VOLUME 4

SYSTEMS MANAGEMENT

AREMA

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2024

2021 EDITION

AREMA Scale Handbook

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WIM related requirements are highlighted in blue.
Static scale related requirements are highlighted in yellow.
Shared requirements are highlighted in green.

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AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION

AREMA SCALE HANDBOOK
2024 Edition

The rules and specifications for construction and maintenance of track scales for the weighing of railroad vehicles. Includes railroad-related hopper scales, belt conveyor scales, mass flow meters, and non-railway vehicle scales.

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AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION

SCALE

HANDBOOK

Current as of January 1, 2020

FOREWORD

The rules and specifications contained herein apply primarily to weighing systems designed and installed to support railroad locomotives and cars and to weigh the latter. Accordingly, they also specify equipment, procedures, and tolerances for testing track scales intended for static or motion weighing of cars. The rules and specifications meet or exceed the minimum requirements of Handbook 44 as adopted by the National Conference on Weights and Measures (NCWM) under the direction of the National Institute of Standards and Technology (NIST). Handbook 44 is adopted, as law, by most states.

As hereby issued, the material included in this handbook is under the jurisdiction of Committee 34 of the American Railway Engineering and Maintenance of Way Association (AREMA). Recommendations for updates, changes, and modifications are provided by this committee. Committee 34 follows an affirmation program designed to maintain a current *AREMA Scale Handbook.* The affirmation program is a continuous, systematic process whereby the entire handbook is reviewed in segments by members of the committee who have specific expertise in the appropriate subject.

The current edition supersedes all previous editions of the *AREMA Scale Handbook.* Part or Section headings indicate the "Amended year" or "Added year" when more than 50% of the part or section is changed. Article headings indicate the "Amended year" or "Added year" when any change is made to the Article. Undated parts, sections, or articles originated prior to 2003.

The Chief Engineering Officer of the serving railroad or the Chief Engineering Officer's designated representative may amend these specifications or any part of them in order to accomplish the stated objectives. Any amendment that does not comply with Handbook 44 or state law should have a consensus agreement in writing by all concerned parties prior to proceeding.

f. Distance between the scale and point of restricted train and car movement.

g. Identity of car weighed.

h. Use of the weight--Sale of commodity, assessment of freight charges, overload detection, automatic adjustment of retarders, etc.

1.1.4 GRADIENT FOR STATIC WEIGHING

When installing a static scale, the gradient of the track, for at least one car length in each direction from the scale shall be the same as that of the weigh rails.

SECTION 1.2 MAINTENANCE AND OPERATION

1.2.1 NUMBERING SCALES

All track scales should be referred to by owner, number, and location.

1.2.2 MAJOR MECHANICAL SCALE REPAIRS

Major scale repairs, which involve renewal or sharpening of pivots, should be made in a scale repair shop which has facilities for controlling pivot gauge, range and alignment.

1.2.3 CLEANING

To assure proper operation, the weighbridge, scale parts, substructure and foundation should be cleaned as necessary to assure proper operation.

1.2.4 RUST PREVENTION FOR PIVOT AND BEARING STEELS

The best rust preventive obtainable should be applied to pivots and bearing steel, however, it should be so applied as not to interfere with the proper function of the scale.

1.2.5 CORROSION PREVENTION

The scale mechanism and structural steel should be treated often enough to prevent corrosion.

1.2.6 REMOVAL OF ICE (AMENDED 2013)

Ice obstructing the action of the scale should be removed by heat and not by application of salt or any other corrosive chemical. In the application of heat to remove ice, care must be exercised not to damage electrical wiring, load cells, electronic equipment, and that there is adequate drainage.

1.2.7 WEIGH AND APPROACH RAILS

The weigh rails should be smooth, straight, and without joints throughout their entire length. Surface and alignment must be preserved between the ends of the approach and weigh rails. The gap between the approach and weigh rails shall be maintained to not less than 1/8 in. (4 mm) and shall not exceed 5/8 in. (16 mm). The gap

where:

S = the section modulus (in^3) of the crossmember

d = The height (in) from the top of the load cell to the top of the weighrail, or to the top flange of the beam when the scale is provided with weighrail pedestals that are braced to resist transverse tipping.

RSC = rated sectional capacity

L = weighrail length (ft) of the weighbridge module

Fb = 10,000 lb/in^2

(4) The minimum crossmember depth shall be not less than 20% of the weighbridge beam depth.

(5) The minimum crossmember cross-sectional area shall be not less than 4 in^2.

b. Diagonal bracing shall consist of not less than 3 in. x 3 in. x ½ in. (76 mm x 76 mm x 12.7 mm) angles or equivalent. Not less than three diagonals per module shall be used unless otherwise specified.

c. Transverse bracing, when required, shall be located between the longitudinal beams at each section and shall consist of not less than 3 in. x 3 in. x ½ in. (76 mm x 76 mm x 12.7 mm) angles or equivalent in either an "X" or "A" configuration. Transverse bracing shall be used if the ratio of the longitudinal beam height to the crossmember height exceeds 2:1.

2.7.5 WEIGHRAIL PEDESTALS

Steel weighrail pedestals, when used, shall be mounted to the longitudinal weighbridge beams, and the pedestals shall be spaced no greater than 30 in. (760 mm), center to center. The top and bottom surface of the pedestals shall be parallel. Pedestals shall be designed so that they will transfer the transverse loads specified in Section 2.7.1.c. to the weighbridge. Each pair of pedestals shall be connected with transverse ties rods to prevent spreading of the weighrails.

2.7.6 WEIGHRAILS

a. The size of the weighrails shall be not less than 115#RE. The rails shall have full section and be in good condition. Each weighrail shall be one continuous piece for the full length of the weighbridge.

b. The weighrails shall be properly anchored to prevent creeping in order to maintain the gap between the weighrails and approach rails.

c. On scales equipped with fixed deck structures, the clearance between the weighrails or weighrail pedestals and the deck structure shall be not less than 1½ in. (38 mm) unless other adequate clearance provisions are made. Openings shall be protected from weather and foreign material.

SECTION 2.8 PROTECTION FROM CORROSION

2.8.1 SURFACE TREATMENT

The finish and treatment of all surfaces shall be durable and appropriate for the intended use.

SECTION 2.9 APPROACH RAILS

2.9.1 ANTI-CREEP PROVISIONS (AMENDED 2013)

The approach rails shall be in the same plane and alignment as the weighrails. Weigh rail and approach rail shall be properly anchored to prevent creepage. Expansion rails should be used whenever temperature extremes or mechanical displacement due to repeated loadings, as at humps, are anticipated. The gap should be not less than 1/8 in. (4 mm) or greater than 5/8 in. (16 mm) unless special means are utilized to reduce impact from wheel loads passing from the approach rails to the weighrails.

2.9.2 APPROACH WEIGHRAILS-JOINTS

Mitered joints, easer rails or suitable transition joints should be provided.

2.9.3 ALIGNMENT (AMENDED 2018)

Good alignment must be provided over the scale, approaches, and ballasted track adjacent to the approaches with respect to all rail elevation and horizontal alignment. Where there is a large variance in the track stiffness modulus between the approach track and the adjacent ballasted track, remediation should be installed for a minimum of the first 15 ft off the ends of the approach track. Example remediation techniques are using larger ties; having tighter tie spacing; and installing a sub-ballast section.

Note: See Chapter 30 Section 1.8 Influence of Cross Ties on Track Stiffness and Track Transitions in the AREMA Manual for Railway Engineering for more details.

2.9.4 WEIGHT OF RAILS

Approach and scale rails shall be of the same weight. Rail shall be continuous with no rail joints on the scale or approaches.

SECTION 2.10 DEAD RAILS AND DEAD RAIL BEAMS

2.10.1 DEAD RAILS-WHEN REQUIRED (AMENDED 2013)

Scales located where loads in excess of their sectional capacity are expected should be equipped with dead rails.

2.10.2 ELEVATION

Dead rails should be constructed and maintained to the same elevation as the weighrails.

2.10.3 WEIGHT OF RAILS

Rails shall be a minimum of 115 lb/yd.

2.10.4 TRANSVERSE BEAMS SUPPORTING DEAD RAILS

Structural steel and workmanship shall conform to A.R.E.M.A, Chapter 15, Steel Structures.

SECTION 2.11 DECK

2.11.1 TYPE

The scale deck should be constructed of suitable material and may be either a floating or fixed type.

2.11.2 CONSTRUCTION

The material for the deck shall be surfaced to conform to safety requirements and shall be sufficiently strong to support incidental traffic.

2.11.3 CLEARANCE

The clearance between the bottom of any fixed beams, or deck supports, and the girder forming the weighbridge shall not be less than 2 in. (5 cm).

SECTION 2.12 FOREIGN MATERIAL AND PRECIPITATION

2.12.1 EXCLUSION

Means shall be provided to prevent accumulation of foreign material, condensation, and precipitation which could interfere with the action of the scale or cause undue deterioration of any part of the scale structure.

SECTION 2.13 LIGHTING

2.13.1 SCALE HOUSE AND SURROUNDING AREA

Lighting of the scale house and deck shall be adequate for the needs for safe operation and enable the weigher to observe the weighing instrument, car numbers and position of car wheels with certainty. Maintenance outlets shall be provided.

2.13.2 PIT

The pit shall be provided with sufficient illumination to permit inspection of the scale.

SECTION 2.14 LOCATION AND ELEVATION

2.14.1 LOCATION

Scale shall be so located that an adequate foundation and at least 75 ft (23 m) of tangent track at each approach to the weighrails can be provided.

2.14.2 ELEVATION

In areas with poor drainage, the scale shall be raised to such an elevation that drainage of the surface water will be away from it. Means shall be provided to prevent accumulation of water at the scale site. Solutions for saturated areas with poor drainage shall be determined by a competent soils engineer.

SECTION 2.15 FOUNDATION AND PIT

NOTE: TIlis section presumes that a scale pit fully enclosing the scale mechanism is necessaly. When conditions pennit, however, consideration should be given to the possibility of installing scales on foundations without side walls.

2.15.1 MATERIAL

Scale foundations shall be constructed of reinforced concrete. The quality of materials and methods of mixing and placing the concrete shall conform to the AREMA, Chapter 8, Concrete Structures and Foundations.

2.15.2 DIMENSIONS OF PIT

The pit shall be dimensioned to suit the type of scale installed.

2.15.3 WALLS OF PIT

Side and end walls shall be no less than 15 in. (40 cm) [preferably 18 in. (45 cm)] thick at the top.

2.15.4 DRAINAGE

The pit floor shall be pitched to a common point for drainage and shall be smooth and free from pockets in which water may stand. If the pit floor is below subsurface water level, the pit shall be drained from its lowest point into a sump adequately equipped with automatic means for removal of water as it collects.

2.15.5 APPROACH APRONS (AMENDED 2011)

a. Approach aprons shall be provided at each end of the scale and at any dead spaces between weigh modules to preserve the line and surface of the rails. The scale and its approaches shall be on tangent track, and the top of rail shall be on the same grade. The approach structure shall be either supported by or integral with the scale foundation. Approach apron designs shall be one of the following:

   (1) A continuous, reinforced concrete slab.

   (2) Parallel reinforced concrete piers beneath each rail and supported on a common, continuous, reinforced concrete footing.

   (3) Parallel steel beams, complying with the applicable parts of Section 2.14, beneath each rail and supported on either a common continuous reinforced concrete footing or pili$_{ng}$.

b. The design criteria for the approach apron concrete and soil bearing capacity shall be the same as required for the scale foundation.

c. The minimum approach apron lengths as measured from the ends of the weighrails shall be as follows:

(1)	Single draft static and single draft uncoupled-in-motion:	25'-0" (7.7 m)
(2)	Multi-draft static, multi-draft uncoupled-in-motion, and single draft coupled-in-motion:	50'-0" (15.3 m)
(3)	Multi-draft coupled-in-motion:	75'-0" (22.9 m)

2.15.6 WALL BATTER

Wall surfaces, next to earth, subject to freezing shall be constructed with a batter of no less than 1 to 12.

2.15.7 CONCRETE BEARING SURFACE

Bearing stresses on concrete shall not exceed 300 psi (2 Mpa) under load-cell bearing plates and lever stands and 400 psi (3 Mpa) at all other points.

2.15.8 LOADS

a. *Live Loads*. E 80 recommended live load, per AREMA Bridge Specifications [4 axles of 80,000 lb (360 kN) each with 60 in. (1.5 m) between axles]. The Chief Engineer shall specify the live load to be used.

b. Dead load shall be as required by design with a minimum of 500 lb/linear ft (750 kg/linear m) of platform. On short [under 6 ft (2 m)] weighbridge concrete decks and, where possible, preloading should be applied.

c. Section design loads on load cells shall be equal to or exceed the maximum weighbridge end reaction or pier reaction when the section supports two weighbridges.

2.15.9 FOOTING OR PIERS FOR LOAD CELLS

Concrete footings or piers supporting load-cell base plates shall not be less than 18 in. (45 cm) thick. Their tops shall be above the floor a sufficient distance to prevent the accumulation of water around or under the base plates.

2.15.10 PIT FLOOR (AMENDED 2013)

The portion of the pit floor not used to support or retain any portion of the weighbridge structure shall be a concrete mat no less than 6 in. (15 cm) thick.

2.15.11 ANCHOR BOLTS (AMENDED 2006)

a. Load cell masonry plates shall be secured with a minimum of four anchor bolts.

b. All cast-in-place anchor bolts shall be a minimum of 1 in. (25 mm) diameter and shall be embedded a minimum of 10 in. (25 cm). They shall have hooks, plates, or other suitable projections embedded a minimum of 8 in. (20 cm) below the finished concrete surface.

c. Anchor bolts used for fastening rail clips to a concrete foundation shall be a minimum of 1 in. (25 mm) diameter, spaced not greater than 2 ft (61cm) and embedded a minimum of 8 in. (20 cm) below the finished concrete bearing surface.

there are more stringent requirements for ballast supported scales used for revenue service as specifically detailed in this manual part.

SECTION 3.2 DRAINAGE

The objective of this section is to prevent the accumulation of water or other foreign material in the track bed and subgrade of the scale and approaches which could degrade or compromise the vertical relationship of the scale elements, lead to uneven settlement under traffic, or degrade function and performance.

3.2.1 GROUND WATER

a. If ground water is encountered at the proposed scale site and/or it has been determined that the sub-grade is likely to become saturated, alternate scale locations should be investigated.

b. If alternate locations are not available, the manufacturer's drainage remediation specifications shall be followed. For scales used for revenue service, the drainage remediation shall be completed under the supervision of a competent Geotechnical Engineer or the Chief Engineering Officer of the serving railroad and their respective recommendations shall be adhered to.

3.2.2 DRAINAGE CRITERIA

a. When developing an adequate drainage plan, the heaviest of rains known for the site shall not saturate the sub-grade or the track bed to the point of degradation of track stability.

b. The sub-grade and sub-ballast layer shall be crowned at a 40:1 ratio and adequately drain water away from the track bed.

SECTION 3.3 TIE SPACING

The maximum tie spacing shall be 24 inches center-to-center for the weighing segments of rail and approaches thereof.

Exception: For Instrumented Rail Scales that require more than 24" tie spacing for the weight sensing element, see Section 3.7.2.

SECTION 3.4 APPROACHES

3.4.1 APPROACH TRACK BED

a. The requirements for the approach track bed shall be the same as required for the track bed of the scale weighing segments.