Association of American Railroads

SAFETY AND OPERATIONS

AAR SCALE HANDBOOK
2013 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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HANDBOOK

Current as of January 1, 2013

FORWARD

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 the Technical Services Working Committee of the AAR. Recommendations for updates, changes, and modifications are provided by Committee 34 of the American Railway Engineering and Maintenance of Way Association (AREMA). Committee 34 follows an affirmation program designed to maintain a current AAR *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 *AAR 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.

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Part 1

Specifications for the Location, Maintenance, Operation, and Testing of Railway Track Scales

— 2013 —

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SECTION 1.1 LOCATIONS

1.1.1 GENERAL CONDITIONS

The proper location of track scales depends principally on the following conditions:

a. The volume of traffic to be weighed in comparison with that switched over the scale and not to be weighed. Location of a scale in a much-used track may increase the costs of maintenance, inspection, or testing.

b. Whether cars will be switched to a separate track for weighing. Where static weighing is done or where track time for testing and maintenance is limited, a runaround track may be desirable.

c. Whether cars are to be weighed in motion. The scale location must be carefully selected to consider train operating and weighing requirements, maintenance, and testing.

d. The cost of switching.

e. The cost of maintenance.

f. The necessity for quick dispatch of cars that are weighed, if overload, etc.

g. The cost of “down time” for maintenance and testing of the track scale.

1.1.2 ALIGNMENT OF DEAD AND WEIGH RAILS (AMENDED 2006)

Dead rails should be provided for all scales when the designed capacity of the weighing system does not correspond with the greatest combined load likely to cross over the weigh rails or the volume of traffic not being weighed is greater. The rails shall be installed as outlined below:

a. Static Scales

The weigh rails shall be installed as the offset track; the dead rails shall be installed in line with the main track.

b. Motion Scales

The weigh rails shall be installed in line with the main line track; the dead rails shall be installed as the offset track.

1.1.3 FACTORS FOR MOTION WEIGHING

The following must be considered:

a. Vertical curvature approaching the scale.

b. Length of the scale.

c. Gradient before, across and after the scale.

d. Vertical curvature beyond the scale.

e. Scale response time.

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 should be protected against change by the use of expansion joints or other suitable means, in the approach track.

1.2.8 WEIGHBEAM

The weighbeam shall be balanced before the scale is used. When not in use, it shall be secured by the beam lock. The poise shall be set at the maximum graduation.

1.2.9 STANDING OF EQUIPMENT PROHIBITED

Equipment shall not be allowed to stand on the scale except when being weighed. Oil, sand, and debris from locomotives and other equipment are detrimental to the operation of the scale and should be removed.

1.2.10 RESTRICTIONS TO USE OF WEIGH RAILS ON SCALES EQUIPPED WITH DEAD RAILS

Engines or similar heavy equipment must not be passed over the weighrails, except on authority of the department having supervision over the installation and maintenance of scales. The unnecessary movement of cars over the weigh rails should be prohibited, and cars which have passed beyond the dead rail switch must not be returned over the weigh rails. The dead rail switches should be set for the dead rail track except when cars are being weighed. When coupling cars which have been stopped on the scale, impact must not exceed 2 mph (3 km/h).

1.2.11 CARS ON WEIGH RAILS

Cars on the weigh rails must not be moved by cars or engines on the dead rails or vice versa. Cars must not be moved over the scale with one truck on the weigh rails and the other truck on the dead rails.

1.2.12 USE OF SAND

The slipping of locomotive wheels on the weigh or dead rails is injurious to the structure. Only a sufficient amount of sand to provide the necessary traction shall be applied.

1.2.13 STOPPING CARS ON SCALES (AMENDED 2012)

Cars or locomotives should not be suddenly stopped on the scale by impact, chocking, or violent brake application. Locomotives should not be parked on the scale.

1.2.14 INSPECTION BY WEIGHERS

The weighers should be familiar with the construction of the scale and make inspections at such intervals as are necessary to determine that the scale is in proper working condition. The weigher, and anyone appointed to inspect and clean the scale, should be properly instructed; and it is desirable that they be present with the scale inspector when the scale is tested.

1.2.15 SECURITY OF THE SCALE HOUSE

Scale houses and beam boxes should be kept locked when not in use.

SECTION 1.3 TESTING

1.3.1 TEST FREQUENCY

Track scales in regular car weighing service shall be tested at least once per year. The frequency with which tests are conducted depends upon the amount of weighing performed, the character and amount of maintenance given the scale, and the presence of errors, or lack of them, as shown in results of successive tests.

SECTION 1.4 EQUIPMENT FOR TESTING

1.4.1 STANDARDS OF MASS

The standards of mass (test cars) shall be designed and manufactured in accordance with AAR specifications for test cars, and the calibration maintained to NIST Class F tolerances, 1 part in 10,000.

SECTION 1.5 SPECIFICATIONS FOR RAILWAY TRACK SCALE TEST WEIGHT LOADS (AMENDED 2008)

1.5.1 GENERAL GUIDELINES

A test weight load is a traceable standard used to determine the accuracy of railway scales. All equipment used for testing railway scales shall be designed, maintained, and operated in a safe manner.

1.5.2 CLASSIFICATION

Certified Mass Standards, traceable to NIST, are classified into two categories according to their design.

a. Used to calibrate and certify railway scale

   (1) Composite railcar

   (2) Test weight railcar

   (3) Test weight railcart

b. Used to verify scale accuracy

   (1) Certified standard railcar

1.5.3 PRIMARY REQUIREMENTS

The nominal weight of any certified mass standard used for static testing of a railway track scale, as defined in Section 1.8.6, shall be no less than 80,000 lb (36,300 kg). The nominal weight of any certified mass standard used for an interim test, as described in Section 1.8.8, shall be no less than 30,000 lb (13,600 kg).

1.5.4 COMPOSITE RAILCAR

Test weight load designed as a certified mass standard supported by two axles with the following design characteristics:

a. All metal construction.

b. Wheelbase not to exceed 7 ft (2.2 m) and have uniform load distribution.

c. No unnecessary equipment.

d. A minimum of ledges, cavities, or projections that hold dirt, water, or other foreign matter.

e. The calibration cavity must be waterproof and sealable.

f. Minimum surface area with smooth and sloped top to ensure drainage.

g. Accessibility of all parts for inspection.

h. Ruggedness and durability in order to minimize repairs.

1.5.5 TEST WEIGHT RAILCAR

Test weight load designed as a certified mass standard supported by two 2-axle trucks, built for AAR interchange service, with the following design characteristics:

a. All metal construction except ballast. Ballast material must be stable.

b. Loading points must not exceed 7 ft (2.2 m) and have uniform load distribution.

c. No unnecessary equipment.

d. A minimum of ledges, cavities, or projections that hold dirt, water, or other foreign matter.

e. The calibration cavities, capable of holding at least 1,000 lb (500 kg), must be waterproof and sealable.

f. Operational controls functional from both sides of the railcar.

g. Drive system, when used, shall be adequate to propel the railcar on a 3% grade.

h. Smooth and sloped top to ensure drainage.

i. Accessibility of all parts for inspection.

j. Ruggedness and durability in order to minimize repairs.

k. Overall truck centers shall not exceed 50 ft (15 m).

l. Side-mounted hand brake accessible from the ground.

m. Fuel tank, when used, must be attached and not exceed 16 lb (7 kg) capacity or 2 gal (8 L).

n. Lifting system must be adequate to lift all wheels a minimum of 2 in. (5 cm) above the rail.

o. Hydraulic oil tank, when used, must be equipped with a sight gauge or other means to indicate the proper amount of oil to maintain calibration.

1.5.6 TEST WEIGHT RAILCART

Test weight load designed as a certified mass standard supported by two axles on steel wheels, with the following design characteristics:

a. All metal construction.

b. Wheelbase not to exceed 7 ft (2.2 m) with uniform load distribution.

c. No unnecessary equipment.

d. A minimum of ledges, cavities, or projections that hold dirt, water, or other foreign matter.

e. The calibration cavities must be waterproof and sealable.

f. Minimum surface area with smooth and sloped top to ensure drainage.

g. Accessibility of all parts for inspection.

h. Ruggedness and durability in order to minimize repairs.

i. Fuel tank, when used, must be attached and not exceed 16 lb (7 kg) capacity or 2 gal (8 L).

j. Hydraulic oil tank, when used, must be equipped with a sight gauge or other means to indicate the proper amount of oil to maintain calibration.

k. The weight cart, as well as the separable weights, must be traceable.

1.5.7 STANDARD RAILCAR

Standard railcar converted to a certified mass standard supported by two 2-axle trucks, built for AAR interchange service, with the following design characteristics:

a. All metal construction except ballast. Ballast material must be stable.

b. Load uniformly distributed over trucks.

c. No unnecessary equipment.

d. A minimum of ledges, cavities, or projections that hold dirt, water, or other foreign matter.

e. The calibration cavity, if provided, must be waterproof and sealable.

f. Smooth and sloped top to ensure drainage.

g. Accessibility of all parts for inspection.

h. Ruggedness and durability in order to minimize repairs.

SECTION 1.6 MAINTENANCE AND TRANSPORTATION OF TRACK SCALE TEST WEIGHT CARS (AMENDED 2010)

1.6.1 TWO MAIN CATEGORIES

The circumstances of use require that Test Weight Cars be classified into two main categories, namely “Test Weight Cars” and “Terminal Test Weight Cars.”

a. Test weight cars, by the circumstances of use, may be handled normally in road-haul movements over a considerable territory, and interchange rules may become applicable.

b. Test weight cars whose field of use is normally within the switching limits of a given locality are referred to as terminal test weight cars.

1.6.2 WEIGHT CONTROL

a. General—All test weight cars are required to be maintained accurately to their designed or nominal weight values. For this purpose, each car weight shall be corrected as close to zero error as practical and certified within Class F tolerances as often as may be required. Such certification shall be conducted on a Master Scale that has been tested and calibrated with standards, traceable to NIST, of equal nominal mass to that of the nominal mass of the test weight car or by comparison with known traceable standards on a mechanical railroad track scale with adequate sensitivity. A test weight car shall be considered unsatisfactory as a certified mass standard when its actual weight differs in excess or deficiency from the nominal weight by more than 16 lb (7 kg).

   NOTE: The foregoing paragraph is intended for literal application within the United States. Within Canada and Mexico, it should govern as to permissible limits of variation unless modified by existing law or government regulation.

b. Responsibility for Weight Control—The scale inspector in charge of each car shall be responsible for its weight control in the interval between successive certifications. It shall be his duty to supervise all repairs and recommend advisable modifications, in addition to and in anticipation of AAR Interchange Rules. The scale inspector shall weigh all parts used in modifications and changes to cars made en-route between certifications or have the car recalibrated following modifications and changes. He shall either attend to lubrication or supervise it. Since lubrication is an important factor in weight control, varying in degree with different cars, he shall, with due regard for the requirement of each car, take necessary measures to maintain an adequate supply of lubricant to keep the weight of the car within the prescribed limits of variation. All other variables (e.g., hydraulic fluid, engine oil, etc.) shall be maintained and checked before each scale test and calibration.

c. Frequency of Certification

   (1) Test weight cars shall be certified at least annually.

   (2) The frequency of certification for terminal test weight cars, in special cases, may be extended with the required approvals.

d. Certification Following Repairs—All test weight cars shall be certified following major repairs for damage or wear and following repairs or alterations of any kind that involve weight changes that cannot be confidently controlled by weighing removed and applied material.

e. Classification of Repairs—Repairs to test weight cars shall be classified as either major or minor repairs:

   (1) Major repairs require recertification. They include either repair or replacement of wheels, axles, roller-bearing assemblies, journal boxes, draft gear, and couplers; replacement of lost or destroyed parts whose weight is unknown or whose replacement is likely to cause a weight variation greater than that allowable; repairs of a general nature subsequent to damage by derailment, collision, or the like; and painting.

   (2) Minor repairs may include lubrication and replacement of bolts, nuts, grab irons, air hose, air hose fitting, knuckles, brake rigging, journal brasses, springs, or other parts of known weight.

   (3) Record of Repairs—A historical record describing the nature of all repairs shall be maintained.

f. Semi-elliptical Springs—If a test weight car is equipped with semi-elliptical springs, each spring, when installed, shall have its weight stamped or otherwise permanently marked on the band. If spare springs are carried, each shall be marked with its weight.

g. Air Equipment—Test weight cars equipped with air-operated brakes should have the equipment inspected, cleaned, repaired if necessary, lubricated,and stenciled at the time of certification. In any event, such work shall be done at such periods that expiration of the interval, allowed as a maximum by AAR Interchange Rules for operation without re-inspection, will not occur while a car is on a testing trip.

h. Removing Foreign Material—Test weight cars carrying accumulations of snow, ice, or sleet must not be used for testing. Frozen matter may be removed by either placing the car in a heated building or by using steam. Removal by the use of salt or chemicals is not acceptable. Oil and dirt on the car wheels shall be removed by suitable means. Accumulated moisture in closed compartments shall be removed whenever circumstances require.

i. Painting—Test weight cars shall be kept well painted.

j. Surplus Lading—Articles such as car movers, tools, personal effects, etc., shall not be included in the nominal weight of a test weight car, and such items shall be removed while the test weight car is being used for scale-testing purposes.

k. Inspection Preceding Test—Test weight cars shall be examined by the scale inspector immediately before each test to determine if there are any damaged or missing parts or if there has been unauthorized substitution of parts that may affect the calibration of the test weight car.

l. Date of Latest Certification—The most recent certification date shall be stenciled on both sides of the test car and the scale inspector shall have a current certificate of calibration.

m. Yard Handling—Test weight cars should be protected from rough handling at all times and shall not be humped. They shall not be used on a hump scale without proper safety precautions and warning of potential runaways. Impacts at speeds greater than 2 mph (3 km/h) shall be avoided. When in motion and uncoupled from a train, the test weight car brakes shall be manned. The brakes shall be firmly set after motion has stopped.

n. Fuel Level—The fuel tank of the test weight car (if applicable) shall be filled before the start of a scale test or test weight calibration and the fuel level maintained as appropriate.

SECTION 1.7 DISPOSITION OF TRACK SCALES

1.7.1 REMOVED TRACK SCALE

A track scale which has been removed by reason of inaccuracy or insufficient capacity shall be disposed of in either of the following ways:

a. Treat as scrap metal after rendering any uncertified scale, or parts thereof unfit for further use.

b. Retain functional parts for use as repair parts in existing scales of the same type and size.

SECTION 1.8 STATIC TESTING A RAILWAY TRACK SCALE

1.8.1 TEST EQUIPMENT (AMENDED 2013)

A Test Weight Load, as the term is used herein, is a railroad car or cart constructed, operated, and maintained according to the applicable specifications and rules approved by the Association of American Railroads. See Section 1.5—Specifications for Railway Track Scale Test Weight Loads (Amended 2008) and Section 1.6—Maintenance and Transportation of Track Scale Test Weight Cars (Amended 2010). The Test Weight Load shall be 80,000 lb (36,300 kg) or greater. Test weight loads, traceable to NIST standards, shall be used for interim testing. See Section 1.8.8.

1.8.2 SCALE INSPECTION

The scale should be thoroughly checked for any obstructions, binds, or any other conditions that could affect the test results. Any such conditions found are to be recorded on the report form. An "As Found" test should be conducted before any adjustments or repairs are initiated.

1.8.3 ZERO LOAD BALANCE (AMENDED 2013)

Automatic Zero-Tracking Mechanism (AZTM) shall be disabled prior to conducting a test. An "As Found" zero-balance condition of a scale shall be noted and recorded on the Test Report Form by the scale inspector before any adjustment or repair. Any out-of-balance conditions shall be corrected and the scale zeroed before placing a Test Weight Load on the scale. Zero-load balance shall be observed and recorded each time a Test Weight Load is removed from the scale during the testing process. Zero shall not change more than the minimum applicable tolerance each time the Test Weight Load is removed from the scale. "As Found" and "As Left" zero balance readings shall be recorded.

1.8.4 SENSITIVITY REQUIREMENT (SR) TEST

A sensitivity test shall be conducted only on non-automatic-indicating (weighbeam) scales. Sensitivity requirement (SR) tests shall be made at zero load and at the maximum test load applied to the scale by either increasing or decreasing by a specified amount the test weight load on the load-receiving element of the scale. The following minimum response shall be the same for maintenance or acceptance tests of the scale:

a. A Scale with a Trig Loop but without a Balance Indicator: The position of rest of the weighbeam shall change from the horizontal or midway between limiting stops to either stop.

   (1) Weighbeams not marked III or IIIL: SR shall not exceed three times the value of the minimum graduated interval on the weighbeam or 100 lb (50 kg), whichever is less.

   (2) Weighbeams marked III or IIIL: SR shall not exceed one minimum division on the weighbeam at zero load and two minimum divisions on the weighbeam at the maximum test load.

b. A Scale with a Single Balance Indicator: The position of rest of the indicator shall change at least one division on the graduated scale or the width of the central target area, whichever is greater.

1.8.5 DISCRIMINATION TEST (AMENDED 2012)

A discrimination test shall be conducted on all automatic indicating scales with the weighing device in equilibrium at or near zero load and at or near maximum test load, and under controlled conditions in which environmental factors are reduced to the extent that they will not affect the results obtained. For scales equipped with an automatic zero-tracking mechanism (AZTM), the discrimination test may be conducted at a range outside of the AZTM range. On a digital device, this test is conducted from just below the lower edge of the zone of uncertainty for increasing load tests or from just above the upper edge of the zone of uncertainty for decreasing load tests. A test load equivalent to 1.4 divisions shall cause a change in the indicated value of at least 2.0 divisions. This requires the zone of uncertainty to be not greater than three tenths of the value of the scale division.

1.8.6 STATIC TESTING OF A TRACK SCALE (AMENDED 2013)

A shift test is required to ensure the scale is performing within applicable tolerance and to verify a railcar can be accurately weighed from any direction or at any position on the scale. Shift tests should be conducted “As Found” in both directions before any repairs or adjustments are made. “As Found” and “As Left” readings shall be recorded. No less than 80,000 lb (36,300 kg) may be used for track scale certification except for Interim Approval (returning a scale temporarily to service after repairs—see Section 1.8.8).

The sections of a railway track scale shall be numbered 1, 2, 3, etc., from left to right when standing at the weight indicator and facing the scale deck. Normal sectional placement positions of a scale Test Weight Load when performing a shift test are designated in order from left to right (viewed from the weight indicator) as 1R, 2L, 2, 2R 3L, 3, 3R, etc. The numbers represent the sections. The letters, when affixed, indicate whether the body of the Test Weight Load lies to the left or right of the section, with one pair of wheels or jacks directly over the section. The following are standard combinations of normal Test Weight Load placement positions (using a four-section scale as an example), any one of which combinations may be used while conducting a standard track scale shift test.

a. 1R, 2, 3, 4L

b. 1R, 2L, 2R, 3L, 3R, 4L

When testing a two-section scale, the standard combination of normal test car positions is 1R, Center, 2L.

NOTE: When using self-propelled test cars, the following additional test procedure may be used: Place the entire car with jacks retracted on the left, center, and right end of the scale load receiving element. Test Weight Cars shall be uncoupled at both ends to avoid coupler error.

1.8.7 STRAIN TEST (AMENDED 2013)

In addition to the standard test (see Section 1.8.6), the scale should be strain tested by using a load and a scale Test Weight Load or known test weight. The load is placed on the scale and its weight is recorded. The Test Weight Load or test weight is then added so that the load and the test weight are on the scale. Record the combined weight and subtract the load weight from the combined weight of the load and the test weight. The difference between the value of the load and the load plus the test weight should be equal to the value of the test weight. If it is not, the deviation must not exceed the applicable tolerance as applied to the test weight.

NOTE: One half of a railcar can be used as a load if the scale is too short to accommodate an entire railcar plus the Test Weight Load or test weight.

1.8.8 INTERIM TEST (AMENDED 2009)

The interim test allows a track scale to be used temporarily pending a test conducted in accordance with Section 1.8 using a test weight load of no less than 80,000 lb (36,300 kg). The time period of temporary use is at the discretion of the testing railroad.

An interim test, using a certified test weight load of not less than 30,000 lb (13,600 kg) and a strain test at no less than 25% of scale capacity, may be used to return a scale into service following emergency repairs. The interim test shall include all of the tests outlined in Section 1.8. The testing railroad and the official with statutory authority shall be immediately notified when scales are repaired and placed in service with an interim test.

1.8.9 TEST RECORD

The results of the test shall be recorded on a suitable report form. The following information shall be shown:

a. Date of test and signature of inspector.

b. Full and complete identification of the scale. This should include the scale owner’s name, address, and some identifying location within the facility if there is more than one scale.

c. Identification, nominal weight, and calibration date of Test Weight Load(s)

d. Balance condition “As Found” by the inspector upon arrival and each time the Test Weight Load(s) is removed from the scale, except during calibration.

e. Results of test before any adjustment or repairs are made, with readings and errors to the nearest minimum graduation.

f. The value of the SR at zero load and at maximum applied load.

g. Any defective condition found during inspection of the scale.

h. Any action taken (calibration adjustments or repairs, etc.) at the time of the test to correct defective conditions found to exist in the scale mechanism or structure.

i. Results of test readings and errors to the nearest minimum graduation after making adjustments or corrections in the scale mechanism or structure.

j. Recommendations of the inspector.

k. Any additional information required by the testing agency (e.g., seal numbers, witnesses, unusual conditions affecting the test, etc.)

1.8.10 TOLERANCES (AMENDED 2012)

Every track scale shall be kept in the closest possible adjustment; the weighing performance shall be considered unsatisfactory when the scale is not maintained within the appropriate tolerance as set forth herein. The formally adopted tolerances, in excess or deficiency, on all static railway track scales used as a commercial device are as follows:

a. Maintenance Tolerance

Table 1-1. Accuracy Class III L—Static Maintenance Tolerance

Test load in divisions	0–500	501–1000	Add 1 scale division of tolerance for each additional 500 divisions of test load or fraction thereof
Tolerance in divisions	1	2	

b. Acceptance Tolerance shall not exceed one half of the maintenance tolerance for any position of the Test Weight Load load on the scale. The minimum Test Weight Load to be applied shall be 80,000 lb (36,300 kg). Acceptance tolerance is to be applied for the following testing situations:

(1) The first official test of a track scale.

(2) The first field test after scale adjustments; rejection for failure to meet performance requirements; or to return a scale to service after repairs, overhaul, or interim test.

(3) Testing a track scale used as a reference scale or weight verification scale to test or certify another scale.

c. Shift or Section Tests: The range of the results obtained during a shift test or a section test shall not exceed the absolute value of the maintenance tolerance, and each test result shall be within applicable tolerance.

d. Repeatability Tests: The results obtained from several weighments of the same load at the same position on the scale shall agree within the absolute value of the maintenance tolerance for that load, and each weight result shall be within applicable tolerances.

SECTION 1.9 STANDARD TESTS FOR AN IN-MOTION RAILCAR WEIGHING SYSTEM (AMENDED 2004)

1.9.1 GENERAL GUIDELINES

The information contained in this section applies to all types of in-motion weighing. Single draft systems record weights while the entire railcar is scaleborne, whereas, multi-draft systems record weights by summing railcar axle or truck weights.

a. A general inspection of the weighing system, including the approach track, scale, and instrumentation should be made before proceeding with the in-motion test.

b. The test train should be weighed once in each mode of operation to determine the “As Found” in-motion weights before making any static or in-motion adjustments.

c. The test equipment used for the in-motion test should represent the range of weights and commodities used during the normal operation of the weighing system.

d. The reference weight cars used for the in-motion test should be uncoupled when obtaining the static reference weights. The scale used to obtain the reference weights shall be tested as specified in Section 1.8. Reference car weights should be obtained on a single draft scale where practical. Axle weight scales should not be used to obtain reference car weights.

e. A static test shall be performed on the in-motion weighing system before any adjustments are made.

f. A test shall not be conducted or continued in conditions, such as rain, snow, or ice that adversely affect the weights of the cars before the in-motion test is completed.

1.9.2 TEST EQUIPMENT

The following equipment may be used for the in-motion test of the weighing system provided the equipment is free of defects.

a. Certified test weight cars—Special railcars meeting the specifications of Section 1.5.

b. Reference weight cars—Standard railcars that have been statically weighed for temporary use as a mass standard over a short period of time, typically the time required to test one scale.

c. Monitor weight cars—Standard railcars filled with a stable material and permanently sealed. These cars are typically used as reference weight cars and to monitor scale performance

1.9.3 UNCOUPLED-IN-MOTION TEST PROCEDURES

The car speed and direction of travel shall be the same as when the scale is in normal use. The minimum in-motion test shall be three cars weighed three times after final adjustment.

1.9.4 COUPLED-IN-MOTION TEST PROCEDURES

The weighing system should be tested in the modes used, with the locomotive either pushing or pulling the cars at the designed speed and in the proper direction. The motion test shall be conducted with a test train as outlined below:

a. Weighing systems used to weigh trains of less than 10 cars—These weighing systems shall be tested using a consecutive-car test train consisting of the number of cars weighed in the normal operation and weighed a minimum of five times in each mode of operation following the final calibration.

b. Weighing systems placed in service prior to January 1, 1991, and used to weigh trains of 10 or more cars—These weighing systems shall be tested using a consecutive-car test train of no less than 10 cars weighed a minimum of five times in each mode of operation following final calibration.

c. Weighing systems placed in service on or after January 1, 1991, and used to weigh trains of 10 or more cars—

(1) These weighing systems shall be tested using a consecutive-car test train of no less than 10 cars weighed a minimum of five times in each mode of operation following final calibration; or

(2) If the official with statutory authority determines it necessary, the As Used Test Procedures outlined below shall be used.

AS-USED TEST PROCEDURES

A weighing system shall be tested in a manner that represents the normal method of operation and lengths of trains normally weighed. The weighing system may be tested using either:

(a) A consecutive-car test train of a length typical of trains normally weighed; or

(b) A distributed-car test train of a length typical of trains normally weighed.

However, a consecutive-car test train of a shorter length may be used, provided the initial verification test results for the shorter consecutive-car test train agree with the test results for the distributed-car or full-length consecutive-car test train as specified below in the Initial Verification section. The official with statutory authority shall be responsible for determining the minimum test train length to be used on subsequent tests.

Initial Verification

Initial verification tests should be performed on any new weighing system and whenever either the track structure or the operating procedure changes. If a consecutive-car test train of length shorter than trains normally weighed is to be used for subsequent verification, the shorter consecutive-car test train results shall be compared to either a distributed-car or to a consecutive-car test train of lengths typical of trains normally weighed. The difference between the total train weight of the train representing the normal method of operation and the weight of the shorter consecutive-car test train shall not exceed 0.15%. If the difference in the test results exceeds 0.15%, the length of the shorter consecutive-car test train shall be increased until agreement within 0.15% is achieved. Any adjustments to the weighing system based upon the use of a shorter consecutive-car test train shall be offset to correct the bias that was observed between the full-length train test and the shorter consecutive-car test train.

Subsequent Verification

The test train may consist of either a consecutive-car test train with a length not less than that used in initial verification, or a distributed-car test train representing the number of cars used in the normal operation.

Distributed-Car Test Trains

1 The length of the train shall be typical of trains that are normally weighed.

2 The test equipment shall be split into three groups, each group consisting of 10 cars or 10% of the train length, whichever is less.

3 The test groups shall be placed near the front, around the middle, and near the end of the train.

4 Following the final adjustment, the distributed-car test train shall be weighed at least three times or shall produce 50 weight values, whichever is greater.

5 The weighing system shall be tested in each mode of operation.

Consecutive-Car Test Trains

1 A consecutive-car test train shall consist of at least 10 cars.

2 If the consecutive-car test train consists of between 10 cars and 20 cars, inclusive, it shall be weighed a minimum of five times in each mode of operation following the final calibration.

3 If the consecutive-car test train consists of more than 20 cars, it shall be weighed a minimum of three times in each mode of operation following the final calibration.

1.9.5 TOLERANCES

a. Uncoupled-in-motion

The basic maintenance and acceptance tolerance in the static versus the in-motion gross weight for an uncoupled-in-motion test of a single car shall not exceed plus or minus the basic static maintenance tolerance as stated in 1.8.10.a.

b. Coupled-in-motion used for single car weights

The basic maintenance and acceptance tolerances shall be as follows:

(1) For any group of weighments, the error in the sum of the individual weights of the group must be within the sum of the maintenance static tolerances appropriate to the weights of the group established in 1.8.10.a; and

(2) For any single weighment within a group, the weighment error shall not exceed the following:

(a) No single error may exceed three times the static maintenance tolerance established in 1.8.10.a;

(b) Not more than 5% of the errors may exceed two times the static maintenance tolerance established in 1.8.10.a;

(c) Not more than 35% of the errors may exceed the static maintenance tolerance established in 1.8.10.a.

c. Coupled-in-motion used for multi-car group weights of 10 or more cars and/or unit train weights.

The tolerance stated in 1.9.5.b.(1) shall apply to the group of cars and/or unit train. Individual car weights shall be printed, however, the tolerance to apply to errors on individual cars within the group or unit train will be determined by the serving carrier, as may be applicable to load restrictions on trackage or routing.

d. For scales used to weigh trains of less than five cars, no single car weight within the group may exceed the static maintenance tolerance established in 1.8.10.a.

1.9.6 FREQUENCY OF TESTS

a. A maintenance test using the procedure in 1.9.3 or 1.9.4 shall be made at least once a year.

b. Motion weighing scales, particularly electronic scales during the first several months after acceptance, shall be frequently monitored to assure proper performance. Reference weight cars may be used for monitoring.

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Association of American Railroads

Safety and Operations

Part 2

Basic Specifications for the Manufacture and Installation of Railway Track Scales

— 2013 —

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SECTION 2.1 INTRODUCTION

a. These specifications are intended to apply to railway track scale systems used for revenue service.

b. They do not apply to scales previously installed except that re-installation of such scales shall conform to the provisions of these specifications.

c. They are intended to secure reasonable uniformity in scales for similar service without preventing improvement in types of scales or in their component parts.

d. For special cases which are not covered in these specifications, the material workmanship, and other qualities shall be at least equal to those required herein, and the principles herein set forth should be followed so far as they apply.

e. These specifications consolidate and supersede previous specifications.

f. Tolerances, testing and test car specifications are covered in Part 1, Specifications for the Location, Maintenance, Operation, and Testing of Railway Track Scales.

g. All automatic indicating and full automatic indicating scales shall be recording scales.

SECTION 2.2 CAPACITIES AND SIZES (AMENDED 2010)

2.2.1 RATED SECTIONAL CAPACITY

a. Lever Scales: The rated sectional capacity is the greatest live load that may be divided equally on the load pivots of a section without producing stresses in any member in excess of those specified in Sections 2.14.3.c and 2.14.3.d.

b. Load Cell Scales: The rated sectional capacity is based on the capacity of the load cells installed. Table 2-1 illustrates the rated sectional capacities when pairs of load cells with the given capacities are installed. Rated sectional capacities for other load cells can be calculated as follows and should be rounded down to the nearest 5 ton.

$$\text{Rated Sectional Capacity (ton)} \le \frac{\text{Section Load Cell Capacity} - \text{Dead Load Allowance}}{2,000}$$

where:

$$\begin{aligned} \text{Section Load Cell Capacity} &= \text{ the load cell capacity (lb)} \times \text{the quantity of load cells of the section} \\ \text{Dead Load Allowance} &= \text{ 10\% of the section load cell capacity or 30,000 lb, whichever is greater} \end{aligned}$$

Table 2-1. Rated Sectional Capacity

Load Cell Capacity (lb)	Sectional Capacity (ton)
100,000	85
110,000	95
120,000	105
130,000	115
200,000	180
300,000	270

2.2.2 WEIGH MODULE CAPACITY

The weigh module capacity shall not exceed the heaviest live load that can be applied without producing stresses in excess of those specified in Section 2.14. The minimum live load to be used is Cooper E-80 as illustrated in AREMA, Chapter 15, Steel Structures, Figure 1-2. The Cooper E-80 capacities for weigh modules of given lengths are shown in Table 2-2 below.

Table 2-2. Cooper E-80 Weigh Module Capacity

Weigh Module Length (ft)	Weigh Module Capacity (ton)
<5	40
5 to < 10	80
10 to < 15	120
15 to < 23	160
23 to < 29	186
29 to < 35	212
35 to < 40	258
40 to < 56	284

2.2.3 NOMINAL SCALE CAPACITY

The nominal scale capacity shall not exceed the lesser of:

a. The sum of the Weigh Module Capacities; or

b. Rated Sectional Capacity (RSC) multiplied by the quantity of the Number of Sections (Ns) minus the Number of Dead Spaces (Nd) minus 0.5.

   As a formula this is stated as RSC × (Ns – Nd – 0.5); or

c. 640,000 lb (based on 12.5% minimum test weight)

2.2.4 SIZES

The size of a scale is expressed by the length of the weighrail.

SECTION 2.3 PLANS

2.3.1 DRAWINGS

The scale owner and Chief Engineer of the serving rail carrier shall be furnished drawings, specifications and descriptions in sufficient dimensional detail to permit design calculations for stresses and to allow adequate checking of the design requirements for finish, and workmanship of steel, approach wall, and scale pit construction. Such information with site plan showing scale, scale house, equipment location, and soil characteristic data shall be furnished by the scale designing company, distributor or installer for review prior to commencement of construction. All plans shall include location of scale and owner's name.

2.3.2 MATERIALS

The purchaser shall be furnished written information showing the material of which scales proposed to be furnished are made. If any material does not meet the safe stresses listed in 2.14.3, the chemical and physical properties must be given in sufficient detail to permit confident judgement of the safe stresses or factors of safety used in design. Such information shall be furnished to the Chief Engineer of the serving rail carrier, prior to installation.

2.3.3 ASSEMBLY PLANS

Assembly plans shall be furnished, prior to installing, showing the location of field connections and all information necessary for the purchaser to design and construct the pit and install parts not furnished by the manufacturer. As-built plans showing pit connections and detailed instrument wiring arrangements, including component identification and values, maintenance instructions, and any other information pertinent to the maintenance of the weighing system, shall be furnished to the Chief Engineer of the serving rail carrier upon completion of the installation of the weighing station.

SECTION 2.4 WEIGHBEAMS AND ACCESSORIES

2.4.1 DESIGN

a. *Nominal Capacity*. The nominal capacity as defined in 2.2.3 shall not exceed the scale capacity.

b. *Weighbeam.* The weighbeam of the full capacity type shall be provided.

c. *Poise Stop.* On each bar of the weighbeam, a poise stop shall be provided to prevent the poise from traveling and remaining back of the zero notch or graduation, or beyond full capacity.

d. *Notches.* On main bars, the notches shall be spaced no closer than six per 1 in. (2.5 cm). Notches shall be so formed and positioned that accurate positioning of a poise will automatically result at any graduation at which the poise may be placed.

e. *Pawl or Latch.* For a poise on a notched weighbeam, the design and construction of the pawl or latch and its appurtenance shall be such that accurate positioning of the poise will automatically result at any graduation at which the poise may be placed.

f. *Projections and Recesses.* Poises shall be designed with the object of reducing to a minimum the number of projections that may become chipped or broken off, and recesses that may retain foreign material.

2.4.2 RATIO

A pivot and loop shall be provided at the weighbeam tip and the ratio at the weighbeam tip pivot shall be marked on the beam. The ratio of the scale to the weighbeam butt pivot shall be plainly and permanently stamped on the beam.

2.4.3 POISE BEARINGS

Each poise shall be constructed to move along its bar without side play. The main poises shall be equipped with ball bearings.

2.4.4 FRACTIONAL POISES ON REGISTERING WEIGHBEAMS

The fractional poise on a registering weighbeam shall be constructed to stop positively at each graduation and to prevent movement beyond the last graduation.

2.4.5 PRINTING LEVEL

On registering weighbeams, a substantial type of hand grip shall be provided to facilitate the registration of the weight. The natural operation of the registering mechanism shall not cause lateral displacement of the weighbeam.

2.4.6 TYPE FIGURES

On type registering weighbeams, type figures shall be made of material sufficiently hard that, under the designed conditions of use, the figures will not become battered or defaced. The figures shall be plain and raised sufficiently high to insure a clear impression upon the weigh ticket or tape. They shall be so attached that they cannot become loosened or detached without a positive indication that the weighbeam is out of order.

2.4.7 RECEPTACLE FOR WEIGH TICKET

On registering weighbeams, means shall be provided to prevent placing the weight ticket in its receptacle in any position in which a weight can be registered different from that represented by the poise setting.

2.4.8 POISE

a. *Materials.* The exterior shell of poises shall be made of corrosion-resistant alloys, steel, iron, brass, or any other metal not softer than brass making contact with the weighbeam.

b. *Moveable Parts.* All moveable elements forming a part of a poise shall be so constructed as not to be detachable without manifest mutilation of the poise. Set screws, if used to secure a poise at any point on a weighbeam, shall not be removable.

2.4.9 IDENTIFICATION OF PARTS

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

2.4.10 FACTORY ADJUSTMENT OF NOTCHES

Each weighbeam notch shall be adjusted to within 0.002 in. (0.05 mm) of the nominal distance from the zero notch.

2.4.11 BEAM FULCRUM STAND

a. *Design.* The weighbeam shall be supported on a stand fitted with compensating bearings. Beam fulcrum stands shall be so designed, constructed and installed that the resultant line of forces applied through the bearing carrier by the stand will fall within the middle third of the length and width of the base.

b. *Heights.* The height of the stand measured from the bottom surface to the base of the pivot bearing surface shall not exceed 13 in. (33 cm).

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.

2.4.12 BALANCE BALL

The position of the balance ball shall be vertically adjustable. Unless otherwise required by law or regulation, longitudinal movement shall be controlled by means of a self-contained, hand-operated screw, or other devise, which will not require the ball to be rotated in making adjustments.

2.4.13 TRIG LOOP

a. *Weighbeam Travel.* The travel of the weighbeam in the trig loop shall be not more than 2% of the distance from the trig to the fulcrum pivot, not less than 0.9 in. (2.3 cm).

b. *Pointer.* the weighbeam shall be fitted with an indicator to be used in conjunction with a graduated target or other devise on the trig loop to indicate a central position in the trig loop when the weighbeam is horizontal.

c. *Material.* The contact parts of the trig loop shall be made of a non-magnetic material.

2.4.14 WEIGHBEAM SUPPORT

The weighbeam fulcrum stand and trig loop stand shall be supported on a metal shelf mounted on metal pillars, or equivalent in strength and durability. The shelf shall be sufficiently rigid that within the capacity of the scale, deflection cannot occur to such an extent as will affect the weighing performance.

SECTION 2.5 SCALE LEVERS

2.5.1 QUALITY OF MATERIALS

Castings, steel tubing and structural shapes used for levers shall not be warped. They shall be clean, smooth and uniform, and castings shall be free of blisters, blowholes, shrinkage holes and cracks. All welding shall conform to current AREMA, Chapter 15, Steel Structures.

2.5.2 NOSE IRON GUIDES

The guides for all nose irons shall be such that when one is moved for the purpose of adjustment, the pivot will be held parallel to its original position. The guide and ways of each cast iron lever shall be machined.

2.5.3 LEVELING LUGS

In scales of the straight lever type, each lever shall be provided with leveling lugs for longitudinal alignment. In scales of the torsion lever type, leveling lugs shall be provided on the pipe or torsion member for transverse alignment and on the extension arm for longitudinal alignment. Each pair of lugs shall be finished to a common plane, which shall be parallel to the plane through the knife-edges of the end pivots.

2.5.4 TRUSS RODS

Truss rods shall not be used in parts of the lever system except to stiffen levers laterally, or to prevent whipping and vibration due to impact. Truss rods designed as parts of a lever structure to support vertically applied loads will not be permitted.

2.5.5 MARKING OF LEVERS

Figures denoting the ratio of each lever shall be cast or otherwise permanently marked on the lever. On a weighing element not permanently attached to an indicating element, there shall be clearly and permanently marked for the purposes of identification the name, initials, or trademark of the manufacturer, the manufacturer’s designation that positively identifies the pattern or design, the nominal capacity, and the sectional capacity.

2.5.6 PERMANENCY OF ADJUSTMENT

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

SECTION 2.6 PIVOTS AND BEARINGS

2.6.1 MATERIAL

The material to be used for pivots and bearings shall be alloy steel (SAE 52100) or a steel which will give equivalent performance, hardened to Rockwell C scale not less than 58 nor more than 62.

2.6.2 DESIGN AND MANUFACTURE

Pivots shall be so formed that the included angle of the sides forming the knife-edge will not exceed 90° and that the offset of the knife-edge from the centerline of the pivot will not exceed 10% of the width of the pivot.

2.6.3 MOUNTING

a. *Fastening.* Pivots shall be firmly fastened in position without swaging or caulking.

b. *Machined-in Pivots, When Required.* For scales of greater sectional capacity than 100,000 lb (45,000 kg), main lever pivots shall be machine finished and fitted into machined ways.

c. *Continuous Contact Required.* Pivots shall be so mounted that continuous contact of the knife-edge with their respective bearings for the full length of the parts designed to be in contact will be obtained. In loop bearings, the knife-edges shall project slightly beyond the bearings in the loops.

2.6.4 POSITION

In any lever the pivots shall be so mounted that:

a. Each knife-edge will be maintained in a horizontal plane under any load within the capacity of the scale.

b. A plane bisecting the angle of a knife-edge will be perpendicular to the plane through the knife-edges of the end pivots.

c. The actual distance between the end knife-edge of any lever will not differ from the nominal distance by more than $\frac{1}{64}$ in./ft (1.3 mm/m).

d. The knife-edges in any lever shall be parallel.

2.6.5 SUPPORT FOR PROJECTING PIVOTS

The reinforcing on the levers to support projecting pivots shall be tapered off to prevent accumulation of foreign matter next to the pivots and to provide proper clearances.

2.6.6 FULCRUM DISTANCES

The minimum distance between the fulcrum pivot knife-edge and the load pivot knife-edge in main levers of scales 150,000 lb (68,000 kg) sectional capacity or less shall be 6.5 in. (16.5 cm). In scales of greater than 150,000 lb (68,000 kg) sectional capacity, the minimum distance shall be 8 in. (20 cm).

2.6.7 DESIGN OF BEARINGS

Bearing steels and the parts supporting or containing them shall be so applied to the mechanism that permissible movement of the load receiving element will not displace the line of contact between any bearing and the opposing pivot.

2.6.8 INTERCHANGEABILITY OF BEARING STEELS

All bearing steels of the same nominal dimensions or manufacturers' part-list identification shall be interchangeable or mounted at interchangeable bearing blocks.

2.6.9 FINISH OF BEARING STEELS

The bearing surfaces shall be brought to a smooth, true, and accurate finish to insure continuity of contact with opposing pivots.

SECTION 2.7 NOSE IRONS

2.7.1 DESIGN

Nose irons shall be so constructed that:

a. they will be positioned by means of adjusting screws of standard size and thread.

b. they will be retained in position by means of screws or bolts of standard size and thread.

c. the surfaces of nose irons intended to be in sliding contact with the levers will be machined true, so as to secure an accurate fit in or on the levers.

d. when adjustments are made, the knife-edge will be held parallel to its normal position.

2.7.2 SCREWS AND BOLTS

Adjusting and retaining screws and bolts shall be made of a corrosion-resistant material.

2.7.3 RETAINING DEVICE

A device for retaining each nose iron in position shall be provided and shall be so designed and constructed that it will:

a. be independent of the means provided for adjustment.

b. not cause indentations in the lever.

c. not cause tension in the remaining bolts when loads are applied to the scale.

d. cause the nose iron to remain in position when the retaining device is released.

2.7.4 MARKING OF POSITION

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

SECTION 2.8 LEVER FULCRUM STANDS

2.8.1 QUALITIES OF MATERIALS

Castings or structural steel for lever stands shall be clean, smooth and uniform and castings shall be free of blisters, blowholes, shrinkage holes and cracks. All welding shall conform to current AREMA, Chapter 15, Steel Structures.

2.8.2 PROPORTIONS

Lever stands shall be so designed, constructed, and installed, that, under any practical condition of loading the resultant force through the bearing will fall within the middle third of the length and width of the base.

2.8.3 BASES FOR LEVER STANDS

The base of any lever stand shall be smooth, or shall be finished in any suitable manner true within a tolerance of $\frac{1}{32}$ in. (0.8 mm) to a plane perpendicular to a vertical line through the center of the knife-edge bearing carried by the upright position of the stand.

2.8.4 FINISH OF TOPS OF STANDS

The top of any lever stand receiving a bearing steel, cap or block shall be finished smooth and shall be parallel to the base within $\frac{1}{32}$ in. (0.8 mm).

2.8.5 ANCHOR BOLT HOLES

Two or more anchor bolt holes, not less than 2 in. (60 mm) in diameter, shall be provided in the proper places in the base of every fulcrum stand, unless other equally effective means for anchorage are provided.

2.8.6 TIE BARS

When tie bars for lever stands are used, contacting surfaces shall be machined.

SECTION 2.9 LOOPS AND CONNECTIONS

2.9.1 MATERIAL

The requirements for material and hardness of bearing surfaces in loop connection shall be the same as those herein prescribed for pivots and bearings.

2.9.2 DESIGN

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 loop shall be not less than 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 are used.

2.9.3 LENGTH

Loops in like connections except when adjustable shall be of the same length.

2.9.4 LOCKNUTS

Bolts used as part of the connections shall be provided with locknuts.

2.9.5 VERTICAL ADJUSTMENT

Means for vertical adjustment shall be provided between the lever system and the indicating elements, which will permit independent leveling of the shelf lever when one is used. When no shelf lever is used, the connection to the indicating elements shall be adjustable. Screw adjustment shall be provided with a locking device.

SECTION 2.10 CHECKS

2.10.1 DESIGN

The checking system shall be designed to hold the weighbridge in position.

2.10.2 NUMBER AND TYPE (AMENDED 2013)

Weighbridge systems shall provide a positive means of maintaining rail and load cell alignment. Typical methods include plate, rod, and bumper checking and may be used in combination. The weighbridge manufacturer will determine the number and type of weighbridge checks that shall be used.

2.10.3 POSITION

Check rods, stay plates or the like shall be set in the same horizontal plane. Longitudinal checks shall be parallel to each other. Transverse checks shall be parallel to each other and be located as close to each section as possible.

2.10.4 STRENGTH

The combined longitudinal and the combined transverse checks shall be designed to resist any anticipated forces applied to the weighbridge.

SECTION 2.11 ANTI-FRICTION POINTS AND PLATES

2.11.1 MATERIAL AND DESIGN

Hardened steel anti-friction contacts shall be used to limit longitudinal displacement between knife-edges and bearings. They shall be smooth and so designed and applied as to provide contact at points on the knife-edge line.

2.11.2 CLEARANCES

The total clearance between anti-friction plates and points shall not exceed 1⁄16 in. (1.6 mm) on the weighbeam, 1⁄8 in. (3.2 mm) on the shelf lever, and 1⁄4 in. (6.4 mm) on all other levers. The minimal clearance shall be not less than one half of these respective amounts.

SECTION 2.12 CLEARANCES

The clearance around and between the fixed and live parts of the lever system shall be at least 3⁄4 in. (20 mm) unless otherwise specified.

SECTION 2.13 INTERCHANGEABILITY

Units or parts of units intended to be interchangeable with the units or parts in scales of the same design and manufacture, shall be identified on the scale drawings or in the subject matter of the proposal in such manner as will clearly indicate the interchangeable parts, the manner of replacement, and the adjustments required, if any, after replacement.

SECTION 2.14 SCALE WEIGHBRIDGES

2.14.1 TYPE OF GIRDERS

Weighbridge girders shall be so designed that the joints over the centers of bearing will admit vertical flexure without deranging the sections. On axle weighbridges tipping of the weighbridges will not be allowed.

2.14.2 WEIGHBRIDGE BEARINGS

The surfaces of weighbridge bearings intended to make contact with the bridge girders shall be finished so that, when in position, all the bearing surfaces will be within 7⁄32 in. (0.8 mm) of the same horizontal plane and parallel to it. To secure proper alignment of parts, the diameter of the bolt holes in the weighbridge bearings and in the girders shall exceed the diameter of the bolts fastening the bearings to the girders by ½ in. (13 mm).

2.14.3 STEEL SPECIFICATIONS

a. Structural steel design and fabrications except for stress limitations shall conform to AREMA, Chapter 15, Steel Structures, except as otherwise specified herein.

b. To allow for impact and normal foundations conditions, all steel design stress in scale weighbridges shall be limited to 10,000 psi[1] (69 Mpa) and maximum deflection in main weighbridge beams or girders shall not exceed 1⁄1200 of the span between sections.

c. A maximum of 6,000 lb/linear in. (1100 kg/linear cm) of knife edge on alloy steels such as E52100 D2, and A2; a maximum of 5,000 lb/linear in. (900 kg/linear cm) of knife edge on high carbon steel.

d. Unit stresses for iron and steel shall conform with Table 2-3.

[1] Note: 10,000 psi (69 Mpa) stress is selected to preserve structural integrity and to allow for impact, trace misalignment and possible reduction of weighbridge sections due to corrosion.

Table 2-3. Allowable Unit Stresses in Pounds per Square Inch for Iron and Steel

Material Cast Iron (Gray) Thickness of Section		Transverse Bending				Direct Stress				Shear and Torsion	
		Tension		Compression		Tension		Compression			
in.	(cm)	psi	(Mpa)	psi	(Mpa)	psi	(Mpa)	psi	(Mpa)	psi	(Mpa)
0.25	(0.6)	5,000	(34.5)	8,500	(58.6)	3,500	(24.1)	10,000	(68.9)	5,000	(34.5)
0.30	(0.8)	4,780	(33.0)	8,180	(56.4)	3,350	(23.1)	9,560	(65.9)	4,780	(33.0)
0.35	(0.9)	4,600	(31.7)	7,820	(53.9)	3,220	(22.2)	9,200	(63.4)	4,600	(31.7)
0.40	(1.0)	4,450	(30.7)	7,560	(52.1)	3,110	(21.4)	8,900	(61.4)	4,450	(30.7)
0.45	(1.1)	4,320	(29.8)	7,340	(50.6)	3,020	(20.8)	8,640	(59.6)	4,320	(29.8)
0.50	(1.3)	4,200	(29.0)	7,140	(49.2)	2,940	(20.3)	8,400	(57.9)	4,200	(29.0)
0.60	(1.5)	4,020	(27.7)	6,830	(47.1)	2,810	(19.4)	8,040	(55.4)	4,020	(27.7)
0.70	(1.8)	3,870	(26.7)	6,830	(47.1)	2,810	(19.4)	7,740	(53.4)	3,870	(26.7)
0.80	(2.0)	3,740	(25.8)	6,360	(43.9)	2,620	(18.1)	7,480	(51.6)	3,740	(25.8)
0.90	(2.3)	3,630	(25.0)	6,170	(42.5)	2,540	(17.5)	7,260	(50.1)	3,630	(25.0)
1.00	(2.5)	3,540	(24.4)	6,020	(41.5)	2,480	(17.1)	7,080	(48.8)	3,540	(24.4)
1.10	(2.8)	3,450	(23.8)	5,860	(40.4)	2,410	(16.6)	6,900	(47.6)	3,450	(23.8)
1.20	(3.0)	3,380	(23.3)	5,760	(39.7)	2,370	(16.3)	6,767	(46.6)	3,380	(23.3)
1.30	(3.3)	3,310	(22.8)	5,620	(38.7)	2,320	(16.0)	6,620	(45.6)	3,310	(22.8)
1.40	(3.6)	3,250	(22.4)	5,520	(38.1)	2,270	(15.7)	6,500	(44.8)	3,250	(22.4)
1.50	(3.8)	3,190	(22.0)	5,420	(37.4)	2,230	(15.4)	6,380	(44.0)	3,190	(22.0)
1.60	(4.1)	3,140	(21.6)	5,340	(36.8)	2,200	(15.2)	6,280	(43.3)	3,140	(21.6)
1.80	(4.6)	3,050	(21.0)	5,180	(35.7)	2,130	(14.7)	6,100	(42.1)	3,050	(21.0)
2.00	(5.1)	2,970	(20.5)	5,050	(34.8)	2,080	(14.3)	5,940	(41.0)	2,970	(20.5)
2.50	(6.4)	2,810	(19.4)	4,780	(33.0)	1,970	(13.6)	5,620	(38.7)	2,810	(19.4)
3.00	(7.6)	2,690	(18.5)	4,570	(31.5)	1,880	(13.0)	5,380	(37.1)	2,690	(18.5)
3.50	(8.9)	2,580	(17.8)	4,390	(30.3)	1,810	(12.5)	5,160	(35.6)	2,580	(17.8)
4.00	(10.2)	2,500	(17.2)	4,250	(29.3)	1,750	(12.1)	5,000	(34.5)	2,500	(17.2)
Steel-Structural (SAE 110 ASTM A36 or 1020 A588)		10,000	(69)	10,000	(69)	10,000	(69)	10,000	(69)	7,000	(48)
Castings (SAE 1020 to 1030)		10,000	(69)	12,000	(83)	10,000	(69)	12,000	(83)	8,000	(55)
Pivots and Bearings SAE 1095, hardened		24,000	(165)	24,000	(165)	24,000	(165)	24,000	(165)	N/A	N/A
SAE 52100 hardened		30,000	(207)	30,000	(207)	30,000	(207)	30,000	(207)	N/A	N/A

***Note:** 10,000 psi (69 Mpa) stress is selected to preserve structural integrity and to allow for impact, trace misalignment and possible reduction of weighbridge sections due to corrosion.

e. In designing cast iron members, the maximum allowable unit stress of any character shall be determined by the greatest thickness, exclusive of fillets, of the portion of the section carrying the stress being considered. In the main portion of a beam the thickness of the flange shall be considered either as the average depth of the outstanding portion or the breadth of flange outside to outside, whichever is less.

2.14.4 BRACING

Each weighbridge span shall be designed for a lateral force of 200 lb/linear ft (300 kg/linear m) plus 4% of the sectional capacity of the scale uniformly distributed along the top of the weighrail.

2.14.5 DIAGONAL BRACING

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

2.14.6 TRANSVERSE BRACING

To carry the lateral load to the load cells, each span shall be provided at its ends with transverse bracing, for which the section modules shall be not be less than that determined by the formula:

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

where:

S = the section modulus, inches

C = the sectional capacity, pounds

L = the length of span, feet

d = the distance in inches from the load-cell convex loading surface to top of weighrail, or to top flange of girder when pedestals are braced to resist tipping transversely to the girder

Intermediate transverse bracing shall be used at intervals not exceeding 6 ft (2 m) having a section modulus not less than that used at the ends of the span.

2.14.7 STIFFENERS AT POINTS OF BEARING

a. Stiffeners shall be placed in pairs at bearing of the girder in each span of weigh bridge. They shall extend as nearly as practicable to the edge of the flange to give effective distribution and shall be connected to the web with sufficient rivets, bolts or welds to transmit the load. Where angle stiffeners are used, they shall not be crimped. Where plate stiffeners are used, they shall be cut on a 45° angle at upper and lower ends to clear fillet of flange angle or weld connecting flange plat to web, as applicable.

b. The end of stiffeners at points of bearing shall be milled or ground to bear against the flange, or shall be welded to the flange with a full penetration groove weld.

2.14.8 WEIGHRAIL PEDESTALS

The weighrails shall be carried on metal pedestals, except when the design excludes such pedestals, spaced not over 30 in. (75 cm) center to center on metal ties or directly on the weighbridge. The tops of pedestals should be machined. The bottoms of the pedestals shall be machined unless type metal or equivalent is to be poured between the bottoms and the surface supporting them. Pedestals shall be designed so that they will transfer the lateral loads specified in 2.14.4 to the weighbridge. Tie rods shall be provided to prevent spreading of the weighrails due to the wedging action of the wheel flanges.

2.14.9 FABRICATION AND ASSEMBLY

In order to avoid distortion, each pair of weighbridge girders shall be fabricated complete with diagonal and transverse 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 alignment and the bracing then introduced and secured.

2.14.10 WEIGHRAILS

a. *Length and Weight.* The weight and section of weighrails shall be as large as is consistent with surrounding yard track conditions but shall be no less than 115 lb/yd. Rails shall have full section and be in good condition. Rails shall be one piece full length of scale.

b. *Anchoring.* Positive means shall be provided to prevent creeping.

c. *Clearance Along Weighrails.* The clearance between weighrails or their pedestals and the rigid deck should be no less than 1½ in. (4 cm) unless other adequate provisions for clearance is made, and the openings shall be protected from weather and foreign material.

SECTION 2.15 PROTECTION FROM CORROSION

2.15.1 SURFACE TREATMENT

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

SECTION 2.16 APPROACH RAILS

2.16.1 ANTI-CREEP PROVISIONS (AMENED 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 ⅛ in. (4 mm) or greater than ⅝ in. (16 mm) unless special means are utilized to reduce impact from wheel loads passing from the approach rails to the weighrails.

2.16.2 APPROACH WEIGHRAILS—JOINTS

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

2.16.3 ALIGNMENT

Good alignment must be provided over the approaches and scale with respect to rail elevation and horizontal alignment.

2.16.4 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 2.17 DEAD RAILS AND DEAD RAIL BEAMS

2.17.1 DEAD RAILS – WHEN REQUIRED (AMENDED 2013)

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

2.17.2 ELEVATION

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

2.17.3 WEIGHT OF RAILS

Rails shall be a minimum of 115 lb/yd.

2.17.4 TRANSVERSE BEAMS SUPPORTING DEAD RAILS

Structural steel and workmanship shall conform to AREMA, Chapter 15, Steel Structures.

SECTION 2.18 DECK

2.18.1 TYPE

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

2.18.2 CONSTRUCTION

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

2.18.3 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 2.19 FOREIGN MATERIAL AND PRECIPITATION

2.19.1 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 2.20 LIGHTING

2.20.1 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.

2.20.2 PIT

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

SECTION 2.21 LOCATION AND ELEVATION

2.21.1 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.

2.21.2 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.

2.21.3 SHELF LEVERS AND WEIGHBEAM

Scale shall be so located that levers other than the shelf lever between the transverse extension lever and the weighbeam are unnecessary. Right-handed weighbeams are always to be preferred.

SECTION 2.22 FOUNDATION AND PIT

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

2.22.1 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.

2.22.2 DIMENSIONS OF PIT

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

2.22.3 WALLS OF PIT

The side and end walls shall be no less than 15 in. (40 cm) [preferably 18 in. (45 cm)] thick at the top. The foundation walls of the scale house shall be no less than 12 in. (30 cm) thick at the top and shall be solidly formed to the side walls of the scale pit.

2.22.4 WATERPROOFING

Where necessary to prevent seepage of water through foundations, scale pits shall be membrane-waterproofed, or waterproofed by methods equally effective.

2.22.5 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.

2.22.6 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 piling.

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)

2.22.7 WALL BATTER

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

2.22.8 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.

2.22.9 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, pivots or fulcrums shall be equal to or exceed the maximum weighbridge end reaction or pier reaction when the section supports two weighbridges.

2.22.10 FOOTING OR PIERS FOR LEVER STANDS AND LOAD CELLS

a. Concrete footing or piers supporting the lever stands shall be no less than 18 in. (45 cm) thick. Their tops shall be above the floor a sufficient distance to prevent the accumulation of water under the bases of stands. The tops shall be finished to exact level and elevation to receive the lever stands directly without the use of shims or grouting where possible. Grouting, if used, shall be of the best non-shrink impact resistant materials available. If the scale is of a type having main levers or parts of the bearing assemblies that hang below the bases of the main lever stands, the piers shall be provided with recess of a size to give a minimum clearance of 1.5 in. (4 cm) and so formed as to prevent accumulation of foreign matter.

b. 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.

2.22.11 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.

2.22.12 ANCHOR BOLTS (AMENDED 2006)

a. Lever stands shall be secured with a minimum of two anchor bolts.

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

c. 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.

d. 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.

e. Anchor bolts utilizing an epoxy type anchoring system shall include a threaded or swaged anchor rod and a suitable epoxy bonding material. The installation of the anchor bolt shall be completed in strict accordance with the procedures as specified by the manufacturer of the anchoring system.

2.22.13 FLOATING LEVERS

Floating levers shall be anchored to the foundation to resist no less than twice the uplift produced by the capacity live load.

2.22.14 DECK-BEAM SUPPORTS

The structural-steel, deck-beam support bearings shall be set in each side wall of the pit with the center of the bearings no less than 6 in. (15 cm) from the inside face of the pit wall.

2.22.15 WEIGHBEAM FOUNDATIONS

The pillars supporting the weighbeam shelf shall rest upon a reinforced-concrete floor, steel beams, or reinforced-concrete beams. The pillars and supporting beams, if used, shall be independent of the scale house floor, if it is of timber. When necessary to install the weighbeam in a building other than a regular scale house, the pillar support shall rest on the floor if capable of carrying the load without settlement or on foundations independent of the building.

2.22.16 VENTILATION

All scale pits shall be ventilated to meet the needs of each particular case to minimize the relative humidity in the pit and to retard corrosion of scale parts and structural steel.

2.22.17 ENTRANCE TO SCALE PIT

Suitable access to the scale pit shall be provided. The entrance shall be closed by a suitable closure fastened to prevent the entry of unauthorized persons.

2.22.18 SAFETY PIERS

Suitable piers, columns, or other supports should be provided to prevent excessive drop of the girders if there should be a failure of other scale parts. Clearance should be maintained at fullscale capacity.

2.22.19 BEARING PRESSURES UNDER FOUNDATIONS

The bearing areas of the foundation footings shall be such that the pressure under the footings will not exceed:

For fine sand and clay	4,000 lb/ft^2
For coarse sand and gravel or hard clay	6,000 lb/ft^2
For boulders or solid rock	20,000 lb/ft^2

If the soil does not have a bearing capacity of at least 4,000 lb/ft^2 and its bearing capacity cannot be increased by drainage, stabilization, or other means, pile foundations shall be provided. Careful soil exploration, including borings, is always desirable.

SECTION 2.23 SETTING OF THE SCALE

2.23.1 FASTENING OF STANDS

After aligning the lever stands, the anchor bolt holes shall be filled with non-shrink grout, washers applied to the anchor bolts, and the nuts tightened appropriately for the anchor bolt diameter.

2.23.2 LEVELING

All levers shall be level and connections plumb. Load-cell assemblies shall be raised or lowered, as required, by means of leveling screws, shims or other methods to bring the weighbridge into level transversely and on grade longitudinally. After leveling the load cell base plates, to a tolerance of not more than 0.015 in./ft (1.25 mm/m), they shall be grouted as required.

SECTION 2.24 SCALE HOUSE

2.24.1 SCALE HOUSE DESIGN (AMENDED 2013)

The scale instrument shall be installed in a suitable equipment bungalow or building providing sufficient environmental protection for the instrument, maintainer, and scale operator. For attended scales, there shall be an unobstructed view of the railcar being weighed and of approaching traffic. For unattended scales, there shall be a simple means of communications from the weighbridge to instrument locations.

2.24.2 LOCATION

The lateral clearance between the scale house and centerline of scale or any track shall not be less than 8 ft (2.5 m), unless otherwise required by law, or the serving railroad.

2.24.3 INDICATOR-RECORDER SHELF

If a shelf is required for mounting the indicator and/or recorder, it shall be so located as to provide for ease of operation without obscuring the weigher’s view of the scale deck and approaching cars or trucks. The shelf must not limit ready access to the instrument for maintenance purposes.

2.24.4 CLEARANCES

Weighbeam Shelf. A clearance of not less than 1 in. (25 mm) shall be provided between the inside of the scale house and weighbeam supports and shelf.

SECTION 2.25 WEIGHT INDICATORS AND RECORDING DEVICES (AMENDED 2012)

2.25.1 INTRODUCTION

These specifications cover electronic weight indicators and recording devices, including the following:

a. Weight indicators where data processing is limited and related to weighing

b. Virtual Weight Indicators where weight processing is done as part of a more complex computing system

NOTE: Mechanical Indicator specifications (last documented in the 2011 *AAR Scale Handbook*) were removed due to reduced market presence.

2.25.2 CAPACITY

The nominal capacity of the electronic weight indicator shall not exceed the nominal capacity of the weighing system.

2.25.3 GRADUATIONS OR DIGITAL INCREMENTS

The value of a scale division (d) expressed in a unit of weight shall be equal to 1, 2, or 5, or a decimal multiple of 1, 2, or 5.

2.25.4 HOUSING

All electronic weight indicators and recording devices shall be contained in a suitable housing for protection from the environment.

2.25.5 MARKING REQUIREMENTS

As a minimum, electronic weight indicators shall be marked with the following:

a. Manufacturer’s name or manufacturer’s trademark

b. Model and/or part number

c. Nominal capacity

d. Scale division

e. Section capacity

f. Non-repetitive serial number

2.25.6 SEALING OF ADJUSTABLE COMPONENTS ON ELECTRONIC DEVICES

An adjustable component on an electronic device that can affect the metrological performance of the device (except zero adjustment) shall be held securely in adjustment and shall not be adjusted without breaking a mechanical security seal or creating a permanent record in an approved electronic audit trail. When a security seal has been broken or the calibration or other metrologically significant parameter has been changed, it shall be reported to the testing authority.

2.25.7 ZERO INDICATION

A provision shall be made to either indicate or record a zero balance condition.

2.25.8 ZERO MECHANISMS

a. A semi-automatic zero-setting mechanism shall be operable only when the indication is stable within ±3 scale divisions.

b. Any automatic zero-tracking mechanism must be disabled during the static testing of the scale.

2.25.9 ELECTRONIC MOTION DETECTION

The recording of weight values from an electronic weight indicator shall be prohibited until the indicator is stable within ±3 scale divisions.

SECTION 2.26 LOAD CELL SCALES

2.26.1 BEARING SURFACES

a. Convex surfaces of a load cell or its extension in contact with the bearing surface shall be steel hardened to Rockwell C50-55.

b. Bearing plates in contact with convex loading surface(s) of a load cell or its extension shall be steel hardened to Rockwell C50-55. The minimum thickness of the plate(s) shall be as shown below. In addition to the bearing plates, a mounting plate of A36 steel shall be provided above and below the load cell with the minimum thickness shown in Table 2-4.

Table 2-4. Mounting Plate Thicknesses

Load Cell Capacity		Bearing Plate Thickness		Upper Mounting Plate Thickness		Lower Mounting Plate Thickness	
lb	**(kg)**	**in.**	**(cm)**	**in.**	**(cm)**	**in.**	**(cm)**
50,000	(22,700)	0.75	(2)	0.75	(2)	1.50	(4)
100,000	(45,400)	1.00	(2.6)	1.00	(2.6)	1.50	(4)
200,000	(90,700)	1.50	(4)	1.00	(2.6)	1.50	(4)
300,000	(136,000)	2.00	(5)	1.50	(4)	1.50	(4)

2.26.2 CLEARANCES

Clearances shall be provided between anchor bolts so that load cells can be changed with minimum jacking of the weighbridge.

2.26.3 LINEARITY

The output characteristics of a load cell shall be linear within ±0.05% of the “best fit” to the calibration curve representing a plot of voltage or pressure output versus load applied.

2.26.4 TEMPERATURE CHARACTERISTICS

Load-cell characteristics shall be stable with respect to the temperature within the following limits:

a. Zero shift shall not exceed 0.0015% of full-scale output per degree Fahrenheit.

b. Span calibration shall not change more than 0.0008% per degree Fahrenheit.

2.26.5 LOAD CELL OVERLOAD CHARACTERISTICS (AMENDED 2013)

Load cells shall be designed to withstand loads up to 150% of their rated capacity without change in weighing performance. Load cells shall be designed to withstand loads up to 300% of their rated capacity without structural failure.

2.26.6 MOISTURE PROTECTION

Load cells shall be sealed hermetically to prevent moisture penetration.

2.26.7 CORROSION

Load cells shall be provided with a finish that will be corrosion-resistant under normal pit conditions.

2.26.8 POWER SOURCE (AMENDED 2013)

The power source of the electronic instrumentation and load cell circuitry shall conform to the following:

a. The power source shall reliably provide the voltage specified by the manufacturer.

b. With AC supplies, the frequency shall be stable within the manufacturers' specification. One side of the AC power source shall be at earth ground potential.

c. Power surge protection shall be provided for load cells and instrumentation circuits.

d. Adequate shielding should be provided to eliminate radio frequency and electromagnetic interference. The scale must satisfy the weighing tolerance requirements when the scale equipment is subjected to RFI and EMI influences.

2.26.9 CABLING

All cabling between load cells, junction boxes, and electronic instrumentation shall conform to the following:

a. All cables shall be electrostatically shielded.

b. All cable shields shall be interconnected and carried to a single ground. This should be a separate ground from the power source ground and be provided for the load cells and instrumentation circuits only. It should be a copper rod which, when possible, is driven to the depth of the water table.

c. The connection between the ground rod and the common ground point of the load cell and the instrumentation circuits shall be made with copper wire, or the equivalent, of No. 10 gauge or larger.

d. All cable shields in the load-cell circuits shall be grounded at one end only.

e. All cables shall be insulated with materials having good non-hygroscopic qualities and stable capacitance between conductors.

f. Load-cell cables shall be physically separated from power cables and never run in the same conduit system.

g. All cable connections, junction boxes, etc., in the load-cell circuits shall be properly protected against the entrance of moisture.

h. All multi-conductor cabling shall be color-coded or provided with other means of identification of the individual conductors

i. Cables from the load cells to the first junction box shall be in one unspliced length. Junction boxes shall be located near the top of the pit but not on the weighbridge. Cabling from the first junction box to a common master junction box shall be in one length unspliced.

2.26.10 TUBING

All tubing between each hydraulic load cell and readout instrumentation should conform to the following:

a. Tubing should be of copper or stainless steel and of a size and bore to give such responses as will meet the performance requirements of the installation.

b. Tubing should be housed in conduit or otherwise protected from mechanical damage.

c. Tubing connections must be of a type and quality that will preclude any possible leakage.

d. All hydraulic connections should be located to insure ease of inspection.

2.26.11 MARKING REQUIREMENTS (AMENDED 2011)

As a minimum, load cells shall be marked with the following:

a. Manufacturer’s name or manufacturer’s trademark

b. Model and/or part number

c. Nominal capacity

d. Non-repetitive serial number

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Part 3

Specifications for the Design and Installation of Low Profile, Pitless, and Instrumented Railway Track Scales

— 2013 —

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SECTION 3.1 GENERAL

The following specifications apply to railway track scales which require no pit entrances for maintenance. Applicable specifications in Part 1, Specifications for the Location, Maintenance, Operation, and Testing of Railway Track Scales and Part 2, Basic Specifications for the Manufacture and Installation of Railway Track Scales of this handbook will apply to track scale systems used for revenue service. Revenue scales shall meet or exceed applicable NTEP requirements.

NOTE: An Instrumented Rail Scale is construed as one where the rail is the weight sensing element.

SECTION 3.2 DESCRIPTION

As a general rule, low profile, pitless, and instrumented rail track scales are manufactured in modules and may be installed as a single weigh module or as multiple weigh modules using a combination of modules.

SECTION 3.3 CAPABILITIES

The multiple module scale, including those with spaces between modules, shall be treated as a single scale.

SECTION 3.4 BALLAST SUPPORTED SCALES

Ballast supported scales shall not be used in revenue service. Size and type of ballast to be approved by the Chief Engineer of the serving railroad. Unprepared ballast will not be used for railroad track scales.

SECTION 3.5 SOIL BEARING CAPACITY FOR BALLAST SUPPORTED SCALES

3.5.1 It is the objective to prevent the accumulation of water or other foreign material in the scale subgrade or the scale structure which could degrade or compromise the vertical relationship of the scale elements, lead to uneven settlement under traffic, or degrade function and performance.

3.5.2 If ground water is encountered at the proposed scale site and subgrade is saturated, alternate scale locations should be investigated. If alternate locations are not available, manufacturer's specifications must be followed with the supervision of a competent Soils Engineer. Solutions to soil bearing problems or saturated areas may require over excavation and emplacement of engineering fabrics, the use of an engineered aggregate base as backfill, the design and installation of a drainage system for the entire scale site or a combination of all three. In unsuitable soils as described above, it is mandatory that the entire process be supervised by a competent Soils and/or Foundation Engineer.

SECTION 3.6 APPROACHES FOR BALLAST SUPPORTED SCALES

Approach foundation requirements shall be the same as required for the scale.

SECTION 3.7 SCALE STABILIZATION FOR BALLAST SUPPORTED SCALES

3.7.1 Adequate means shall be provided to ensure scale stabilization, effectively tieing the scale to the ballast or foundation elements with suitable restraining devices.

3.7.2 Rail ties, for Instrumented rail scales, shall be box anchored 25ft (8 m) either side of weigh modules.

SECTION 3.8 MULTIPLE MODULE SCALE INSTALLATIONS

All scale weigh modules and their approaches shall be installed and maintained in horizontal and vertical alignment with each other.

SECTION 3.9 INSTRUMENTED RAIL TRACK SCALES

3.9.1 Rail scale sections shall be securely attached to the adjoining track to ensure that track integrity is maintained. standard rail joint bars, thermite welds, or other approved methods shall be used.

3.9.2 Spacing between rail supports shall be such as to ensure that rail stresses under normal use shall not exceed 25,000 psi (170 mPa). Maximum permissible spacing is dependent on many factors and shall be subject to approval by the chief engineer of the serving railroad.

SECTION 3.10 WEATHER PROTECTION

In regions with snow and ice, means shall be provided to prevent the accumulation of snow and ice between weighing and non weighing elements.

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Association of American Railroads

Safety and Operations

Part 4

Rules for the Manufacture, Installation, Location, Operation and Testing of Railway Master Track Scales

— 2013 —

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NOTE: Railway master track scales are high precision weighing instruments that are employed to calibrate Track Scale Test Weight Cars. These scales provide the link in traceability between the National Institute of Standards and Technology (NIST) and railway track scales, used to weigh railway cars, that is necessary under State laws. Such scales cannot be used to perform routine weighing of railway cars and must not be expected to perform any service except that for which they are designed and intended.

SECTION 4.1 MANUFACTURE AND INSTALLATION

4.1.1 Master track scales shall be of the mechanical type, manufactured and installed essentially as specified for revenue track scales in Part 2, Basic Specifications for the Manufacture and Installation of Railway Track Scales of this manual.

4.1.2 The scale shall be of sufficient capacity to accommodate the heaviest anticipated test load.

4.1.3 The weighbeam shall have a capacity equal to that of the scale minimum graduations of 2 lb (1 kg) or less.

4.1.4 The weighbridge design shall be such that the maximum deflection in the main girders or main beams shall not exceed $\frac{1}{1200}$ of the span between sections.

SECTION 4.2 LOCATION

4.2.1 Master track scales should be conveniently located to minimize haul, switching, and delays and afford ease of access for testing and maintenance.

4.2.2 Access and sufficient tangent track shall be provided on either side of the scale.

4.2.3 The approach track on either side of the scale shall be level and without joints for a distance of 20 ft (6 m). The gaps between the weigh rails and the approach rails shall be not less than ⅛ in. (4 mm) nor more than ⅜ in. (10 mm).

4.2.4 A master track scale must be housed inside a building to protect it from the elements with provisions for adequate ventilation and temperature control.

SECTION 4.3 LENGTH

The scale should be of sufficient length to accommodate the longest test car.

SECTION 4.4 SCALE PIT

A pit shall be provided with easy access, ample lighting, sufficient head room, adequate ventilation and means for removing water to maintain a dry pit.

SECTION 4.5 MAINTENANCE AND REPAIRS

4.5.1 Required maintenance which may affect the calibration of the scale should be performed just prior to the scheduled test or after the as-found test.

4.5.2 All maintenance of the scale should be performed under the supervision or authority of the person in charge of the scale.

4.5.3 Repairs should be made as needed. Following any repairs, arrangements should be made, as soon as possible, to schedule a reverification test.

SECTION 4.6 HOUSEKEEPING

4.6.1 The master track scale should be kept in the best of condition at all times.

4.6.2 The scale and associated area must not be used for storage or as a place of work, other than weight adjustment of a test car. Maintenance or repairs of test cars, or other equipment, while on the scale is prohibited.

SECTION 4.7 TESTING AND CALIBRATION (1996)

4.7.1 All railway master track scales should be tested, at least once each year, by an agency that has been delegated this responsibility. The agency shall maintain documents certifying that all test standards are traceable and in compliance with specifications and tolerances set forth by the National Institute of Standards and Technology (NIST). All railway master track scales shall be tested and certified with approved standards complying with the above.

4.7.2 The test and/or calibration shall be conducted in accordance with the test and calibration procedures of NIST and the United States Department of Agriculture—Grain Inspection and Packers and Stockyards Administration (USDA—GIPSA).

4.7.3 Tolerance for railway master track scales shall be those listed in Table 4-1, which were adopted by the National Institute of Standards and Technology and those contained in the publications listed in 4.7.2. The tolerances are applied to the respective maximum errors developed under the test load, applied on a 5 ft (1.524 m) wheelbase and spotted at five equidistant positions along the weigh rail.

Table 4-1. Master Track Scale Tolerances

Test Load		Tolerance		Adjustment	
lb	(kg)	lb	(kg)	lb	(kg)
60,000	(27,240)	10.4	(4.72)	5.2	
70,000	(31,780)	–		5.6	
80,000	(36,320)	12.0	(5.45)	6.0	
90,000	(40,860)	–		6.4	
100,000	(45,360)	–		6.7	

4.7.4 The tolerances on counterpoise weights (Table 4-2), used on master scales, have been adopted by the National Institute of Standards and Technology:

Table 4-2. Counterpoise Weight Tolerances

Weight		Tolerance	
lb	**(kg)**	**grains**	**(mg)**
20	(9.072)	6	(390)
10	(4.536)	4	(260)
8	(3.629)	3	(190)
5	(2.268)	3	(190)
4	(1.814)	2	(130)
2	(0.907)	1.5	(97)
1	(0.454)	1.0	(65)

SECTION 4.8 FIELD CALIBRATION OF TRACK SCALE TEST WEIGHT CAR (AMENDED 2011)

When a test weight car cannot be calibrated on a master track scale due to logistical or mechanical constraints, the car owner may request that the appropriate agency perform a field calibration of the test weight car on a single draft static weighing mechanical track scale. In such instances, the scale chosen will be prepared by the testing agency utilizing rules of the National Institute of Standards and Technology (NIST) and the United States Department of Agriculture—Grain Inspection and Packers and Stockyards Administration (USDA—GIPSA).

NOTE: The practice of control described in this section applies within the boundaries of the United States. In Canada and Mexico, the practice shall be amended as required by law or regulation in the respective National jurisdictions or their civic subdivisions.

Part 5

Vehicle Scales

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SECTION 5.1 GENERAL

a. The purpose of these rules is to establish recognized requirements for vehicle scales other than railroad track scales.

b. All scales represented as complying with this recommendation shall meet all of the requirements.

c. Vehicle scales may be mechanical, analog, digital or a combination thereof.

d. All vehicle scales shall meet the specifications and requirements of the National Institute of Standards and Technology (NIST), Handbook 44, and State laws for the jurisdiction in which the scale is located.

e. Vehicle scales shall have valid NTEP Certificates of Conformance.

f. All vehicle scales shall be equipped with indicating and recording elements.

SECTION 5.2 FOUNDATION REQUIREMENTS

A scale foundation must provide the following properties:

a. Adequate strength to resist pressures from earth and traffic.

b. Adequate bearing area to provide a minimum soil bearing capacity as follows:

(1) Reinforced[1] pier type (non-reinforced floor), soil-bearing capacity of 3,000 lb/ft^2 (140 kPa).

(2) Reinforced[1] full floor slab (full reinforced floor), soil-bearing of 1,500 lb/ft^2 (70 kPa).

c. Adequate drainage.

d. Adequate access to scale mechanism for proper servicing.

5.2.1 REQUIREMENTS FOR PIT TYPE FOUNDATION

a. The minimum pit depth, measured from the bottom of the weighbridge structure to the floor of the pit, should be:

(1) 24 in. (600 mm) for load cell or two section lever-type vehicle and axle load scales.

(2) 32 in. (800 mm) for three or more section lever-type scales.

b. Entrance to Pit

(1) A minimum of one opening shall be provided in the scale platform, pit neck covering, or pit wall to provide access to the pit; except that two openings shall be provided in the platform for scales with platforms longer than 40 ft (12 m).

(2) Openings in the scale platform or pit neck cover may be either a circle of not less than 24 in. (600 mm) in diameter or a square with at least 22 in. (560 mm) sides. A suitable cover shall be provided.

[1] One which has sufficient rods to prevent cracking from unequal temperatures.

(3) An entrance through a pit wall should be a minimum of 3 ft (1 m) wide. The top of the opening shall not be lower than the bottom of the main girders and the bottom of the opening shall be approximately even with the floor. The centerline of any lever extending through a pit wall opening should be at least 27 in. (700 mm) from one side of the opening.

c. Walls and Piers

(1) Main load bearings shall be of reinforced concrete not less than 12 in. (300 mm) thick poured to a depth of not less than the local frost line. Steel perimeter coping angles shall be installed around the inside edge of the top of the pit walls.

5.2.2 APPROACHES

a. On the approach end or ends of a scale there shall be a straight approach as follows:

(1) At least the width of the platform and at least one-half the length of the platform but not required to be more than 40 ft (12 m).

(2) Not less than 10 ft (3 m) of any approach adjacent to the platform shall be constructed of durable material to ensure that this portion remains smooth and level and in the same plane as the platform.

5.2.3 GROUT

a. Lever stands or load cell base plates shall be properly leveled, and grouted if necessary, to provide even distribution of the load over the full surface of the stands or plates.

b. Load cell base plates shall be leveled to a tolerance of not more than 0.015 in./ft (1.25 mm/m) with consideration to leveling the weighbridge transversely and on grade longitudinally.

5.2.4 PIERS

a. Piers must support the combined loads applied by the weight of the scale, the weighbridge, plus the maximum anticipated load on the scale so that any settlement shall be uniform throughout the structure.

5.2.5 ANCHOR BOLTS

a. A minimum of four anchor bolts shall be used for load cell base plates where the design creates an uplift or sheer reaction to the anchor bolts.

b. The anchor bolts referenced in 5.2.5.a shall be not less than 7/8 in. (22 mm) in diameter and shall be embedded at least 8 in. (200 mm) in a concrete foundation. Anchor bolts shall have hooks or plates embedded at least 6 in. (150 mm) below the finished concrete bearing surface.

5.2.6 SAFETY PIERS

a. Safety piers or other devices shall be provided which will restrict the vertical movement of the weighbridge to no more than 2 in. (50 mm) or less in case of failure of a scale member.

5.2.7 FOUNDATION COPING (PIT COPING) AND MISCELLANEOUS

a. Forming of pit walls shall provide for a structural steel angle iron frame to form the pit opening. The angle shall be at least 2 in. × 2 in. × 1/4 in. (50 mm × 50 mm × 6.35 mm) and shall have welded projections to provide anchoring in the concrete at 4 ft (1.25 m) intervals (maximum).

b. It is highly recommended that this frame be welded at the joints to prevent minor cracking of the pit walls that will otherwise occur.

c. The foundation and supports of any scale installed in a fixed location shall be such as to provide strength, rigidity, and permanence of all components, and clearance shall be provided around all live parts to the extent that no contacts may result when the load-receiving element is empty and throughout the weighing range of the scale.

SECTION 5.3 CAPACITY AND SIZE

The vehicle scale concentrated load capacity (Dual Axle Capacity) and weighbridge size must be suitable for the normal traffic vehicle configuration and axle loads using the scale. The concentrated load capacity shall be no less than 125% of the heaviest axle load. The Concentrated Load Capacity (CLC) is defined as a capacity rating of a vehicle, axle load, or livestock scale, specified by the manufacturer, defining the maximum load concentrated for which the weighbridge is designed. In the case of vehicle and axle load scales, it is the maximum axle load concentration (for a group of two axles with a centerline spaced 4 ft (1.2 m) apart and an axle width of 8 ft (2.4 m) for which the weighbridge is designed as specified by the manufacturer. The concentrated load capacity rating is for both test and use.

5.3.1 WEIGHBRIDGES

a. Main girders for weighbridge~~s~~ shall not deflect more than 1/600 of the span at mid-point when loaded to the rated concentrated load capacity (Dual Axle Capacity).

SECTION 5.4 TESTING PROCEDURES AND TOLERANCES

Testing procedures and tolerances must meet the requirements of the jurisdiction in which the scale is located.

SECTION 5.5 SECURITY MEANS

a. Provision shall be made for applying a security seal in a manner that requires the security seal to be broken before an adjustment can be made to any component affecting the performance of an electronic device.

b. A device shall be designed with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that affects the metrological integrity of the device can be made to any electronic mechanism.

SECTION 5.6 MARKING REQUIREMENTS

All scales manufactured after January 1, 1986, must be marked with the accuracy class designation, nominal capacity, concentrated load capacity, scale division “d,” and verification scale division “e” if different than “d,” clearly on the device. Unless temperature range is 14 °F to 104 °F (–10 °C to 40 °C), the temperature range must be conspicuously marked.

SECTION 5.7 GRADUATIONS OR DIGITAL INCREMENTS

The value of a scale division “d” expressed in a unit weight shall be equal to

(1) 1, 2, or 5; or

(2) a decimal multiple or submultiple of 1, 2, or 5; or

(3) a binary submultiple of a specific unit of weight.

SECTION 5.8 SCALES EQUIPPED WITH AN AUTOMATIC ZERO-TRACKING MECHANISM (AMENDED 2012)

Under normal operating conditions when scale is empty, the maximum weight that can be “zeroed” when it is placed on or removed from the weighing platform all at once shall be three scale divisions. The automatic zero-tracking mechanism must be disabled during static testing of the scale.

SECTION 5.9 SEMI-AUTOMATIC ZERO SETTING MECHANISM

A semi-automatic zero setting mechanism shall be operable only when the indication is stable within plus or minus three scale divisions.

SECTION 5.10 MANUAL ZERO SETTING

A manual zero setting mechanism shall be operable or accessible by a tool outside of and entirely separate from this mechanism, or enclosed in a cabinet.

SECTION 5.11 ELECTRONIC MOTION DETECTION

The recording (printing) of weight values from electronic indicating elements will be prohibited until the indicator is stable within plus or minus three scale divisions; or device is equipped with averaging circuits that have been tested and found to meet applicable tolerances.

SECTION 5.12 POWER SOURCE

The power requirements of the electronic instrumentation and load cell circuitry for electronic scales must conform to applicable regulatory requirements and codes; and the scale must satisfy the tolerance requirement when scale equipment is subjected to RFI and EMI influences which may exist during normal scale operation.

Part 6

Hopper Type Scales

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SECTION 6.1 GENERAL (1999)

Hopper type scales shall include hopper scales, bulk weighers, and tank scales.

a. Hopper scales may be mechanical, electronic, or a combination of each. They shall register a zero condition before and after use and shall register the net weight of the contents of the weigh hopper.

b. Bulk weigher scales may be mechanical, electronic, or combination of each. They shall register the weight of the empty weigh hopper and the gross weight of the weigh hopper and its contents at each draft.

c. All hopper type scales must meet the specifications and requirements of the jurisdiction in which the scale is located. Additionally, grain scales must comply with items of this document that specifically refer to grain scales.

d. Tank scales, for all practical purposes, shall be considered the same as bulk weighers, except that they shall weigh liquids or very fine dry material such as flour.

e. Hopper scales must be NTEP approved.

SECTION 6.2 RULES FOR THE LOCATION, MANUFACTURE, AND INSTALLATION OF HOPPER SCALES

6.2.1 LOCATION

Hopper type scales should be located so that the discharge is by gravity; or if such scales are so situated where material must be conveyed or pumped from the discharge, such an operation should be so constructed to insure that it will not interfere with the weighing operation or permit loss of material.

6.2.2 FOUNDATION

a. The supporting structure for a hopper type scale shall extend up from the main foundation of the building and shall, insofar as practicable, be rigid, integral, and free from all secondary vibrations under normal conditions of operation. The immediate support for the scale shall be the scale floor with a minimum of openings through which air current may flow to disturb the balance condition of scale.

b. Where hopper type scales are located in other than concrete structures, either within a multiple purpose building or in a separate structure, the scale system shall be supported by an adequate steel structure resting on a suitable foundation or footings. The structure shall be free of secondary vibrations and interference from all other operations. Where located as a separate structure, the entire system shall be enclosed to prevent adverse effects on the scale's balance by air currents.

c. A hopper type scale shall not be installed in a bin, over an open bin or open pit, or on bin cribbing.

6.2.3 WEIGH HOPPERS AND GARNERS

a. Must be of substantial construction, preferably of steel, and shall be braced as necessary to prevent distortion under load. In concrete elevators, garners may be constructed of reinforced concrete.

b. They shall be self-cleaning of any type material handled through them.

c. The bottoms shall be so formed or the valleys so filled, that sharp v-valleys will be avoided. The slope of valley angles shall not be less than 36° in the weigh hopper and 40° in the garner.

d. Gates shall be tight and shall operate freely. When manually operated, devices for opening and closing the gates should be located on the control side of the hopper.

6.2.4 WEIGHBRIDGES

a. Weighbridges shall be of steel and be so designed and constructed that the tops of the main load bearing assemblies may be bolted to it in proper alignment. Insofar as practicable, the hopper supports shall transmit the load to the weighbridge vertically over the main load knife-edges or load cells of the scale. The design and assembly of the hopper and weighbridge on the scale system shall produce, as nearly as may be, equal distribution of the load to the main bearings or load cells of the scale, without measurable tendency to alter the horizontal alignment as a result of normal filling or emptying of the hopper or application or removal of test weights.

b. When weighbridges are not used but the weigh hopper is resting on load cells, the load bearing supports and related structure shall comply in principle with the provisions contained in (a) above.

c. When weigh hoppers are hung from pipe or torsion levers, the principles expressed in (a) above shall be followed.

d. When a load cell is affixed to the lever system to provide an electronic readout, adequate support shall be provided.

e. Adequate provision for anchoring lever fulcrum stands and shelf pillars shall be provided. The design shall permit reasonably convenient removal of the scale parts for reconditioning and servicing.

6.2.5 WEIGHT INDICATING ELEMENT LOCATION

a. Beams shall be located adjacent to the weigh hopper so that not more than one extension lever is required between the shelf lever and the load receiving levers, “Right hand” beams are preferred.

b. Mechanical dial indicating elements should be located as near as practical to the weigh hopper with no more than one extension lever being utilized between the lever system and the dial.

c. Dial heads, printers, and all equipment cabinets must be purged with clean dry air of 2 to 3 psi (14 to 21 kPa) (or as the manufacturer recommends); or such equipment may be placed in a dust-free, air-purged room.

d. All electronic scale components, except load cells and cabling, must be placed in a dust-free, air-purged, temperature-controlled room as the manufacturer or serving rail carrier recommends.

6.2.6 CLEARANCES

A clearance of at least 6 in. (150 mm) shall be provided around all weigh hoppers and sufficient clearance shall be provided to allow easy access to all parts.

6.2.7 AIR DISPLACEMENT

A method must be employed to remove air displaced when material enters or leaves the weigh hopper, garner, or surge bin. This may be accomplished with the use of vent stacks (vented to atmosphere), socking or inner connected ductwork between the garner, weigh hopper, and surge bin, provided the uppermost portion of the ductwork is vented to a vent stack to the atmosphere. Movement of air must not affect the scale's weighability.

NOTE: In instances where high speed elevating legs are used to convey material to garners or weigh hoppers, a tremendous amount of air pressure is generated for which normal venting is not adequate. In these cases the top of the elevating leg must be vented to relieve the pressure.

6.2.8 CANVAS DUST GUARD

When canvas or similar material is used to enclose the opening between the garner and weigh hopper and the lower surge bin, it shall be attached only at the top and weighted at the bottom; or it may be secured at both top and bottom if it does not cause a binding condition or entrap material.

6.2.9 DUST CONTROL SYSTEM

When federal, state, or insurance regulations prevent venting to the atmosphere or the use of socking, a dust control system may be attached to the venting only if a pant leg connection is placed in the duct work or stack. Dust eradication equipment must not be directly connected to the garner, weigh hopper, surge bin, or elevating leg.

NOTE: A pant leg connection is a section of duct inserted for a short distance into a bell like section of another duct, the diameter of which is such that a free space is created around the smaller of the two, equal to three times its diameter. This allows free movement of air into the dust system and creates neither positive nor negative pressures within the scale system.

6.2.10 CAPACITY AND SIZE

a. Scales for weighing other than grain, grain products, agricultural products, feed and feed ingredients shall be of at least 5,000 lb (2,250 kg) capacity.

b. Scales for weighing grain, grain products, agricultural products, feed, and feed ingredients shall be of the following capacity:

   (1) Hopper scales shall be of at least 50,000 lb (22,500 kg) capacity.

   (2) Bulk weigher scales shall be of at least 5,000 lb (2,250 kg) capacity.

   NOTE: Capacity should be based on cubical capacity of wheat per bushel.

c. Beam scales shall utilize full draft beams. For mechanical hopper scales over 10,000 lb (4,500 kg), scale divisions shall be increased in multiples of 1, 2, or 5 not to exceed 10,000 scale divisions.

d. Garners should be of at least the same capacity as that of the weigh hoppers, unless a high speed system is used to convey material with sufficient speed and quantity to warrant a smaller garner.

SECTION 6.3 RULES FOR MAINTENANCE, OPERATION AND TESTING

6.3.1 MAINTENANCE AND OPERATION

Scales must be maintained and operated in accordance with the manufacturer's instructions, and any special provisions of the serving rail carrier or its agent.

6.3.2 EQUIPMENT FOR TESTING

It shall be the responsibility of the scale owner to provide suitable and approved test weights as well as the means of placing such weights on the weigh hopper.

NOTE: In some instances, it is more practical to suspend test weights from chains, cables or rods. In such cases it shall also be the scale owner's responsibility to provide the means of suspension and to attach the test weights thereto.

6.3.3 MAINTENANCE AND TRANSPORTATION OF TEST WEIGHTS

All test weights must be correctly sealed and approved.

a. When moving test weights into or out of a scale area, care must be exercised not to damage them in any way. Damaged test weights must not be used.

b. All test weights for each location or hopper shall be identified by serial number.

c. Where approved test weights remain in one location, are only moved vertically during the test, and are protected from physical abuse or exposure to corrosive elements, the time period for resealing or recertification of the weights may be extended to 5 years. The weights may be recertified on a rotation basis, by serial number each year, as long as no individual weight certification exceeds 5 years; however, if any of the weights are found to be out of tolerance, all tests weights shall be checked and recertified at that time.

d. In every case, provision must be made to remove all testing equipment from the scale area when necessary.

6.3.4 TESTING

Hopper type scales should be tested at least twice a year, utilizing approved test weights, by the substitution or step test method to capacity.

a. Tolerances must meet the requirements of the jurisdiction in which the scale is located.

b. The printed weight indication shall be considered the primary weight indicating element and all test results will be based on such indications.

6.3.5 RECORDS

a. Bulk weigher scale records shall consist of printed tapes indicating the tare weight of the empty weigh hopper and the gross weight of the filled weigh hopper at each draft. A printout indicating cumulative net weight shall be provided at the end of each weighing transaction.

b. Scale tickets and/or scale tapes shall be maintained on file in a clear and systematic manner so that they may be easily located. Scale tickets and/or tapes constitute the original weight records and must be carefully preserved for the length of time prescribed by applicable laws or rules.

6.3.6 SECURITY MEANS

An adjustable component on an electronic device that can affect the performance of the device (except zero adjustment) shall be held securely in adjustment, and shall not be capable of adjustment without breaking a security means. When a security means is broken, it shall be reported to the certifying authority.

SECTION 6.4 MARKING REQUIREMENTS

All scales manufactured after January 1, 1986, must be marked with the accuracy class designation, nominal capacity, scale division “d,” and verification scale division “e” if different than “d,” clearly on the device. Unless temperature range is 14 °F to 104 °F (–10 °C to 40 °C), the temperature range must be conspicuously marked.

SECTION 6.5 GRADUATIONS OR DIGITAL INCREMENTS

The value of a scale division “d” expressed in a unit of weight shall be equal to

a. 1, 2, or 5; or

b. a decimal multiple or submultiple of 1, 2, or 5; or

c. a binary submultiple of a specific unit of weight.

SECTION 6.6 ZERO SETTING MECHANISMS

6.6.1 SCALES EQUIPPED WITH AN AUTOMATIC ZERO-TRACKING MECHANISM (AMENDED 2012)

Under normal operating conditions when scale is empty, the maximum weight that can be “zeroed” when it is placed on or removed from the load receiving element all at once shall be two scale divisions. The automatic zero-tracking mechanism must be disabled during the testing of the scale.

6.6.2 SEMI-AUTOMATIC ZERO SETTING MECHANISM

A semi-automatic zero setting mechanism shall be operable only when the indication is stable within plus or minus three scale graduations.

6.6.3 MANUAL ZERO SETTING

A manual zero setting mechanism shall be operable or accessible by a tool outside of and entirely separate from this mechanism, or enclosed in a cabinet.

SECTION 6.7 ELECTRONIC MOTION DETECTION

The recording (printing) of weight values from electronic indicating elements will be prohibited until the indicator is stable within plus or minus three scale divisions; or device is equipped with averaging circuits that have been tested and found to meet applicable tolerances.

SECTION 6.8 POWER SOURCE

The power requirements of the electronic instrumentation and load cell circuitry for electronic scales must conform to applicable regulatory requirements and codes; and the scale must satisfy the tolerance requirements when scale equipment is subjected to RFI and EMI influences.

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Part 7

Belt Conveyor Scales

(AMENDED 2009)

— 2013 —

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SECTION 7.1 GENERAL

The following is intended to apply to scales installed on belt conveyors for the purpose of weighing bulk materials carried by conveyors to ascertain weights, and to the system to which they are applied and of which they have become a part. Belt-conveyor scales used in railroad applications shall have an accuracy within 0.25%.

SECTION 7.2 CONVEYORS

a. Each belt conveyor on which a scale is located should be rigid in design and so constructed that it is free from vibration and not subject to stress. The conveyor stringers shall be so designed that the deflection between any two adjacent idlers within the weigh area does not exceed 0.025 in. (0.6 mm) under load. The conveyor length should not be longer than 1,000 ft (300 m) or shorter than 40 ft (12 m) from center of head pulley to center of tail pulley.

b. Each belt conveyor on which a belt-conveyor scale is located should be equipped with an adequate gravity take-up so as not to allow slippage of the belt on the drive pulley and to maintain a constant tension from empty to maximum rated capacity.

c. The belt conveyor on which the belt-conveyor scale is located should be free from interference from all other operations but in no way shall exceed an angle such that slippage of material along the belt may occur. The belt conveyor incline shall not exceed 18°. There shall be provisions to ensure that weighed material does not adhere to the belt and return to the scale system area.

d. All conveyor belt scales shall be so installed that a material test can be conveniently conducted.

e. The system should be so designed that the entire content of each individual vehicle may be guaranteed to pass over the scale.

f. The conveyor belt should track centrally through the weigh area. It shall not extend past the edge of the wing rollers under any conditions (loaded or unloaded). Training idlers, when used, shall not be installed any closer than 60 ft (18 m) from the centerline of the scale. The belt shall remain in contact with all idlers in the weighing element area and shall not come in contact with any part of the structure on the return belt side of the conveyor.

g. Alignment verification, as directed by the manufacturer, shall be made when conveyor work is performed in the scale area.

SECTION 7.3 INFEEDS

a. Sufficient impact idlers shall be installed under each infeed to prevent deflection of the belt.

b. All infeed gates, feeders, etc., should be positive in action and so designed that material will flow freely through them when opened or placed in operation. The material shall be deposited onto the center of the belt, so as not to create a side loading condition. The gates shall be positive in their closing action so that leakage does not occur. The scale shall be so installed that the material will have to come to rest on the belt prior to reaching the weighbridge. The first weigh idler of the scale is at least 20 ft (6 m) or five idler spaces, whichever is greater, from the loading point or end of skirt boards. The scale shall be a sufficient distance from skirting to allow proper idler alignment and to allow material to stabilize.

c. A concave curve shall be no closer than 40 ft (12 m) from the nearest scale-mounted idler.

SECTION 7.4 CAPACITY

The system shall be designed and rated so that material flowing over the scale will remain within 20% to 100% of rated capacity.

SECTION 7.5 ACCESS TO SCALE

Adequate and safe access to scale shall be provided. This includes a walkway, step, lighting, etc., so that servicing can be accomplished safely and with ease.

SECTION 7.6 PROTECTION OF SCALES AND INSTRUMENTATION

a. Scales and especially instrumentation should be protected from the elements by weatherproof structures. Control rooms that house instruments should be air purged with air conditioning, fans with filters, heaters, etc., so that a dust-free environment will be created.

b. Scale housing and instrumentation should be securely locked.

c. The load-receiving elements shall be equipped with means for overload protection of not less than 150% of the rated capacity, and overloading shall not affect accuracy of the scale in its normal loading range.

d. The scale and area surrounding the scale shall be kept clean of debris or materials that can detrimentally affect the performance of the system.

SECTION 7.7 WIND SCREENS

Windscreens shall be erected around the entire weigh area when wind may affect scale performance.

SECTION 7.8 GUARDS

a. All “live” portions of the scale shall be protected with appropriate guards and clearances as recommended by the scale manufacturer to prevent accidental interference with the weighing operation.

b. The scale area and five idlers on both ends of the scale shall be of a contrasting color, or other suitable means shall be used to distinguish the scale from the remainder of the conveyor installation. The scale shall be readily accessible.

SECTION 7.9 INTERFERENCE

Hydraulic machinery, large motors, or any equipment that will cause excessive stress or vibration should not be placed in, or affixed to, the scale or control room.

SECTION 7.10 CABINETS

Where scales and component parts are subject to a rapid or extreme change in temperature or humidity, environmental conditioning should be installed.

SECTION 7.11 POWER SOURCE

Provisions shall be taken to protect the equipment from the effects of RFI and EMI influences.

SECTION 7.12 INSTRUMENTATION

a. A belt conveyor scale shall be equipped with a primary indicating element in the form of a master weight totalizer and shall also be equipped with a recording element and a rate-of-flow indicator and recorder. An auxiliary indicator shall not be considered part of the master weight totalizer.

b. A belt conveyor scale shall indicate and record weight units in terms of pounds, tons, long tons, metric tons, or kilograms. The value of the scale division (d) expressed in a unit shall be equal to

(1) 1, 2, or 5; or

(2) a decimal multiple or submultiple of 1, 2, or 5.

c. Permanent means shall be provided to produce an audio or visual signal when the rate of flow is equal to or less than 20% and when the rate of flow is equal to or greater than 100% of the rated capacity of the scale. The type of alarm (audio or visual) shall be determined by the individual installation. The value of the scale division of the recording element shall be the same as that of the indicating element. It shall record the initial indication and the final indications on the master weight totalizer, the quantity delivered, the unit of measurement (e.g., kilograms, tones, pounds, tons, etc.), the date, and the time. This information shall be recorded for each delivery. The belt conveyor scale system shall be capable of recording the results of automatic or semi-automatic zero load tests.

d. The value of the scale division shall be no greater than 0.125% (1/800) of the minimum totalized load.

e. The master weight totalizer shall not be resettable without breaking a security means and shall advance only when the belt conveyor is in operation and under load.

f. The accumulated measured quantity on the master totalizer of an electronic digital indicator shall be retained in memory during a power outage.

g. An adjustable component that can affect the performance of the device (except zero adjustment) shall be held securely in adjustment and shall not be capable of adjustment without breaking a security means.

h. The range of the zero setting mechanism shall not be greater than ±2% of the rated capacity of the scale without breaking a security means. Automatic and semi-automatic zero-setting mechanisms shall be so constructed that the resetting operation is carried out only after a whole number of belt revolutions and the completion of the setting or whole operation is indicated. An audio or visual signal shall alert the operator when the automatic and semi-automatic zero-setting mechanisms reach the limit of adjustment of the zero-setting mechanism.

SECTION 7.13 TYPES OF TESTS DEFINED

7.13.1 OFFICIAL TEST

An official test to certify a belt-conveyor scale system shall include a Zero Load Test, a Material Test, and, if applicable, a Simulated Load Test. This test determines if a belt scale system is acceptable for use by the railroad.

7.13.2 ZERO LOAD TEST

A Zero Load Test is a determination of the error in zero of a belt conveyor while running without material.

7.13.3 MATERIAL TEST

A Material Test is a test of a belt-conveyor scale using material normally conveyed by the belt conveyor. The material used in this test shall be weighed on a reference scale to an accuracy of 0.1%. Material Tests include either Initial Test for new and modified installations or Subsequent Test for routine testing.

a. Initial Test—This test shall be used both for initial verification of the belt-conveyor system and after modification to the belt-scale or conveyor system.

b. Subsequent Test—This test is used to recertify a belt-conveyor system.

7.13.4 SIMULATED LOAD TEST

A Simulated Load Test is a test of a belt-conveyor scale using artificial means of loading to determine the performance of the belt-conveyor scale and shall not be used as the basis to adjust calibration.

SECTION 7.14 SIMULATED LOAD TESTING EQUIPMENT

Simulated load testing equipment includes test chains or test weights. Electronic calibration is not an acceptable simulated load test. Simulated load testing equipment shall be equal to or greater than 60% of the rated capacity of the scale, which cannot be determined by using multipliers.

When the simulated load tests are conducted with test chains, the following will apply:

a. Test chains shall be stored in an area protected from the elements.

b. Test chains shall be maintained and lubricated to ensure that all rollers are free from binds.

c. Test chains track parallel to the centerline of the conveyor belt.

d. All test chains shall be permanently marked with a readily identifiable mark that is referenced to a corresponding point on the scale.

e. Each time the test chains are used, the reference mark shall be placed over the corresponding point of the weight sensing element.

f. Adequate cables, bridles, hooks, etc., shall be provided to relieve the wench cable tension and hold the test chains in place, on the belt, as recommended by the scale manufacturer.

g. Test chains held in place by a winch cable shall not be allowed.

SECTION 7.15 TOLERANCE

7.15.1 REFERENCE MATERIAL TOLERANCE

The quantity of material used to conduct a material test shall be weighed statically to an accuracy of at least 0.1%.

7.15.2 MATERIAL TEST TOLERANCE

Acceptance and subsequent test tolerances relative to the test load shall be ±0.25%. The variation in the values obtained when conducting a material test shall not be greater than 0.25%. The performance of the equipment is not to be determined by averaging the individual test results. The results of all tests shall be within the tolerance limits.

7.15.3 SIMULATED LOAD TEST TOLERANCE

All belt-conveyor scales should maintain a ±0.25% tolerance between material tests. All belt-conveyor scales using simulated load testing equipment should be tested for a repeatability of not greater than 0.1% for consecutive tests.

7.15.4 ZERO TOLERANCE

All belt-conveyor scales shall maintain a zero balance of ±0.06% of rated capacity for one or more full revolutions of the empty belt. The zero indication shall not change more than 0.18% of rated scale capacity during any portion of the test. Following a material test, the zero balance shall not exceed 0.12% of rated scale capacity.

SECTION 7.16 REFERENCE SCALE AND TEST LOADS

a. Where practicable, a reference scale should be tested within 24 hours prior to being used in conjunction with a belt-conveyor scale material test.

b. A reference scale with errors that exceed maintenance tolerance “as found” should be reverified if the belt-conveyor scale material test error exceeds maintenance tolerance.

c. If any suitable known weight load other than a test weight load is used to reverify the reference scale accuracy, its weight shall be determined on the reference scale after the reference scale certification and before commencing the belt scale material test.

d. The containers, whether railroad cars, trucks, or boxes, shall not leak or be loaded in a manner where material will be lost.

e. The actual empty or tare weight of the containers shall be determined at the time of the test. Gross and tare weights shall be determined on the same scale.

f. The test shall not be conducted if the weight of the test load has been affected by environmental conditions.

g. Sampling systems that may remove materials from pre- or post-weighed test loads must be disabled for the duration of the material test or the sample taken, and rejects must be accounted for.

SECTION 7.17 STANDARD PROCEDURE FOR TESTS

In preparation for any test, personnel shall be familiar with the scale and its operation and safe operating requirements.

7.17.1 OFFICIAL TEST

An official test should be made once every 6 months or as directed by the serving rail carrier or its agent. Any change to the conveyor or scale system between official tests that affects the calibration of the scale will require an official test to be conducted. This may include, but is not limited to, conveyor belt replacement, structural changes, repairs to the conveyor structure, and realignment of scale idlers. The rail carrier shall be contacted at least two weeks before the official test.

a. Test the reference scale in accordance with Section 1.8 if a rail scale or with H-44 for other vehicle scales or hopper scales.

b. Perform a scale inspection to ensure the scale and all conveyor components are completely installed and in good condition before any tests will be made.

c. Conduct three consecutive Zero Tests without adjustments.

d. Conduct a Simulated Load Test.

e. Conduct a Material Test.

f. Conduct a Zero Test. The zero error shall not exceed the tolerance as stated in Section 7.15.4.

g. Conduct a Simulated Load Test to establish the new factor for future simulated load tests.

7.17.2 ZERO TEST

a. Warm up the belt to establish a stable zero reading by running the conveyor without load for at least 30 minutes before testing; longer if the temperature is below 40 °F (5 °C).

b. Disable flow-rate filtering and dead band.

c. Inspect the belt consistency. During one complete belt revolution, the totalizer shall not change more than +/- 0.06%.

d. Check the zero tolerance. Run the belt continuously for a period of time equivalent to that required to deliver the minimum test load of 800d; a whole number of belt revolutions of not less than three; or 10 minutes operation, whichever is greater. For belt-conveyor scales with electronic totalizers, the test may be performed over a period of at least 3 minutes and a whole number of belt revolutions. The zero error shall not exceed the tolerance as stated in Section 7.15.4.

7.17.3 MATERIAL TEST

A Material Test should be conducted using actual belt-loading conditions. These belt loading conditions, where applicable, shall include, but are not limited to, conducting material tests using different belt-loading points, all types and sizes of products weighed on the scale, at least one other belt speed, and in both directions of weighing. If a calibration adjustment is made, the Material Test will be restarted.

(1) Initial Verification

Initial verification requires two test loads at each of three flow rates: the normal-use flow rate, 35% of the maximum rated capacity, and an intermediate flow rate between these two points. A Zero Test shall be run between each Flow Rate Test and be adjusted within the tolerance indicated in Section 7.15.4.

(2) Subsequent Verification

Subsequent testing shall include testing at the normal-use flow rate and other flow rates used at the installation. A minimum of three tests shall be included. The testing authority may determine that testing only at the normal-use flow rate is necessary for subsequent verifications if evidence is provided that the system is used to operate

- at no less than 70% of the maximum rate capacity for at least 80% of the time (excluding time the belt is unloaded), or
- with a normal-use flow rate that does not vary by more than 10% of the maximum rated capacity.

For Initial and Subsequent Verifications, each test shall be conducted with test loads no less than the minimum test load, which shall be the greater of the following values:

- 800 scale divisions; or
- The load obtained at the maximum flow rate in one revolution of the belt; or
- At least 10 minutes' operation or for the time of a normal weighment when the normal weighment requires less than 10 minutes. For Subsequent Verifications, the testing authority may reduce the time requirement when consecutive official testing has demonstrated the system complies with applicable tolerances.

For Belt Conveyor Scales in loading systems, each test is conducted as follows:

a. Weigh the empty containers on certified reference scale

b. Purge extra material from the system

c. Load the containers

d. Ensure all material weighed is transferred into containers

e. Weigh the loaded containers on a certified reference scale

f. Compare net weight results from reference scale and belt scale and adjust the belt conveyor scale as necessary

For Belt Conveyor Scales in unloading systems, each test is conducted as follows:

a. Weigh the loaded containers on certified reference scale

b. Purge extra material from the system

c. Empty the containers

d. Ensure all material transferred from containers is weighed

e. Weigh the empty containers on a certified reference scale

f. Compare net weight results from reference scale and belt scale and adjust the belt conveyor scale as necessary

7.17.4 SIMULATED LOAD TEST

A Simulated Load Test shall be performed during the Official Test and between Official Tests as part of a maintenance program. The Simulated Load Test shall be conducted on a weekly basis, preferably as soon after actual use of the belt as possible. A Material Test may be substituted for the Simulated Load Test. The method of testing shall be recommended by the manufacturer and approved by the testing authority. The minimum test time shall be equal to or greater than the time to deliver the minimum test load.

a. Perform a scale inspection to ensure the scale and all conveyor components are completely installed and in good condition before any tests are made.

b. Conduct a Zero Test. The results shall be within tolerance specified in Section 7.15.4. If the results are out of tolerance, inspect and maintain the conveyor and scale, repeat the Zero Test, and zero as required. If the results continue to be out of tolerance, do not use the scale weights until an Official Test is conducted.

c. Apply the test weights or test chains to the conveyor.

d. Check scale repeatability by running three consecutive tests.

e. If the test results are within tolerance, no further action is required. If the results are out of tolerance, then conduct belt maintenance and retest the system. If the results continue to be out of tolerance, do not use the scale weights until an Official Test is conducted.

f. Conduct a Zero Test to confirm that the zero did not change.

g. Provide the Zero Test and Simulated Load Test results to the testing authority.

SECTION 7.18 SECURITY MEANS

When a security means has been broken, it shall be promptly reported to the testing authority. Continued use of the belt conveyor scale is at the discretion of the testing authority.

SECTION 7.19 RECORDS

Records of calibration and maintenance, including conveyor alignment, analog or digital recorder, zero-load test, and material test data, shall be maintained on site for at least the three concurrent years as a history of scale performance. Copies of any report as a result of a test or repair shall be provided to the testing authority as required. The current date and correction factor(s) for simulated load testing equipment shall be recorded and maintained in the scale cabinet.

SECTION 7.20 MARKING REQUIREMENTS

A belt conveyor scale shall be marked with the following:

a. The rated capacity in units of weight per hour (minimum and maximum)

b. The value of the scale division

c. The belt speed in terms of feet or meters per minute at which the belt will deliver the rated capacity

d. The load in terms of pounds per foot or kilograms per meter

e. The operational temperature range if other than 14 °F to 104 °F (-10 °C to 40 °C)

f. The name, initials, or trademark of the manufacturer or distributor

g. A model designation that positively identifies the pattern or design of the device

h. Except for equipment with no moving or electronic component parts, a non-repetitive serial number

i. A serial number prefaced by words, an abbreviation, or a symbol, that clearly identifies the numbers as the required serial number

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Part 8

Mass Flow Meters

(ADDED 2010)

— 2013 —

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SECTION 8.1 GENERAL

The following specifications apply to mass flow devices used to deliver and measure the net contents of railway cars. The specifications for the location, testing, and operation of mass flow devices herein will apply to devices used for revenue service. Revenue devices shall meet or exceed applicable NIST requirements and have an NTEP certification.

SECTION 8.2 DESCRIPTION

As a general rule, mass flow devices are meters placed in a delivery pipe in which product dynamically flows through for purposes of measurement for loading or unloading railcars. The mass flow device typically is comprised of a meter assembly and an indicator.

SECTION 8.3 SPECIFICATIONS

8.3.1 INDICATING AND RECORDING ELEMENTS

a. A mass flow measuring assembly shall include an indicating element. Indications shall be accurate and easily read under normal conditions of operation of the instrument.

b. Product delivery shall be indicated and recorded in kilograms, metric tons, pounds, or tons.

c. Numerical values of quantity (value of divisions) shall be equal to

- 1, 2, 5, or
- a decimal multiple or sub-multiple thereof.

d. Indicated values shall be adequately defined by a sufficient number of figures, words, symbols, or combinations thereof. A display of “zero” shall be a zero digit for all displayed digits to the right of the decimal mark and at least one to the left.

e. A recording device shall be used.

8.3.2 OPERATING REQUIREMENTS

a. One indicator and the primary recording element shall be provided with a means for readily returning the indication to zero either automatically or manually.

b. It shall not be possible to return the primary recording and indicating elements beyond the correct zero position.

c. The indicator’s reset mechanism shall not be operable during product delivery. Once the zeroing operation has begun, it shall not be possible to indicate a value other than the latest measurement, or “zeros” when the zeroing operation has been completed.

d. The indicating device shall automatically show, on its face, the initial zero condition and the quantity delivered (up to the nominal capacity). However, the first 0.009 gal (0.03 L) of product need not be indicated.

8.3.3 MEASURING ELEMENTS AND SYSTEMS

8.3.3.1 Maximum and Minimum Flow Rates

a. The ratio of maximum-to-minimum flow rates specified by the manufacturer for devices measuring liquefied gases shall be 5:1 or greater.

b. The ratio of maximum-to-minimum flow rates specified by the manufacturer for devices measuring other than liquefied gases shall be 10:1 or greater.

8.3.3.2 Vapor Elimination

A liquid measuring device or system shall be equipped with an effective vapor or air eliminator or other effective means, automatic in operation, to prevent the measurement of vapor and air. Vent lines from the vapor or air eliminator shall be made of metal tubing or other suitable rigid material.

8.3.3.3 Maintenance of Liquid State

A liquid measuring device shall be installed so that the measured product remains in a liquid state during passage through the device.

SECTION 8.4 RECORDING DEVICE

The following conditions apply to the recording device:

a. The interval shall be the same as that of the indicator.

b. The value of the recorded quantity shall be the same as the indicated quantity.

c. A quantity for a delivery (other than an initial reference value) cannot be recorded until the measurement and delivery has been completed.

d. The recorded values shall meet the requirements applicable to the indicated values.

SECTION 8.5 PROVISIONS FOR SEALING

Adequate provisions shall be made for an approved means of security (e.g., data change audit trail) or for physically applying security seals in such a manner that no adjustment may be made of the following:

- Any measurement element;
- Any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries; or
- The zero adjustment mechanism.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal. Audit trails shall use the format set forth in NIST Handbook 44, Section 3.37, Table S.3.5.

SECTION 8.6 NATURAL GAS DISCHARGE HOSE PRESSURIZATION

The discharge hose for compressed natural gas shall automatically pressurize prior to the device beginning to register the delivery.

SECTION 8.7 MARKING

A mass flow measuring system shall be legibly and indelibly marked with the following information:

- NTEP Certificate of Conformance number
- Manufacturer’s name or trademark
- Model designation or product name selected by the manufacturer
- Non-repetitive serial number
- The accuracy class of the meter as specified by the manufacturer consistent with NIST Handbook 44, Section 3.37, Table T.2
- Maximum and minimum flow rates in divisions per unit of time
- Maximum working pressure
- Applicable range of temperature if other than 14 to 122 degrees Fahrenheit (-10 to 50 degrees Celsius)
- Minimum measured quantity
- Product limitations, if applicable

SECTION 8.8 MASS FLOW ASSEMBLY TEST CRITERIA

a. Liquid measuring devices shall be tested with the liquid that the device is intended to measure or another liquid with the same general physical characteristics.

b. Vapor measuring devices shall be tested with air or the product to be measured.

c. The normal test of a mass flow assembly shall be made at the maximum discharge rate developed by the installation. Any additional tests conducted at flow rates down to and including the rated minimum discharge flow rate shall be considered normal tests.

d. Repeatability tests shall include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained.

8.8.1 TOLERANCES

a. In general, tolerances apply equally to errors of under-registration and errors of over-registration.

b. The tolerances apply to all products at all temperatures measured at any flow rate within the rated measuring range of the meter.

c. The tolerances for mass flow devices for specific liquids, gases, and applications are listed in NIST Handbook 44, Section 3.37, Table T.2.

d. Tolerances on a mass flow device with an accuracy class of 0.3 are as follows:

(1) Acceptance Tolerance 0.2%
(2) Maintenance Tolerance 0.3%

8.8.2 REFERENCE SCALE AND TEST LOADS

a. Where practicable, a reference scale should be tested within 24 hours prior to being used in conjunction with a mass flow device material test.

b. A reference scale with errors that exceeds maintenance tolerance “as found” should be re-verified if the mass flow device material test error exceeds maintenance tolerance.

c. If any suitable known weight load other than a test weight load is used to reverify the reference scale accuracy, its weight shall be determined on the reference scale after the reference scale certification and before commencing the mass flow device material test.

d. The containers, whether railroad cars, trucks, or boxes, shall not leak or be loaded in a manner where material will be lost.

e. The actual empty or tare weight of the containers shall be determined at the time of the test. Gross and tare weights shall be determined on the same scale.

f. The test shall not be conducted if the weight of the test load has been affected by environmental conditions.

g. Sampling systems that may remove materials from pre- or post-weighed test loads must be disabled for the duration of the materials test or the sample taken and rejects must be accounted for.

8.8.3 TESTING FREQUENCY

Mass flow meters shall be tested annually. If the “as found” indications are found out of tolerance, more frequent testing may be required.

8.8.4 TESTING PROCEDURE

In preparation for any test, personnel shall be familiar with the mass flow meter and its operation and safe operating requirements.

a. For mass flow devices used in loading systems, each flow meter is tested as follows:

   (1) Test the reference scale in accordance with Section 1.8.

   (2) For each mass flow meter being tested, weigh three railcars statically and uncoupled on the reference scale to determine their empty reference weight.

   (3) Zero the mass flow meter being tested.

   (4) Fill three railcars, to at least 90% of their load limit capacity, from the mass flow meter being tested. Record the metered net weight for each railcar.

   (5) Weigh the loaded railcars on the reference scale statically and uncoupled to determine their reference loaded weight. Determine the reference net weight of each railcar by subtracting the empty reference weight from the loaded reference weight.

   (6) For the three railcars loaded, compare the sum of the metered net weights to the sum of the reference net weights to determine the weighing accuracy.

   (7) Compare the accuracy to the tolerance allowed in 8.8.1.d.

b. For mass flow devices used in unloading systems, each flow meter is tested as follows:

   (1) Test the reference scale in accordance with Section 1.8

   (2) For each mass flow meter being tested, weigh three railcars statically and uncoupled on the reference scale to determine their loaded reference weight.

   (3) Zero the mass flow meter being tested.

   (4) Empty three railcars through the mass flow meter being tested. Record the metered net weight for each railcar.

   (5) Weigh the empty railcars on the reference scale statically and uncoupled to determine their reference empty weight. Determine the reference net weight of each railcar by subtracting the empty reference weight from the loaded reference weight.

   (6) For the three railcars unloaded, compare the sum of the metered net weights to the sum of the reference net weights to determine the weighing accuracy.

   (7) Compare the accuracy to the tolerance allowed in 8.8.1.d.

Part 9

Other Scales

— 2013 —

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SECTION 9.1 GENERAL (1994)

Scales included in this classification may be any type of weighing system or device other than those specifically described in this Chapter, provided said scales comply with railroad rules and federal, state, or local laws.

SECTION 9.2 DEFINITION (1994)

Other scales are those weighing systems or devices other than railway track, vehicle, hopper type, or belt conveyor scales, used to ascertain weights for assessment of railway freight charges.

SECTION 9.3 CAPACITY AND SIZE (1994)

Scales should be of a type suitable for their intended purpose and be of sufficient capacity without danger of being overloaded.

SECTION 9.4 TESTING AND TOLERANCES (1994)

Scales must be tested at least twice each year by a qualified scale technician utilizing methods and tolerances prescribed by railroad rules.

SECTION 9.5 TEST WEIGHTS (1994)

Test weights used for testing scales must be correctly sealed and approved.

SECTION 9.6 RECORDS (1994)

Scale tickets, tapes, and test reports shall be maintained on file in a clear and systematic manner so that they can be easily located. Scale tickets or tapes constitute the original weight records and must be carefully preserved for the length of time prescribed by applicable laws or rules.

Appendix A

Definition of Terms

(ADDED 2003)

— 2013 —

ACCURACY—(1) (Belt Scales) The ratio of the error to the full-scale output or the ratio of the error to the output, as specified, in percent. (2) The degree of agreement between the result of a measurement and the true value of the quantity measured. Cf. "Statistical Accuracy"—Degree of conformation with a standard. (SMA)

AIR PURGE—The act of creating a cleaner atmosphere on the inside than outside, using clean, dry air, to discourage intrusion of dust, humidity, and other foreign matter.

ALIGNMENT (Belt Scales)—The proper adjustment or correct relative position of the idler frames and rollers to the movement of the belt.

AUDIT TRAIL—An electronic count and/or information record of changes to the values of the calibration or configuration parameters of a device. (H-44)

AUTOMATIC-INDICATING SCALE—One on which the weights of applied loads of various magnitudes are automatically indicated throughout all or a portion of the weighing range of the scale. (A scale that automatically weighs out commodity in predetermined drafts, such as an automatic hopper scale, a packaging scale, and the like, is not an "automatic-indicating" scale.) (H-44)

AUTOMATIC ZERO-TRACKING MECHANISM (Amended 2012)—Automatic means provided to maintain zero balance indication without the intervention of an operator. (H-44)

AUXILIARY INDICATOR (Belt Scales)—Any indicator other than the master weight totalizer that indicates the weight of material determined by the scale. (H-44)

AXLE LOAD SCALES—Each axle of the car is weighed separately and the weights obtained are added to produce a gross weight of the car. The scale can weigh any vehicle either coupled or uncoupled-in-motion weighing, having standard freight car trucks.

BALANCE BALL—A relatively small mass attached to a weighbeam or lever and designed to be moved for the purpose of balancing a mechanical scale at zero load. (SMA) Also see COUNTERBALANCE WEIGHT.

BEAM BOX—Housing for supporting and enclosing a weighbeam and accessories and protecting them from the weather and from tampering. (SMA)

BEAM FULCRUM STAND—An upright member, usually a casting, to support the fulcrum of a weighbeam or lever. (SMA)

BEAM LOCK—A device provided to lock in position a weighbeam that is not provided with a trig. (SMA)

BEAMS, MAIN—One of the two principal longitudinal structural elements of a weighbridge. (SMA)

BEARING CARRIER—An element, usually of a main bearing, which contains a separable bearing steel. (SMA)

BINARY SUBMULTIPLES—Fractional parts obtained by successively dividing by the number 2. Thus, one half, one forth, one eighth, one sixteenth, and so on, are binary submultiples. (H-44)

BELT CONVEYOR (Belt Scales)—An endless moving belt for transporting material from place to place. (H-44)

BELT CONVEYOR SCALE—A device that employs a weighing element in contact with a belt to sense the weight of the material being conveyed and the speed (travel) of the material, and integrates these values to produce total delivered weight. (H-44)

BUILD-UP TEST—A process of testing a scale whose capacity is large as compared to the amount of test weights available. Essentially, the available test weights are applied and the scale indication noted; the weights are removed and a load of other than test weights is applied to result in the same indication; the test weights are again applied. The process is repeated through as many steps as necessary to reach the nominal capacity of the scale. (SMA)

BULK WEIGHER—A scale designed for the weighing of various materials in bulk. The load receiving element of this scale is a self-emptying hopper with an outlet gate. (SMA)

CABLE CONVEYOR (Belt Scales)—A belt conveyor utilizing cable or rope as the supporting member for the conveyor on which the idlers are mounted.

CALIBRATED PLATE (Belt Scales)—A suitable metal plate, provided by the scale manufacturer, determined to have the same effect on a belt conveyor scale as a specified load or bulk material. A calibrated plate is the equivalent of a test chain or test weights used with other types of belt conveyor scales.

CHART RECORDER (Belt Scales)—A device used with a belt conveyor scale that continuously records the rate flow of bulk material over the scale. (H-44)

CHECKS, CHECKING SYSTEM—A device designed to limit horizontal displacement of a scale part. (SMA)

COMPENSATING BEARINGS—A bearing so designed as to seat itself longitudinally against its opposing knife-edge when a load is applied. (SMA)

CONCAVE CURVE (Belt Scales)—A change in the angle of inclination of a belt conveyor where the center of the curve is above the conveyor. (H-44)

CONCENTRATED LOAD CAPACITY—A capacity rating of a vehicle, axle load, or livestock scale, specified by the manufacturer, defining the maximum load concentrated for which the weighbridge is designed. In the case of vehicle and axle load scales, it is the maximum axle load concentration (for a group of two axles with a centerline spaced 4 ft apart and an axle width of 8 ft) for which the weighbridge is designed as specified by the manufacturer. The concentrated load capacity rating is for both test and use. (H-44)

CONSECUTIVE-CAR TEST TRAIN—A train consisting of cars weighed on a reference scale, then coupled consecutively and run over the coupled-in-motion railway track scale under test. (H-44)

CONVEYOR STRINGERS (Belt Scales)—Support members for the conveyor on which the scale and idlers are mounted. (H-44)

COUNTERBALANCE WEIGHT—One intended for application near the butt of a weighbeam for zero-load balancing purposes. (H-44)

COUNTERPOISE WEIGHT—A slotted or "hanger" weight intended for application near the tip of the weighbeam of a scale having a multiple greater than 1. (H-44)

COUPLED-IN-MOTION RAILROAD WEIGHING SYSTEM—A device and related installation characteristics consisting of (1) the associated approach trackage, (2) the scale (i.e., the weighing element, the load-receiving element, and the indicating element with its software), and (3) the exit trackage which permit the weighing of railroad cars coupled in motion. (H-44)

DEAD RAILS—Either rail of the independent track provided over a railway track scale for the movement of locomotives and cars not to be weighed. (SMA)

DECREASING-LOAD TEST—A test for automatic-indicating scales only, wherein the performance of the scale is tested as the load is reduced. (H-44)

DIAL—A circular reading face of an automatic indicating scale, upon which values are indicated by the relative positions of an indicator and the dial graduations. (SMA)

DISCRIMINATION (of an automatic-indicating scale)—The value of the test load on the load-receiving element of the scale that will produce a specified minimum change of the indicated or recorded value on the scale. (H-44)

DISTRIBUTED-CAR TEST TRAIN—A train consisting of cars weighed first on a reference scale, cars coupled consecutively in groups at different locations within the train, then run over the coupled-in-motion railway track scale under test. The groups are typically placed at the front, middle, and rear of the train. (H-44)

DIVISION—See SCALE DIVISION.

DRIVE (Belt Scales)—The device or apparatus used to transmit energy from a motor to move the conveyor belt.

ELECTROMAGNETIC INTERFERENCE (Added 2009)—Electrical disturbances that propagate into electronic and electrical circuits and cause deviations from normally expected performance.

EMI (Added 2009)—See ELECTROMAGNETIC INTERFERENCE (Added 2009).

EXPANSION RAILS—A rail assembly, especially designed for the use in the approach to a railway track scale or similar structure, one end of which can be secured in a fixed position while the other end is longitudinally movable within designed limits. (SMA)

EXTENSION LEVER—In a scale of the straight lever type, any lever between a main lever and the shelf lever in the lever train, or between a main lever and the weighbeam if there is no shelf lever. Examples are extension lever, longitudinal extension lever, middle extension lever, transverse extension lever. (SMA)

EVENT COUNTER—A nonresettable counter that increments once each time the mode that permits changes to sealable parameters is entered and one or more changes are made to sealable calibration or configuration parameters of a device. (H-44)

EVENT LOGGER—A form of audit trail containing a series of records where each record contains the number from the event counter corresponding to the change to a sealable parameter, the identification of the parameter that was changed, the time and date when the parameter was changed, and the new value of the parameter. (H-44)

FACTOR (Belt Scales) (Added 2009)—A reference number produced by a belt conveyor scale system over a defined range established during a simulated load calibration using known standard test weight loads. Sometimes referred to as *K-Factor*.

FEEDERS (Belt Scales)—See INFEED (Belt Scales).

FIXED DECK, RIGID DECK—A scale deck, usually of a railway track scale, which is rigidly supported by the foundation or otherwise, through which the pedestals supporting the load receiving element project. Sometimes also called “dead deck.” (SMA)

FLOATING LEVER—A lever whose fulcrum reaction is upward, also called an “up-pull lever.” (SMA)

FRACTIONAL BAR—A weighbeam bar of relatively small capacity for obtaining indications intermediate between notches or graduations on a main or tare bar. (H-44)

FULCRUM, LEVER—A pivotal point or line about which a lever may turn or may be assumed to turn. (SMA)

FULL AUTOMATIC INDICATING SCALE—One on which the capacity of the automatic-indicating elements equals the nominal capacity of the scale.

GARNERS—A bin, positioned above a hopper scale, in which material to be weighed is collected while a draft is being weighed and discharged from the scale hopper. (SMA)

GATE (Belt Scales)—See INFEED (Belt Scales).

GIRDERS, MAIN—A principal horizontal beam or compound structure acting as a beam, receiving vertical load and bearing vertically on its supports, as, one of the principal elements of a weighbridge. (SMA)

GRADUATION (Amended 2010)—For mechanical scales, a defining line or one of the lines defining the subdivisions of a graduated series. The term includes such special forms as raised or indented or scored reference lines and special characters such as dots.

HEAD PULLEY (Belt Scales)—The pulley at the discharge end of the belt conveyor. The power drive to drive the belt is generally applied to the head pulley. (H-44)

HERMETIC SEAL (Amended 2011)—An airtight seal designed to be impervious to external influence.

HOPPER SCALE—A scale designed for weighing bulk commodities whose load receiving element is a tank, box, or hopper mounted on a weighing element. (H-44)

IDLER OR IDLER ROLLERS (Belt Scales)—Freely turning cylinders mounted on a frame to support the conveyor belt. For a flat belt, the idlers may consist of one or more horizontal cylinders transverse to the direction of belt travel. For a trough belt, the idler will consist of one or more horizontal cylinders and one or more cylinders at an angle to the horizontal to lift the sides of the belt to form a trough. (H-44)

IDLER FRAME (Belt Scales)—The frame or device which holds the idler rollers, affixed to the conveyor stringers.

IDLER SPACE (Belt Scales)—The center-to-center distance between idler rollers measured parallel to the belt. (H-44)

INCREMENT—The value of the smallest unit that can be indicated or recorded by a digital device in normal operation. (H-44) See also GRADUATION (Amended 2010) and SCALE DIVISION.

INDICATING ELEMENT—An element incorporated in a weighing or measuring device by means of which its performance relative to quantity or money value is “read” from the device itself as, for example, an index-and-graduated-scale combination, a weigh-beam-and-poise combination, a digital indicator, and the like. (H-44)

INFEED (Belt Scales)—The gate, short belt, vibrator feeder, striker feeder, etc., that deposits material on the belt conveyor to be weighed.

KNIFE-EDGE—In general, the prepared edge of a scale pivot, designed to make linear contact with an opposing bearing surface. (SMA)

LEVER RATIO—The ratio of the lengths of the arms of a lever; usually the quotient resulting from dividing the distance from the fulcrum to the tip by the distance from the fulcrum to the load. Sometimes called Arm Ratio, Multiple, Ratio. (SMA)

LOOP—A U-shaped element of a bearing assembly or a connection, formed with an Eye at each extremity. Sometimes also colloquially called Clevis. (SMA)

LOAD CELL VERIFICATION INTERVAL (v)—The load cell interval, expressed in units of mass, used in the test of the load cell for accuracy classification. (H-44)

LOADING POINT (Belt Scales)—The location at which material to be conveyed is applied to the conveyor. (H-44)

LOAD-RECEIVING ELEMENT—That element of a scale that is designed to receive the load to be weighed; for example, platform, deck, rail, hopper, platter, plate, scoop. (H-44)

MANUAL ZERO-SETTING MECHANISM—Nonautomatic means provided to attain a zero balance indication by the direct operation of a control. (H-44)

MASTER WEIGHT TOTALIZER (Belt Scales)—A device used with a belt conveyor scale to indicate the weight of material which has been conveyed over the scale. The master weight totalizer is the primary indicating element of the belt conveyor scale. An auxiliary vernier counter used for scale calibration is not (necessarily) part of the master weight totalizer. Auxiliary remote totalizers may be provided. The totalizer shows the accumulated weight and may be nonresettable or may be reset to zero to measure a definite amount of material conveyed.

MATERIAL TEST (Belt Scales)—The test of a belt conveyor scale using material (preferably that for which the device is normally used) that has been weighed to an accuracy of 0.1%. (H-44)

METROLOGICAL INTEGRITY (of a device)—The design, features, operation, installation, or use of a device that facilitates (1) the accuracy and validity of a measurement or transaction, (2) compliance of the device with weights and measures requirements, or (3) the suitability of the device for a given application. (H-44)

MINIMUM CAPACITY—The smallest load that may be accurately weighed. The weighing results may be subject to excessive error if used below this value. (H-44)

MINIMUM TOTALIZED LOAD—The least amount of weight for which the scale is considered to be performing accurately. (H-44)

MOTION WEIGHING—The weighing of loads without causing them to come to a stop on the load receiving element of a scale, such as weighing freight cars on a grade track or hump scale or weighing packages on some indexing type check weighers. (SMA)

NOMINAL—Refers to “intended” or “named” or “stated,” as opposed to “actual.” For example, the “nominal” value of something is the value that it is supposed or intended to have, the value that it is claimed or stated to have, or the value by which it is commonly known. Thus, “1-pound weight,” “1-gallon measure,” “1-yard indication,” and “500-pound scale” are statements of nominal values; corresponding actual values may be greater or lesser. (H-44)

NOMINAL CAPACITY (Amended 2011)—The maximum allowable weight limit set by the manufacturer.

NOSE IRON—A slide-mounted, manually adjustable pivot assembly for changing the multiple of a lever. (SMA)

PANT LEG CONNECTION—A section of duct inserted for a short distance into a bell like section of another duct, the diameter is such that a free space is created around the smaller of the two, equal to three times its diameter. This allows free movement of air into the dust system and creates neither positive nor negative pressures within the scale system.

PENDULUM— (1) In general, a body suspended from a fixed point so as to swing freely to and fro. (2) In an especially restricted sense and with respect to certain types of scales, an element consisting of a mass and rigid arm connecting the mass to an axis of rotation. (SMA)

PENDULUM WEIGHTS (Pendulum Ball)—The mass, sometimes adjustably positioned, at the outer or lower end of the arm of a pendulum. (SMA)

PINION—In an automatic indicating scale, a relatively small spur gear, mounted usually on the shaft which carries the rotating member of the indicating assembly, and designed to mesh with a rack which is usually moved vertically by change of applied load. (SMA)

PIPE LEVER—That of which a cylindrical arm, usually called Pipe Arm or Extension Arm, supports the load and fulcrum pivots. Under load, the cylindrical arm is stressed in torsion. (SMA)

PIVOT—That about which something turns or may be supposed to turn; hence, that essential element of a conventional scale lever, designed to transmit external forces through its knife-edge. (SMA)

PIVOT GAUGE; LEVER GAUGE—The distance between specified points, as, between the knife-edges of a scale lever, when Short Gauge is the distance between the fulcrum knife-edge and the knife-edge nearer to it, and Long Gauge is the distance between the fulcrum knife-edge and the knife-edge farther removed from it. (SMA)

POISE—A movable weight mounted upon or suspended from a weighbeam bar and used in combination with graduations, and frequently with notches, on the bar to indicate weight values. (A suspended poise is commonly called a hanging poise) (H-44)

PRINTER—See RECORDING ELEMENT.

PULLEY (Belt Scales)—A cylindrical roller over which the belt passes to change direction, such as the head pulley or tail pulley or bend pulley.

RACK—In an automatic indicating scale, an element of the indicating mechanism consisting of a straight bar with teeth on one face designed to mesh with those of a pinion, and so attached to the lever train that its motion is proportional to the change in applied load. (SMA)

RADIO FREQUENCY INTERFERENCE (RFI)—Is a type of electrical disturbance which, when introduced into electrical and electronic circuits, may cause deviations from the normally expected performance. (H-44)

RAILWAY MASTER TRACK SCALES—High precision weighing instruments that are employed to calibrate Track Scale Test Weight Cars. These scales provide the link in traceability between the National Institute of Standards and Technology (NIST) and railway track scales, used to weigh railway cars, that is necessary under State laws. Such scales cannot be used to perform any service except that for which they are designed and intended.

RANGE STEP—One of a complete series of graduations or increments or an extended range instrument. (SMA)

RANGE (PIVOT); RANGE (LEVER)—The amount by which the knife-edge of the intermediate pivot of a scale lever projects through (closed range) of fails to reach (open range) the plane of the knife edges of the end pivots of that lever; sometimes, as a practical matter, measured as the distance from the tip knife edge to the plane to the other knife edges, in which case it is expressed in inches per foot of the length of the lever. (SMA)

RATE-OF-FLOW (Belt Scales)—See CHART RECORDER (Belt Scales).

RATED SCALE CAPACITY (Belt Scales)—That value representing the weight that can be delivered by the device in one hour. (H-44)

READING FACE—That element of an automatic indicating scale in which balance condition or weight or other values are indicated. (H-44)

RECORDER, ANALOG— An instrument for plotting data in a graphical form. Typical recorders use either circular, cylindrical, or strip charts. See also RECORDING ELEMENT. (SMA)

RECORDER, DIGITAL—See RECORDING ELEMENT.

RECORDING ELEMENT—An element incorporated in a weighing or measuring device by means of which its performance relative to quantity or money value is permanently recorded on a tape, ticket, card, or the like, in the form of a printed, stamped, punched, or perforated representation. (H-44)

RECORDING SCALE—One on which weights of applied loads may be permanently recorded on tape, ticket, card, or the like, in the form of a printed, stamped, punched, or perforated representation. (H-44)

REFERENCE SCALE (Added 2009)—A scale, tested to within an accuracy of 0.1% and used to determine the weight of railcars or material used in an official test.

REFERENCE WEIGHT CAR (Amended 2010)—A standard railcar that has been statically weighed for temporary use as a mass standard over a short period of time, typically the time required to test one scale.

REGISTERING WEIGHBEAM—A weighbeam which in addition to or instead of providing conventional visual weight indications is equipped with means for a perforated or imprinting on a card or ticket a representation of the weight value indicated by the poise setting. (SMA)

REGISTRATION (Belt Scales)—The unit of weight in which the scale is calibrated, such as lb. tons, long tons, metric tons, etc.

REMOTE CONFIGURATION CAPABILITY—The ability to adjust a weighing or measuring device or change its sealable parameters from or through some other device that is not itself necessary to the operation of the weighing or measuring device or is not a permanent part of that device. (H-44)

REPEATABILITY (Amended 2009)—The ability of a device to produce consistent readings when the same measured value is applied to it consecutively under the same conditions over a short period of time.

REVENUE SERVICE—That which is used or employed in establishing the size, quantity, extent, area, or measurement of quantities, things, produce, or articles for distribution or consumption, purchased, offered, or submitted for sale, hire, or award, or in computing any basic charge or payment for services rendered on the basis of weight or measure. (H-44)

RFI—See RADIO FREQUENCY INTERFERENCE (RFI).

RIGID DECK—See FIXED DECK, RIGID DECK.

SCALE CAPACITY (Amended 2011)—The maximum allowable weight that can be applied to a scale without exceeding the scale's design limits.

SCALE DIVISION—The value of the scale division, expressed in units of mass, is the smallest subdivision of the scale for analog indication or the difference between two consecutively indicated or printed values for digital indication or printing. [Also see VERIFICATION SCALE DIVISION (value of "e").] (H-44)

SCALE RESPONSE TIME—The time required for a system to adjust from one set of defined conditions to another set of defined conditions. (SMA)

SCALE SECTION—A part of a vehicle, axle-load, livestock, or railway track scale consisting of two main load supports, usually transverse to the direction in which the load is applied. (H-44)

SCALE TAPES—See TAPES.

SECTION, SCALE—In a straight lever scale, a pair of main levers; in a torsion lever scale, any main lever; in a full load cell scale, a pair of load cells; along with their less significant bearings and connections. The plane of a section is the vertical plane perpendicular to the longitudinal axis of the scale and passing through the centers of the main load pivots or centers of the load cells. Sections are numbered consecutively from left to right when standing at the indicating element and facing the load receiving element. (SMA)

SECTION TEST—A shift test in which the test load is applied over individual sections of the scale. This test is conducted to disclose the weighing performance of individual sections, since scale capacity test loads are not always available and loads weighed are not always distributed evenly over all main load supports. (H-44)

SECTIONAL CAPACITY—The sectional capacity of a scale is the greatest live load which may be divided equally on the load pivots or load cells of a section without producing stresses in any member in excess of those specified in Section 2.14.3.

SECURITY MEANS—A method used to prevent access by other than qualified personnel, or to indicate that access has been made to certain parts of a scale that affect the performance of the device. (H-44)

SEMI-AUTOMATIC ZERO SETTING MECHANISM—Automatic means provided to attain a direct zero balance indication requiring a single initiation by an operator. (H-44)

SENSITIVITY (SR)—A performance requirement for a non automatic-indicating scale; specifically, the minimum change in the position of rest of the indicating element or elements of the scale in response to the increase or decrease, by a specified amount of the test load on the load-receiving element of the scale. (H-44)

SHELF LEVER—The lever nearest the translation of forces to the weighbeam. When the term applies, the lever is relatively short, is fulcrumed from the shelf, and is parallel to the weighbeam. Sometimes also called bench lever. (SMA)

SHELF PILLAR—One of the vertical supports for a weighbeam shelf. Sometimes also called column. (SMA)

SHIFT TEST—A test intended to disclose the weighing performance of a scale under off-center loading. (H-44)

SIMULATED LOAD TEST (Belt scales) (Amended 2011)—A test using artificial means of loading a belt-conveyor scale to determine its performance.

SINGLE DRAFT SCALE (Amended 2010)—A scale on which all wheels of a railcar are weighed simultaneously.

SIZE, OF A SCALE—The size of a scale is expressed by length of the weighrail.

SKIRTING (Belt Scales)—Stationary side boards or sections of belt conveyor attached to the conveyor support frame or other stationary support to prevent the bulk material from falling off the side of the belt. Usually used at infeeds. (H-44)

STATIC MAINTENANCE TOLERANCE—Maintenance Tolerance is a tolerance for application under test conditions to a device in service; usually applied to errors as found. (SMA) Static Maintenance Tolerance, usually referred to in motion weighing, is that which is applicable to a static weighing scale.

STATIC WEIGHING—A weighing system in which the load being applied is stationary during the weighing operation. (SMA)

STAY—A device designed and applied to any portion of a scale mechanism so as to prevent horizontal displacement of the part to which it is attached. (SMA)

STAY PLATES—A type of STAY consisting of a specially formed and relatively wide plate. Sometimes also colloquially called Place Check. (SMA)

STEP TEST—See BUILD-UP TEST.

STIFFENERS—A structural element provided to stiffen the web and or flange or a beam. (SMA)

STRAIN-LOAD TEST—The test of a scale beginning with the scale under load and applying known test weights to determine accuracy over a portion of the weighing range. The scale errors for a strain-load test are the errors observed for the known test loads only. The tolerances to be applied are based on the known test load used for each error that is determined. (H-44)

SUBSTITUTION TEST—See BUILD-UP TEST.

SWIVEL IDLER (Belt Scales)—An idler frame pivoted in its center to the idler stringers so that it may change position.

TAIL PULLEY (Belt Scales)—The pulley at the opposite end of the conveyor from the head pulley. (H-44)

TAPES—(1) In a scale, a thin metal strip or band used for transmitting force, as from the lever system to the cam of a pendulum assembly. Sometimes also called ribbon. (2) In a printer, a strip of paper on which the print is made. (SMA)

TEST CHAIN (Belt Scales) (Amended 2009)—A device consisting of a series of rollers or wheels linked together in such a manner as to ensure uniformity of weight and freedom of motion to reduce wear, with consequent loss of weight to a minimum.

TEST TRAIN—A train consisting of or including reference weight cars and used to test coupled-in-motion railway track scales. The reference weight cars may be placed consecutively or distributed in different places within a train. (H-44)

TEST WEIGHT CAR (Amended 2010)— A railroad car designed to be a stable mass standard to test railway track scales. The test weight car may be one of the following types: a composite railcar, a test weight railcar, or a standard railcar

TEST WEIGHTS (Belt Scales)—A weight(s) applied to the weighbridge. Equivalent lb/ft loading is dependent on total weight, idler spacing and conveyor incline.

TESTING AUTHORITY (Added 2009)—A railroad or railroad's designated scale contractor who is responsible for testing or verifying scale compliance.

TOLERANCE—A value fixing the limit of allowable error or departure from true performance or value. (H-44)

TORSION LEVER—See PIPE LEVER.

TOTALIZER (Belt Scales)—A device used with a belt conveyor scale to indicate the weight of material which has been conveyed over the scale. The master weight totalizer is the primary indicating element of the belt conveyor scale. An auxiliary vernier counter used for scale calibration is not (necessarily) part of the master weight totalizer. Auxiliary remote totalizers may be provided. The totalizer shows the accumulated weight and may be non-resettable or may be reset to zero to measure a definite amount of material conveyed.

TRAINING IDLERS (Belt Scales)—Idlers of special design or mounting intended to shift the belt sideways on the conveyor to assure the belt is centered on the conveying idlers. (H-44)

TRANSVERSE EXTENSION LEVER—In a railroad pattern scale, that lever, usually parallel to the transverse centerline of the scale, whose principal function is to translate the forces due to the applied load to a point from which they can be directly applied to the indicating element of a mechanical scale or to a load cell. Sometimes also colloquially called Fifth Lever. (SMA)

TRIG—The latch-like, pivoted element of a trig loop assembly, used to lock the weighbeam. (SMA)

TRIG LOOP—The fixture through which the tip of the weighbeam projects in usual construction, designed to restrict vertical angular motion of the weighbeam to designed limits. (SMA)

TRUSS RODS—A rod used for trussing a lever. (SMA)

TWO DRAFT SCALES—The two ends of a car are weighed separately and the two weights obtained are added to produce a gross weight of the car.

UNCOUPLED-IN-MOTION RAILROAD WEIGHING SYSTEM—A device and related installation characteristics consisting of (1) the associated approach trackage, (2) the scale (i.e., the weighing element, the load receiving element, and the indicating element with its software), and (3) the exit trackage which permit the weighing of railroad cars uncoupled in motion. (H-44)

UNIT TRAIN—A unit train is defined as a number of contiguous cars carrying a single commodity from one consignor to one consignee. The number of cars is determined by agreement among the consignor, consignee, and the operating railroad. (H-44)

UNIT WEIGHT—One contained within the housing of an automatic-indicating scale and mechanically applied and removed from the mechanism. The application of a unit weight will increase the range of automatic indication, normally in increments equal to the reading face capacity. (H-44)

VERIFICATION SCALE DIVISION (value of "e")—A value, expressed in units of weight (mass) and specified by the manufacturer of a device, by which the tolerance values and the accuracy class applicable to the device are determined. The verification scale division is applied to all scales, in particular to ungraduated devices since they have no graduations. The verification scale division, e, may be different from the displayed scale division, d, for certain other devices used for weight classifying or weighing in pre-determined amounts, and certain other Class I and II scales. (H-44)

WALL BATTER—The slope or inclination of the face or back of a wall from the vertical plane, usually resulting in decreased thickness of wall as its height increases. (SMA)

WEIGH MODULE (Added 2009)—The single or articulated portion of a weighing element supported by two sections. The length of a module is the distance to which load can be applied.

WEIGH RAIL—Either of the two load receiving elements of a track scale, or the load receiving element of a monorail scale. Sometimes also called "Live Rail." (SMA)

WEIGHBEAM—An element comprising one or more bars, equipped with moveable poises or means for applying counterpoise weights or both. (H-44)

WEIGHBEAM NOTCH—One of a series of V-shaped indentations provided in or on a weighbeam to aid in positioning a poise which is provided with a pawl. Sometimes also called "Beam Notch," "Notch." (SMA)

WEIGHBRIDGE SPAN—The distance between supports of a member subject to transverse bending or the distance between the planes of adjoining sections of a scale. (SMA)

WEIGHING ELEMENT—That portion of a scale that supports the load-receiving element and transmits to the indicating element a signal or force resulting from the load applied to the load-receiving element. (H-44)

WEIGHMENT—A single complete weighing operation. (H-44)

WEIGHT INDICATOR (Added 2012)—An indicating element incorporated into a weighing system for the purpose of setting metrological parameters, adjusting calibration, and displaying the weight value.

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Appendix B

Standard Forms and Reports

— 2013 —

1.) Railroad Test Car Calibration Report (Added 2003)

A blank copy of the standard Railroad Test Car Calibration Report. The field descriptions are on the backside of the report. There is room on the top of the front page to insert the testing agency's heading and logo.

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RAILROAD TEST CAR CALIBRATION REPORT

Owner:

Report Number:

Calibration date:

Seal Numbers:

Submitted By:

Weather Condition

Temperature:
Barometric Pressure:
Humidity:

Car Number:

Car Type:	Nominal Weight:	As Found:	As Left:	Unit of Measure:	Uncertainty:

Remarks:

Test Description:

Witnessed By:

Metrologist / Inspector

Date

Manager / Director

OWNER:	The owner entry consists of 4 lines of information regarding the owner of the test car. This field will normally contain the owner's name and business address.
SUBMITTED BY:	The person's name responsible for the test car would be entered into this field.
PHONE:	The phone number of the person responsible for the test car would be entered into this field.
CAR SUBMITTED:	Enter the test car number including the owner designation here.
REPORT NUMBER:	Enter the report or certificate number here. This number should be traceable to provide replacement certificates of calibration.
CALIBRATION DATE:	This field represents the date on which the test car was calibrated.
SEAL NUMBERS:	Enter the numbers of the compartment seals, when used.
TEMPERATURE:	Enter the average ambient temperature at the time of final calibration.
BAROMETRIC PRESSURE:	Enter the barometric pressure at the time of final calibration.
HUMIDITY:	Enter the humidity at the time of final calibration.
CAR TYPE:	Enter the type of car being calibrated. Choices include monitor car, composite car, self contained car, compartment car, and long wheel base car.
NOMINAL WEIGHT:	Enter the stenciled weight of the test car.
AS FOUND:	Enter the weight indication as the test car is placed on the scale before any adjustments are made.
AS LEFT:	Enter the final weight indication after all adjustments and sealing have been completed.
UNIT OF MEASURE:	Enter “LB” or “KG” representing the calibration measure.
UNCERTAINTY:	Enter the test scales Zone of Uncertainty value.
REMARKS:	Enter information regarding the condition of the test car, repairs that may be pending or recommended, repairs that may have been made before calibration, etc.
TEST DESCRIPTION:	Enter the name of the test scale, the certification information for the test scale, and procedure used to calibrate the test car.
WITNESSED BY:	Enter the names of those in attendance during the calibration of this car.
METROLOGIST/INSPECTOR:	Signature line for qualified individual conducting the calibration.
DATE:	Date of signature by qualified individual conducting the calibration.
MANAGER/DIRECTOR:	Signature line for management approval when required.

Appendix C

Standard Methods of Test Car Calibration on a Master Scale

(ADDED 2007)

— 2013 —

Prior to calibration, the test car should be thoroughly checked to ensure that the test car is suitable for use. All missing or broken parts must be noted on the calibration report. The fuel tank, if applicable, should be full and noted accordingly on the test report. Adjustment compartment seals and locks must remain on the test car during calibration.

Counterpoise weights should be calibrated at least every 2 years (or sooner if the weights have been damaged) by a State metrology lab. Any required adjustment shall be as close to zero error as possible, never to exceed the tolerance listed on FGIS form 969. The weights should be used in the same number group as when the master scale was tested by GIPSA. For example, use weights #1 through #8 for calibrating an 80,000 lb test car.

A pointer should be fixed to the beam, and the trig loop should be marked or a chart should be affixed on the trig loop to clearly show the position of the beam in relation to the trig loop or chart.

Before the master scale is used for the first time in the day, it should be exercised by placing a test car on and off the scale two or three times. The sensitivity should be checked by placing 10 lb on the rail, which should cause the beam's position of equilibrium to change by at least ¼ in.

The "as found" weight of the test car should be determined using the procedures below. If the test car is out of adjustment beyond the limits of counterpoise weights, fractional poise, or error weights, then use whatever means available to determine the error or approximate error and note the circumstances accordingly on the test report. Usually, such extreme errors are due to repairs completed before calibration. In such circumstances, rough adjust the car and then follow the procedures without using the error-calculating steps Steps 4 through 7 inclusive for A or B.

A. Master scale with a fractional poise *not* using error weights

A test car can be calibrated using a fractional poise only if the fractional poise has been tested during a routine master scale test and found to comply with accuracy requirements.

1. Move the fractional poise to the center mark (which is usually 50 lb).
2. Balance the beam with the balance ball until it swings equidistant above and below the center mark of the trig loop or chart. Lock the beam.

3. Place counterpoise weights on the beam tip hanger equal to the nominal value of the test car. Spot the test car centered on the scale. Mark the rail where the wheels make contact .

4. Unlock the beam. Adjust the fractional poise and counterpoise weights, if necessary, with the test car on the scale until the beam swings equidistant above and below the center mark of the trig loop or chart. Lock the beam.

5. **Calculate the apparent error (Ea):** The number of pounds behind (to the left of) the center mark of the fractional poise is minus (–) error. Conversely, the numbers of pounds forward (to the right) of the center mark is plus (+) error. If counterpoise weights had to be adjusted to reach balance, then the values of the counterpoise weights added or removed must be calculated along with the amount of adjustment made to the fractional poise. Added counterpoise weights indicate a plus error, and removed counterpoise weights indicate a minus error.

6. **Calculate the actual "as found" error (Eas)** as follows: Find the average master scale error (**Es**) for the weight range of the test car in the latest master scale test chart provided by GIPSA. Then use the apparent error (**Ea**) from Step 5 and the average master scale error (**Es**) in the following formula to arrive at the "as found" error (**Eas**):

Apparent Error (**Ea**) – Avg. Master Scale Error (**Es**) = As Found Error (**Eas**)
Ea – Es = Eas

Examples:

Ea (+5) – **Es** (+2) = **Eas** (+3)	**Ea** (–5) – **Es** (+2) = **Eas** (–7)
Ea (+5) – **Es** (–2) = **Eas** (+7)	**Ea** (–5) – **Es** (–2) = **Eas** (–3)

7. Record the "**as found**" error (**Eas**).

8. With the test car still on the scale, set the counterpoise weights to the nominal value of the test car. Set the fractional poise to compensate for the average master scale error for the test load as follows: First, move the fractional poise to the center mark, in this example 50 lb. Now use the fractional poise to compensate for the average master scale error. For example, if the average master scale error, taken from the GIPSA master scale test report chart for the weight range of the test car, is –2, then move the fractional poise 2 lb back to 48 lb. If it is +2, then move the fractional poise 2 lb forward to 52 lb. At this point, the beam is not balanced but is set to adjust the test car without having to further adjust for scale error.

9. a. **Adjust the test car using the beam** as follows: Unlock the beam and add or remove weight from the test car until the beam swings equidistant above and below the center mark of the trig loop or chart. The test car is now adjusted to zero error.

   or

   b. **Adjust the test car using a small scale** as follows: Use a small scale that has been tested up to the weight range of the "as found error (**Eas**)" and found repeatable to at least ¼ lb. Weigh scrap metal that is to go into the test car or that has been taken out of the test car equivalent to the "as found error (**Eas**)" amount recorded in Step 7. Adjust the test car. Unlock the beam. If further material adjustment is needed to balance the beam, then recalculate the "as found (**Eas**)" error and record. Lock the beam and move the test car off the scale.

Optional: Zero balance may be rechecked by setting the poise back to the center position. If balance is maintained within 1 lb, continue; otherwise, rerun the test from the beginning.

10. With the poise set as described in Step 8 (adjusted for scale error), move the test car back on the scale, spotting it at the same marked position as noted in Step 3.

11. Unlock the beam. If the balance is maintained, lock the beam and move the test car off the scale. If balance cannot be obtained within 1 lb of the original poise setting in Step 8, then rerun the test from the beginning.

12. Remove the counter balance weights and then move the fractional poise back to its center position. If zero balance is within 1 lb, consider the test acceptable. Unlock the beam. If zero has changed more than 1 lb, then repeat the test.

    Seal and stencil the test car with the date and location of calibration.

B. Master scale without a fractional poise using error weights

1. Place about 30 lb of error weights on the scale rail using 10-, 5-, 2- and 1-lb weights. Have another 20 lb of error weights available to add to the test car if needed.

2. Balance the beam with the balance ball until it swings equidistant above and below the center mark of the trig loop or chart. Lock the beam.

3. Place counter poise weights on the beam tip hanger equal to the nominal value of the test car. Spot the test car centered on the scale. Mark the rail where the wheels make contact. Place the error weights (equal to the amount placed in Step 1) on the test car.

4. Unlock the beam. Adjust the counterpoise weights, if necessary. Add or remove error weights until the beam swings equidistant above and below the center mark of the trig loop or chart. Lock the beam.

5. **Determine the apparent error (Ea)** of the test car: The error weight amount that is added or removed is the amount of minus or plus error respectively in the test car before scale error is taken in to account. If counterpoise weights had to be adjusted to reach balance, then the values of the counterpoise weights added or removed must be calculated with the amount of adjustment made to the error weights. Added counterpoise weights indicate a plus error, and removed counterpoise weights indicate a minus error.

6. **Calculate the actual "as found" error (Eas)** as follows: Find the average master scale error (**Es**) for the weight range of the test car in the latest master scale test chart provided by GIPSA. Then, use the apparent error (**Ea**) from Step 5 and the average master scale error (**Es**) in the following formula to arrive at the "as found" error (**Eas**):

Apparent Error (**Ea**) – Avg. Master Scale Error (**Es**) = As Found Error (**Eas**)
Ea – **Es** = **Eas**

Examples:

Ea (+5) – **Es** (+2) = **Eas** (+3)	**Ea** (–5) – **Es** (+2) = **Eas** (–7)
Ea (+5) – **Es** (–2) = **Eas** (+7)	**Ea** (–5) – **Es** (–2) = **Eas** (–3)

7. Record the "as found" error (**Eas**).

8. With the test car still on the scale, set the counterpoise weights to the nominal value of the test car. Replace the amount of error weights that was on the test car when it was zero balanced, in this case 30 lb. Adjust the error weights to compensate for the average scale error for the weight range of the test car in the latest master scale test chart provided by GIPSA. For example, if the average scale error is –2, then add 2 lb more error weights. If it is +2, then remove 2 lb of error weights. At this point, the scale beam is not balanced but is set to adjust the test car without having to further adjust for scale error.

9. a. Unlock the beam and adjust the test car by adding or removing metal from the test car until the beam swings equidistant above and below the center mark of the trig loop or chart. The test car is now adjusted to zero error. Lock the beam and move the test car off the scale.

   or

   b. Use a small scale that has been tested up to the weight range of the "as found error (**Eas**)" and found repeatable to at least ¼ lb. Weigh scrap metal that is to go into the test car or that has been taken out of the test car equivalent to the "as found error (**Eas**)" amount recorded in Step 5. Adjust the test car. If further material adjustment is needed to balance the beam, then recalculate the "as found error (**Eas**)" and record. Lock the beam and move the test car off the scale.

   Optional: Zero balance may be rechecked by setting the error weights back to the value described in Step 1. If balance is maintained within 1 lb, continue; otherwise, rerun the test from the beginning.

10. With the amount of error weights described in Step 8 (adjusted for scale error) on the test car, move the test car back on the scale, spotting it at the same marked position as noted in Step 3. Unlock the beam and, if balance is within 1 lb, continue; otherwise, start over.

11. Lock the beam, move the test car off the scale, and remove the counterpoise weights. Place the amount of error weights assembled in Step 1 on the rail. Unlock the beam. If the balance is maintained within 1 lb, the test is acceptable. If balance is not maintained within 1 lb, rerun the test from the beginning.

    Seal and stencil the test car with the date and location of calibration.

Appendix D

Guidelines for Using a Static Railroad Track Scale

(ADDED 2008)

— 2013 —

(POST IN RAILROAD TRACK SCALE HOUSE IN CLEAR VIEW)

1.) Check weigh rails and decking to ensure scale is clear of obstructions.

2.) Balance the beam or zero the digital indicator before using the scale.

3.) Check the sensitivity of a weigh beam prior to weighing.

4.) Do not weigh if it appears that the scale is not functioning correctly.

5.) Position the car correctly on the weigh rails.

6.) Cars shall be uncoupled at both ends.

7.) Allow liquid ladings to stabilize before recording the weight.

8.) Check that recorded weights are correct.

9.) Avoid unnecessary movement or storage of equipment on the scale.

10.) Report scale problems to supervisor immediately.

11.) Notify the servicing railroad scale department whenever any of the following occurs:

- A security seal or an approval sticker that serves as a security seal is broken.
- An audit trail calibration or configuration number has changed since the last test.
- The scale is serviced and calibration could have been affected.

ACCURATE AND PROPERLY RECORDED WEIGHTS ARE YOUR RESPONSIBILITY

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