DEPARTMENT OF COMMERCE

CIRCULAR

OF THE

BUREAU OF STANDARDS

S. W. STRATTON, DIRECTOR

No. 83

SPECIFICATIONS FOR THE MANUFACTURE AND INSTALLATION OF RAILROAD TRACK SCALES

[PREPARED BY A JOINT COMMITTEE OF THE AMERICAN RAILROAD ASSOCIATION THE AMERICAN RAILWAY ENGINEERING ASSOCIATION, THE RAILROAD AND WAREHOUSE COMMISSION OF THE STATE OF MINNESOTA, THE NATIONAL SCALE MEN'S ASSOCIATION, THE SCALE MANUFACTURERS ASSOCIATION, AND THE BUREAU OF STANDARDS]

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FOREWORD

About six years ago (in 1913) the National Bureau of Standards began an investigation of railroad track scales. A number of facts influenced the Bureau to take this step. Little or no attention had been given to the engineering features of scale construction, and scales were being built largely by rule of thumb and with but little regard to the stresses which the different members would be required to withstand. For instance, it was not an unknown practice to increase the nominal capacity of a scale merely by furnishing it with a scale beam of greater capacity than that usually supplied. Moreover, the capacity and weights of the rolling stock of the railroads had been steadily increasing for a number of years without a corresponding increase in the dimensions of the scales upon which it was being weighed. No specifications had been established either by the Government or by the scale manufacturers for fixing the capacity of scales and the purchaser was required to accept whatever was given him.

Up-to-date information appeared, then, to be necessary, and in order to make this of maximum utility to all parties concerned it appeared that it should be such that it would be generally recognized as being entirely impartial and unprejudiced and based upon data covering all phases of the situation existing. Such information could best be obtained by an agency to which all sources of information would be freely opened. Believing that the Bureau of Standards could render useful service along these lines to all parties involved, the investigation of railroad track scales was accordingly inaugurated with the main ideas in view, first, of determining just what degree of accuracy was being obtained in practice, and second, of drawing up specifications when sufficient data were at hand, which would enable the railroads and other users to secure scales which would be adequate to perform the work which would be required of them in service.

The first step taken by the Bureau was to design and procure a special equipment which made it possible to transport a truck and 90 000 pounds of standard weights for long periods of time and over long distances without important changes in their value. This original equipment is familiar to nearly all scale men and no description of it need be included here.

About the same time the Interstate Commerce Commission undertook, by hearings conducted in different parts of the country, to bring out some of the facts connected with railroad weighing in general. These hearings indicated that not only was there

great room for improvement in the conditions surrounding the determination of railroad weights, but also in the scales used.

The entry of this country into the war interfered with the issuance of specifications by the Bureau of Standards in their final form. However, at a meeting of interested parties called by the regional director of the northwest region of the Railroad Administration for the primary purpose of postponing the time at which the specifications adopted by the State of Minnesota should be put into effect, it appeared that there was an excellent spirit of cooperation among the various interests represented and a general desire to get a decision on specifications for railroad track scales. It was, therefore, proposed by the regional director that advantage be taken of the meeting to organize a committee to prepare specifications acceptable to all interests, if possible. Such a committee was thereupon formed. The Bureau of Standards heartily indorsed the plan and accepted representation on the committee, along with representatives of the American Railroad Association, the American Railway Engineering Association, the Railroad and Warehouse Commission of Minnesota, the National Scale Men's Association, and the Scale Manufacturers' Association.

The accompanying specifications have been drawn up by this committee and have been unanimously approved by its members.

In arriving at their conclusions the committee took under consideration the work done and the specifications previously drawn up by the railroads, the Minnesota Railroad and Warehouse Commission, and the Bureau of Standards. In many cases sections and items have been taken bodily from them and acknowledgment is freely made of this material. All this has been coordinated to produce a standard which we believe should be acceptable to all interests throughout the United States for general use. The Bureau of Standards indorses these specifications and recommends them to all who require scales of the types herein described.

Railroad track scales for the weighing of grain do not come under the provisions of these specifications as they form a special class which will have to be considered separately. The Bureau of Standards is cooperating in the preparation of specifications for such scales with another committee representing the interests associated with the grain industry, and these specifications will be published at a later date.

The specifications given here do not and are not intended to cover methods of test or of maintaining scales. Future publications will be issued covering these matters in detail.

SPECIFICATIONS FOR THE MANUFACTURE AND INSTALLATION OF RAILROAD TRACK SCALES

(For Knife-edge Scales only, not including Overhead Suspension Scales)

INTRODUCTION

These specifications are intended to apply to knife-edge scales of the straight and torsion lever types for weighing cars in railroad service. They do not apply to overhead suspended scales, nor to scales now in service, except that reinstallations 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 reasonable uniformity in scales for similar service, but without preventing improvements in types of scales or in scale parts.

Requirements not in common with other track scale specifications are the provision for two classes of scales to meet weighing conditions as determined by the volume of traffic to be weighed; and standardization of capacities and lengths, as follows:

Heavy service scales to have sectional capacities of 75 and 100 tons; and lengths of 50, 56, and 60 feet.

Light service scales to have sectional capacities of 60 and 75 tons; and lengths of 50, 56, and 60 feet.

Heavy service scales and light service scales differ principally in the features which affect wear in use and not at all in strength for given capacities. It is intended that the heavy service scales shall be selected for usual railroad and industry installations. The use of the light service scales is intended for locations where relatively only a few cars are to be weighed.

Requests for proposals for track scales to conform to these specifications should specify the class, sectional capacity, and length of scale required, together with such other information as will insure complete and uniform proposals.

I. CLASSES OF SCALES

1. Character of Classification.—Scales shall be divided into two classes, namely, heavy service scales and light service scales; and, except when otherwise specifically provided, these specifications are to apply to both classes of scales.

(*a*) *Heavy Service Scales.*—Heavy service scales are those over which a large number of cars are to be weighed, and they shall have sectional capacities of 75 or 100 tons, except for special cases.

(*b*) *Light Service Scales.*—Light service scales are those over which relatively only a few cars are to be weighed, and they shall have sectional capacities of 60 or 75 tons, except for special cases.

2. Special Cases.—For special cases which can not be covered in these specifications, it is recommended that the material, workmanship, etc., shall be at least equal to that required in these specifications, and that the principles herein set forth be followed in so far as they apply.

II. CAPACITY

1. Capacity Defined.—The capacity of a scale is equal to the weight of the heaviest car it will weigh, provided that the scale will support a train of such cars passing over the scale without stresses being developed in the members of the scale which are in excess of those hereinafter specified. The car weight for a given sectional capacity and given length of scale is shown in table for Scale Capacities and Weigh-Bridge Girders, Section XXIV.

2. Capacity Required.—The capacity of the scale shall be sufficient to meet the requirements of the heaviest service to which it may be subjected.

3. Sectional Capacity.—The sectional capacity of the 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

1. 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 capacity as defined above. These stresses include an allowance for impact caused by moving loads. The strength of each member shall be determined by its weakest cross section.

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

Nature of stress	Cast iron	Steel castings	Machinery steel	Structural steel	Steel for pivots and bearings	
					High carbon	Special alloy
Tension	1500	8000	8000	10 000	24 000	30 000
Compression	8000	10 000	8000	10 000	24 000	30 000
Transverse bending tension	2500	8000	8000	10 000	24 000	30 000
Transverse bending compression	8000	10 000	8000	10 000	24 000	30 000
Shear	2500	6000	5000	7000	.....	.....
Torsion	2500	6000	.....	7000	.....	.....

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

3. Knife-Edge Bearing Stresses.—

(*a*) *Heavy Service Scales.*—For heavy service scales the load per linear inch of knife-edge shall not exceed 5000 pounds for high carbon steel or 6000 pounds for special alloy steel.

(*b*) *Light Service Scales.*—For light service scales the load per linear inch of knife-edge shall not exceed 6000 pounds for high carbon steel or 7000 pounds for special alloy steel.

4. Concrete Bearing Stresses.—Stresses to be allowed for bearing on concrete shall not exceed 300 pounds per square inch under scale lever stands, and at all other points shall not exceed 400 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 $\frac{W}{4}\left(L-\frac{l}{2}\right)$ wherein W equals the maximum load applied to the loop, L equals the distance between the center lines of the depending sides, and l 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 = the total load on both ends of pivot, in pounds
L = the moment arm, in inches
l = the length of bearing in loop, in inches
T = distance between friction faces of loop, in inches
B = the width of boss or sustaining member enveloping pivot, in inches
M = bending moment in pivot, in inch-pounds

Then:

$$L = \tfrac{1}{2}l \text{ plus } (T\text{-}B) \text{ plus } \tfrac{1}{4} \text{ inch}$$

and:

$$M = \frac{WL}{2} = \frac{W}{2} [\tfrac{1}{2}l \text{ plus } (T\text{-}B) \text{ plus } \tfrac{1}{4} \text{ inch}]$$

V. LENGTH OF SCALE AND NUMBER OF SECTIONS

1. Scale Length Defined.—The length of a scale shall be considered as the effective weighing 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 Lengths Standardized.—The lengths of scales, except in restricted traffic movements, or for special cases, shall be 50, 56, or 60 feet.

3. Numbers of Sections.—Scales of 60 feet or less in length shall not be constructed in more than four sections.

4. Motion Weighing.—When cars are to be weighed in motion the speed shall not exceed 4 miles per hour, and each car shall be entirely and alone on the scale a minimum of 3 seconds. This condition applies to cars normally weighed. When scales are of such a design or length as not to permit of the above condition, cars shall be spotted to secure accurate weights.

VI. SCALE LEVERS

1. 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.

2. Machined Ways for Nose Irons.—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.

3. Leveling Lugs.—In scales of the straight lever type each lever shall be provided with leveling lugs for longitudinal alinement. In scales 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 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.

4. Marking of Levers.—Figures denoting the multiple of each lever shall be cast or otherwise permanently marked in plain figures thereon.

5. Length, Allowable Variation.—All main levers shall be true to within one-eighth of an inch, and all extension levers shall be true to within one-fourth of an inch of their nominal lengths between the knife-edges of end pivots.

6. Loading of Levers Other Than Main Levers.—In establishing the load for determining the stresses in the 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; and 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; the transverse extension lever, shelf lever, and beam, 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 in the annealed state:
- 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 lless 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.
- Shore hardness.....Not less than 85.

(*c*) High carbon steel in the annealed state:
- 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.
- Shore hardness.....Not less than 85.

2. Design.—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°; that the tolerance for offset of the knife-edge of the pivot, 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*) *Machining.*—For heavy service scales all pivots of the main levers shall be machined and fitted into machined ways.

(*c*) *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.

(*d*) *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 shall be so mounted 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 shall be so mounted 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.

5. Fulcrum Distance.—The distance between the fulcrum-pivot knife-edge and the load pivot knife-edge in main levers of heavy service scales shall be not less than 8 inches. For light service scales it is recommended that this fulcrum distance 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 line of the live rails can be placed in the vertical plane established by the centers of those knife-edges.

VIII. 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 means for clamping the nose irons in position shall be of such design that indentations in the lever 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.

(*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. 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.

IX. LEVER FULCRUM STANDS

1. Design.—

(*a*) *Height of Pillars and Area of Bases.*—The height of the pillars and the dimensions of the bases of the stands shall be sufficient to prevent a tipping action. In stands of the two pillar type, both pillars shall be of equal height.

(*b*) *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 shall be over the centers of gravity of the bearing surfaces of the stands.

(*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 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 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. Pillars, Finish of Tops.—The tops of the pillars for receiving the bearing steels, caps, or blocks shall be finished to a tolerance of one thirty-second of an inch.

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

X. BEARINGS, BEARING BLOCKS, AND LINKS

1. Material for Bearing Steels.—The character of the material for bearing steels will be found under Pivots and Knife-Edges, Section VII. The bearing steels shall be equal to or greater in hardness than the knife-edges which oppose them. It is found good practice to have the bearing steels not less than 95 points hardness on the Shore recording scleroscope for high carbon steel, and not less than 90 for special alloy steel.

2. Design of Bearings.—Scales shall be so designed that when the load is applied to the live rails, the oscillation of the weigh-bridge 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-steel blocks. When the steels are separable and interchangeable in the blocks they shall be fastened in position by means of set screws of a recognized standard size and thread, and of a material which will not corrode, or by other equally effective device.

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

5. Weigh-Bridge Bearings.—The tops of weigh-bridge bearings making contact with the weigh-bridge girders shall be finished to within one thirty-second of an inch of a true plane that will bring them all to the same height when in position, and in a plane parallel to the bottom of the bases of the fulcrum stands. 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.

XI. LOOPS AND CONNECTIONS

1. Design Proportion.—In loops which form bearings for projecting pivots, the radius of the portion of the bearing making immediate contact with the knife-edges 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 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. Steelyard Rod.—The steelyard rod shall be equipped with a turnbuckle.

4. Lock-Nuts.—Bolts or turnbuckles used as a part of the connections shall be provided with lock-nuts.

XII. CHECKS

1. Type.—All weigh-bridges shall be checked by adjustable checks of the rod or other approved type which shall be equal to the rod type in functioning.

2. Character.—Both longitudinal and transverse checks shall be provided.

3. Position.—The checks shall be attached as high as possible and shall be horizontal, and parallel with or perpendicular to the vertical plane through the center line of the track according to whether they are longitudinal or transverse checks.

4. Number.—Not less than four longitudinal and eight transverse checks shall be provided. When the rod type is used, they shall be assumed to act in tension only.

5. Strength.—The combined area in square inches of the check rods at either end or side shall be not less than the sectional capacity in pounds divided by 60 000 when steel check rods are used.

XIII. WEIGH-BEAM AND ACCESSORIES

1. Design.—

(*a*) *Capacity.*—The maximum capacity of the beam shall be not greater than one and two-thirds times the sectional capacity.

(*b*) *Full Capacity Beam.*—Except for special cases a beam of the full capacity type shall be provided.

(*c*) *Shoulder Stop.*—A shoulder stop shall be provided on all beams 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 designed so as to present the least number of recesses or projections in or on which dust or dirt may accumulate.

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

140532°—20——3

(*h*) *Registering Beam.*—Scales that are to be used exclusively for spot weighing of cars or carload freight shall be equipped with a type registering, or other registering beam, of a capacity that will enable the entire load to be weighed in one draft, and without the use of additional weights of any kind, except for special weighing.

(*i*) *Fractional Bar Stops.*—On registering beams the fractional poise shall be equipped with means to insure a positive stop at any 20-pound interval, and a stop shall be provided to prevent the movement of the fractional bar beyond its proper travel in either direction.

(*j*) *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.

(*k*) *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 an incorrect weight can be registered.

2. Marking.—

(*a*) *Intervals.*—The notches and graduations on the main beam shall be made at the 1000-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 lengths 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 (i. e., 0, 10, 20, etc.) marked by figures three-eighths inch in height, except the last graduation on the beam, which shall be marked in full—for example, 200 000 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 readings 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 to one-eighth inch of the graduation.

(*d*) *Fractional Beam.*—For registering beams the graduations for the fractional beam shall be placed at 20-pound intervals up to and including 980 pounds, or if the fractional beam corresponds to a full 1000 pounds, the last figure shall be marked to read 999 pounds. Nonregistering fractional beams shall be graduated in 50-pound intervals, except for special cases.

3. Balance Ball.—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.

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 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.

5. Multiplication.—A pivot with a loop shall be provided at the tip of the beam. The multiplication to this pivot knife-edge shall be 7000 or 10 000, which 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 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 more than 2 per cent of the distance from the trig 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 the trig stand 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.—The antifriction points 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 shall be 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-edges, the contact will continue to be made with the antifriction points on the line of the knife-edge.

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

XV. CLEARANCES

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

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

XVII. INTERCHANGEABILITY

1. 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

1. The manufacturers' tolerance to be allowed on the first field test, after installation corrections, of all new railroad track scales shall not exceed one-twentieth of 1 per cent, or 50 pounds per 100 000 pounds, for any position of the test carload on the scale. The minimum test carload 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 50 feet of tangent track at each approach to the live rails, can be provided.

2. Elevation.—The scale shall be raised with respect to the other tracks of the yard to 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 the railroad's specifications for first-class concrete, or other first-class engineering practice may be followed.

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—

	Lbs. per sq. ft.
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 7 feet 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 10 feet for light service scales or less than 10 feet 6 inches for heavy service scales, provided that there shall be a hori-

zontal clearance of not less than 16 inches between the faces of the side walls and the scale parts below the weigh-bridge girders and above the base of the stands. The length of the pit inside of end walls shall be not less than 2 feet greater than the length of the scale parts.

4. Walls of Pit.—The side and end walls shall be not less than 15 inches and preferably 18 inches thick at the top. The foundation walls of the scale house shall be not less than 12 inches thick at the top and shall be formed solidly to the side walls of the scale pit.

5. Waterproofing.—Where necessary to prevent seepage of water through foundations into the scale pit, they shall be waterproofed and drained into a waterproofed cistern 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 15 feet, preferably 25 feet, from the pit face of the end wall at the approach and back under the track, to preserve line and surface of approach tracks. They may be built in one solid mass of concrete or they may consist of two parallel walls or piers, but with either type of construction they shall have a single foundation footing. Where necessary to secure safe bearing capacity they shall be carried to the same depth as the pit walls.

7. Wall Batter.—All wall surfaces next to earth subject to freezing shall be constructed with a uniform batter of not less than 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.

8. Footings or Piers for Lever Stands.—The concrete footings or piers supporting the lever stands shall be not less than 18 inches thick. 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 may be a solid mat of concrete nearly the same thickness as that required to support the lever stands, or it may be not less than 6 inches thick where local conditions permit. 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. If the scale is of a type having main levers or parts of the platform bearings

that hang below the bases of the main lever stands, the piers shall be provided with recesses of a size to give a clearance of not less than 1½ inches, and the recesses shall be formed to prevent lodgment of dirt.

9. Anchor Bolts.—Anchor bolts shall be provided in foundations for lever stands to match the bolt holes provided for securing the stands, and they shall extend into the concrete not less than 15 inches.

10. 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.

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

12. 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 scale beam 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. SCALE BEAM HOUSE

1. Design.—The minimum inside width of the scale house shall be 4 feet, and the minimum length shall be sufficient to allow the installation therein of a full-sized beam shelf and regulation beam of proper capacity for the scale, and self-recording attachment if used. It shall be provided with a bay window, or front and end windows, located with their sills about on a level with the top of the beam shelf, and of sufficient size to give the weigher a clear and unobstructed view of the scale deck and approaching cars, so that he can read the car numbers and stenciled light weights when he is weighing. The windows shall be glazed with clear glass, or clear wire glass, free from bubbles or other imperfections.

2. Clearances.—The lateral clearance between the scale house and the center of any track shall be not less than 7 feet 6 inches, or greater if required by law or by the railroad. A clearance of

not less than 1 inch shall be provided between the inside of the scale house and beam supports and shelf.

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

XXIII. SETTING OF THE SCALE

1. Fastening of Stands.—After alining 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, sulphur, or other suitable material.

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

XXIV. SCALE WEIGH-BRIDGES

1. Type of Girders.—In scales of more than two sections, weigh-bridge girders may be of either the continuous type or the non-continuous type, but noncontinuous girders of such design of joints over centers of bearings as will admit of flexure vertically without derangement of sections are recommended.

2. Steel Specifications.—Structural steel work shall conform to the specifications of the American Railway Engineering Association.

3. Size and Strength.—The following table of scale capacities and weigh-bridge girders (see p. 26) gives the required sizes for weigh-bridge girders. This table is based on a representative car having two axle trucks 22 feet from center to center, truck axles 5 feet 6 inches center to center, and 12 feet center to center of adjacent end trucks of coupled cars.

4. Bracing.—Each weigh-bridge span shall be designed for a lateral force of 200 pounds per linear foot plus 4 per cent of the sectional capacity of the scale, applied at the top of the live rail and uniformly distributed.

(*a*) *Diagonal Bracing.*—Diagonal bracing shall consist of not less than 3 by 3 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*) *Transverse Bracing.*—To carry the lateral load to the knife-edges of the main levers, each span shall be provided at its ends with a transverse bracing, of which the section modulus shall be not less than that determined by the formula:

SCALE CAPACITIES AND WEIGH-BRIDGE GIRDERS

Length of scale center to center end sections, feet	Span center to center of sections, feet	Main-lever capacity, pounds	Dead load main-lever reaction, pounds	Live load main-lever reaction, pounds	Bureau of Standards representative car			Dead load moment one girder, inch-pounds ÷1000	Required section moduli, (f= 10 000)	Alternative girder sections [a]					
					Wheel load, pounds	Carload, tons	Live load moment one girder, inch-pounds ÷1000			Bethlehem girder beams		Double I-beams		Single I-beams	
										Sizes	Section moduli	Sizes	Section moduli	Sizes	Section moduli
60-TON SECTIONAL CAPACITY															
45	15	60 000	3750	56 250	23 440	93.76	1476.7	84.4	156.1	18″x92 lbs.	176.8	.....	.....	1–24″x80 lbs.	173.9
48	16	60 000	4000	56 000	22 400	89.60	1612.8	96.0	170.9	18″x92 lbs.	176.8	.....	.....	1–24″x80 lbs.	173.9
50	*16.67*	*60 000*	*4170*	*55 830*	*21 810*	*87.24*	*1704.5*	*104.3*	*180.9*	*18″x92 lbs.*	*176.8*	.....	.....	*1–24″x90 lbs.*	*186.5*
51	17	60 000	4250	55 750	21 540	86.16	1744.7	108.4	185.3	18″x92 lbs.	176.8	.....	.....	1–24″x90 lbs.	186.5
54	18	60 000	4500	55 500	20 810	83.24	1872.9	121.5	199.4	20″x112 lbs.	234.2	.....	.....	1–24″x100 lbs.	198.3
56	*18.67*	*60 000*	*4670*	*55 330*	*20 390*	*81.56*	*1960.4*	*130.8*	*209.1*	*20″x112 lbs.*	*234.2*	*2–20″x65 lbs.*	*234.0*	*1–24″x105 lbs.*	*234.3*
57	19	60 000	4750	55 250	20 190	80.76	1998.8	135.4	213.4	20″x112 lbs.	234.2	2–20″x65 lbs.	234.0	1–24″x105 lbs.	234.3
60	*20*	*60 000*	*5000*	*55 000*	*19 640*	*78.56*	*2121.1*	*150.0*	*227.1*	*20″x112 lbs.*	*234.2*	*2–20″x65 lbs.*	*234.0*	*1–24″x105 lbs.*	*234.3*
63	21	60 000	5250	54 750	19 160	76.64	2241.7	165.4	240.7	20″x112 lbs.	234.2	2–20″x65 lbs.	234.0	1–24″x105 lbs.	234.3
66	22	60 000	5500	54 500	18 730	74.92	2360.0	181.5	254.2	24″x120 lbs.	300.6	2–24″x80 lbs.	347.8	.....	.....
69	23	60 000	5750	54 250	18 350	73.40	2523.1	198.4	272.2	24″x120 lbs.	300.6	2–24″x80 lbs.	347.8	.....	.....
72	24	60 000	6000	54 000	18 000	72.00	2687.4	216.0	290.3	24″x120 lbs.	300.6	2–24″x80 lbs.	347.8	.....	.....
75-TON SECTIONAL CAPACITY															
45	15	75 000	3750	71 250	29 690	118.76	1870.5	84.4	195.5	20″x112 lbs.	234.2	2–20″x65 lbs.	234.0	1–24″x105 lbs.	234.3
48	16	75 000	4000	71 000	28 400	113.60	2044.8	96.0	214.1	20″x112 lbs.	234.2	2–20″x65 lbs.	234.0	1–24″x105 lbs.	234.3
50	*16.67*	*75 000*	*4170*	*70 830*	*27 670*	*110.68*	*2162.4*	*104.3*	*226.7*	*20″x112 lbs.*	*234.2*	*2–20″x65 lbs.*	*234.0*	*1–24″x105 lbs.*	*234.3*
51	17	75 000	4250	70 750	27 340	109.36	2214.5	108.4	232.3	20″x112 lbs.	234.2	2–20″x65 lbs.	234.0	1–24″x105 lbs.	234.3
54	18	75 000	4500	70 500	26 440	105.76	2379.6	121.5	250.1	24″x120 lbs.	300.6	2–24″x80 lbs.	347.8	.....	.....
56	*18.67*	*75 000*	*4670*	*70 330*	*25 910*	*103.64*	*2491.1*	*130.8*	*262.2*	*24″x120 lbs.*	*300.6*	*2–24″x80 lbs.*	*347.8*	.....	.....
57	19	75 000	4750	70 250	25 670	102.68	2541.3	135.4	267.7	24″x120 lbs.	300.6	2–24″x80 lbs.	347.8	.....	.....

60	***20***	***75 000***	***5000***	***70 000***	***25 000***	***100.00***	***2700.0***	***150.0***	***285.0***	***24″x120 lbs.***	***300.6***	***2-24″x80 lbs.***	***347.8***	.....	.....
63	21	75 000	5250	69 750	24 410	97.64	2856.0	165.4	302.1	24″x120 lbs.	300.6	2-24″x80 lbs.	347.8	.....	.....
66	22	75 000	5500	69 500	23 890	95.56	3010.1	181.5	319.2	24″x140 lbs.	350.1	2-24″x80 lbs.	347.8	.....	.....
69	23	75 000	5750	69 250	23 420	93.68	3220.3	198.4	341.9	24″x140 lbs.	350.1	2-24″x80 lbs.	347.8	.....	.....
72	24	75 000	6000	69 000	23 000	92.00	3433.9	216.0	365.0	24″x140 lbs.	350.1	2-24″x80 lbs.	347.8	.....	.....
							100-TON SECTIONAL CAPACITY								
45	15	100 000	3750	96 250	40 100	160.40	2526.3	84.4	261.1	24″x120 lbs.	300.6	2-24″x80 lbs.	347.8	.....	.....
48	16	100 000	4000	96 000	38 400	153.60	2764.8	96.0	286.1	24″x120 lbs.	300.6	2-24″x80 lbs.	347.8	.....	.....
50	***16.67***	***100 000***	***4170***	***95 830***	***37 440***	***149.76***	***2925.9***	***104.3***	***303.0***	***24″x120 lbs.***	***300.6***	***2-24″x80 lbs.***	***347.8***	.....	.....
51	17	100 000	4250	95 750	36 990	147.96	2096.2	108.4	310.5	24″x120 lbs.	300.6	2-24″x80 lbs.	347.8	.....	.....
54	18	100 000	4500	95 500	35 810	143.24	3222.9	121.5	334.4	24″x140 lbs.	350.1	2-24″x80 lbs.	347.8	.....	.....
56	***18.67***	***100 000***	***4670***	***95 330***	***35 120***	***140.48***	***3376.6***	***130.8***	***350.7***	***24″x140 lbs.***	***350.1***	***2-24″x80 lbs.***	***347.8***	.....	.....
57	19	100 000	4750	95 250	34 800	139.20	3445.2	135.4	358.1	26″x150 lbs.	396.5	2-24″x100 lbs.	396.6	.....	.....
60	***20***	***100 000***	***5000***	***95 000***	***33 930***	***135.72***	***3664.4***	***150.0***	***381.4***	***26″x156 lbs.***	***396.5***	***2-24″x100 lbs.***	***396.6***	.....	.....
63	21	100 000	5250	94 750	33 160	132.64	3879.7	165.4	404.5	26″x150 lbs.	396.5	2-24″x100 lbs.	396.6	.....	.....
66	22	100 000	5500	94 500	32 480	129.92	4092.5	181.5	427.4	28″x165 lbs.	468.8	2-24″x105 lbs.	468.6	.....	.....
69	23	100 000	5750	94 250	31 880	127.52	4383.5	198.4	458.2	28″x165 lbs.	468.8	2-24″x105 lbs.	468.6	.....	.....
72	24	100 000	6000	94 000	31 330	125.32	4677.6	216.0	489.4	28″x165 lbs.	468.8	2-24″x105 lbs.	468.6	.....	.....

[a] Beams in pairs to be spaced 12 inches center to center.

$$S = \frac{1}{4} \frac{(0.04C + 200L)d}{10\,000}$$

Where

S = section modulus

C = sectional capacity in pounds

L = length of span in feet

d = distance in inches from knife-edge of main lever to top of live rail, or to top flange of girder if ties are used or when pedestals are braced to resist tipping transversely to the girder.

Intermediate transverse bracing shall also be provided of a section not less than that used in the ends of the span.

(*c*) *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 weigh-bridge. The ends of these stiffeners shall be milled to fit the fillets of the girder flanges.

5. Live Rail Pedestals.—The live rail shall be carried on metal pedestals, which shall be mounted on metal ties or directly on the weigh-bridge. It is recommended that, when practicable, the pedestals mounted directly on the girders be cast or fabricated in units of two, set lengthwise with the girder to prevent the tilting action of the stands, produced by the deflection of the rails under load, and that they be transversely braced. Where pedestals mounted directly on weigh-bridge girders are used they shall be so designed that they will transfer the specified lateral load to the weigh-bridge. Where cast pedestals make contact with the rail they shall have their tops machined to grade or parallel to the bottoms of the pedestals. The bottoms of the pedestals shall be machined or type metal shall be used to pour between the base and the surface on which it rests.

6. Fabrication and Assembly.—In order to avoid distortion, each pair of weigh-bridge girders shall be fabricated complete with sway and lateral bracing in the shop under proper inspection where practicable; where this method is impracticable and where field assembly is necessary, each pair of girders shall be placed in proper alinement and the bracing then introduced and secured by bolts or rivets.

7. 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.*—Full-length live and dead rails without splices are desirable where they can be secured, but in all cases new rails shall be used, and where splices are necessary they shall be accurately applied.

8. Clearance Along Live Rails.—The clearance between the live rails or their pedestals and rigid deck shall be not less than 1½ inches, and the openings shall be protected from the weather and dirt.

XXV. APPROACH RAILS

1. Positive means shall be provided to prevent creeping of the ends of approach rails, and to maintain a clearance which shall be not less than one-fourth inch nor more than three-fourths inch between the approach rails and the live rails unless some special means is employed to reduce impact when wheel loads pass from approach rails to live rails. The effects of rail creeping may be eliminated by the use of switch points and bent stock rails placed in the approach track in the same alinement and plane with the live rails; each switch point to be set with its squared end either next adjacent to the live rail on the scale, or with an intermediate rail between the switch point and the live rail, and securely anchored to the approach piers by means of bolts anchored therein.

XXVI. DECK

1. Type.—The deck or platform shall be of the fixed type, except to meet special cases.

2. Construction.—The material for the deck shall be either reinforced concrete, wooden planking, or metal plates covered to prevent slipping, and as impervious to water as practicable.

3. Clearances.—The clearance 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, When Required.—Scales shall be installed with dead rails or relieving apparatus, except to meet special requirements.

2. Weight of Rails.—The weight of rails when supported on floor beams spaced 2 feet 6 inches center to center shall be not less than that given in table corresponding to the axle load; for greater spacing of the floor beams the weight of the rails shall be correspondingly increased.

Axle load, pounds	Weight of rail, pounds
50 000	80
55 000	85
60 000	85
65 000	90
70 000	100

3. Transverse Beams Supporting Dead Rail.—

(*a*) *Structural Steel Work.*—Structural steel work shall conform to the specifications of the American Railway Engineering Association.

(*b*) *Strength.*—The following tables give the sizes and strengths required for the transverse floor beams for different axle loads and the stated assumptions:

Assumptions: 11 feet 0 inches center to center of bearings; dead rail offset 16 inches; floor beams 2 feet 6 inches center to center; 75 per cent of axle load carried by one beam; dead rails 4 feet 11 inches center to center.

Axle loads	Live load moments in 1000 inch-pounds	Required section moduli (f=10 000)	Alternative floor beam sections			
			Bethlehem beams		I-beams	
			Sizes	Section moduli	Sizes	Section moduli
50 000	745.7	74.6	1–15″x54 lbs.	81.3	1–15″x60 lbs.	81.2
55 000	820.3	82.0	1–15″x54 lbs.	81.3	1–15″x60 lbs.	81.2
60 000	894.9	89.5	[a] 1–15″x73 lbs.	117.8	1–15″x75 lbs.	92.2
65 000	969.5	96.9	[a] 1–15″x73 lbs.	117.8	1–15″x80 lbs. or 2–15″x42 lbs.	106.1 117.8
70 000	1044.0	104.4	[a] 1–15″x73 lbs.	117.8	1–15″x80 lbs. or 2–15″x42 lbs.	106.1 117.8
75 000	1118.6	111.9	[a] 1–15″x73 lbs.	117.8	1–15″x90 lbs. or 2–15″x42 lbs.	112.7 117.8

[a] Girder.

Assumptions: 11 feet 6 inches center to center of bearings; dead rail offset 16 inches; floor beams 2 feet 6 inches center to center; 75 per cent of axle load carried by one beam; dead rails 4 feet 11 inches center to center.

Axle loads	Live load moments in 1000 inch-pounds	Required section moduli (f=10 000)	Alternative floor beam sections			
			Bethlehem beams		I-beams	
			Sizes	Section moduli	Sizes	Section moduli
50 000	799.3	79.9	1–15″x54 lbs.	81.3	1–15″x60 lbs.	81.2
55 000	879.3	87.9	1–15″x64 lbs.	88.6	1–15″x70 lbs.	88.5
60 000	959.2	95.9	[a] 1–15″x73 lbs.	117.8	1–15″x80 lbs. or 2–15″x42 lbs.	95.8 117.8
65 000	1039.1	103.9	[a] 1–15″x73 lbs.	117.8	1–15″x80 lbs. or 2–15″x42 lbs.	106.1 117.8
70 000	1119.0	111.9	[a] 1–15″x73 lbs.	117.8	1–15″x90 lbs. or 2–15″x42 lbs.	112.7 117.8
75 000	1199.0	119.9	[a] 1–15″x104 lbs.	162.7	1–15″x100 lbs or 2–15″x42 lbs.	120.1 117.8

[a] Girder.

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 scale parts.

XXIX. LIGHT, DRAINAGE, VENTILATION, AND CLEANING

1. Light.—Proper lighting of the scale weighing beam, scale house, scale deck, and scale pit shall be provided.

2. Drainage.—The scale pit should 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 possible 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, and 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 scale pit for the purpose of inspection shall be through either the floor of the scale house or foundation wall, 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

1. Shop Painting.—When no shop inspection is provided the steel castings and structural steel shall be given one shop coat of boiled linseed oil only. Other parts shall be painted one shop coat of red lead paint. When shop inspection is provided, all parts of the scale mechanism and structural steel shall be given one coat of red lead paint after inspection. In riveted work, surfaces coming in contact shall be given one coat of red lead paint before being riveted together. All parts inaccessible after erection shall be given a second shop coat of red lead paint.

2. Field Painting.—Scales and structural steel work shall be cleaned and painted with one coat (and preferably two coats) of paint in the field before installation.

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