with their respective bearings for the full length of the parts designed to be in contact; in loop bearings the knife edges shall project slightly beyond the bearings in the loops.

(c) Position. -- The pivots shall be so mounted that each knife edge in a given lever will be maintained in a horizontal plane under any load; and so that a plane bisecting the angle of a knife edge will be perpendicular to the horizontal plane established by the knife edges of the end pivots, and so that the knife edges in a given lever will be parallel to each other.

4. Support for Projecting Pivots. -- The reinforcing on the levers to support projecting pivots shall be tapered off to prevent lodgment of dirt next to the pivots and to provide proper clearances.

(VII) NOSE IRONS

1. Design and Fastening. -- The nose irons shall be firmly fastened in proper position by means of screws or bolts of a recognized standard size and thread, or other equally effective mechanical device.

(a) Design of Fastening. -- The device for clamping the nose irons in position shall be of such design that indentations in the lever will not be made, and for motor truck scales and built-in scales it shall be independent of any means provided for adjustment.

(b) Direction of Fastening. -- For motor truck scales and built-in scales the device for clamping nose irons in position shall force or hold them against the lever in the same direction as they would be forced by the load, and shall be such that the nose irons will remain in place when the clamping device is released.

(c). Control of Nose Iron Movement. -- The movement of the nose irons shall be controlled by means of adjusting screws of recognized standard size and thread. For motor truck scales these screws shall be made of a material which will not corrode.

2. Marking of Position. -- The position of each nose iron as determined by the factory adjustment shall be accurately, clearly and permanently indicated by a well-defined mark on the lever and nose iron, which shall meet on a common line.

3. Finish and Pivot Mounting. -- Those surfaces of the nose irons intended to come into slidable contact with the levers shall be made true so as to secure an accurate fit of the nose irons on or in the levers. Each nose iron shall be of such design that when adjustments are made the knife edge will be held parallel to its original position.

(VIII) LEVER FULCRUM STANDS

1. Design:

(a) Height of Stands and Area of Bases. -- The height of the stands and the dimensions of their bases shall be sufficient to prevent tipping action.

(b) Stands, Position on Bases. -- The upright portions of the stands carrying the bearings shall be so placed on the bases that the centers of the bearing lines shall fall within the middle third of the length and of the width of the base.

(c). Anchor Bolt Holes. -- One anchor bolt hole in the case of "A" lever scales, and two or more anchor bolt holes in the case of other scales, not less than 1 1/2 inches in diameter, shall be provided in proper places in the bases of all the stands, unless other equally effective means for anchorage is provided.

2. Qualities of Castings. -- The castings shall be free from blisters and large holes, or other imperfections, and shall be brought to a reasonably smooth finish.

3. Bases for Lever Stands. -- The bases of the stands shall be finished to within a tolerance of one thirty-second (1/32) of an inch, or machined when to be mounted on metal bed plates, accurate to a plane perpendicular to the axis of the upright portion of the stand, and the knife-edge bearing line shall be parallel to the surface of the base.

4. Stands, Finish of Tops. -- The tops of the stands for receiving the bearing steels, caps or blocks shall be finished to a tolerance of one thirty-second (1/32) of an inch.

5. Tie Bars. -- Tie bars for the lever frames are not required, but if used, the contiguous surfaces shall be machined.

(IX) BEARING BLOCK AND LINKS

1. Material for Bearing Steels. -- The character of the material for bearing steels will be found under "Knife-Edges," Section VI. The bearing steels shall be equal to or greater in hardness than the knife edges which oppose them.

2. Design of Bearings. -- Scales shall be so designed that when the load is applied the movement of the platform will not displace the bearings at points of contact on the knife edges.

3. Mounting of Bearing Steels. -- All like bearing steels shall be interchangeable or mounted in interchangeable bearing blocks. In either case the interchangeable part shall be fastened securely.

4. Finish of Bearing Steels. -- The bearing surfaces shall be brought to a smooth, true and accurate finish to provide continuity of contact with the opposing knife edges.

5. Platform Bearings. -- In motor truck scales and built-in scales the tops of platform bearings making contact with the weigh-bridge girders shall be finished to within one thirty-second (1/32) of an inch of a true plane. These tops shall be provided with bolt holes of a sufficiently large diameter to allow for adjustment both transversely and longitudinally to secure a proper alinement of parts.

(X) LOOPS AND CONNECTIONS

1. Design Proportion. -- Loops which form bearings for projecting pivots may be of any type desired provided the radius of the portion of the bearing making immediate connection with the knife edges equals five-eighths (5/8) of the greatest dimension of the cross-section of the pivot to be used in the loop.

2. Length. -- All loops in like connections, except where made adjustable, shall be of the same length.

3. Vertical Adjustment. -- Means for vertical adjustment shall be provided between the lever system and the beam, which shall permit the independent leveling of the shelf lever when one is used. The connection to the beam shall be adjustable only when it is disconnected. Screw adjustments shall be provided with lock nuts or equivalent device.

(XI) CHECKS

1. Type. -- The weigh-bridges and platforms of all scales shall be equipped with checks of the rod or other approved type, which shall be equal to the rod type in functioning, and motor truck and built-in scales shall have adjustable checks.

2. Character. -- Checks shall be provided to limit movement of weigh-bridge or platform in any horizontal direction.

3. Position. -- The checks shall be attached to the weigh-bridge or platforms at a point as high as possible and shall be horizontal.

4. Number. -- Motor truck and built-in scales using rod or bumper type of checks shall have not less than four longitudinal and four transverse checks. Those of the rod type shall be not less than three-fourths (3/4) inches in diameter and they shall be assumed to act in tension only.

(XII) WEIGH BEAMS AND ACCESSORIES

1. Definition of Capacity. -- The capacity of the beam is the total weight determinable by using all of the poises and counterpoise weights, provided, however, that a fractional poise may be ignored when it corresponds to less than 2 1/2 per cent of the corresponding main beam.

2. Capacity of Beams Provided:

(a) For Motor Truck Scales. -- For motor truck scales the capacity of the beam shall be as follows:

Truck Capacity Mfg. Rating	Beam Capacity
3 1/2 ton	20,000 lbs.
5 ton	30,000 lbs.
7 1/2 ton	40,000 lbs.

(b) For Built-In, Self-Contained and Portable Scales. -- For built-in, self-contained and portable scales the capacity of the beam shall not exceed the rated capacity of the scale as provided for under Section II.

3. Capacity Plainly Marked. -- The capacity of the scale as defined in Section II, Article 1, shall be marked plainly and conspicuously on or near the beam, in such a manner as to be readily and naturally observed by anyone using the scale.

4. Type of Beam.

(a) Type of Beam for Motor Truck Scales. -- For motor truck scales a full capacity beam shall be provided. Registering beams shall be provided, if specified. When registering beams are used, tare beams shall not be provided unless specified. When tare beams are provided the graduation of main and fractional bars shall comply with the specification provided herein for the main beam.

(b) Type of Beam for Built-In, Self-Contained and Portable Scales. -- Built-in scales shall be equipped with a full capacity beam with tare bar, or doublt beam with counterpoise weight, as may be specified.

Self-contained scales shall be equipped with a double beam with counterpoise weights.

Portable scales shall be equipped with a single beam with counterpoise weights.

(c) On full capacity beams counterpoise hanger or weights shall not be used.

5. Multiplication. -- A pivot with a loop shall be provided at the tip end of the beam, and the multiplication to this knife edge shall be plainly and permanently stamped on the beam and provided further that for beams with counterpoise weights the multiplication at the tip of the beam shall be as follows:

For built-in scales.....500 or 1,000
For self-contained scales.....200 or 300
For portable scales..... 100

6. Pointer. -- On motor truck scales the beams shall be provided with a pointer registering with a suitable and easily visible target on the trig loop to indicate the horizontal position of the beam.

7. Shoulder Stop. -- A shoulder stop shall be provided on all beams to prevent the travel of the poise back to the zero notch.

8. Notches. -- The number of notches for the main poise shall not exceed six (6) per inch. Each notch shall be so made that when the pawl rests in it, a line projected from the center of the side of the notch nearer the zero graduation to the axis about which the pawl revolves will be perpendicular to that side of the notch.

9. Pawl or Latch. -- The tip or point of the pawl or latch shall be of the same width as the notches of the beam, and shall be rounded off so that a small amount of dirt in the bottom of the notch will not prevent the poise from assuming its correct position.

10. Projection and Recesses. -- Poises shall be designed so as to present the least number of recesses of projections in or on which dust or dirt may accumulate.

11. Poise Bearings. -- Rollers or other means shall be provided to secure a free movement of the poise along the beam, without side play.

12. Fractional Beam. -- The capacity of the fractional beam, on full capacity beams, shall be 100 lb. by 2 lb. graduations or 1,000 lb. by 10 lb. graduations. When a type registering beam is employed it shall be so designed as to insure a positive stop of the poise at each graduated subdivision and also to prevent the movement of the fractional poise beyond its proper travel in either direction.

In type-registering beams, the last figure of the fractional beam shall read 999 pounds when the capacity of the fractional poise is 1,000 pounds and 99 pounds when the capacity of the fractional poise is 100 pounds.

13. Operating Lever. -- On registering beams a substantial double or other approved type of hand grip shall be provided to facilitate the printing or registering of the weight on the ticket with the least possible disturbance of the beam.

14. Receptacle for Weight Ticket. -- On registering beams means shall be provided to prevent the placing of the weight ticket in its receptacle in any position in which a weight can be registered differing from the setting of the poise.

15. Balance Ball. -- For motor truck scales a balance ball shall be provided and its movement shall be controlled by means of a self-contained hand-operated screw or other device which will not require that the ball be rotated in making any adjustments. A means for locking the ball in position shall be provided. The balance ball shall be provided with vertical adjustment.

16. Weight.

(a) Material. -- The poises and weights for the beam shall be made of steel, iron, brass or any other metal or alloy of metals not softer than brass.

(b) Protection from Corrosion. -- Ordinary cast iron or steel weights shall be protected from corrosion by the application of a durable coating or process, which shall not take the form of a soft or brittle coat.

(c) Surface and Form. -- The weights shall be smooth, without sharp points or corners, and of such form as to give the minimum wearing and exposed surface.

(d) Adjusting Cavities. -- All cavities provided for the reception of adjusting material shall be formed in the top or sides of the counterpoise weights, and shall be of such a form that this material will be permanently and securely held in place. In no case shall this adjusting material project beyond the surface of the weight; and when in the top of the weight, in no case shall the top of the material closing the hole be more than 0.04 inch below the surface of the weight.

(e) Poises. -- The poises which operate along the beam shall have no metal softer than brass making contact with the beam.

(f) Movable Parts.-- All movable elements forming a part of a poise operated on the beam shall be constructed so as not to be readily detachable. Set screws, if used to secure the poise at any point on the beam, shall not be removable.

(g). Marking. -- All counterpoise weights shall be clearly marked with their nominal weight, i. e., 1 lb., 2 lb., etc., as the case may be, and also with the value they represent when used upon the scale for which they are intended.

(h) Sealing. -- After the weights are adjusted to their proper value, all caps or plugs closing adjusting cavities shall receive the impression of a seal, appropriate in character or design, to attest the factory adjustment, if made at the factory of the manufacturer; or, if readjusted elsewhere, the seal shall be such as to indicate where the adjustment was made.

(i) Counterbalance Weights. -- If counterbalance weights are to be used, the lower end of the hanger stem shall be threaded; a cup for the loose balancing material shall be screwed to the lower end of the stem and each additional weight shall be provided with an elongated hole in the center through which the hanger stem may pass. No slotted counterbalance weights are to be used. When no counterbalance weights are necessary on top of the counterbalance cup the cavity shall be closed by a cover, secured in a positive manner. No counterbalance weights shall be used in any place in the scale except at the beam.

(j) Tolerances. -- The maintenance tolerances to be allowed in excess or deficiency on commercial loose counterpoise weights shall not be greater than the values in the following table. The manufacturers' tolerances, or the tolerances to be allowed on new commercial weights and the tolerances which shall apply on readjusting the weights shall be not greater than one-half of the value tabulated.

Avoirdupois System

Weight	Tolerance, Ordinary Weights	Tolerance, Counterpoise Weights for Multiplying-Lever Scales		
	(Ratio 1:1)	Ratio less than 100:1	Ratio 100:1 and less 1000:1	Ratio 1000:1 and over
Pounds	Grains	Grains	Grains	Grains
50	100.0	60.0	40.0	20.0
25	60.0	36.0	24.0	12.0
20	60.0	36.0	24.0	12.0
15	40.0	24.0	16.0	8.0
10	40.0	24.0	16.0	8.0
8	30.0	18.0	12.0	6.0
5	30.0	18.0	12.0	6.0
4	20.0	12.0	8.0	4.0
3	20.0	12.0	8.0	4.0
2	15.0	9.0	6.0	3.0
1	10.0	6.0	4.0	2.0
Ounces				
10	10.0	6.0	4.0	2.0
8	5.0	3.0	2.0	1.0
5	5.0	3.0	2.0	1.0
4	5.0	3.0	2.0	1.0
2	3.0	1.8	1.2	.6
1	2.0	1.2	.8	.4
1/2	2.0	1.2	.8	.4
1/4	1.0	.6	.4	.2
1/8	.5	.3	.2	.1
1/16	.5	.3	.2	.1
1/32	.5	.3	.2	.1
1/64	.2	.12	.08	.04

17. Identification of Parts. -- A serial number shall be stamped on the front of each complete beam.

On beams of motor truck scales identification marks shall be stamped on the pivots, poises and fractional bar, to show to which beam each belongs.

18. Type Figures. -- On registering beams, type figures, shall be made of a material sufficiently hard so that they will not easily become battered or defaced. The figures shall be plain and raised sufficiently high to insure a clear impression when the weight ticket or tape is stamped. They shall be so attached and secured in their proper place that they will not become loosened.

19. Beam Fulcrum Stands. -- The relation of dimensions of the base to the height of all beam fulcrum stands shall be such as to prevent tipping action. A vertical line through the center of the pivot bearing line shall fall within the middle third of the bearing surface of the base.

For motor truck scales the beam shall be supported on a stand provided with compensating bearings and shall not be suspended.

20. Trig Loops.

(a) Materials. -- When an iron or steel beam is used, the trig loop shall be made of a non-magnetic material.

(b) Play of the Beam. -- The play of the beam in the trig loop shall not be less than that given in the following table:

Length of Beam*	Minimum Travel of Beam in Trig Loop
Under 12 inches	0.4 In.
Over 12 inches, including 20 inches	.5 In.
Over 20 inches, including 40 inches	.7 In.
Over 40 inches	.8 In.

21. Beam Support. -- A substantial and rigid beam shelf and support shall be provided. The beam fulcrum stand and the trig stand shall be securely fastened thereto. The shelf shall be strong and sufficiently rigid so that it will not deflect to an extent affecting the accuracy of the scale. For portable scales the design of the pillars shall provide ample rigidity.

(XIII) ANTI-FRICTION POINTS AND PLATES

1. Anti-friction contacts shall be used to limit longitudinal displacement between knife edges or pivots and their bearings. They shall be smooth and so designed as to provide contact at a point on the line of the knife edge of pivots; provided, that for motor truck and built-in scales they shall be of hardened steel.

---

*The "Length of Beam" refers to the distance from the fulcrum to the trig loop.

(XIV) CLEARANCES

1. The clearance around and between the fixed and live parts of the lever system of motor truck scales shall be at least three-fourths (3/4) of an inch, and for built-in and self-contained scales the clearance shall be not less than three-eighths (3/8) of an inch. The total clearance between loops and stands shall be not less than one-eighth (1/8) of an inch nor greater than one-fourth (1/4) of an inch.

(XV) FACTORY ADJUSTMENTS

1. Levers. -- The design, workmanship and factory adjustment of the levers and beam shall be such that the proper ratio of the lever arms will be maintained.

2. Beams. -- The notches in the beams shall be adjusted so that weights correct to within one-half the value of the minimum division will be obtained.

(XVI) INTERCHANGEABILITY

1. Like parts of all like motor truck and built-in scales of the same design and manufacture shall be interchangeable unless otherwise herein specified. The scale drawings and the parts of the scale shall be marked to indicate the proper positions of the parts in the scale.

(XVII) SENSIBILITY RECIPROCAL

(Abbreviation "SR")

1. Definition. -- The sensibility reciprocal shall be that weight required to be added to or removed from the scale platform to turn the beam from a horizontal position of equilibrium in the center of the trig loop to a position of equilibrium at either limit of its travel.

2. Tolerance for Sensibility Reciprocal.--The sensibility reciprocal for new scales shall not exceed the value indicated by one of the minimum divisions of the beam, at capacity or lesser load.

(XVIII) TOLERANCES

The tolerances to be allowed in excess or deficiency on motor-truck built-in, self-contained and portable scales shall not be greater than the values shown in the following table; provided, however, that the manufacturer's tolerance or the tolerances on new scales shall not be greater than one-half the values given; and provided further, that the tolerances shall in no case be less than the value of one of the minimum

graduations of the beam, except that the manufacturer's tolerances or the tolerances on new scales shall in no case be less than the value of one-half of one of the minimum graduations on the beam.

Load	Tolerance, Class A		Tolerance, Class B	
	On ratio	On beam	On ratio	On beam
Pounds	Ounces	Ounces	Ounces	Pounds
50.....	1/2	1	.....	.....
100.....	1	2	.....	.....
200.....	2	4	.....	.....
240.....	3	6	.....	.....
300.....	3	6	.....	.....
400.....	4	8	.....	.....
500.....	5	10	10	1 1/4
600.....	6	12	12	1 1/2
		Pounds	Pounds	
800.....	8	1	1	2
1,000.....	8	1	1	2
1,200.....	10	1 1/4	1 1/4	2 1/2
1,500.....	12	1 1/2	1 1/2	3
1,800.....	14	1 3/4	1 3/4	3 1/2
	Pounds			
2,000.....	1	2	2	4
2,500.....	1 1/4	2 1/2	2 1/2	5
4,000.....	2	4	4	8
6,000.....	3	6	6	12
8,000.....	4	8	8	16
10,000.....	5	10	10	20
12,000.....	6	12	12	24
16,000.....	8	16	16	32
20,000.....	10	20	20	40
24,000.....	12	24	24	48
30,000.....	15	30	30	60
40,000.....	20	40	40	80
80,000.....	40	80	80	160
100,000.....	50	100	100	200
160,000.....	80	160	160	320
200,000.....	100	200	200	400
300,000.....	150	300	300	600
400,000.....	200	400	400	800

Definition of Terms Used in the Preceding Table. -- "Class A" scales are those installed inside of a building having side walls and roof which protect the scale from weather effects and from sudden changes in temperature.

"Class B" scales are those not installed inside of a building having side walls and roof, and which are exposed to weather effects and sudden changes of temperature.

The columns with the heading "Tolerance on Ratio" refer to the error in the ratio or multiplying power of scales with which counterpoise weights are used.

The columns with the heading "Tolerance on Beam" refer to those parts of scales not requiring the use of removable weights; for example, a beam.

The column with the heading "Load" refers to the amount of weight on the platform of the scale.

(XIX) LOCATION AND ELEVATION

1. Location. -- Motor truck, built-in and self-contained scales shall be so located that an adequate foundation and a straight approach in line with the scale platform and of a length in excess of that of the longest vehicle to be weighed can be provided.

2. Elevation. -- The scale platform shall be raised to such an elevation that the drainage of surface water shall be away from it, and, unless space will not permit it, the approaches shall be level, or nearly level and paved for a length equal to that of the scale platform.

(XX) FOUNDATIONS

1. Material. -- Scale foundations resting upon or extending into the ground shall be constructed of concrete.

2. Bearing Area. -- The bearing areas of the foundation footings shall be such that the bearing pressure on the soil, under the worst condition of loading, will not exceed

For fine sand or clay.....4,000 lbs. per sq. ft.
For coarse sand and gravel or hard clay....6,000 lbs. per sq. ft.
For boulders or solid rock.....20,000 lbs. per sq. ft.

If the soil has not a safe bearing capacity equal to that of fine sand or clay, its bearing capacity shall be increased, by drainage, by adding a layer of gravel or broken stone, or by driving piles.

3. Dimensions of Pit. -- For motor truck and built-in scales the size of the pit shall be such as to give a vertical clearance between the scale levers and the finished floor of the pit of not less than two (2) feet, and a horizontal clearance between the face of the pit walls and the scale parts below the platform, or below the weigh-bridge girders, if any, and above the bases of the stands, of not less than four (4) inches for motor truck scales and 1 1/2 inches for built-in scales.

4. Walls of Pit. -- The walls of the pit shall have a thickness at the top of not less than twelve (12) inches for motor truck scales, and not less than eight (8) inches for built-in scales.

5. Waterproofing. -- When necessary, the pit shall be waterproofed.

6. Wall Batter. -- All wall surfaces next to earth, subject to freezing, shall be constructed with a uniform batter of not less than one (1) inch to the foot, and as much more as necessary to permit the heaving of adjacent ground by frost action without disturbing the walls.

7. Pit Floors and Lever Stand Piers. -- The concrete piers supporting the lever stands shall be not less than nine (9) inches deep, but shall in any case be carried to proper foundation. Their tops shall be above the floor of the pit a distance sufficient to prevent the accumulation of water under the bases of the stands, and they shall be finished to exact level and elevation to receive the lever stands. The floor of the pit may be designed as a mat footing of concrete, or as a simple floor not less than four (4) inches thick. The pit floor shall, in all cases, be smooth, with a pitch to a common point of drainage and free from pockets in which water will stand. If the scale is of a type having main levers or parts of the platform bearings that hang below the base of the main lever stands, the piers shall be provided with recesses of a size to give a clearance of not less than one and one-half (1 1/2) inches and the recesses shall be formed to prevent lodgment of dirt.

8. Anchor Bolts. -- Anchor bolts, not less than seven-eighths (7/8) inches in diameter, threaded and with nuts and washers, shall be provided in the foundations for lever stands to match the bolt holes provided for securing the stands, and they shall extend into the concrete not less than eight (8) inches.

9. Anchorage for Floating Levers. -- A floating lever that is, one exerting an upward pull at its fulcrum, shall be

anchored to the foundation to resist not less than twice the upward pull produced at the fulcrum pivot by a capacity load on the scale.

10. Beam Foundations. -- The beam shelf and pillars shall be supported in a manner similar to and as securely and rigidly as the other parts of the scale.

(XXI) SCALE BEAM HOUSE OR BOX

1. Scale Beam House or Box. -- When the scale is not located in a building the scale beam shelf shall be adequately protected from the weather by being enclosed in a house or box. When a scale is located in a builting it shall, when necessary, be similarly protected from injury.

2. Design. -- The minimum inside width of the scale house shall be four (4) feet and the minimum length shall be sufficient to allow the installation therein of the beam shelf and beam. It shall be provided with windows of such size and location as will give the weigher, when weighing, a clear and unobstructed view of the scale deck and approaches. The windows shall be glazed with clear glass or clear wire glass.

The scale beam box shall be of such size as to suitably enclose the beam shelf and beam. It shall be provided with a hinged door, or doors, of such size and in such location as to give the weigher clear and unobstructed access to the beam.

3. Clearance. -- A clearance of not less than (1) inch shall be provided between the inside of the scale house and the beam supports and shelf.

For motor truck scales the lateral clearance between the outside wall of the scale house or beam box and the edge of the platform shall be not less than two feet and six inches (2' 6").

(XXII) SETTING OF THE SCALES

1. Fastening of Stands. -- After aligning the stands, the anchor bolt holes in the castings shall be filled with cement, sulphur or other suitable material and the anchor bolt nuts brought down tight.

2. Alinement. -- All levers shall be level and connections plumb throughout the scale.

(XXIII) PLATFORMS

(A) For Motor Truck and Built-In Scales

1. Weigh Bridges.

(a) Material. -- Girders and floor beams shall be of steel conforming in quality with the American Railway Engineering Association specifications, Section II, for steel railway bridges.

(b) Sections and Strength. -- Sections of the various members of the weigh bridge shall be designed in accordance with Sections 4 and 5 of the American Railway Engineering Association specifications for steel railway bridges, except as the permissible working stresses are modified in Section IV hereof.

(c) Bracing. -- Weigh-bridges for built-in scales will usually require no bracing other than the floor beams and corner plates.

Weigh-bridges of motor truck scales with solid floor construction or with transverse floor beams, 3 ft. centers or less, will require no lateral bracing, otherwise lateral bracing shall be provided for a lateral force of 100 pounds per linear foot plus 20 per cent. of the sectional capacity, all applied laterally at the center of the span. The members of the lateral bracing shall be not less than 3" x 3" x 1/4" angles.

Motor truck scale weigh-bridge girders shall be provided with end cross frames and at least one intermediate cross frame. These frames shall be preferably solid diaphrams, rolled or built up, and as deep as the girders will permit.

(d) Fabrication and Assembly. -- The weigh-bridges for built-in scales shall be assembled and riveted or bolted up in the shop under proper inspection, so that they shall be square and free from wind when installed.

When practicable the weigh-bridges for motor truck scales shall be assembled and riveted up complete in the shop. When this method is impracticable and field assembling is necessary, the parts shall be properly assembled in the shop and match marked and have connecting holes reamed to fit.

2. Deck.

(a) Design. -- The floor shall be designed so that without exceeding the permissible stresses it will support and distribute the rated capacity load when applied in a manner to produce the maximum stress in any part of the floor.

(b) Flooring. -- The flooring shall be of such material as will resist wear and abrasion, will not present a slippery surface and which can be waterproofed. If timber is used it should be creosoted or treated with some other wood preservative.

Where the floor consists of a sub-floor and wearing surface a steel facing or retaining strip, such as an angle, shall be attached along the sides and ends of the deck.

(B) For Self-Contained and Portable Scales

3. Material and Design. -- The platform shall be entirely of metal or a metal frame, with a hardwood center panel and shall be so designed that, without exceeding the permissible stresses, it will support and distribute the rated capacity load when applied in a manner to produce the maximum stress in any part of the platform.

(XXIV) APPROACHES

1. Wherever possible the approaches shall be straight and level or nearly level, in line with the scale platform, and paved for a length at least equal to the scale platform.

(XXV) LIGHT, DRAINAGE AND VENTILATION

1. Light. -- Proper lighting of the scale weighing beam and scale platform shall be provided.

2. Drainage. -- Adequate drainage for scale pits shall be provided and maintained.

3. Ventilation. -- All scale pits shall be ventilated to meet the needs of each particular case, the object being to minimize the amount of moisture in the air in the pit and so to retard rusting of scale parts and structural steel.

(XXVI) ENTRANCE TO SCALE PIT

1. Location. -- For the built-in scales, the entrance to the scale pit for inspection purposes shall be through the platform of the scale, foundation wall, or the neck of the scale pit, and shall be closed by a suitable door; for motor truck scales, the entrance to the scale pit shall be through the foundation wall or neck of the pit.

(XXVII) PROTECTION FROM CORROSION

1. Shop Painting. -- When no shop inspection is provided, or after shop inspection when it is provided, all parts of the mechanism and structural steel of motor truck and built-in scales shall be given one coat of red lead and linseed oil and all parts of the mechanism of self-contained and portable scales shall be given two coats and the inside of the platform and the frame one coat of paint.

In riveted work, surfaces coming in contact shall be given one coat of red lead paint before being riveted together. All parts of motor truck and built-in scales which are inaccessible after erection shall be given a second shop coat of red lead paint.

2. Field Painting. -- All parts of the scale mechanism and structural steel of motor truck and built-in scales shall be cleaned and painted with one coat (and preferably two coats) of approved paint in the field before installation.