U. S. DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS

SPECIFICATIONS FOR THE MANUFACTURE AND INSTALLATION OF RAILWAY TRACK SCALES FOR LIGHT INDUSTRIAL SERVICE

(FOR KNIFE-EDGE SCALES ONLY)

CIRCULAR OF THE BUREAU OF STANDARDS No. 386

U. S. DEPARTMENT OF COMMERCE
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BUREAU OF STANDARDS
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FOREWORD

The detail work of preparing the following specifications was handled by a committee appointed and sponsored by the National Scale Men's Association. The committee hereby expresses its appreciation of the aid and cooperation extended by the American Railway Engineering Association, the Scale and Balance Manufacturers' Association, and the National Bureau of Standards, and acknowledges the value of similar work previously done by railways and organizations, from whose specifications preferred sections and items have been selected and incorporated herein.

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CONTENTS

INTRODUCTION

These specifications are intended to apply to knife-edge scales of the straight lever types for weighing cars in light industrial service. Requests for proposals for track scales conforming to these specifications should call for "Light Industrial Service Railway Track Scales," and should include such other information as will insure complete and intelligent proposals.

I. CLASS OF SCALE

There shall be only one class of scales known as Light Industrial Service Railway Track Scales. These shall be 46 feet long, have a sectional capacity of 50 tons, be of the 4-section type, and be built level.

NOTE.—The emphatic warning that the type of scale covered by these specifications is by deliberate intent limited in scope of use to the peculiar purposes of industrial weighing for which it is designed, should be closely heeded by

prospective purchasers. The scale is designed for the following essential conditions of use, namely: (*a*) Where gross weights of cars will not exceed 180,000 pounds; (*b*) where the over-all wheel base of cars will not exceed 45 feet; and (*c*) where cars will not be weighed one end at a time; and not for any other conditions.

II. SECTIONAL CAPACITY

The sectional capacity of a scale is the greatest weight which, if applied on the load knife-edges of each pair of main levers, will produce stresses in the scale parts not exceeding those given in the table of working stresses, Section IV.

III. PLANS

The manufacturer shall furnish to the purchaser plans of design showing stresses and detailed dimensions for all scale parts, and the material of which they are to be fabricated; also assembly plans showing location of all field connections, and all information necessary for the purchaser to design and construct the pit and parts not furnished by the scale manufacturer.

IV. WORKING STRESSES

1. **General.**—The following unit stresses shall not be exceeded when the scale is loaded to its sectional capacity as defined above. The strength of each member shall be determined by its weakest cross section.

2. **Iron and Steel, Working Stresses in Pounds per Square Inch.**

	Transverse bending tension	Transverse bending compression	Direct tension	Direct compression	Shear and torsion
Steel castings	8,000	10,000	8,000	10,000	5,000
Machinery steel	12,000	12,000	12,000	12,000	7,500
Structural steel	16,000	16,000	16,000	16,000	10,000
Steel for pivots and bearings:					
High carbon	24,000	24,000	24,000	24,000	----------
Special alloy	30,000	30,000	30,000	30,000	----------
Cast iron (thickness of section, inches):					
0.25	5,000	8,500	3,500	10,000	5,000
.30	4,780	8,130	3,350	9,560	4,780
.35	4,600	7,820	3,220	9,200	4,600
.40	4,450	7,560	3,110	8,900	4,450
.45	4,320	7,340	3,020	8,640	4,320
.5	4,200	7,140	2,940	8,400	4,200
.6	4,020	6,830	2,814	8,040	4,020
.7	3,870	6,580	2,710	7,740	3,870
.8	3,740	6,360	2,620	7,480	3,740
.9	3,630	6,170	2,540	7,260	3,630
1.0	3,540	6,020	2,480	7,080	3,540
1.1	3,450	5,860	2,410	6,900	3,450
1.2	3,380	5,750	2,370	6,760	3,380
1.3	3,310	5,620	2,320	6,620	3,310
1.4	3,250	5,520	2,270	6,500	3,250
1.5	3,190	5,420	2,230	6,380	3,190
1.6	3,140	5,340	2,200	6,280	3,140
1.8	3,050	5,180	2,130	6,100	3,050
2.0	2,970	5,050	2,080	5,940	2,970
2.5	2,810	4,780	1,970	5,620	2,810
3.0	2,690	4,570	1,880	5,380	2,690
3.5	2,580	4,390	1,810	5,160	2,580
4.0	2,500	4,250	1,750	5,000	2,500

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 the flange, out to out, whichever is the less.

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

3. Knife-Edge Bearing Stresses.—The load per linear inch of contact between knife-edges and their opposing bearings shall not exceed 6,000 pounds for high-carbon steel or 7,000 pounds for special alloy steel.

4. Concrete Bearing Stresses.—Bearing stresses on concrete shall not exceed 300 pounds per square inch under scale lever stands, and 400 pounds per square inch at all other points.

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 $(W/4) \times (L - d/2)$, wherein W is the maximum load applied to the loop, L is the distance between the center lines of the depending sides, and d is 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 containing them. Where pivots can not be so supported, bending moments in the pivots shall be determined as follows:

Let

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

Then

$$L = d/2 + (T - B) + 1/4''$$

and

$$M = WL/2$$
$$= (W/2) \times (d/2 + T - B + 1/4'')$$

V. LENGTH OF SCALE AND NUMBER OF SECTIONS

1. Scale Length Defined.—The length of a track scale is the length of the live rails. In no case shall this effective weighing length be greater than the distance between the centers of end sections.

2. Scale Length Standardized.—The length of scale covered by these specifications shall be 46 feet.

3. Number of Sections.—Scales covered by these specifications shall be constructed in four sections.

VI. SCALE LEVERS

1. **Qualities of Castings.**—Castings for use in scales 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.

2. **Machined Ways for Nose Irons.**—That portion of any lever that is to be fitted with a nose iron shall be machined for the full distance over which the nose iron is to move.

3. **Leveling Lugs.**—Each lever shall be provided with leveling lugs. Each pair of lugs shall be spaced 11 inches center to center. The leveling surface of each pair of lugs shall be finished to a plane parallel to the plane through the knife-edges of the end pivots.

4. **Marking of Levers.**—The multiple shall be permanently and legibly marked on each scale lever.

5. **Length, Allowable Variation.**—The lengths of main and extension levers shall conform to their nominal lengths between end knife-edges within one-eighth inch and one-fourth inch, respectively.

6. **Loading of Levers Other than Main Levers.**—In designing levers other than main levers, it shall be assumed that the end extension levers carry a total live and dead load corresponding to 100 per cent of the sectional capacity; the portion of the middle extension levers carrying the load from the end section only, 100 per cent of the sectional capacity; the portion of the middle extension levers carrying the combined load from the end section and inner section, 160 per cent of the sectional capacity; and the transverse extension lever, shelf lever, and weighbeam, 300 per cent of the sectional capacity.

VII. PIVOTS AND KNIFE-EDGES

1. **Material.**—The requirements for physical properties of the steel used for pivots shall be as follows:

(*a*) *Special alloy steel—annealed:*
Elastic limit.—Not over 75,000 pounds per square inch.
Tensile strength.—Not over 110,000 pounds per square inch.
Elongation in 2 inches.—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 pounds per square inch.
Tensile strength.—Not less than 200,000 pounds per square inch.
Elongation in 2 inches.—Not less than 5 per cent.
Reduction in area.—Not less than 25 per cent.
Rockwell hardness.—Not less than 56.
(*c*) *High carbon steel—annealed:*
Elastic limit.—Not over 55,000 pounds per square inch.
Tensile strength.—Not over 117,000 pounds per square inch.
Elongation in 2 inches.—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 pounds per square inch.
Tensile strength.—Not less than 180,000 pounds per square inch.

Elongation in 2 inches.—Not less than 3 per cent.
Reduction in area.—Not less than 12 per cent.
Rockwell hardness.—Not less than 60.

2. Design.—All pivots shall be so designed and manufactured that the included angle of the sides forming the knife-edge will not exceed 90°, and the offset of the knife-edge as referred to the center line of the pivot will not exceed 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, calking, or the use of liners or shims.

(*b*) *Continuous contact.*—All pivots shall be mounted so as to secure equal and continuous contact of the knife-edges with their opposing 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.*—In any lever the pivots shall be so mounted that: (1) Each knife-edge will be maintained in a horizontal plane under practical conditions of loading; (2) a plane bisecting the angle of a knife-edge will be perpendicular to the plane through the knife-edges of the end pivots; and (3) the knife-edges in each 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.

5. Fulcrum Distance.—The distance between the knife-edges of fulcrum and load pivots of main levers shall be not less than 6½ inches.

6. Location of Main Lever Load Knife-Edges.—The load knife-edges of the main levers shall be so located that the center lines of the weighbridge girders can be placed in the vertical planes through those knife-edges.

VIII. NOSE IRONS

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

(*a*) *Design of fastening.*—The means for clamping the nose irons in position shall be of such design that indentations in the levers will not be made, and shall be independent of any means provided for adjustment.

(*b*) *Direction of fastening.*—The means 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.

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.—Nose-iron surfaces intended to be in slidable contact with the levers shall be made true so as to secure

an accurate fit on or in the levers. Nose irons and guides shall be of such construction that, when a nose iron is moved through any portion of its allowable travel, the knife-edge will be held parallel to its normal position.

IX. LEVER FULCRUM STANDS

1. Design:

(*a*) *Pillars position on bases.*—The pillars or upright portions of the stands carrying the bearings shall be so placed on the bases that the centers of the bearing lines will be over the centers of gravity of the bearing surfaces of the stands.

(*b*) *Height of pillars.*—In stands of the 2-pillar type, the pillars shall be of equal height.

(*c*) *Anchor bolt holes.*—Two or more anchor bolt holes, not less than 2 inches in diameter, shall be provided in proper places in the base of each stand, unless other equally effective means for anchorage are provided.

2. Quality of Castings.—Castings for lever stands shall be clean, smooth, uniform, and free from blisters, blowholes, and shrinkage cracks.

3. Finish of Bases.—The base of each stand shall be machined to a plane perpendicular to the upright axis through the center of the knife-edge bearing line.

4. Finish of Pillar Tops.—The tops of pillars for receiving bearing steels, caps, or blocks, shall be finished so that the knife-edge bearing line will be parallel to the machined surface of the base of the stand within one-thirty-second inch.

X. BEARINGS AND BEARING BLOCKS

1. Material for Bearing Steels.—The requirements for physical properties of steel used for bearings shall be the same as those set forth in section VII–1 hereof for pivots. The bearing steels shall be equal to or greater in hardness than the knife-edges which oppose them.

2. Design of Bearings.—Bearings shall be so designed that displacement of the line of contact between a bearing and its opposing knife-edge will not occur under practical conditions of loading.

3. Mounting of Bearing Steels.—All like bearing steels shall be interchangeable, or mounted in interchangeable bearing steel blocks. When the steels are separable and interchangeable in the blocks, they shall be fastened in position by means of United States standard thread set screws of a noncorrosive material at least as hard as brass, or by other equally effective mechanical device.

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. Weighbridge Bearings.—The tops of weighbridge bearings intended to make contact with the weighbridge girders shall be finished so that, when in position, all the bearing surfaces will be within one thirty-second inch of the same horizontal plane and parallel

to it. These tops shall be provided with bolt holes of a sufficiently large diameter to allow for necessary transverse and longitudinal adjustment.

XI. LOOPS AND CONNECTIONS

1. Material.—The requirements for material and hardness of bearing surfaces in loops shall be the same as those herein prescribed for pivots and bearings.

2. Design Proportion.—In loops which form bearings for projecting pivots, the radius of the portion of the bearing making immediate contact with the knife-edge, and the radius of the eye of the loop shall be not less than the length of the longest side of the cross section of the square pivot to be used in the loop, and like clearance shall be provided if pivots of other than square cross section be used.

3. Length.—Loops in like connections, except when adjustable, shall be of the same length.

4. Steelyard Rod.—The steelyard rod shall be equipped with a turnbuckle.

5. Locknuts.—Bolts or turnbuckles used as a part of the connections shall be provided with locknuts.

XII. CHECKS

1. Type.—Weighbridge checks shall be provided, and shall be of the rod or other type which shall be equal to the rod type in functioning. Checks of the rod or bumper type shall be adjustable.

2. Character and Number.—When of the rod or bumper type, not less than four longitudinal and eight transverse checks shall be provided.

3. Position.—The checks shall be set as high as possible, and shall be in the same horizontal plane. Longitudinal and transverse checks shall be, respectively, parallel or perpendicular to the vertical plane through the center line of the track.

4. Strength.—Checks of the rod type shall be considered to act only in tension. The combined area of the check rods at either end or side shall be not less than 1⅔ square inches when steel check rods are used.

XIII. WEIGHBEAM AND ACCESSORIES

1. Design:

(*a*) *Capacity.*—The maximum capacity of the weighbeam shall be not greater than 180,000 pounds.

(*b*) *Type.*—The weighbeam shall be of the full-capacity registering type.

(*c*) *Shoulder stop.*—A shoulder stop shall be provided on all weighbeams to prevent the travel of the main poise back of the zero notch.

(*d*) *Notches.*—The number of notches for the main poise shall not exceed six 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.

(*e*) *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 dust or dirt in the bottom of the notch will not prevent the poise from assuming its correct position.

(*f*) *Projections and recesses.*—Poises shall be so designed as to present the least number of projections or recesses on or in which dust or dirt may accumulate.

(*g*) *Ball or cone bearings.*—Ball bearings, cone bearings, or other equally effective means shall be provided to secure as free movement of the main poise along the beam as possible, but without sideplay of the poise.

(*h*) *Fractional bar stops.*—Stops shall be provided to prevent the movement of the fractional poise or bar beyond its proper travel in either direction. The fractional poise shall be equipped with means to insure a positive stop at any 20-pound graduation.

(*i*) *Operating lever.*—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.

(*j*) *Receptacle for weight ticket.*—Means shall be provided to prevent the placing of the weight ticket in its receptacle in any position in which an incorrect weight can be registered.

2. Marking:

(*a*) *Intervals.*—The notches and graduations on the main beam shall be made at the 1,000-pound intervals.

(*b*) *Length of graduations.*—For the main beam, the zero graduation and all graduations representing multiples of 10,000 pounds shall be three-fourths inch in length. All graduations having values in thousands of pounds ending in 4 and 8 shall be one-half inch in length. All other graduations shall be one-fourth inch in length. An alternative method of marking may be used, in which the marks representing 5, 15, 25, etc., thousand pounds shall be not less than one and one-half times the intermediate lines, and every tenth line shall be longer than every fifth line, and the length of the graduations other than the fives and tens shall be not greater than twice the distance between their centers, preferably one and one-half times the distance between their centers.

(*c*) *Size of figures.*—For the main beam, the zero graduation and every tenth graduation therefrom shall have its value in thousands of pounds (that is, 0, 10, 20, etc.) marked by figures three-eighths inch in height, except the last graduation in the beam, which shall be marked in full; for example, 180,000 pounds. All other graduations in beams graduated by the first method, having values in thousands of pounds ending in an even figure, namely, 2, 4, 6, and 8, shall be marked by figures three-sixteenths inch in height. On beams graduated by the second method, the fives, fifteens, etc., may or may not have the value in thousands of pounds marked, or may have a star or other device placed opposite the line. No other graduations having values in thousands of pounds ending in an uneven figure shall be marked. All numbers shall be placed directly beneath their

respective graduations, and shall be within one-sixteenth inch to one-eighth inch of the graduation.

(*d*) *Fractional beam.*—The graduations for the fractional beam shall be placed at 20-pound intervals, up to and including 980 pounds.

3. Balance Ball.—A balance ball shall be provided. If it be a rotating ball, its center of gravity shall lie in the axis of rotation. Otherwise 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. Means for locking the ball in position shall be provided. The balance ball shall be provided with vertical adjustment.

4. 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 thereon, 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.

5. Multiplication.—A pivot with a loop shall be provided at the tip of the beam. The multiplication to the knife-edge of this pivot shall be 7,000 or 10,000, and shall be plainly and permanently stamped on the beam.

6. Identification of Parts.—Each beam shall be given a serial number, which shall be stamped on the beam. The pivots, poises, and fractional bar shall have stamped on them identification marks to show to which beam each belongs, and the pivots shall be so marked as to indicate their proper positions in the beam.

7. Type Figures.—Type figures, when used, 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 places that they will not become loosened.

8. Beam Fulcrum Stand:

(*a*) *Design.*—The beam shall be supported on a stand provided with compensating bearings, and shall not be suspended. The height of the pillars and the dimensions of the base of the stand shall be such as to prevent a tipping action.

(*b*) *Height.*—The height of the stand, measured from the bottom surface of the base to the pivot bearing surface, shall not exceed 13 inches.

(*c*) *Finish.*—The bearing surface of the base of the stand shall be finished to a plane perpendicular to the axis of the upright portion of the stand, and the knife-edge line of the bearing shall be parallel to the base. The center of the bearing line shall be vertically over the center of gravity of the bearing surface of the base.

9. Trig Loop:

(*a*) *Material.*—The contact parts of the trig loop shall be made of a nonmagnetic material.

(*b*) *Play of the beam.*—The play of the beam in the trig loop shall be not less than 2 per cent of the distance from the trip loop to the knife-edge of the fulcrum pivot.

(*c*) *Pointer.*—The beam shall be fitted with a pointer to be used in connection with a fixed graduation or other device on the trig loop to indicate a central position in the trig loop when the beam is horizontal.

10. Beam Support.—Cast-iron pillars, or equivalent, and a beam shelf shall be provided for all scales. The beam fulcrum and trig stands shall be securely erected thereon. This shelf shall be strong and sufficiently rigid so that it will not deflect to an extent that the action of the scale will be affected.

XIV. ANTIFRICTION POINTS AND PLATES

1. Required.—Antifriction points and plates shall be provided to limit the relative lengthwise displacement of all knife-edges with respect to their bearings.

2. Material.—The antifriction points and plates shall be made of hardened carbon steel, and the plates shall be at least as hard as the points which come in contact with them.

3. Design.—An antifriction point shall consist of a point or projection of small area formed on the knife-edge, in the case of full length contact knife-edges, or formed on plates securely attached to the levers or pivots. The design of the antifriction points shall be such that they will always make contact with their opposing plates on the line of the knife-edges, within practical limits. In loop bearings, the parts which come in contact with the antifriction points shall be formed without any points or projections so that, when the loop is relatively displaced in a direction at right angles to the knife-edge, the contact with the antifriction points will continue to be made on the line of the knife-edge.

4. Clearances.—The clearances between the antifriction plates and antifriction points shall not exceed one-sixteenth inch on the beam, one-eighth inch on the shelf lever, and one-fourth inch on all other levers, and the minimum clearances shall be not less than one-half these amounts, respectively.

XV. CLEARANCES

The clearance around and between the fixed and live parts of the lever system of a scale shall be at least three-fourths inch, except at points where other clearances are specified.

XVI. FACTORY ADJUSTMENTS

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

2. Beams.—Each notch in the beam shall be adjusted to within 0.002 inch of the nominal distance from the zero notch.

XVII. INTERCHANGEABILITY

Like parts of all like 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, so as to prevent parts not symmetrically designed being incorrectly placed when the scale is set up.

XVIII. SENSIBILITY RECIPROCAL

1. Definition.—The sensibility reciprocal shall be that weight required to be added to or removed from the live rails 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. Value.—The sensibility reciprocal shall not exceed 50 pounds in any case.

XIX. TOLERANCE

The manufacturers' tolerance to be allowed on the first field test, after installation corrections, of all new railway track scales shall not exceed one-twentieth of 1 per cent, or 50 pounds per 100,000 pounds, for any position of the test car load on the scale. The minimum test car load to be applied shall be 30,000 pounds.

XX. LOCATION AND ELEVATION

1. Foundation.—Scales shall be so located that an adequate foundation and at least 20 feet of tangent track at each approach to the live rails can be provided.

2. Elevation.—The scale shall be installed at such an elevation that the drainage of the surface water will be away from it. Means shall be provided to prevent surface water between the rails of the scale tracks from running into the pit.

3. Right-Handed Beam.—Scales shall be so located that a right-handed beam can be used in all cases without the use of extension levers, exclusive of shelf lever, between transverse extension lever and beam.

XXI. FOUNDATIONS

1. Material.—All scale foundations shall be constructed of concrete. The qualities of the materials and the methods of mixing and placing the concrete shall be in accordance with recognized specifications for first-class concrete.

2. Bearing Area.—The bearing areas of the foundation footings shall be such that the bearing pressure on the soil will be uniform throughout and not exceed—

	Pounds per square foot
For fine sand or clay	4,000
For coarse sand and gravel or hard clay	6,000
For bowlders or solid rock	20,000

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

3. Dimensions of Pit.—The depth of the scale pit shall be not less than 5 feet 6 inches from the base of the rail to the finished floor of the pit. The width of the pit between faces of side walls shall be

not less than 9 feet. The length of the pit inside of end walls shall be 50 feet.

4. Walls of Pit.—The side and end walls shall be not less than 15 inches thick. The walls of the neck of the pit shall be not less than 10 inches thick, and shall be formed solidly to the side wall of the scale pit.

5. Waterproofing.—In order to prevent seepage of water through foundations into the scale pit, they should be waterproofed and drained into a waterproof sump located outside the scale pit and equipped with either pump, siphon, or automatic "cellar drainer."

6. Approach Walls.—Approach walls or piers of concrete shall be built to extend at least 6 feet back under the approach track at each end of the scale pit. The footings of these walls shall be carried to such depth as may be necessary to secure proper bearing capacity to preserve the line and surface of approach tracks.

7. Footings or Piers for Lever Stands.—The concrete footings or piers supporting the lever stands shall be not less than 18 inches deep. 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 directly without the use of shims or grouting. The floor of the pit shall be not less than 4 inches thick. The pit floor shall in all cases be smooth and with a pitch to a common point of drainage, and free from pockets in which water will stand.

8. Anchor Bolts.—Anchor bolts shall be provided in foundations for lever stands to match the bolt holes provided in the bases of the stands, and they shall extend into the concrete not less than 12 inches.

9. Anchorage for Floating Levers.—Floating levers, viz, levers exerting an upward pull at their fulcrums, shall be anchored to the foundation to resist not less than twice the uplift produced by a train of capacity cars passing over the live rails.

10. Deck Beam Supports.—Inverted T rails or bearings of steel shall be set in the side walls of the pit, with the center of bearing not less than 6 inches from the inside face of the walls, but such bearings shall not be fastened to transverse beams.

11. Beam Foundations.—The pillars supporting the beam shelf shall rest upon a reinforced concrete floor, steel beams, or reinforced concrete beams, but the pillars and supporting beams, if used, shall be independent of the scale-house floor, if of timber construction. When it is necessary to install the weighbeam in any building other than a regulation scale house, the pillar supports shall rest on foundations independent of the building, unless the foundation of the building is free from vibrations and settlement.

XXII. WEIGHBEAM SHELTER

1. Design.—All weighbeams shall be provided with adequate shelter from the elements, so constructed as to afford the weigher a clear and unobstructed view of the scale deck and approaching cars when he is standing at the weighbeam. When a scale house is provided the minimum inside width thereof should be 4 feet, and the minimum length should permit the installation therein of a full size beam shelf and regulation weighbeam. It should be

provided with a bay window, or front and end windows, the sills of which should be about on a level with the top of the beam shelf. The windows should be glazed with clear glass or clear wired glass.

2. Clearances.—The lateral clearance between the weighbeam shelter and the center of any track shall be not less than 7 feet 6 inches, or greater if required by law or by the railway. A clearance of not less than 1 inch shall be provided between the inside of the beam shelter and the beam supports and shelf.

3. Ventilation.—Where a scale house is erected but not provided with artificial heat a ventilator in the roof shall be provided.

XXIII. SETTING OF THE SCALE

1. Fastening of Stands.—After aligning the stands, large washers shall be applied to the anchor bolts and the nuts brought down tight. The anchor bolt holes in the castings shall then be filled with cement grout or other suitable material.

2. Alignment.—All levers shall be level and connections plumb throughout the scale.

XXIV. SCALE WEIGHBRIDGES

1. Type of Girders.—Weighbridge girders shall be of the articulated type, and the design of joints over centers of bearings shall be such as will admit of flexure vertically without derangement of sections.

2. Size and Strength.—The section modulus of each weighbridge girder shall be not less than 130.

3. Bracing:

(*a*) *Diagonal bracing.*—Diagonal bracing shall consist of not less than 2½ by 2½ by ⅜ inch angles, and not less than three diagonals per span shall be used, or the equivalent of this bracing shall be employed.

(*b*) *Stiffeners.*—Not less than one pair of stiffener angles, other than splicing angles, shall be provided over each bearing of the girders in each span of the weighbridge.

(*c*) *Cross bracing.*—Each span of the weighbridge shall be provided at its ends with cross bracing, the section modulus of which shall be not less than 6.0.

4. Live Rail Pedestals.—The live rails shall be carried on metal pedestals, which shall be mounted directly on the weighbridge.

5. Live Rails:

(*a*) *Weight.*—The weight and section of the live rails shall be the same as that of the dead rails. (See Sec. XXVII.)

(*b*) *Length.*—New full length live and dead rails without splices are desirable. Where old rails must be used, all battered portions at ends shall be sawed off square, and where splices are necessary they shall be accurately applied.

(*c*) *Clearance along live rails.*—The clearance between the live rails or their pedestals and the rigid deck shall be not less than 1½ inches. The openings shall be protected from the weather and dirt.

XXV. APPROACH RAILS

Means shall be provided to prevent creeping of the ends of the approach rails and to maintain a clearance of not less than one-fourth inch nor more than three-fourths inch between the approach rails and the live rails on the scale. This may be accomplished by the use of switch points and bent stock rails placed in the approach track in the same alignment and plane with the live rails. Each switch point should be set with its square end next adjacent to the live rail on the scale, and should be securely anchored in place.

XXVI. DECK

1. Type.—The deck or platform shall be of the fixed type.
2. Construction.—The material for the deck shall be wooden planking, and it shall be made as impervious to water as practicable.
3. Clearances.—The clearances between the bottom of the fixed deck beams or deck supports and the I beams forming the weighbridge shall be not less than 2 inches.

XXVII. DEAD RAILS AND DEAD-RAIL BEAMS

1. Dead Rails.—Dead rails shall be provided where a locomotive will pass over the scale.
2. Weight of Rails.—The weight of the rails shall be not less than 80 pounds per yard, and they shall be supported at intervals of 2 feet 6 inches.
3. Transverse Beams Supporting Dead Rails.—The transverse beams supporting the dead rails shall be not less than 12 inches deep, and shall have a section modulus of not less than 50.

XXVIII. WEATHER AND DIRT SHIELDS

1. Weather Guards.—Substantial metal guards shall be provided to cover the openings between the live rails and the deck to exclude dirt, snow, and rain. They shall be so designed and fastened in place that they will be secure, but may be easily removed for inspection or repairs.
2. Dirt Shields.—Substantial metal shields shall be provided throughout the pit over all scale bearings and connections, applied to the deck, structural steel, or scale parts, to prevent water or dirt falling into them or the accumulation of dirt or ice at points where it would interfere with the action of the scale parts.

XXIX. LIGHT, DRAINAGE, AND VENTILATION

1. Light.—Proper lighting of the weighbeam, scale house, scale deck, and scale pit shall be provided.
2. Drainage.—The scale pit shall be kept free from water by adequate drainage.
3. Ventilation:

(*a*) *Requirement.*—All scale pits shall be ventilated to meet the needs of each particular case, the object being to have the least pos-

sible amount of moist air in the pit to prevent rusting of scale parts and structural steel.

(*b*) *Automatic natural ventilation.*—The following arrangement is recommended for securing natural ventilation. An opening should be made to the pit at each corner to connect with flues which terminate near the bottom of the pit, and another opening without flues extending downward should be made into the pit at its top and near its center. With such an arrangement, circulation will always tend to be set up by the air whenever the pit is warmer or more moist than the outside. When the pit is cooler or drier than the outside, circulation will tend automatically to stop. When this is done, circulation will be set up only when it will tend to dry the pit.

XXX. ENTRANCE TO SCALE PIT

1. Location.—Entrance to the scale pit for the purpose of inspection shall be through either the floor of the scale house or the foundation walls, and shall be closed by a suitable door so fastened as to prevent entrance of unauthorized persons.

2. Hatches in Deck.—If it is desired to have hatches or openings in the deck except such as are provided for ventilation, they shall be securely fastened from the inside of the pit.

XXXI. PROTECTION FROM CORROSION

All parts of the scale mechanism and structural steel shall be given one and preferably two shop coats of red lead paint. In riveted work, surfaces coming in contact shall be given one coat of red lead paint before being riveted together.

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