Section 2

Page

2.20. Scales 2-3

2.21. Belt-Conveyor Scale Systems 2-47

2.22. Automatic Bulk Weighing Systems 2-57

2.23. Weights 2-63

2.24. Automatic Weighing Systems 2-67

DO NOT PRINT THIS PAGE.

Sec. 2.20. Scales

A. Application

A.1. General. - This code applies to all types of weighing devices other than automatic bulk-weighing systems, belt-conveyor scales, and automatic weighing systems. The code comprises requirements that generally apply to all weighing devices, and specific requirements that are applicable only to certain types of weighing devices.
(Amended 1972 and 1983)

A.2. Wheel-Load Weighers, Portable Axle-Load Weighers, and Axle-Load Scales. - The requirements for wheel-load weighers, portable axle-load weighers, and axle-load scales apply only to such scales in official use for the enforcement of traffic and highway laws or for the collection of statistical information by government agencies.

A.3. Also see General Code requirements.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Zero Indication.

(a) On a scale equipped with indicating or recording elements, provision shall be made to either indicate or record a zero-balance condition.

(b) On an automatic-indicating scale or balance indicator, provision shall be made to indicate or record an out-of-balance condition on both sides of zero.

(c) A zero-balance condition may be indicated by other than a continuous digital zero indication, provided that an effective automatic means is provided to inhibit a weighing operation or to return to a continuous digital indication when the scale is in an out-of-balance condition.
(Added 1987) (Amended 1993)

(Amended 1987)

S.1.1.1. Digital Indicating Elements.

(a) A digital zero indication shall represent a balance condition that is within ± ½ the value of the scale division.

(b) A digital indicating device shall either automatically maintain a "center-of-zero" condition to ± ¼ scale *division or less, or have an auxiliary or supplemental "center-of-zero" indicator that defines a zero-balance condition to ± ¼ of a scale division or less.*
[Nonretroactive as of January 1, 1993]

(Amended 1992)

S.1.1.2. No-Load Reference Value. - On a single draft manually operated receiving hopper scale installed below grade, used to receive grain, and utilizing a no-load reference value, provision shall be made to indicate and record the no-load reference value prior to the gross load value.
(Added 1983)

S.1.2. Value of Scale Division Units. *- Except for batching scales and weighing systems used exclusively for weighing in predetermined amounts, 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;

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

Examples: scale divisions may be 0.01, 0.02, 0.05; 0.1, 0.2, or 0.5; 1, 2, or 5; 10, 20, 50, or 100; or, scale divisions may be 1/2, 1/4, 1/8, 1/16, etc.
[Nonretroactive as of January 1, 1986]

S.1.2.1. Weight Units. *- Except for postal scales, a digital-indicating scale shall indicate weight values using only a single unit of measure. Weight values shall be presented in a decimal format with the value of the scale division expressed as 1, 2, or 5, or a decimal multiple or submultiple of 1, 2, or 5.*
[Nonretroactive as of January 1, 1989]
(Added 1987)

S.1.2.2. Verification Scale Interval.

S.1.2.2.1. Class I and II Scales and Dynamic Monorail Scales. If $e \neq d$, the verification scale interval "e" shall be determined by the expression:

$$d < e \leq 10\ d$$

If the displayed division (d) is less than the verification division (e), then the verification division shall be less than or equal to 10 times the displayed division.

The value of e must satisfy the relationship, $e = 10^k$ of the unit of measure, where k being a positive or negative whole number or zero. This requirement does not apply to a Class I device with d < 1 mg where e = 1 mg. If $e \neq d$, the value of "d" shall be a decimal submultiple of "e," and the ratio shall not be more than 10:1. If $e \neq d$, and both "e" and "d" are continuously displayed during normal operation, then "d" shall be differentiated from "e" by size, shape, color, etc. throughout the range of weights displayed as "d."
(Added 1999)

S.1.2.2.2. Class III and IIII. The value of "e" is specified by the manufacturer as marked on the device. Except for dynamic monorail scales, "e" must be less than or equal to "d."
(Added 1999)

S.1.2.3. Prescription Scale with a Counting Feature. - A Class I or Class II prescription scale with an operational counting feature shall not calculate a piece weight or total count unless the sample used to determine the individual piece weight meets the following conditions:

(a) minimum individual piece weight is greater than or equal to 3 e; and

(b) minimum sample piece count is greater than or equal to 10 pieces.
(Added 2003)

S.1.3. Graduations.

S.1.3.1. Length. - Graduations shall be so varied in length that they may be conveniently read.

S.1.3.2. Width. - In any series of graduations, the width of a graduation shall in no case be greater than the width of the clear space between graduations. The width of main graduations shall be not more than 50 % greater than the width of subordinate graduations. Graduations shall be not less than 0.2 mm (0.008 in) wide.

S.1.3.3. Clear Space Between Graduations. - The clear space between graduations shall be not less than 0.5 mm (0.02 in) for graduations representing money values, and not less than 0.75 mm (0.03 in) for other graduations. If the graduations are not parallel, the measurement shall be made:

(a) along the line of relative movement between the graduations at the end of the indicator, or

(b) if the indicator is continuous, at the point of widest separation of the graduations.

S.1.4. Indicators.

S.1.4.1. Symmetry. - The index of an indicator shall be of the same shape as the graduations, at least throughout that portion of its length associated with the graduations.

S.1.4.2. Length. - The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case, the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).

S.1.4.3. Width. - The width of the index of an indicator in relation to the series of graduations with which it is used shall be not greater than:

(a) the width of the narrowest graduation,
[Nonretroactive as of January 1, 2002]

(b) the width of the clear space between weight graduations, and

(c) three-fourths of the width of the clear space between money value graduations.

When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation.

S.1.4.4. Clearance. - The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).

S.1.4.5. Parallax. - Parallax effects shall be reduced to the practicable minimum.

S.1.5. Weighbeams.

S.1.5.1. Normal Balance Position. - The normal balance position of the weighbeam of a beam scale shall be horizontal.

S.1.5.2. Travel. - The weighbeam of a beam scale shall have equal travel above and below the horizontal. The total travel of the weighbeam of a beam scale in a trig loop or between other limiting stops near the weighbeam tip shall be not less than the minimum travel shown in Tables 1M and 1. When such limiting stops are not provided, the total travel at the weighbeam tip shall be not less than 8 % of the distance from weighbeam fulcrum to the weighbeam tip.

Table 1M.
Minimum Travel of Weighbeam of Beam Scale Between Limiting Stops

Distance from weighbeam fulcrum to limiting stops (centimeters)	Minimum travel between limiting stops (millimeter)
30 or less	10
30+ to 50, inclusive	13
50+ to 100, inclusive	18
Over 100	23

Table 1.
Minimum Travel of Weighbeam of Beam Scale Between Limiting Stops

Distance from weighbeam fulcrum to limiting stops (inches)	Minimum travel between limiting stops (inch)
12 or less	0.4
12+ to 20, inclusive	0.5
20+ to 40, inclusive	0.7
Over 40	0.9

S.1.5.3. Subdivision. - A subdivided weighbeam bar shall be subdivided by scale division graduations, notches, or a combination of both. Graduations on a particular bar shall be of uniform width and perpendicular to the top

edge of the bar. Notches on a particular bar shall be uniform in shape and dimensions and perpendicular to the face of the bar. When a combination of graduations and notches is employed, the graduations shall be positioned in relation to the notches to indicate notch values clearly and accurately.

S.1.5.4. Readability. - A subdivided weighbeam bar shall be so subdivided and marked, and a weighbeam poise shall be so constructed, that the weight corresponding to any normal poise position can easily and accurately be read directly from the beam, whether or not provision is made for the optional recording of representations of weight.

S.1.5.5. Capacity. - On an automatic-indicating scale having a nominal capacity of 15 kg (30 lb) or less and used for direct sales to retail customers:

(a) the capacity of any weighbeam bar shall be a multiple of the reading-face capacity,

(b) each bar shall be subdivided throughout or shall be subdivided into notched intervals, each equal to the reading-face capacity; and

(c) the value of any turnover poise shall be equal to the reading-face capacity.

S.1.5.6. Poise Stop. - Except on a steelyard with no zero graduation, a shoulder or stop shall be provided on each weighbeam bar to prevent a poise from traveling and remaining back of the zero graduation.

S.1.6. Poises.

S.1.6.1. General. - No part of a poise shall be readily detachable. A locking screw shall be perpendicular to the longitudinal axis of the weighbeam and shall not be removable. Except on a steelyard with no zero graduation, a poise shall not be readily removable from a weighbeam. The knife-edge of a hanging poise shall be hard and sharp and so constructed as to allow the poise to swing freely on the bearing surfaces in the weighbeam notches.

S.1.6.2. Adjusting Material. - The adjusting material in a poise shall be securely enclosed and firmly fixed in position; if softer than brass, it shall not be in contact with the weighbeam.

S.1.6.3. Pawl. - A poise, other than a hanging poise, on a notched weighbeam bar shall have a pawl that will seat the poise in a definite and correct position in any notch, wherever in the notch the pawl is placed, and hold it there firmly and without appreciable movement. The dimension of the tip of the pawl that is transverse to the longitudinal axis of the weighbeam shall be at least equal to the corresponding dimension of the notches.

S.1.6.4. Reading Edge or Indicator. - The reading edge or indicator of a poise shall be sharply defined, and a reading edge shall be parallel to the graduations on the weighbeam.

S.1.7. Capacity Indication, Weight Ranges, and Unit Weights. -

(a) Gross Capacity. An indicating or recording element shall not display nor record any values when the total platform load (not counting the initial dead load that has been canceled by an initial zero-setting mechanism) is in excess of 105 % of scale capacity.

(b) *Capacity Indication. Electronic computing scales (excluding postal scales and weight classifiers) shall neither display nor record a gross or net weight in excess of scale capacity plus 9 d.*
[Nonretroactive as of January 1, 1993]

The total value of weight ranges and of unit weights in effect or in place at any time shall automatically be accounted for on the reading face and on any recorded representation.

This requirement does not apply to: (1) single-revolution dial scales, (2) multi-revolution dial scales not equipped with unit weights, (3) scales equipped with two or more weighbeams, nor (4) devices that indicate mathematically derived totalized values.
(Amended 1990, 1992, and 1995)

S.1.8. Computing Scales.

S.1.8.1.M. Money-Value Graduations, Metric Unit Prices. - The value of the graduated intervals representing money values on a computing scale with analog indications shall not exceed:

(a) 1 cent at all unit prices of 55 cents per kilogram and less;

(b) 2 cents at unit prices of 56 cents per kilogram through $2.75 per kilogram (special graduations defining 5-cent intervals may be employed but not in the spaces between regular graduations);

(c) 5 cents at unit prices of $2.76 per kilogram through $7.50 per kilogram; or

(d) 10 cents at unit prices above $7.50 per kilogram.

Value figures and graduations shall not be duplicated in any column or row on the graduated chart. (See also S.1.8.2.)

S.1.8.1. Money-Value Graduations, Inch-Pound Unit Prices. - The value of the graduated intervals representing money values on a computing scale with analog indications shall not exceed:

(a) 1 cent at all unit prices of 25 cents per pound and less;

(b) 2 cents at unit prices of 26 cents per pound through $1.25 per pound (special graduations defining 5-cent intervals may be employed but not in the spaces between regular graduations);

(c) 5 cents at unit prices of $1.26 per pound through $3.40 per pound; or

(d) 10 cents at unit prices above $3.40 per pound.

Value figures and graduations shall not be duplicated in any column or row on the graduated chart. (See also S.1.8.2.)

S.1.8.2. Money-Value Computation. - A computing scale with analog quantity indications used in retail trade may compute and present digital money values to the nearest quantity graduation when the value of the minimum graduated interval is 0.005 kg (0.01 lb) or less. (Also see Sec. 1.10; G-S.5.5.)

S.1.8.3. Customer's Indications. – Weight indications shall be shown on the customer's side of computing scales when these are used for direct sales to retail customers. Computing scales equipped on the operator's side with digital indications, such as the net weight, unit price, or total price, shall be similarly equipped on the customer's side. Unit price displays visible to the customer shall be in terms of single whole units of weight and not in common or decimal fractions of the unit. Scales indicating in metric units may indicate price per 100 g. (Amended 1985 and 1995)

S.1.8.3.1. *Scales that will function as either a normal round off scale or as a weight classifier shall be provided with a sealable means for selecting the mode of operation and shall have a clear indication (annunciator), adjacent to the weight display on both the operator's and customer's side whenever the scale is operating as a weight classifier.*
[Nonretroactive as of January 1, 2001]
(Added 1999)

S.1.8.4. Recorded Representations, Point-of-Sale Systems. - The sales information recorded by cash registers when interfaced with a weighing element shall contain the following information for items weighed at the checkout stand:

(a) the net weight,[1]

(b) the unit price,[1]

(c) the total price, and

(d) the product class or, in a system equipped with price look-up capability, the product name or code number.

S.1.9. Prepackaging Scales.

S.1.9.1. Value of the Scale Division. - On a prepackaging scale, the value of the intervals representing weight values shall be uniform throughout the entire reading face. The recorded weight values shall be identical with those on the indicator.

S.1.9.2. Label Printer. - A prepackaging scale or a device that produces a printed ticket to be used as the label for a package shall print all values digitally and of such size, style of type, and color as to be clear and conspicuous on the label.

S.1.10. Adjustable Components. - An adjustable component such as a pendulum, spring, or potentiometer shall be held securely in adjustment and, except for a zero-load balance mechanism, shall be located within the housing of the element.
(Added 1986)

S.1.11. Provision for Sealing.

(a) Except on Class I scales, 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.
[Nonretroactive as of January 1, 1979]

(b) Except on Class I scales, 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 detrimentally affects the metrological integrity of the device can be made to any electronic mechanism.
[Nonretroactive as of January 1, 1990]

(c) Except on Class I scales, audit trails shall use the format set forth in Table S.1.11.
[Nonretroactive as of January 1, 1995]

A device may be fitted with an automatic or a semi-automatic calibration mechanism. This mechanism shall be incorporated inside the device. After sealing, neither the mechanism nor the calibration process shall facilitate fraud.
(Amended 1989, 1991, and 1993)

[1] For devices interfaced with scales indicating in metric units, the unit price may be expressed in price per 100 grams. Weight values shall be identified by kilogram, kg, grams, g, ounces, oz, pound, or lb. *The "#" symbol is not acceptable.*
[Nonretroactive as of January 1, 2006]
(Amended 1995 and 2005)

Table S.1.11. Categories of Device and Methods of Sealing	
Categories of Device	***Method of Sealing***
Category 1: No remote configuration capability.	*Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.*
Category 2: Remote configuration capability, but access is controlled by physical hardware. *The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode.*	*The hardware enabling access for remote communication must be at the device and sealed using a physical seal or two event counters: one for calibration parameters and one for configuration parameters.*
Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).	*An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)*

[Nonretroactive as of January 1, 1995]
(Table added 1993)

S.1.12. Manual Weight Entries. - *A device when being used for direct sale shall accept an entry of a manual gross or net weight value only when the scale gross or net* weight indication is at zero. Recorded manual weight entries, except those on labels generated for packages of standard weights, shall identify the weight value as a manual weight entry by one of the following terms: "Manual Weight," "Manual Wt," or "MAN WT." The use of a symbol to identify multiple manual weight entries on a single document is permitted, provided that the symbol is defined on the same page on which the manual weight entries appear and the definition of the symbol is automatically printed by the recording element as part of the document.*
*[Nonretroactive as of January 1, 1993] [*Nonretroactive as of January 1, 2005]*
(Added 1992) (Amended 2004)

S.1.13. Vehicle On-Board Weighing Systems: Vehicle in Motion. - When the vehicle is in motion, a vehicle on-board weighing system shall either:

(a) be accurate; or

(b) inhibit the weighing operation.
(Added 1993)

S.2. Design of Balance, Tare, Level, Damping, and Arresting Mechanisms.

S.2.1. Zero-Load Adjustment.

S.2.1.1. General. - A scale shall be equipped with means by which the zero-load balance may be adjusted. Any loose material used for this purpose shall be enclosed so that it cannot shift in position and alter the balance condition of the scale.

S.2.1.2. Scales used in Direct Sales. - A manual zero-setting mechanism (except on a digital scale with an analog zero-adjustment mechanism with a range of not greater than one scale division) shall be operable or accessible only by a tool outside of and entirely separate from this mechanism, or it shall be enclosed in a cabinet. Except on Class I or II scales, a balance ball shall either meet this requirement or not itself be rotatable.

A semiautomatic zero-setting mechanism shall be operable or accessible only by a tool outside of and separate from this mechanism or it shall be enclosed in a cabinet, or it shall be operable only when the indication is stable within:

(a) plus or minus 3 scale divisions for scales of more than 2000 kg (5000 lb) capacity in service prior to January 1, 1981, and for all axle load, railway track, and vehicle scales; or

(b) plus or minus 1 scale division for all other scales.

S.2.1.3. Scales Equipped with an Automatic Zero-Setting Mechanism (Zero-Tracking).

S.2.1.3.1. Zero-Tracking for Scales Manufactured Between January 1, 1981 and January 1, 2007. *– The maximum load that can be "rezeroed," when either placed on or removed from the platform all at once under normal operating conditions, shall be:*

(a) for bench, counter, and livestock scales: 0.6 scale division;

(b) for vehicle, axle-load, and railway track scales: 3.0 scale divisions; and

(c) for all other scales: 1.0 scale division.
(Amended 2005)

S.2.1.3.2. Zero-Tracking for Scales Manufactured On or After January 1, 2007. *– The maximum load that can be "rezeroed," when either placed on or removed from the platform all at once under normal operating conditions, shall be:*

(a) for vehicle, axle-load, and railway track scales: 3.0 scale divisions; and

(b) for all other scales: 0.5 scale division.
(Added 2005)

S.2.1.3.3. Means to Disable Zero-Tracking on Class III L Devices. - *Class III L devices equipped with automatic zero-setting mechanisms shall be designed with a sealable means to allow the automatic zero-setting mechanism to be disabled during the inspection and test of the device.*
[Nonretroactive as of January 1, 2001]
(Added 1999) (Amended 2005)

S.2.1.4. Monorail Scales. - On a static monorail scale equipped with digital indications, means shall be provided for setting the zero-load balance to within 0.02 % of scale capacity. On a dynamic monorail weighing system, means shall be provided to automatically maintain these conditions.
(Amended 1999)

S.2.1.5. Initial Zero-Setting Mechanism.

(a) Scales of accuracy classes I, II, and III may be equipped with an initial zero-setting device.

(b) An initial zero-setting mechanism shall not zero a load in excess of 20 % of the maximum capacity of the scale unless tests show that the scale meets all applicable tolerances for any amount of initial load compensated by this device within the specified range.

(Added 1990)

S.2.1.6. Combined Zero-Tare ("0/T") Key. - Scales not intended to be used in direct sales applications may be equipped with a combined zero and tare function key, provided that the device is clearly marked as to how the key functions. The device must also be clearly marked on or adjacent to the weight display with the statement "Not for Direct Sales."
(Added 1998)

S.2.2. Balance Indicator. - On a balance indicator consisting of two indicating edges, lines, or points, the ends of the indicators shall be sharply defined. When the scale is in balance, the ends shall be separated by not more than 1.0 mm (0.04 in).

S.2.2.1. Dairy-Product Test, Grain-Test, Prescription, and Class I and II Scales. - Except on digital indicating devices, a dairy-product-test, grain-test, prescription, or Class I or II scale shall be equipped with a balance indicator. If an indicator and a graduated scale are not in the same plane, the clearance between the indicator and the graduations shall be not more than 1.0 mm (0.04 in).

S.2.2.2. Equal-Arm Scale. *- An equal-arm scale shall be equipped with a balance indicator. If the indicator and balance graduation are not in the same plane, the clearance between the indicator and the balance graduation shall be not more than 1.0 mm (0.04 in).*
[Nonretroactive as of January 1, 1989]
(Added 1988)

S.2.3. Tare. - *On any scale (except a monorail scale equipped with digital indications), the value of the tare division shall be equal to the value of the scale division.** The tare mechanism shall operate only in a backward direction (that is, in a direction of underregistration) with respect to the zero-load balance condition of the scale. *A device designed to automatically clear any tare value shall also be designed to prevent the automatic clearing of tare until a complete transaction has been indicated.**
(Amended 1985)

*[**Note**: On a computing scale, this requires the input of a unit price, the display of the unit price, and a computed positive total price at a readable equilibrium. Other devices require a complete weighing operation, including tare, net, and gross weight determination]**
*[*Nonretroactive as of January 1, 1983]*

S.2.3.1. Monorail Scales Equipped with Digital Indications. - On a static monorail weighing system equipped with digital indications, means shall be provided for setting any tare value of less than 5 % of the scale capacity to within 0.02 % of scale capacity. On a dynamic monorail weighing system, means shall be provided to automatically maintain this condition.
(Amended 1999)

S.2.4. Level-Indicating Means. - Except for portable wheel-load weighers and portable axle-load scales, a portable scale shall be equipped with level-indicating means if its weighing performance is changed by an amount greater than the appropriate acceptance tolerance when it is moved from a level position and rebalanced in a position that is out of level in any upright direction by 5 % (approximately 3 degrees). The level-indicating means shall be readable without removing any scale parts requiring a tool.

[This requirement is nonretroactive as of January 1, 1986, for prescription, jewelers', and dairy-product-test scales and scales marked I and II]

[**Note:** Portable wheel-load weighers and portable axle-load scales shall be accurate when placed out of level up to and including 5 % (approximately 3 degrees).]
(Amended 1991)

S.2.4.1. Vehicle On-Board Weighing Systems. - A vehicle on-board weighing system shall operate within tolerance when the weighing system is out of level up to 3 degrees or 5 %. If the accuracy of the system is affected by out-of-level conditions normal to the use of the device, the system shall be equipped with an out-of-level sensor that inhibits the weighing operation when the system is out of level to the extent that the accuracy limits are exceeded.
(Added 1992)

S.2.5. Damping Means. - An automatic-indicating scale and a balance indicator shall be equipped with effective means to damp oscillations and to bring the indicating elements quickly to rest.

S.2.5.1. Digital Indicating Elements. - Digital indicating elements equipped with recording elements shall be equipped with effective means to permit the recording of weight values only when the indication is stable within:

(a) plus or minus 3 scale divisions for scales of more than 2000 kg (5000 lb) capacity in service prior to January 1, 1981, hopper (other than grain hopper) scales with a capacity exceeding 22 000 kg (50 000 lb), and for all vehicle, axle load, livestock, and railway track scales;

(b) plus or minus 1 scale division for all other scales.

The values recorded shall be within applicable tolerances.
(Amended 1995)

S.2.5.2. Jewelers', Prescription, and Class I and Class II Scales. - A jewelers', prescription, Class I, or Class II scale shall be equipped with appropriate means for arresting the oscillation of the mechanism.

S.2.5.3. Class I and Class II Prescription Scales with a Counting Feature. -A Class I or Class II prescription scale shall indicate to the operator when the piece weight computation is complete by a stable display of the quantity placed on the load receiving element.
(Added 2003)

S.3. Design of Load-Receiving Elements.

S.3.1. Travel of Pans of Equal-Arm Scale. - The travel between limiting stops of the pans of a nonautomatic-indicating equal-arm scale not equipped with a balance indicator shall be not less than the minimum travel shown in Table 2M and Table 2.

Table 2M.
Minimum Travel of Pans of
Nonautomatic Indicating Equal-Arm Scale
Without Balance Indicator

Nominal capacity (kilograms)	Minimum travel of pans (millimeters)
2 or less	9
2+ to 5 inclusive	13
5+ to 12, inclusive	19
Over 12	25

Table 2.
Minimum Travel of Pans of
Nonautomatic Indicating Equal-Arm Scale
Without Balance Indicator

Nominal capacity (pounds)	Minimum travel of pans (inch)
4 or less	0.35
4+ to 12, inclusive	0.5
12+ to 26, inclusive	0.75
Over 26	1.0

S.3.2. Drainage. - A load-receiving element intended to receive wet commodities shall be so constructed as to drain effectively.

S.3.3. Scoop Counterbalance. - A scoop on a scale used for direct sales to retail customers shall not be counterbalanced by a removable weight. A permanently attached scoop-counterbalance shall indicate clearly on both the operator's and customer's sides of the scale whether it is positioned for the scoop to be on or off the scale.

S.4. Design of Weighing Elements.

S.4.1. Antifriction Means. - Frictional effects shall be reduced to a minimum by suitable antifriction elements. Opposing surfaces and points shall be properly shaped, finished, and hardened. A platform scale having a frame around the platform shall be equipped with means to prevent interference between platform and frame.

S.4.2. Adjustable Components. - An adjustable component such as a nose-iron or potentiometer shall be held securely in adjustment. The position of a nose-iron on a scale of more than 1000 kg (2000 lb) capacity, as determined by the factory adjustment, shall be accurately, clearly, and permanently defined.
(Amended 1986)

S.4.3. Multiple Load-Receiving Elements. - Except for mechanical bench and counter scales, a scale with a single indicating or recording element, or a combination indicating-recording element, that is coupled to two or more load-receiving elements with independent weighing systems, shall be provided with means to prohibit the activation of any load-receiving element (or elements) not in use, and shall be provided with automatic means to indicate clearly and definitely which load-receiving element (or elements) is in use.

S.5. Design of Weighing Devices, Accuracy Class.

S.5.1. Designation of Accuracy Class. - *Weighing devices are divided into accuracy classes and shall be designated as I, II, III, III L, or IIII.*
[Nonretroactive as of January 1, 1986]

S.5.2. Parameters for Accuracy Class. - *The accuracy class of a weighing device is designated by the manufacturer and shall comply with parameters shown in Table 3.*
[Nonretroactive as of January 1, 1986]

S.5.3. Multi-Interval and Multiple Range Scales, Division Value. - On a multi-interval scale and multiple range scale, the value of "e" shall be equal to the value of "d."[2]
(Added 1986) (Amended 1995)

S.5.4. Relationship of Load Cell Verification Interval Value to the Scale Division. *- The relationship of the value for the load cell verification scale interval, v_{min}, to the scale division, d, for a specific scale installation shall be:*

(a) where N is the number of load cells in the scale for scales without lever systems: $v_{\min} \leq \frac{d}{\sqrt{N}}$

and,

(b) for scales with lever systems: $v_{\min} \leq \frac{d}{\sqrt{N} \text{ x (scale multiple)}}$

[Nonretroactive as of January 1, 1994]

*[**Note:** When the value of the scale division, d, is different than the verification scale division, e, for the scale, the value of e must be used in the formulae above]*

This requirement does not apply to complete scales and weighing elements which satisfy the following criteria:

(1) The device has been evaluated for compliance with T.N.8.1. Temperature under the National Type Evaluation Program (NTEP);

(2) The device has received an NTEP Certificate of Conformance; and

(3) The device must be equipped with an automatic zero-setting mechanism which cannot be made inoperative in the normal weighing mode. (A test mode which permits the disabling of the automatic zero-setting mechanism is permissible, provided the scale cannot function normally while in this mode.)
(Added 1993) (Amended 1996)

[2] See Footnote 1 to Table 3 Parameters for Accuracy Classes

Table 3 ***Parameters for Accuracy Classes***			
Class	***Value of the verification scale division (d or e[1])***	***Number of scale[4] divisions (n)***	
		Minimum	***Maximum***
SI Units			
I	*equal to or greater than 1 mg*	*50 000*	*--*
II	*1 to 50 mg, inclusive*	*100*	*100 000*
	equal to or greater than 100 mg	*5 000*	*100 000*
III[2,5]	*0.1 to 2 g, inclusive*	*100*	*10 000*
	equal to or greater than 5 g	*500*	*10 000*
III L[3]	*equal to or greater than 2 kg*	*2 000*	*10 000*
IIII	*equal to or greater than 5 g*	*100*	*1 200*
INCH-POUND Units			
III[5]	*0.0002 lb to 0.005 lb, inclusive*	*100*	*10 000*
	0.005 oz to 0.125 oz, inclusive	*100*	*10 000*
	equal to or greater than 0.01 lb	*500*	*10 000*
	equal to or greater than 0.25 oz	*500*	*10 000*
III L[3]	*equal to or greater than 5 lb*	*2 000*	*10 000*
IIII	*greater than 0.01 lb*	*100*	*1 200*
	greater than 0.25 oz	*100*	*1 200*

[1]For Class I and II devices equipped with auxiliary reading means (i.e., a rider, a vernier, or a least significant decimal differentiated by size, shape, or color), the value of the verification scale division "e" is the value of the scale division immediately preceding the auxiliary means.

[2] A scale marked "For prescription weighing only" may have a verification scale division(e) not less than 0.01 g.
(Added 1986) (Amended 2003)

[3] The value of a scale division for crane and hopper (other than grain hopper) scales shall be not less than 0.2 kg (0.5 lb). The minimum number of scale divisions shall be not less than 1 000.

[4]On a multiple range or multi-interval scale, the number of divisions for each range independently shall not exceed the maximum specified for the accuracy class. The number of scale divisions, n, for each weighing range is determined by dividing the scale capacity for each range by the verification scale division, e, for each range. On a scale system with multiple load-receiving elements and multiple indications, each element considered shall not independently exceed the maximum specified for the accuracy class. If the system has a summing indicator, the n_{max} for the summed indication shall not exceed the maximum specified for the accuracy class.
(Added 1997)

[5]The minimum number of scale divisions for a Class III Hopper Scale used for weighing grain shall be 2000.
(Added 2004)

[*Nonretroactive as of January 1, 1986*]
(Amended 1986, 1987, 1997, 1998, 1999, 2003, and 2004)

S.6. Marking Requirements. [See also G-S.1., G-S.4., G-S.6., G-S.7., G-UR.2.1.1., and UR.3.4.1.]

S.6.1. Nominal Capacity; Vehicle and Axle-Load Scales. *- For all vehicle and axle-load scales, the marked nominal capacity shall not exceed the concentrated load capacity (CLC) times the quantity of the number of sections in the scale minus 0.5.*

As a formula, this is stated as: *nominal capacity $\leq$ CLC x (N - 0.5)*
where N = the number of sections in the scale.
(See N.1.3.4. and T.N.3.1.)
[Nonretroactive as of January 1, 1989]

[**Note:** When the device is used in a combination railway track and vehicle weighing application, the above formula shall apply only to the vehicle scale application.]
(Added 1988) (Amended 1999 and 2002)

S.6.2. Location of Marking Information. - Scales that are not permanently attached to an indicating element, and for which the load-receiving element is the only part of the weighing/load-receiving element visible after installation, may have the marking information required in G-S.1. of the General Code and S.6. of the Scales Code located in an area that is accessible only through the use of a tool; provided that the information is easily accessible (e.g., the information may appear on the junction box under an access plate). The identification information for these scales shall be located on the weighbridge (load-receiving element) near the point where the signal leaves the weighing element or beneath the nearest access cover.
(Added 1989)

S.6.3. Scales, Main Elements, and Components of Scales or Weighing Systems. - Scales, main elements of scales when not contained in a single enclosure for the entire scale, load cells for which Certificates of Conformance (CC) have been issued under the National Type Evaluation Program, and other equipment necessary to a weighing system, but having no metrological effect on the weighing system, shall be marked as specified in Table S.6.3.a. and explained in the accompanying notes (Table S.6.3.b.)
(Added 1990)

S.6.4. Railway Track Scales. - A railway track scale shall be marked with the maximum capacity of each section of the load-receiving element of the scale. Such marking shall be accurately and conspicuously presented on, or adjacent to, the identification or nomenclature plate that is attached to the indicating element of the scale. *The nominal capacity of a scale with more than two sections shall not exceed twice its rated section capacity. The nominal capacity of a two-section scale shall not exceed its rated section capacity*.*
*[*Nonretroactive as of January 1, 2002]*
(Amended 1988, 2001, and 2002)

S.6.5. Livestock Scales. - A livestock scale manufactured prior to January 1, 1989, or after January 1, 2003, shall be marked with the maximum capacity of each section of the load-receiving element of the scale. Livestock scales manufactured between January 1, 1989, and January 1, 2003, shall be marked with either the Concentrated Load Capacity (CLC) or the Section Capacity. Such marking shall be accurately and conspicuously presented on, or adjacent to the identification or nomenclature plate that is attached to the indicating element of the scale. *The nominal capacity of a scale with more than two sections shall not exceed twice its rated section capacity. The nominal capacity of a two-section scale shall not exceed its rated section capacity*.*
*[*Nonretroactive as of January 1, 2003]*
(Added 2002)

See also Note 14 in Table S.6.3.b.

S.6.6. Counting Feature, Minimum Individual Piece Weight and Minimum Sample Piece Count - A Class I or Class II prescription scale with an operational counting feature shall be marked with the minimum individual piece weight and minimum number of pieces used in the sample to establish an individual piece weight.
(Added 2003)

Table S.6.3.a.
Marking Requirements

To Be Marked With ⇓	Weighing Equipment				
	Weighing, load-receiving, and indicating element in same housing or covered on the same CC[1]	**Indicating element not permanently attached to weighing and load-receiving element or covered by a separate CC**	**Weighing and load-receiving element not permanently attached to indicating element or covered by a separate CC**	**Load cell with CC (11)**	**Other equipment or device (10)**
Manufacturer's ID (1)	x	x	x	x	x
Model Designation and Prefix (1)	x	x	x	x	x
Serial Number and Prefix (2)	x	x	x	x	x (16)
Certificate of Conformance Number (CC) (23)	x	x	x	x	x (23)
Accuracy Class (17)	x	x (8)	x (19)	x	
Nominal Capacity (3)(18)(20)	x	x	x		
Value of Scale Division, "d" (3)	x	x			
Value of "e" (4)	x	x			
Temperature Limits (5)	x	x	x	x	
Concentrated Load Capacity (CLC) (12)(20)(22)		x	x (9)		
Special Application (13)	x	x	x		
Maximum Number of Scale Divisions (n_{max}) (6)		x (8)	x (19)	x	
Minimum Verification Scale Division (e_{min})			x (19)		
"S" or "M" (7)				x	
Direction of Loading (15)				x	
Minimum Dead Load				x	
Maximum Capacity				x	
Safe Load Limit				x	
Load Cell Verification Interval (v_{min}) (21)				x	
Section Capacity and Prefix (14)(20)(22)(24)		x	x		

Note: For applicable notes, see Table S.6.3.b.

[1]Weighing/load receiving elements and indicators which are in the same housing or which are permanently attached will generally appear on the same CC. If not in the same housing, elements shall be hard wired together or sealed with a physical seal or an electronic link. This requirement does not apply to peripheral equipment that has no input or effect on device calibrations or configurations.
(Added 2001)

(Added 1990) (Amended 1992, 1999, 2000, 2001, 2002, and 2004)

Table S.6.3.b.
Notes For Table S.6.3.a.

1. Manufacturer's identification and model designation and *model designation prefix*.* *[*Nonretroactive as of January 1, 2003*]
(See also G-S.1.) *[Prefix lettering may be initial capitals, all capitals or all lower case]*
(Amended 2000)

2. *Serial number [Nonretroactive as of January 1, 1968] and prefix [Nonretroactive as of January 1, 1986].* (See also G-S.1.)

3. The device shall be marked with the nominal capacity. *The nominal capacity shall be shown together with the value of the scale division (e.g., 15 x 0.005 kg, 30 x 0.01 lb, or capacity = 15 kg, d = 0.005 kg) in a clear and conspicuous manner and be readily apparent when viewing the reading face of the scale indicator unless already apparent by the design of the device. Each scale division value or weight unit shall be marked on multiple range or multi-interval scales. [Nonretroactive as of January 1, 1983]*
(Amended 2005)

4. *Required only if different from "d." [Nonretroactive as of January 1, 1986]*

5. *Required only on Class III, III L, and IIII devices if the temperature range on the NTEP CC is narrower than and within -10° C to 40° C (14° F to 104° F). [Nonretroactive as of January 1, 1986]*

6. *This value may be stated on load cells in units of 1000; e.g., n: 10 is 10 000 divisions. [Nonretroactive as of January 1, 1988]*

7. *Denotes compliance for single or multiple load cell applications. It is acceptable to use a load cell with the "S" or Single Cell designation in multiple load cell applications as long as all other parameters meet applicable requirements. A load cell with the "M" or Multiple Cell designation can be used only in multiple load cell applications. [Nonretroactive as of January 1, 1988]*
(Amended 1999)

8. *An indicating element not permanently attached to a weighing element shall be clearly and permanently marked with the accuracy Class of I, II, III, III L, or IIII, as appropriate, and the maximum number of scale divisions, n_{max} , for which the indicator complies with the applicable requirement. Indicating elements that qualify for use in both Class III and III L applications may be marked III/III L and shall be marked with the maximum number of scale divisions for which the device complies with the applicable requirements for each accuracy class. [Nonretroactive as of January 1, 1988]*

9. *For vehicle and axle-load scales only. The CLC shall be added to the load-receiving element of any such scale not previously marked at the time of modification. [Nonretroactive as of January 1, 1989]*
(Amended 2002)

10. Necessary to the weighing system but having no metrological effect, e.g., auxiliary remote display, keyboard, etc.

11. *The markings may be either on the load cell or in an accompanying document; except that, if an accompanying document is provided, the serial number shall appear both on the load cell and in the document. [Nonretroactive as of January 1, 1988] The manufacturer's name or trademark, the model designation, and identifying symbols for the model and serial numbers as required by paragraph G-S.1. shall also be marked both on the load cell and in any accompanying document. [Nonretroactive as of January 1, 1991]*

12. Required on the indicating element *and the load-receiving element* of vehicle and axle-load scales. *Such marking shall be identified as "concentrated load capacity" or by the abbreviation "CLC."* [*Nonretroactive as of January 1, 1989]*
(Amended 2002)

13. *A scale designed for a special application rather than general use shall be conspicuously marked with suitable words, visible to the operator and to the customer, restricting its use to that application, e.g., postal scale, prepack scale, weight classifier, etc.** When a scale is installed with an operational counting feature, the scale shall be marked on both the operator and customer sides with the statement "The counting feature is not legal for trade," except when a Class I or Class II prescription scale complies with all Handbook 44 requirements applicable to counting features. *[*Nonretroactive as of 1986]* (Amended 1994 and 2003)

Table S.6.3.b.
Notes For Table S.6.3.a.

14. Required on *livestock** and railway track scales. When marked on vehicle and axle-load scales manufactured before January 1, 1989, it may be used as the CLC. For livestock scales manufactured between January 1, 1989 and January 1, 2003, required markings may be either CLC or section capacity. *[*Nonretroactive as of January 1, 2003]*
(Amended 2002)

15. *Required if the direction of loading the load cell is not obvious. [Nonretroactive as of January 1, 1988]*

16. *Serial number [Nonretroactive as of January 1, 1968] and prefix [Nonretroactive as of January 1, 1986]*. (See also G-S.1.) Modules without "intelligence" on a modular system (e.g., printer, keyboard module, cash drawer, and secondary display in a point-of-sale system) are not required to have serial numbers.

17. *The accuracy Class of a device shall be marked on the device with the appropriate designation as I, II, III, III L, or IIII. [Nonretroactive as of January 1, 1986]*

18. The nominal capacity shall be conspicuously marked as follows:

    (a) on any scale equipped with unit weights or weight ranges;
    (b) on any scale with which counterpoise or equal-arm weights are intended to be used;
    (c) on any automatic-indicating or recording scale so constructed that the capacity of the indicating or recording element, or elements, is not immediately apparent;
    (d) on any scale with a nominal capacity less than the sum of the reading elements; and
    *(e) on the load-receiving element (weigh-bridge) of vehicle, axle-load, and livestock scales.**
    *[*Nonretroactive as of January 1, 1989]*
    (Amended 1992)

19. *[Nonretroactive as of January, 1, 1988]*
(Amended 1992)

20. *Combination vehicle/railway track scales must be marked with both the nominal capacity and CLC for vehicle weighing and the nominal capacity and section capacity for railway weighing. All other requirements relating to these markings will apply.*
[Nonretroactive as of January 1, 2000]
(Added 1999)

21. *The value of the load cell verification interval (v_{min}) must be stated in mass units. In addition to this information, a device may be marked with supplemental representations of v_{min}.*
[Nonretroactive as of January 1, 2001]
(Added 1999)

22. *Combination vehicle/livestock scales must be marked with both the CLC for vehicle weighing and the section capacity for livestock weighing. All other requirements relative to these markings will apply. [Nonretroactive as of January 1, 2003]*
(Added 2002) (Amended 2003)

    ***Note**: The marked section capacity for livestock weighing may be less than the marked CLC for vehicle weighing.*
    (Amended 2003)

23. *Required only if a CC has been issued for the device or equipment. [Nonretroactive as of January 1, 2003]*
(G-S.1. Identification (h) Added 2001)

24. *The section capacity shall be prefaced by the words "Section Capacity" or an abbreviation of that term. Abbreviations shall be "Sec Cap" or "Sec C." All capital letters and periods may be used.*
[Nonretroactive as of January 1, 2005]
(Added 2004)

N. Notes

N.1. Test Procedures.

N.1.1. Increasing-Load Test. - The increasing-load test shall be conducted on all scales with the test loads approximately centered on the load-receiving element of the scale, except on a scale having a nominal capacity greater than the total available known test load. When the total test load is less than the nominal capacity, the test load is used to greatest advantage by concentrating it, within prescribed load limits, over the main load supports of the scale.

N.1.2. Decreasing-Load Test (Automatic Indicating Scales). - The decreasing-load test shall be conducted with the test load approximately centered on the load- receiving element of the scale.

N.1.2.1. Scales Marked I, II, III, or IIII. - Except for portable wheel load weighers, decreasing-load tests shall be conducted on scales marked I, II, III or IIII and with n equal to or greater than 1000 with test loads equal to the maximum test load at each tolerance value. For example, on a Class III scale, at test loads equal to 4000 d, 2000 d, and 500 d; for scales with n less than 1000, the test load shall be equal to one-half of the maximum load applied in the increasing-load test. (See Table 6)
(Amended 1998)

N.1.2.2. All Other Scales. - On all other scales, except for portable wheel load weighers, the decreasing-load test shall be conducted with a test load equal to one-half of the maximum load applied in the increasing-load test. (Amended 1998)

N.1.3. Shift Test.

N.1.3.1. Bench or Counter Scales. - A shift test shall be conducted with a half-capacity test load centered successively at four points equidistant between the center and the front, left, back, and right edges of the load-receiving element.

N.1.3.2. Dairy-Product-Test Scales. - A shift test shall be conducted with a test load of 18 g successively positioned at all points on which a weight might reasonably be placed in the course of normal use of the scale.

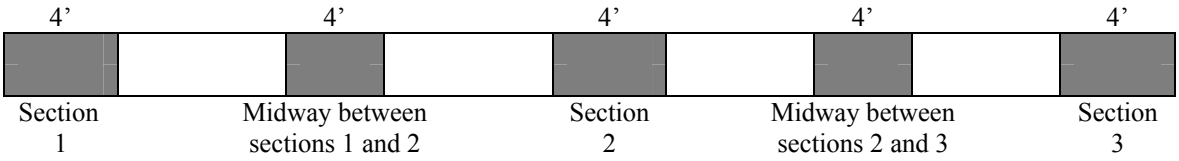
N.1.3.3. Equal-Arm Scales. - A shift test shall be conducted with a half-capacity test load positioned on each pan as prescribed in N.1.3.1. An equal test load shall be centered on the other pan.

N.1.3.4. Vehicle Scales, Axle-Load Scales, and Livestock Scales.

N.1.3.4.1. Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales. -

(a) **Minimum Shift Test.** At least one shift test shall be conducted with a minimum test load of 12.5 % of scale capacity, which may be performed anywhere on the load-receiving element using the prescribed test patterns and maximum test loads specified below. (Combination Vehicle/Livestock Scales shall also be tested consistent with N.1.3.4.2.)
(Amended 1991, 2000, and 2003)

(b) **Prescribed Test Pattern and Loading for Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales.** - The normal prescribed test pattern shall be an area of 1.2 m (4 ft) in length and 3.0 m (10 ft) in width or the width of the scale platform, whichever is less. Multiple test patterns may be utilized when loaded in accordance with paragraph (c), (d), or (e) as applicable. An example of a possible test pattern is shown in the diagram below.
(Amended 1997, 2001, and 2003)



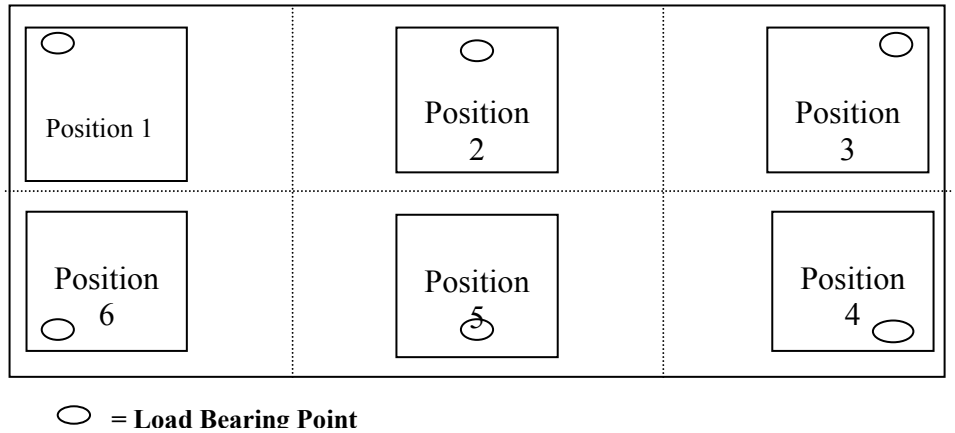
(c) **Loading Precautions for Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales.** - When loading the scale for testing, one side of the test pattern shall be loaded to no more than half of the concentrated load capacity or test load before loading the other side. The area covered by the test load may be less than 1.2 m (4 ft) x 3.0 m (10 ft) or the width of the scale platform, whichever is less; for test patterns less than 1.2 m (4 ft) in length the maximum loading shall meet the formula: [(wheel base of test cart or length of test load divided by 48 in) x 0.9 x CLC]. The maximum test load applied to each test pattern shall not exceed the concentrated load capacity of the scale. When the test pattern exceeds 1.2 m (4 ft), the maximum test load applied shall not exceed the concentrated load capacity times the largest "r" factor in Table UR.3.2.1. for the length of the area covered by the test load. For load-receiving elements installed prior to January 1, 1989, the rated section capacity may be substituted for concentrated load capacity to determine maximum loading. An example of a possible test pattern is shown above.
(Amended 1997 and 2003)

(d) **Multiple Pattern Loading.** - To test to the nominal capacity, multiple patterns may be simultaneously loaded in a manner consistent with the method of use.

(e) **Other Designs.** - Special design scales and those that are wider than 3.7 m (12 ft) shall be tested in a manner consistent with the method of use but following the principles described above.
(Amended 1988, 1991, 1997, 2000, 2001, and 2003)

(Amended 2003)

N.1.3.4.2. Prescribed Test Pattern and Test Loads for Livestock Scales with More Than Two Sections and Combination Vehicle/Livestock Scales. A minimum test load of 5000 kg (10 000 lb) or one-half of the rated section capacity, whichever is less, shall be placed, as nearly as possible, successively over each main load support as shown in the diagram below. For livestock scales manufactured between January 1, 1989, and January 1, 2003, the required loading shall be no greater than one-half CLC. (Two-section livestock scales shall be tested consistent with N.1.3.8.)



(Added 2003)

N.1.3.5. Railway Track Scales Weighing Individual Cars in Single Drafts. - A shift test shall be conducted with at least two different test loads, if available, distributed over, to the right and left of, each pair of main levers or other weighing elements supporting each section of the scale.

N.1.3.6. Monorail Scales, Static Test. - A shift test shall be conducted with a test load equal to the largest load that can be anticipated to be weighed in a given installation, but never less than one-half scale capacity. The load shall be placed successively on the right end, the left end, and the center of the live rail.
(Added 1985)

N.1.3.6.1. Dynamic Monorail Weighing Systems. - Dynamic tests with livestock carcasses should be conducted to duplicate actual use conditions. No less than 20 test loads using carcasses or portions of carcasses of the type normally weighed should be used in the dynamic test; two additional test loads may be included in the test run for use in the event that one or two test loads are rendered unusable during the dynamic test. Prior to starting the dynamic test, the test carcasses must be positioned far enough ahead of the scale so that their swaying motion settles to duplicate the normal sway of a continuously running plant chain. If the plant conveyer chain does not space or prevent the carcasses from touching one another, dynamic tests should not be conducted until this condition has been corrected.

All carcasses shall be individually weighed statically on either the same scale being tested dynamically or another monorail scale with the same or smaller divisions and in close proximity. (The scale selected for weighing the carcasses shall first be tested statically with test weights.)

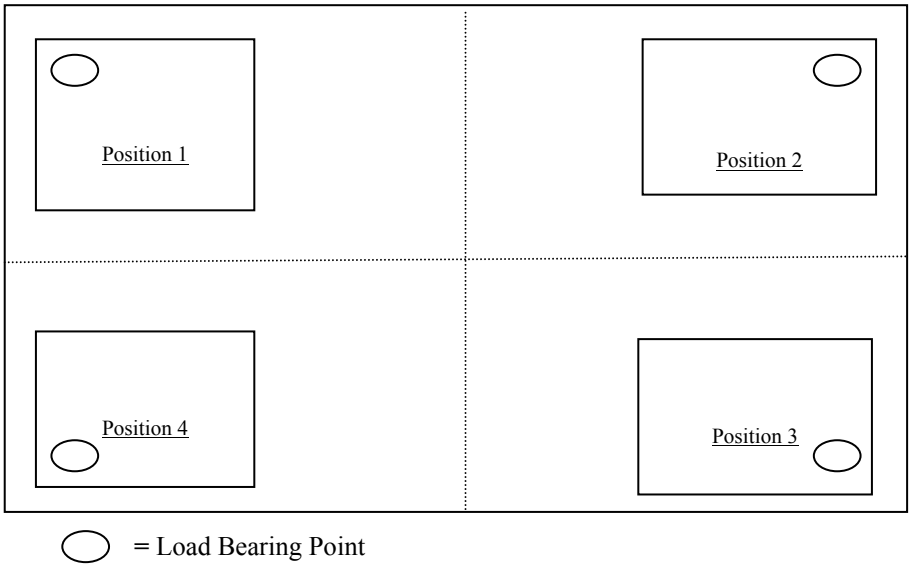
If the scale being tested is used for weighing freshly slaughtered animals, (often referred to as a "hot scale") care must be taken to get a static weighment as quickly as possible before or following the dynamic weighment to avoid loss due to shrink. If multiple dynamic tests are conducted using the same carcasses, static weights should be obtained before and after multiple dynamic tests. If the carcass changes weight between static tests, the amount of weight change should be taken into account, or the carcass should be disregarded for tolerance purposes.

(**Note:** For a dynamic monorail test, the reference scale shall comply with the principles in the in the Fundamental Considerations Paragraph 3.2. Tolerances for Standards.)
(Added 1996) (Amended 1999)

N.1.3.7. Vehicle On-Board Weighing Systems. - The shift test for a vehicle on-board weighing system shall be conducted in a manner consistent with its normal use. For systems that weigh as part of the lifting cycle, the center of gravity of the load may be shifted in the vertical direction as well as from side to side. In other cases, the center of gravity may be moved to the extremes of the load-receiving element using loads of a magnitude that reflect normal use (i.e., the load for the shift test may exceed one-half scale capacity), and may, in some cases, be equal to the capacity of the scale. The shift test may be conducted when the weighing system is out of level to the extent that the weighing system remains operational.
(Added 1992)

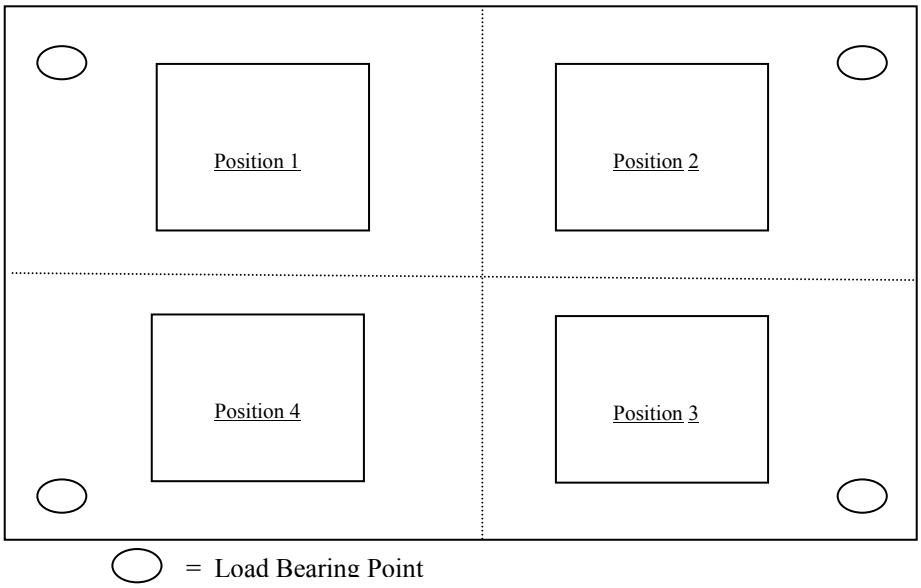
N.1.3.8. All Other Scales Except Crane Scales, Hanging Scales, Hopper Scales, Wheel-Load Weighers, and Portable Axle-Load Weighers. - A shift test shall be conducted using the following prescribed test loads and test patterns. For livestock scales, the shift test load shall not exceed one-half the rated section capacity or one-half the rated concentrated load capacity, whichever is applicable. A shift test shall be conducted using either:

(a) A one-quarter nominal capacity test load centered as nearly as possible, successively over each main load support as shown in the diagram below; or



(Added 2003)

(b) A one-half nominal capacity test load centered as nearly as possible, successively at the center of each quarter of the load-receiving element as shown in the diagram below.



(Added 2003)
(Amended 1987 and 2003)

N.1.4. Sensitivity Test. - A sensitivity test shall be conducted on nonautomatic-indicating (weighbeam) scales only, with the weighing device in equilibrium at zero-load and at maximum test load. The test shall be conducted by increasing or decreasing the test load in an amount equal to the applicable value specified in T.2. or T.N.6.

N.1.5. Discrimination Test. *- 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-Setting Mechanism (AZSM), the discrimination test may be conducted at a range outside of the AZSM range.
[Nonretroactive as of January 1, 1986]
(Added 1985) (Amended 2004)

N.1.5.1. Digital Device. - 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.

N.1.6. RFI Susceptibility Tests, Field Evaluation. - An RFI test shall be conducted at a given installation when the presence of RFI has been verified and characterized if those conditions are considered "usual and customary."
(Added 1986)

N.1.7. Ratio Test. - A ratio test shall be conducted on all scales employing counterpoise weights and on nonautomatic-indicating equal-arm scales.

N.1.8. Material Tests. - A material test shall be conducted on all customer-operated bulk weighing systems for recycled materials using bulk material for which the device is used. Insert into the device, in a normal manner, several accurately pre-weighed samples (free of foreign material) in varying amounts approximating average drafts.

N.1.9. Zero-Load Balance Change. - A zero-load balance change test shall be conducted on all scales after the removal of any test load. The zero-load balance should not change by more than the minimum tolerance applicable. (Also see G-UR.4.2.) (Renumbered 1988)

N.1.10. Counting Feature Test. - A test of the counting function shall be conducted on all Class I and Class II prescription scales having an active counting feature used in “legal for trade” applications. The test should verify that the scale will not accept a sample with less than either the minimum sample piece count or the minimum sample weight of 30 e. Counting feature accuracy should be verified at a minimum of two test loads. Verification of the count calculations shall be based upon the weight indication of the test load.

Note:
(1) The minimum sample weight is equal to the marked minimum individual piece weight times the marked minimum sample piece count.
(2) Test load as used in this section refers to actual calibration test weights selected from an appropriate test weight class.
(Added 2003)

N.1.11. Substitution Test. - In the substitution test procedure, material or objects are substituted for known test weights, or a combination of known test weights and previously quantified material or objects, using the scale under test as a comparator. Additional test weights or other known test loads may be added to the known test load to evaluate higher weight ranges on the scale.
(Added 2003)

N.1.12. Strain-Load Test. - In the strain load test procedure, an unknown quantity of material or objects are used to establish a reference load or tare to which test weights or substitution test loads are added.
(Added 2003)

N.2. Verification (Testing) Standards. - Field standard weights used in verifying weighing devices shall comply with requirements of NIST Handbook 105-Series standards (or other suitable and designated standards) or the tolerances expressed in Fundamental Considerations, paragraph 3.2. (i.e., one-third of the smallest tolerance applied).
(Amended 1986)

N.3. Minimum Test Weights and Test Loads. - The minimum test weights and test loads for in-service tests (except railway track scales) are shown in Table 4. [See Footnote 2 in Table 4.]
(Added 1984) (Amended 1988)

N.3.1. Minimum Test-Weight Load and Recommended Strain-Load Test for Railway Track Scales. (Amended 1990)

N.3.1.1. Approval. - The test-weight load shall be not less than 35 000 kg (80 000 lb). A strain-load test conducted up to the used capacity of the weighing system is recommended.
(Added 1990)

N.3.1.2. Interim Approval. - A test-weight load of not less than 13 500 kg (30 000 lb) and a strain-load test up to at least 25 % of scale capacity may be used to return a scale into service following repairs.
(Added 1990)

Note: The length of time the scale may be used following an interim test is at the discretion of the official with statutory authority.
(Added 1990)

N.3.1.3. Enforcement Action for Inaccuracy. - To take enforcement action on a scale that is found to be inaccurate, a minimum test load of 13 500 kg (30 000 lb) must be used.
(Added 1990)

Table 4.
Minimum Test Weights and Test Loads[1]

Device capacity	Minimums (in terms of device capacity)		(where practicable)
	Test weights (greater of)	Test loads[2]	
0 to 150 kg (0 to 300 lb)	100 %		
151 to 1 500 kg (301 to 3 000 lb)	25 % or 150 kg (300 lb)	75 %	Test weights to dial face capacity, 1 000 d, or test load to used capacity, if greater than minimums specified During initial verification, a scale should be tested to capacity.
1 501 to 20 000 kg (3 001 to 40 000 lb)	12.5 % or 500 kg (1 000 lb)	50 %	
20 001 kg+ (40 001 lb+)	12.5 % or 5 000 kg (10 000 lb)	25 %[3]	

[1]If the amount of test weight in Table 4 combined with the load on the scale would result in an unsafe condition, then the appropriate load will be determined by the official with statutory authority.

[2]The term "test load" means the sum of the combination of field standard test weights and any other applied load used in the conduct of a test using substitution test methods. Not more than three substitutions shall be used during substitution testing, after which the tolerances for strain load tests shall be applied to each set of test loads.

[3]The scale shall be tested from zero to at least 12.5 % of scale capacity using known test weights, and then to at least 25 % of scale capacity using either a substitution or strain load test that utilizes known test weights of at least 12.5 % of scale capacity. Whenever practical, a strain load test should be conducted to the used capacity of the scale. When a strain load test is conducted, the tolerances apply only to the test weights or substitution test loads.
(Amended 1988, 1989, 1994, and 2003)

[**Note:** GIPSA requires devices subject to their inspection to be tested to at least "used capacity," which is calculated based on the platform area of the scale and a weight factor assigned to the species of animal weighed on the scale. "Used capacity" is calculated using the formula:

Used Scale Capacity = Scale Platform Area x Species Weight Factor

Where species weight factor = 540 kg/m^2 (110 lb/ft$^{2)}$ for cattle, 340 kg/m^2 (70 lb/ft^2) for calves and hogs, and 240 kg/m^2 (50 lb/ ft^2) for sheep and lambs]

N.3.2. Field Standard Weight Carts. - Field Standard Weight Carts that comply with the tolerances expressed in Fundamental Considerations, paragraph 3.2. (i.e., one-third of the smallest tolerance applied) may be included as part of the minimum required test load for shift tests and other test procedures.
(Added 2004)

N.4. Coupled-in-Motion Railroad Weighing Systems[3].

N.4.1. 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 run over the weighing system a minimum of 5 times in each mode of operation following the final calibration.
(Added 1990) (Amended 1992)

N.4.2. Weighing Systems Placed in Service Prior to January 1, 1991, and Used to Weigh Trains of 10 or More Cars. - The minimum test train shall be a consecutive-car test train of no less than 10 cars run over the scale a minimum of 5 times in each mode of operation following final calibration.
(Added 1990) (Amended 1992)

N.4.3. Weighing Systems Placed in Service on or After January 1, 1991, and Used to Weigh Trains of 10 or More Cars. -

(a) These weighing systems shall be tested using a consecutive-car test train of no less than 10 cars run over the scale a minimum of 5 times in each mode of operation following final calibration; or

(b) if the official with statutory authority determines it necessary, the As Used Test Procedures outlined in N.4.3.1. shall be used.
(Added 1990) (Amended 1992)

N.4.3.1. As Used Test Procedures - A weighing system shall be tested in a manner that represents the normal method of operation and length(s) of trains normally weighed. The weighing systems may be tested using either:

(1) a consecutive-car test train of a length typical of train(s) normally weighed; or

(2) a distributed-car test train of a length typical of train(s) normally weighed.

However, a consecutive-car test train of a shorter length may be used provided that 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 in N.4.3.1.1.

The official with statutory authority shall be responsible for determining the minimum test train length to be used on subsequent tests.
(Added 1990) (Amended 1992)

N.4.3.1.1. 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 either to a distributed-car or to a consecutive-car test train of length(s) typical of train(s) normally weighed.

The difference between the total train weight of the train(s) 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 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

[3] A test weight car that is representative of one of the types of cars typically weighed on the scale under test may be used wherever reference weight cars are specified.
(Added 1991)

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.
(Added 1990) (Amended 1992 and 1993)

N.4.3.1.2. 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.
(Added 1990)

N.4.3.1.3. Distributed Car Test Trains. -

(a) The length of the train shall be typical of trains that are normally weighed.

(b) The reference weight cars shall be split into three groups, each group consisting of 10 cars or 10 % of the train length, whichever is less.
(Amended 1991)

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

(d) Following the final adjustment, the distributed-car test train shall be run over the scale at least 3 times or shall produce 50 weight values, whichever is greater.

(e) The weighing system shall be tested in each mode of operation.
(Added 1990) (Amended 1992)

N.4.3.1.4. Consecutive-Car Test Trains. -

(a) A consecutive-car test train shall consist of at least 10 cars.

(b) If the consecutive-car test train consists of between 10 cars and 20 cars, inclusive, it shall be run over the scale a minimum of 5 times in each mode of operation following the final calibration.

(c) If the consecutive-car test train consists of more than 20 cars, it shall be run over the scale a minimum of 3 times in each mode of operation.
(Added 1990) (Amended 1992)

N.5. Uncoupled-in-Motion Railroad Weighing System. - An uncoupled-in-motion scale shall be tested statically before being tested in motion by passing railroad reference weight cars over the scale. When an uncoupled-in-motion railroad weighing system is tested, the car speed and the direction of travel shall be the same as when the scale is in normal use. The minimum in-motion test shall be 3 reference weight cars passed over the scale 3 times. The cars shall be selected to cover the range of weights that are normally weighed on the system and to reflect the types of cars normally weighed.
(Added 1993)

N.6. Nominal Capacity of Prescription Scales. - The nominal capacity of a prescription scale shall be assumed to be 1/2 apothecary ounce, unless otherwise marked. (Applicable only to scales not marked with an accuracy class.)

T. Tolerances Applicable to Devices <u>not</u> Marked I, II, III, III L, or IIII

T.1. Tolerance Values.

T.1.1. General. - The tolerances applicable to devices not marked with an accuracy class shall have the tolerances applied as specified in Table T.1.1.
(Amended 1990)

T.1.2. Postal and Parcel Post Scales. - The tolerances for postal and parcel post scales are given in Table T.1.1. and Table 5.
(Amended 1990)

Table T.1.1. Tolerances for Unmarked Scales

Type of Device	Subcategory	Min. Tol.	Accept. Tol.	Maint. Tol.	Decreasing-Load Multiplier[1]	Other Applicable Requirements
Vehicle, axle-load, livestock, railway track (weighing statically), crane, and hopper (other than grain hopper)		Class III L, T.N.3.1 (Table 6) and T.N.3.2.			1.0	T.N.2., T.N.3., T.N.4.1., T.N.4.2., T.N.4.3., T.N.4.4., T.N.5., T.N.7.2.
Grain test scales	n # 10 000 n > 10 000	Class III, T.N.3.1. (Table 6) and T.N.3.2. Class II, T.N.3.1. (Table 6) and T.N.3.2.			1.0	
Railway track scales weighing in motion		T.N.3.6. except that for T.N.3.6.2. (a), no single error shall exceed four times the maintenance tolerance.			1.0	
Monorail Scales, In-Motion		T.N.3.8.			1.0	
Customer-Operated Bulk-Weighing Systems for Recycled Materials		± 5 % of applied material test load. Average error on 10 or more test loads # 2.5 %.			1.0	
Wheel-load weighers and portable axle-load scales	Tested individually or in pairs[2]	0.5 d or 50 lb, whichever is greater	1 % of test load	2 % of test load	1.5[3]	
Prescription scales		0.1 grain (6 mg)	0.1 % of test load load	0.1 % of test load	1.5	
Jewelers' scales	Graduated	0.5 d	0.05 % of test load	0.05 % of test load	1.5	
	Ungraduated	Sensitivity or smallest weight, whichever is less				
Dairy-product-test scale	Loads < 18 g 18 g load	0.2 grain 0.2 grain	0.2 grain 0.3 grain	0.2 grain 0.5 grain	1.5	
Postal and parcel post scales Designed/used to weigh loads < 2 lb	Loads < 2 lb	15 grain, 1 g, 1/32 oz, 0.03 oz, or 0.002 lb	15 grain, 1 g, 1/32 oz, 0.03 oz, or 0.002 lb	15 grain, 1 g, 1/32 oz, 0.03 oz, or 0.002 lb	1.5	
	Loads ∃ 2 lb	Table 5	Table 5	Table 5		
Other postal and parcel post scales		Table 5	Table 5	Table 5	1.5	
All other scales	n > 5000	0.5d or 0.05 % of scale capacity, whichever is less	0.05 % of test load	0.1 % of test load	1.5	T.N.2.5., T.N.4.1., T.N.4.2., T.N.4.3., T.N.5., T.N.7.2.
	n # 5000	Class III, T.N.3.1., Table 6 and T.N.3.2.			1.0	T.N.2., T.N.3., T.N.4.1., T.N.4.2., T.N.4.3., T.N.5., T.N.7.2.

[1] The decreasing load test applies only to automatic indicating scales.
[2] If marked and tested as a pair, the tolerance shall be applied to the sum of the indications.
[3] The decreasing load test does not apply to portable wheel load weighers.

(Table Added 1990; Amended 1992 and 1993)

Table 5. Maintenance and Acceptance Tolerances for Unmarked Postal and Parcel Post Scales					
Scale capacity	**Test loads**	**Maintenance tolerance (±)**		**Acceptance tolerance (±)**	
(lb)	**(lb)**	**(oz)**	**(lb)**	**(oz)**	**(lb)**
0 to 4, inclusive*	0 to 1, inclusive	1/32	0.002	1/32	0.002
	over 1	1/8	0.008	1/16	0.004
over 4*	0 to 7, inclusive	3/16	0.012	3/16	0.012
	7+ to 24, inclusive	3/8	0.024	3/16	0.012
	24+ to 30, inclusive	1/2	0.030	1/4	0.015
	over 30	0.1 % of Test Load		0.05 % of Test Load	
*See Table T.1.1. for scales designed and/or used to weigh loads less than 2 lb.					

T.2. Sensitivity Requirement (SR).

T.2.1. Application. - The sensitivity requirement (SR) is applicable to all nonautomatic-indicating scales not marked I, II, III, III L, or IIII, and is the same whether acceptance or maintenance tolerances apply.

T.2.2. General. - Except for scales specified in paragraphs T.2.3. through T.2.8.: 2 d, 0.2 % of the scale capacity, or 40 lb, whichever is least.

T.2.3. Prescription Scales. 6 mg (0.1 grain).

T.2.4. Jewelers' Scales.

T.2.4.1. With One-Half Ounce Capacity or Less. - 6 mg (0.1 grain).

T.2.4.2. With More Than One-Half Ounce Capacity. - 1 d or 0.05 % of the scale capacity, whichever is less.

T.2.5. Dairy-Product-Test Scales.

T.2.5.1. Used in Determining Butterfat Content. - 32 mg (0.5 grain).

T.2.5.2. Used in Determining Moisture Content. - 19 mg (0.3 grain).

T.2.6. Grain Test Scales. The sensitivity shall be as stated in T.N.6.
(Amended 1987)

T.2.7. Vehicle, Axle-Load, Livestock, and Animal Scales.

T.2.7.1. Equipped With Balance Indicators. - 1 d.

T.2.7.2. Not Equipped With Balance Indicators. - 2 d or 0.2 % of the scale capacity, whichever is less.

T.2.8. Railway Track Scales. - 3 d or 100 lb, whichever is less.

T.3. Sensitivity Requirement, Equilibrium Change Required.

The minimum change in equilibrium with test loads equal to the values specified in T.2. shall be as follows:

(a) Scale With a Trig Loop but Without a Balance Indicator. - The position of rest of the weighbeam shall change from the center of the trig loop to the top or bottom, as the case may be.

(b) Scale With a Single Balance Indicator and Having a Nominal Capacity of Less Than 250 kg (500 lb). - The position of rest of the indicator shall change 1.0 mm (0.04 in) or one division on the graduated scale, whichever is greater.

(c) Scale With a Single Balance Indicator and Having a Nominal Capacity of 250 kg (500 lb) or Greater. - The position of rest of the indicator shall change 6.4 mm (0.25 in) or one division on the graduated scale or the width of the central target area, whichever is greater. However, the indicator on a batching scale shall change 3.2 mm (0.125 in) or one division on the graduated scale, whichever is greater.

(d) Scale With Two Opposite-Moving Balance Indicators. - The position of rest of the two indicators moving in opposite directions shall change 1.0 mm (0.04 in) with respect to each other.

(e) Scale With Neither a Trig Loop nor a Balance Indicator. - The position of rest of the weighbeam or lever system shall change from the horizontal, or midway between limiting stops, to either limit of motion.

T.4. Radio Frequency Interference (RFI) and Other Electromagnetic Interference Susceptibility. - The difference between the weight indication with the disturbance and the weight indication without the disturbance, shall not exceed one scale division (d) or the equipment shall:

(a) blank the indication, or

(b) provide an error message, or

(c) the indicator shall be so completely unstable that it could not be interpreted, or transmitted into memory or to a recording element, as a correct measurement value.

(Added 1986)

T.5. Operating Temperature. *- An indicating or recording element shall not display or record any usable values until the operating temperature necessary for accurate weighing and a stable zero-balance condition has been attained.*
[Nonretroactive and effective January 1, 1981]
(Added 1986)

T.N. Tolerances Applicable to Devices Marked I, II, III, III L, & IIII.

T.N.1. Principles.

T.N.1.1. Design. - The tolerance for a weighing device is a performance requirement independent of the design principle used.

T.N.1.2. Accuracy Classes. - Weighing devices are divided into accuracy classes according to the number of scale divisions (n) and the value of the scale division (d).

T.N.1.3. Scale Division. - The tolerance for a weighing device is related to the value of the scale division (d) or the value of the verification scale division (e) and is generally expressed in terms of d or e.

T.N.2. Tolerance Application.

T.N.2.1. General. - The tolerance values are positive (+) and negative (-) with the weighing device adjusted to zero at no load. When tare is in use, the tolerance values are applied from the tare zero reference; the tolerance values apply to certified test loads only.

T.N.2.2. Type Evaluation Examinations. - For type evaluation examinations, the tolerance values apply to increasing and decreasing load tests within the temperature, power supply, and barometric pressure limits specified in T.N.8.

T.N.2.3. Subsequent Verification Examinations. - For subsequent verification examinations, the tolerance values apply regardless of the influence factors in effect at the time of the conduct of the examination. (Also see G-N.2.)

T.N.2.4. Multi-Interval and Multiple Range (Variable Division-Value) Scales. - For multi-interval and multiple range scales, the tolerance values are based on the value of the scale division of the range in use.

T.N.2.5. Ratio Tests. - For ratio tests, the tolerance values are 0.75 of the applicable tolerances.

T.N.3. Tolerance Values.

T.N.3.1. Maintenance Tolerance Values. - The maintenance tolerance values are as specified in Table 6.

T.N.3.2. Acceptance Tolerance Values. - The acceptance tolerance values shall be one-half the maintenance tolerance values.

T.N.3.3. Wheel-Load Weighers and Portable Axle-Load Weighers of Class IIII. - The tolerance values are two times the values specified in T.N.3.1. and T.N.3.2.
(Amended 1986)

T.N.3.4. Crane and Hopper (Other than Grain Hopper) Scales. - The maintenance and acceptance tolerances shall be as specified in T.N.3.1. and T.N.3.2. for Class III L, except that the tolerance for crane and construction materials hopper scales shall not be less than 1 d or 0.1 % of the scale capacity, whichever is less.
(Amended 1986)

Table 6.
Maintenance Tolerances
(All values in this table are in scale divisions)

Tolerance in scale divisions				
	1	**2**	**3**	**5**
Class	**Test Load**			
I	0 - 50 000	50 001 - 200 000	200 001 +	
II	0 - 5 000	5 001 - 20 000	20 001 +	
III	0 - 500	501 - 2 000	2 001 - 4 000	4 001 +
IIII	0 - 50	51 - 200	201 - 400	401 +
III L	0 - 500	501 - 1 000	(Add 1d for each additional 500 d or fraction thereof)	

T.N.3.5. Separate Main Elements: Load Transmitting Element, Indicating Element, Etc. - If a main element separate from a weighing device is submitted for type evaluation, the tolerance for the element is 0.7 that for the complete weighing device. This fraction includes the tolerance attributable to the testing devices used.

T.N.3.6. Coupled-In-Motion Railroad Weighing Systems. - The maintenance and acceptance tolerance values for the group of weight values appropriate to the application must satisfy the following conditions:
(Amended 1990 and 1992)

T.N.3.6.1. - For any group of weight values, the difference in the sum of the individual in-motion car weights of the group as compared to the sum of the individual static weights shall not exceed 0.2 %.
(Amended 1990)

T.N.3.6.2. - If a weighing system is used to weigh trains of 5 or more cars, and if the individual car weights are used, any single weight value within the group must meet the following criteria:

(a) no single error may exceed 3 times the static maintenance tolerance;

(b) not more than 5 % of the errors may exceed 2 times the static maintenance tolerance; and

(c) not more than 35 % of the errors may exceed the static maintenance tolerance.
(Amended 1990 and 1992)

T.N.3.6.3. - For any group of weight values wherein the sole purpose is to determine the sum of the group, T.N.3.6.1. alone applies.
(Amended 1990)

T.N.3.6.4. - For a weighing system used to weigh trains of less than 5 cars, no single car weight within the group may exceed the static maintenance tolerancee.
(Amended 1990 and 1992)

T.N.3.7. Uncoupled-in-Motion Railroad Weighing Systems. - The maintenance and acceptance tolerance values for any single weighment within a group of non-interactive (i.e., uncoupled) loads, the weighment error shall not exceed the static maintenance tolerance.
(Amended 1992)

T.N.3.8. Dynamic Monorail Weighing System. - Acceptance tolerance shall be the same as the maintenance tolerance shown in Table 6. On a dynamic test of 20 or more individual test loads, 10 % of the individual test loads may be in error, each not to exceed 2 times the tolerance. The error on the total of the individual test loads shall not exceed ± 0.2 %. (See also Note in N.1.3.6.1.) *For equipment undergoing type evaluation, a tolerance equal to one-half the maintenance tolerance values shown in Table 6 shall apply.*
[Nonretroactive January 1, 2002]
(Added 1986) (Amended 1999 and 2001)

T.N.3.9. Materials Test on Customer-Operated Bulk Weighing Systems for Recycled Materials. - The maintenance and acceptance tolerance shall be ± 5 % of the applied materials test load except that the average error on 10 or more test materials test loads shall not exceed ± 2.5 %.
(Added 1986)

T.N.3.10. Prescription Scales with a Counting Feature. - In addition to Table 6 Maintenance Tolerances (for weight), the indicated piece count value computed by a Class I or Class II prescription scale counting feature shall comply with the tolerances in Table T.N.3.10.

Table T.N.3.10.
Maintenance and Acceptance Tolerances
in Excess and in Deficiency for Count

Indication of Count	Tolerance (piece count)
0 to 100	0
101 to 200	1
201 or more	0.5 %

(Added 2003)

T.N.3.11. Tolerances for Substitution Test. - Tolerances are applied to the scale based on the substitution test load.
(Added 2003)

T.N.3.12. Tolerances for Strain-Load Test. - Tolerances apply only to the test weights or substitution test loads.
(Added 2003)

T.N.4. Agreement of Indications.

T.N.4.1. Multiple Indicating/Recording Elements. - In the case of a scale or weighing system equipped with more than one indicating element or indicating element and recording element combination, where the indicators or indicator/recorder combination are intended to be used independently of one another, tolerances shall be applied independently to each indicator or indicator/recorder combination.
(Amended 1986)

T.N.4.2. Single Indicating/Recording Element. - In the case of a scale or weighing system with a single indicating element or an indicating/recording element combination, and equipped with component parts such as unit weights, weighbeam and weights, or multiple weighbeams that can be used in combination to indicate a weight, the difference in the weight value indications of any load shall not be greater than the absolute value of the applicable tolerance for that load, and shall be within tolerance limits.
(Amended 1986)

T.N.4.3. Single Indicating Element/Multiple Indications. - In the case of an analog indicating element equipped with two or more indicating means within the same element, the difference in the weight indications for any load other than zero shall not be greater than one-half the value of the scale division (d) and be within tolerance limits.
(Amended 1986)

T.N.4.4. Shift or Section Tests. - The range of the results obtained during the conduct of a shift test or a section test shall not exceed the absolute value of the maintenance tolerance applicable and each test result shall be within applicable tolerances.
(Added 1986)

T.N.4.5. Time Dependence. – A time dependence test shall be conducted during type evaluation and may be conducted during field verification provided test conditions remain constant.
(Amended 1989 and 2005)

T.N.4.5.1. Time Dependence; Class II, III, and IIII Non-automatic Weighing Instruments. - A non-automatic weighing instrument of classes II, III, and IIII shall meet the following requirements at constant test conditions:

(a) When any load is kept on an instrument, the difference between the indication obtained immediately after placing the load and the indication observed during the following 30 minutes shall not exceed 0.5 e.

(b) However, the difference between the indication obtained at 15 minutes and that at 30 minutes shall not exceed 0.2 e. If these conditions are not met, the difference between the indication obtained immediately after placing the load on the instrument and the indication observed during the following 4 hours shall not exceed the absolute value of the maximum permissible error at the load applied.

(c) The deviation on returning to zero as soon as the indication has stabilized, after the removal of any load which has remained on the instrument for 30 minutes, shall not exceed 0.5 e.

For a multi-interval instrument, the deviation shall not exceed 0.5 e_1 (first weighing segment).

On a multiple range instrument, the deviation on returning to zero from Max_i (load in the applicable weighing range) shall not exceed 0.5 e_i (interval of the weighing segment). Furthermore, after returning to zero from any load greater than Max_1 (capacity of the first weighing range) and immediately after switching to the lowest weighing range, the indication near zero shall not vary by more than e_1 (interval of the first weighing range) during the following 5 minutes.
(Added 2005)

T.N.4.5.2. Time Dependence; Class III L Non-automatic Weighing Instruments. - A non-automatic weighing instrument of class III L shall meet the following requirements:

(a) When any load is kept on an instrument, the difference between the indication obtained immediately after placing the load and the indication observed during the following 30 minutes shall not exceed 1.5 e.

(b) However, the difference between the indication obtained at 15 minutes and that at 30 minutes shall not exceed 0.6 e. If these conditions are not met, the difference between the indication obtained immediately after placing the load on the instrument and the indication observed during the following 4 hours shall not exceed the absolute value of the maximum permissible error at the load applied.

(c) The deviation on returning to zero as soon as the indication has stabilized, after the removal of any load which has remained on the instrument for 30 minutes, shall not exceed one-half of the absolute value of the applicable tolerance for the applied load for class III L devices.

(Added 2005)

T.N.4.6. Time Dependence (Creep) for Load Cells During Type Evaluation. – A load cell (force transducer) marked with an accuracy Class shall meet the following requirements at constant test conditions:

(a) Permissible Variations of Readings. - With a constant maximum load for the measuring range (D_{max}) between 90 % and 100 % of maximum capacity (E_{max}), applied to the load cell, the difference between the initial reading and any reading obtained during the next 30 minutes shall not exceed the absolute value of the maximum permissible error (mpe) for the applied load (see Table T.N.4.6.). The difference between the reading obtained at 20 minutes and the reading obtained at 30 minutes shall not exceed 0.15 times the absolute value of the mpe (see Table T.N.4.6.).

(b) Apportionment Factors. - The mpe for creep shall be determined from Table T.N.4.6. Maximum Permissible Error (mpe) * for Load Cells using the following apportionment factors (p_{LC}):

p_{LC} = 0.7 for load cells marked with S (single load cell applications), and
p_{LC} = 1.0 for load cells marked with M (multiple load cell applications)

(Added 2005)

Table T.N.4.6.
Maximum Permissible Error (mpe)* for Load Cells
During Type Evaluation

mpe in Load Cell Verifications Divisions (v) = p_{LC} x Basic Tolerance in v			
Class	p_{LC} x 0.5 v	p_{LC} x 1.0 v	p_{LC} x 1.5 v
I	0 - 50 000 v	50 001 v - 200 000 v	200 001 v +
II	0 - 5 000 v	5 001 v - 20 000 v	20 001 v +
III	0 - 500 v	501 v - 2 000 v	2 001 v +
IIII	0 - 50 v	51 v - 200 v	201 v +
III L	0 - 500 v	501 v - 1 000 v	(Add 0.5 v to the basic tolerance for each additional 500 v or fraction thereof up to a maximum load of 10 000 v)

v represents the load cell verification interval
p_{LC} represents the apportionment factors applied to the basic tolerance
p_{LC} = 0.7 for load cells marked with S (single load cell applications)
p_{LC} = 1.0 for load cells marked with M (multiple load cell applications)
* mpe = p_{LC} x Basic Tolerance in load cell verifications divisions (v)

(Table Added 2005)

T.N.5. Repeatability. - The results obtained from several weighings of the same load under reasonably static test conditions shall agree within the absolute value of the maintenance tolerance for that load, and shall be within applicable tolerances.

T.N.6. Sensitivity. - This section is applicable to all nonautomatic-indicating scales marked I, II, III, III L, or IIII.

T.N.6.1. Test Load.

(a) The test load for sensitivity for nonautomatic-indicating vehicle, axle-load, livestock, and animal scales shall be 1 d for scales equipped with balance indicators, and 2 d or 0.2 % of the scale capacity, whichever is less, for scales not equipped with balance indicators.

(b) For all other nonautomatic-indicating scales, the test load for sensitivity shall be 1 d at zero and 2 d at maximum test load.

T.N.6.2. Minimum Change of Indications. - The addition or removal of the test load for sensitivity shall cause a minimum permanent change as follows:

(a) for a scale with trig loop but without a balance indicator, the position of the weighbeam shall change from the center to the outer limit of the trig loop;

(b) for a scale with balance indicator, the position of the indicator shall change one division on the graduated scale, the width of the central target area, or the applicable value as shown below, whichever is greater:

Scale of Class I or II: 1 mm (0.04 in),
Scale of Class III or IIII with a maximum capacity of 30 kg (70 lb) or less: 2 mm (0.08 in),
Scale of Class III, III L, or IIII with a maximum capacity of more than 30 kg (70 lb): 5 mm (0.20 in);

(c) for a scale without a trig loop or balance indicator, the position of rest of the weighbeam or lever system shall change from the horizontal or midway between limiting stops to either limit of motion.

(Amended 1987)

T.N.7. Discrimination.

T.N.7.1. Analog Automatic Indicating (i.e., Weighing Device With Dial, Drum, Fan, Etc.). - A test load equivalent to 1.4 d shall cause a change in the indication of at least 1.0 d. (See N.1.5.)

T.N.7.2. Digital Automatic Indicating. - A test load equivalent to 1.4 d shall cause a change in the indicated or recorded value of at least 2.0 d. This requires the zone of uncertainty to be not greater than three-tenths of the value of the scale division. (See N.1.5.1.)

T.N.8. Influence Factors. - The following factors are applicable to tests conducted under controlled conditions only, provided that:

(a) types of devices approved prior to January 1, 1986, and manufactured prior to January 1, 1988, need not meet the requirements of this section, and

(b) new types of devices submitted for approval after January 1, 1986, shall comply with the requirements of this section, and

(c) all devices manufactured after January 1, 1988, shall comply with the requirements of this section.

(Amended 1985)

T.N.8.1. Temperature. - Devices shall satisfy the tolerance requirements under the following temperature conditions:

T.N.8.1.1. If not specified in the operating instructions for Class I or II scales, or if not marked on the device for Class III, III L, or IIII scales, the temperature limits shall be: -10° C to 40° C (14° F to 104° F).

T.N.8.1.2. If temperature limits are specified for the device, the range shall be at least that specified in Table T.N.8.1.2.

Table T.N.8.1.2.
Temperature Range by Class

Class	Temperature Range
I	5 EC (9° F)
II	15 EC (27° F)
III, III L, & IIII	30 EC (54° F)

T.N.8.1.3. Temperature Effect on Zero-Load Balance. - The zero-load indication shall not vary by more than:

(a) three divisions per 5° C (9° F) change in temperature for Class III L devices; or

(b) one division per 5° C (9° F) change in temperature for all other devices.
(Amended 1990)

T.N.8.1.4. Operating Temperature. - Except for Class I and II devices, an indicating or recording element shall not display nor record any usable values until the operating temperature necessary for accurate weighing and a stable zero balance condition have been attained.

T.N.8.2. Barometric Pressure. - Except for Class I scales, the zero indication shall not vary by more than one scale division for a change in barometric pressure of 1 kPa over the total barometric pressure range of 95 kPa to 105 kPa (28 in to 31 in of Hg).

T.N.8.3. Electric Power Supply.

T.N.8.3.1. Power Supply, Voltage and Frequency.

(a) Weighing devices that operate using alternating current must perform within the conditions defined in paragraphs T.N.3. through T.N.7., inclusive, when tested over the range of –15 % to +10 % of the marked nominal line voltage(s) at 60 Hz, or the voltage range marked by the manufacturer, at 60 Hz. (Amended 2003)

(b) Battery operated instruments shall not indicate nor record values outside the applicable tolerance limits when battery power output is excessive or deficient.

T.N.8.3.2. Power Interruption. - A power interruption shall not cause an indicating or recording element to display or record any values outside the applicable tolerance limits.

T.N.9. Radio Frequency Interference (RFI) and Other Electromagnetic Interference Susceptibility. - The difference between the weight indication due to the disturbance and the weight indication without the disturbance shall not exceed one scale division (d); or the equipment shall:

(a) blank the indication, or

(b) provide an error message, or

(c) the indication shall be so completely unstable that it cannot be interpreted, or transmitted into memory or to a recording element, as a correct measurement value.

The tolerance in T.N.9. is to be applied independently of other tolerances. For example, if indications are at allowable basic tolerance error limits when the disturbance occurs, then it is acceptable for the indication to exceed the applicable basic tolerances during the disturbance. [Editors' Note: Following the 1997 NCWM Annual Meeting, the text in this paragraph was revised with concurrence of the S&T Committee to clarify its application.]
(Amended 1997)

UR. User Requirements

UR.1. Selection Requirements. - Equipment shall be suitable for the service in which it is used with respect to elements of its design, including but not limited to, its capacity, number of scale divisions, value of the scale division or verification scale division, minimum capacity, and computing capability.[4]

UR.1.1. General.

(a) For devices marked with a class designation, the typical class or type of device for particular weighing applications is shown in Table 7a.

(b) For devices not marked with a class designation, Table 7b applies.

Table 7a.
Typical Class or Type of Device for Weighing Applications

Class	Weighing Application or Scale Type
I	Precision laboratory weighing
II	Laboratory weighing, precious metals and gem weighing, grain test scales
III	All commercial weighing not otherwise specified, grain test scales, retail precious metals and semi-precious gem weighing, animal scales, postal scales, vehicle on-board weighing systems with a capacity less than or equal to 30 000 lb, and scales used to determine laundry charges
III L	Vehicle scales, vehicle on-board weighing systems with a capacity greater than 30 000 lb, axle-load scales, livestock scales, railway track scales, crane scales, and hopper (other than grain hopper) scales
IIII	Wheel-load weighers and portable axle-load weighers used for highway weight enforcement

Note: A scale with a higher accuracy class than that specified as "typical" may be used.
(Amended 1985, 1986, 1987, 1988, 1992, and 1995)

[4] Purchasers and users of scales such as railway track, hopper, and vehicle scales should be aware of possible additional requirements for the design and installation of such devices.
(Footnote Added 1995)

Table 7b. Applicable to Devices not Marked With a Class Designation	
Scale Type or Design	**Maximum Value of d**
Retail Food Scales, 50 lb capacity and less	1 ounce
Animal Scales	1 pound
Grain Hopper Scales Capacity up to and incl. 50 000 lb Capacity over 50 000 lb	 10 pounds (not greater than 0.05 % of capacity) 20 pounds
Crane Scales	not greater than 0.2 % of capacity
Vehicle and Axle-Load Scales Used in Combination Capacity up to and including 200 000 lb Capacity over 200 000 lb	 20 pounds 50 pounds
Railway Track Scales With weighbeam Automatic indicating	 20 pounds 100 pounds
Scales with capacities greater than 500 lb except otherwise specified	0.1 % capacity (but not greater than 50 lb)
Wheel-Load Weighers	0.25 % capacity (but not greater than 50 lb)
Note: For scales not specified in this table, G-UR.1.1. and UR.1. apply. (Added 1985) (Amended 1989)	

UR.1.2. Grain Hopper Scales. - The minimum number of scale divisions for a Class III Hopper Scale used for weighing grain shall be 2000.

UR.1.3. Value of the Indicated and Recorded Scale Division. *- The value of the scale division as recorded shall be the same as the division value indicated.*
[Nonretroactive as of January 1, 1986]
(Added 1985) (Amended 1999)

UR.1.3.1. Exceptions. *- The provisions of UR.1.3.Value of the Indicated and Recorded Scale Division shall not apply to:*

(a) Class I scales, or

(b) Dynamic monorail weighing systems when the value of d is less than the value of e.
[Nonretroactive as of January 1, 1986]
(Added 1999)

UR.1.4. Grain-Test Scales: Value of the Scale Divisions. - The scale division for grain-test scales shall not exceed 0.2 g for loads through 500 g, and shall not exceed 1 g for loads above 500 g through 1000 g.
(Added 1992)

UR.1.5. Recording Element, Class III L Railway Track Scales. *- Class III L Railway Track Scales must be equipped with a recording element.*
[Nonretroactive as of January 1, 1996]
(Added 1995)

UR.2. Installation Requirements.

UR.2.1. Supports. - A scale that is portable and that is being used on a counter, table, or the floor shall be so positioned that it is firmly and securely supported.

UR.2.2. Suspension of Hanging Scale. - A hanging scale shall be freely suspended from a fixed support when in use.

UR.2.3. Protection From Environmental Factors. - The indicating elements, the lever system or load cells, and the load-receiving element of a permanently installed scale, and the indicating elements of a scale not intended to be permanently installed, shall be adequately protected from environmental factors such as wind, weather, and RFI that may adversely affect the operation or performance of the device.

UR.2.4. Foundation, Supports, and Clearance. - 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, nor throughout the weighing range of the scale. *On vehicle and livestock scales, the clearance between the load-receiving elements and the coping at the bottom edge of the platform shall be greater than at the top edge of the platform.*
[Nonretroactive as of January 1, 1973]

UR.2.5. Access to Weighing Elements. - Adequate provision shall be made for ready access to the pit of a vehicle, livestock, animal, axle-load, or railway track scale for the purpose of inspection and maintenance. Any of these scales without a pit shall be installed with adequate means for inspection and maintenance of the weighing elements.
(Amended 1985)

UR.2.6. Approaches.

UR.2.6.1. Vehicle Scales. *- On the entrance and exit ends of a vehicle scale installed in any one location for a period of 6 months or more, there shall be a straight approach as follows:*

(a) the width at least the width of the platform,

(b) the length at least one-half the length of the platform but not required to be more than 12 m (40 ft), and

(c) not less than 3 m (10 ft) of any approach adjacent to the platform shall be constructed of concrete or similar durable material to ensure that this portion remains smooth and level and in the same plane as the platform. However, grating of sufficient strength to withstand all loads equal to the concentrated load capacity of the scale may be installed in this portion. Any slope in the remaining portion of the approach shall ensure (1) ease of vehicle access, (2) ease for testing purposes, and (3) drainage away from the scale.

[Nonretroactive as of 1976]
(Amended 1977, 1983, and 1993)

UR.2.6.2. Axle-Load Scales. - At each end of an axle-load scale there shall be a straight paved approach in the same plane as the platform. The approaches shall be the same width as the platform and of sufficient length to insure the level positioning of vehicles during weight determinations.

UR.2.7. Stock Racks. - A livestock or animal scale shall be equipped with a suitable stock rack, with gates as required, which shall be securely mounted on the scale platform. Adequate clearances shall be maintained around the outside of the rack.

UR.2.8. Hoists. - On vehicle scales equipped with means for raising the load-receiving element from the weighing element for vehicle unloading, means shall be provided so that it is readily apparent to the scale operator when the load-receiving element is in its designed weighing position.

UR.2.9. Provision for Testing Dynamic Monorail Weighing Systems. - *Provisions shall be made at the time of installation of a dynamic monorail weighing systems for testing in accordance with N.1.3.6.1. (a rail around or other means for returning the test carcasses to the scale being tested).*
[Nonretroactive as of January 1, 1998]
(Added 1997) (Amended 1999)

UR.3. Use Requirements.

UR.3.1. Recommended Minimum Load. - A recommended minimum load is specified in Table 8 since the use of a device to weigh light loads is likely to result in relatively large errors.

Table 8.
Recommended Minimum Load

2Class	Value of scale division (d or e*)	Recommended minimum load (d or e*)
I	equal to or greater than 0.001 g	100
II	0.001 g to 0.05 g, inclusive	20
	equal to or greater than 0.1 g	50
III	All**	20
III L	All	50
IIII	All	10

*For Class I and II devices equipped with auxiliary reading means (i.e., a rider, a vernier, or a least significant decimal differentiated by size, shape or color), the value of the verification scale division "e" is the value of the scale division immediately preceding the auxiliary means. For Class III and IIII devices the value of "e" is specified by the manufacturer as marked on the device; "e" must be less than or equal to "d."

**A minimum load of 10 d is recommended for a weight classifier marked in accordance with a statement identifying its use for special applications.
(Amended 1990)

UR.3.1.1. Minimum Load, Grain Dockage Determination. - When determining the quantity of foreign material (dockage) in grain, the weight of the sample shall be equal to or greater than 500 scale divisions.
(Added 1985)

UR.3.2. Maximum Load. - A scale shall not be used to weigh a load of more than the nominal capacity of the scale.

UR.3.2.1. Maximum Loading for Vehicle Scales. - A vehicle scale shall not be used to weigh loads exceeding the maximum load capacity of its span as specified in Table UR.3.2.1.
(Added 1996)

UR.3.3. Single-Draft Vehicle Weighing. - A vehicle or a coupled vehicle combination shall be commercially weighed on a vehicle scale only as a single draft. That is, the total weight of such a vehicle or combination shall not be determined by adding together the results obtained by separately and not simultaneously weighing each end of such vehicle or individual elements of such coupled combination. However:

(a) the weight of a coupled combination may be determined by uncoupling the various elements (tractor, semitrailer, trailer), weighing each unit separately as a single draft, and adding together the results, or

(b) the weight of a vehicle or coupled-vehicle combination may be determined by adding together the weights obtained while all individual elements are resting simultaneously on more than one scale platform.

Note: This paragraph does not apply to highway-law-enforcement scales and scales used for the collection of statistical data.
(Added 1992)

UR.3.4. Wheel-Load Weighing.

UR.3.4.1. Use in Pairs. - When wheel-load weighers or portable axle-load weighers are to be regularly used in pairs, both weighers of each such pair shall be appropriately marked to identify them as weighers intended to be used in combination.

UR.3.4.2. Level Condition. - A vehicle of which either an axle-load determination or a gross-load determination is being made utilizing wheel-load weighers or portable axle-load weighers, shall be in a reasonably level position at the time of such determination.

UR.3.5. Special Designs. - A scale designed and marked for a special application (such as a prepackaging scale or prescription scale with a counting feature) shall not be used for other than its intended purpose[5].
(Amended 2003)

UR.3.6. Wet Commodities. - Wet commodities not in watertight containers shall be weighed only on a scale having a pan or platform that will drain properly.
(Amended 1988)

UR.3.7. Minimum Load on a Vehicle Scale. - A vehicle scale shall not be used to weigh net loads smaller than:

(a) 10 d when weighing scrap material for recycling;

(b) 50 d for all other weighing.

As used in this paragraph, scrap materials for recycling shall be limited to ferrous metals, paper (including cardboard), textiles, plastic, and glass.
(Amended 1988 and 1992)

UR.3.8. Minimum Load for Weighing Livestock. - A scale with scale divisions greater than 2 kg (5 lb) shall not be used for weighing net loads smaller than 500 d.
(Amended 1989)

UR.3.9. Use of Manual Weight Entries. – Manual gross or net weight entries are permitted for use in the following applications only:

(1) when a point-of-sale system interfaced with a scale is giving credit for a weighed item;

(2) when an item is pre-weighed on a legal for trade scale and marked with the correct net weight;

(3) when a device or system is generating labels for standard weight packages;

(4) when postal scales or weight classifiers are generating manifests for packages to be picked up at a later time; or

(5) when livestock and vehicle scale systems generate weight tickets to correct erroneous tickets.
(Added 1992) (Amended 2000 and 2004)

UR.3.10. Dynamic Monorail Weighing Systems. - When the value of d is different from the value of e, the commercial transaction must be based on e.

---

[5]Prepackaging scales and prescription scales with a counting feature (and other commercial devices) used for putting up packages in advance of sale are acceptable for use in commerce only if all appropriate provisions of Handbook 44 are met. Users of such devices must be alert to the legal requirements relating to the declaration of quantity on a package. Such requirements are to the effect that, on the average, the contents of the individual packages of a particular commodity comprising a lot, shipment, or delivery must contain at least the quantity declared on the label. The fact that a prepackaging scale may overregister, but within established tolerances, and is approved for commercial service is not a legal justification for packages to contain, on the average, less than the labeled quantity. (Amended 2003)

(Added 1999)

UR.3.11. Minimum Count. - A prescription scale with an operational counting feature shall not be used to count a quantity of less than 30 pieces weighing a minimum of 90 e.
(Added 2003)

Note: The minimum count as defined in this paragraph refers to the use of the device in the filling of prescriptions and is different from the minimum sample piece count as defined in S.1.2.3. and as required to be marked on the scale by S.6.6.
(Note Added 2004)

UR.3.12. Correct Stored Piece Weight - For prescription scales with a counting feature, the user is responsible for maintaining the correct stored piece weight. This is especially critical when a medicine has been reformulated or comes from different lots.
(Added 2003)

UR.4. Maintenance Requirements.

UR.4.1. Balance Condition. - The zero-load adjustment of a scale shall be maintained so that, with no load on the load-receiving element and with all load-counterbalancing elements of the scale (such as poises, drop weights, or counterbalance weights) set to zero, the scale shall indicate or record a zero balance condition. A scale not equipped to indicate or record a zero-load balance shall be maintained in balance under any no-load condition.

UR.4.2. Level Condition. - If a scale is equipped with a level-condition indicator, the scale shall be maintained in level.

UR.4.3. Scale Modification. - The dimensions (e.g., length, width, thickness, etc.) of the load receiving element of a scale shall not be changed beyond the manufacturer's specifications, nor shall the capacity of a scale be increased beyond its design capacity by replacing or modifying the original primary indicating or recording element with one of a higher capacity, except when the modification has been approved by a competent engineering authority, preferably that of the engineering department of the manufacturer of the scale, and by the weights and measures authority having jurisdiction over the scale.
(Amended 1996)

UR.5. Coupled-in-Motion Railroad Weighing Systems. - A coupled-in-motion weighing system placed in service on or after January 1, 1991, should be tested in the manner in which it is operated, with the locomotive either pushing or pulling the cars at the designed speed and in the proper direction. The cars used in the test train should represent the range of gross weights that will be used during the normal operation of the weighing system. Except as provided in N.4.2. and N.4.3.(a), normal operating procedures should be simulated as nearly as practical. Approach conditions for a train length in each direction of the scale site are more critical for a weighing system used for individual car weights than for a unit-train-weights-only facility, and should be considered prior to installation.
(Added 1990) (Amended 1992)

Table UR.3.2.1.
Span Maximum Load

Distance in feet between the extremes of any two or more consecutive axles	Ratio of CLC to maximum Load ("r" factor) carried on any group of 2 or more consecutive axles.							
	2 axles	3 axles	4 axles	5 axles	6 axles	7 axles	8 axles	9 axles
4[1]	1.000							
5[1]	1.000							
6[1]	1.000							
7[1]	1.000							
8 and less[1]	1.000	1.000						
More than 8[1]	1.118	1.235						
9	1.147	1.257						
10	1.176	1.279						
11	1.206	1.301						
12	1.235	1.324	1.471	1.632				
13	1.265	1.346	1.490	1.651				
14	1.294	1.368	1.510	1.669				
15	1.324	1.390	1.529	1.688	1.853			
16	1.353	1.412	1.549	1.706	1.871			
17	1.382	1.434	1.569	1.724	1.888			
18	1.412	1.456	1.588	1.743	1.906			
19	1.441	1.478	1.608	1.761	1.924			
20	1.471	1.500	1.627	1.779	1.941			
21	1.500	1.522	1.647	1.798	1.959			
22	1.529	1.544	1.667	1.816	1.976			
23	1.559	1.566	1.686	1.835	1.994			
24	1.588	1.588	1.706	1.853	2.012	2.176		
25	1.618	1.610	1.725	1.871	2.029	2.194		
26		1.632	1.745	1.890	2.047	2.211		
27		1.654	1.765	1.908	2.065	2.228		
28		1.676	1.784	1.926	2.082	2.245	2.412	
29		1.699	1.804	1.945	2.100	2.262	2.429	
30		1.721	1.824	1.963	2.118	2.279	2.445	
31		1.743	1.843	1.982	2.135	2.297	2.462	
32		1.765	1.863	2.000	2.153	2.314	2.479	2.647
33			1.882	2.018	2.171	2.331	2.496	2.664
34			1.902	2.037	2.188	2.348	2.513	2.680
35			1.922	2.055	2.206	2.365	2.529	2.697
36			2.000[2]	2.074	2.224	2.382	2.546	2.713
37			2.000[2]	2.092	2.241	2.400	2.563	2.730
38			2.000[2]	2.110	2.259	2.417	2.580	2.746
39			2.000	2.129	2.276	2.434	2.597	2.763
40			2.020	2.147	2.294	2.451	2.613	2.779
41			2.039	2.165	2.312	2.468	2.630	2.796
42			2.059	2.184	2.329	2.485	2.647	2.813
43			2.078	2.202	2.347	2.502	2.664	2.829
44			2.098	2.221	2.365	2.520	2.681	2.846
45			2.118	2.239	2.382	2.537	2.697	2.862
46			2.137	2.257	2.400	2.554	2.714	2.879
47			2.157	2.276	2.418	2.571	2.731	2.895
48			2.176	2.294	2.435	2.588	2.748	2.912
49			2.196	2.313	2.453	2.605	2.765	2.928

INSTRUCTIONS:

1. Determine the scale's CLC.
2. Count the number of axles on the vehicle in a given span and determine the distance in feet between the first and last axle in the span.
3. Multiply the CLC by the corresponding multiplier in the table*.
4. The resulting number is the scale's maximum concentrated load for a single span based on the vehicle configuration.

*See note and formula on next page.

Table UR.3.2.1.
Span Maximum Load

Distance in feet between the extremes of any two or more consecutive axles	Ratio of CLC to maximum Load ("r" factor) carried on any group of 2 or more consecutive axles.							
	2 axles	3 axles	4 axles	5 axles	6 axles	7 axles	8 axles	9 axles
50			2.216	2.331	2.471	2.623	2.782	2.945
51			2.235	2.349	2.488	2.640	2.798	2.961
52			2.255	2.368	2.506	2.657	2.815	2.978
53			2.275	2.386	2.524	2.674	2.832	2.994
54			2.294	2.404	2.541	2.691	2.849	3.011
55			2.314	2.423	2.559	2.708	2.866	3.028
56			2.333	2.441	2.576	2.725	2.882	3.044
57			2.353[3]	2.460	2.594	2.742	2.899	3.061
58				2.478	2.612	2.760	2.916	3.077
59				2.496	2.629	2.777	2.933	3.094
60				2.515	2.647	2.794	2.950	3.110

*Note: This table was developed based upon the following formula. Values may be rounded in some cases for ease of use. $W = r \times 500\left[\left(\frac{LN}{N-1}\right) + 12N + 36\right]$

[1] Tandem Axle Weight.

[2] Exception - These values in the third column correspond to the maximum loads in which the inner bridge dimensions of 36, 37, and 38 feet are considered to be equivalent to 39 feet. This allows a weight of 68 000 lb on axles 2 through 5.

[3] Corresponds to the Interstate Gross Weight Limit.

DO NO PRINT THIS PAGE.

Scales Code Index

"r" factor 42
Acceptance 11, 28, 30, 31
Acceptance tolerance 11, 28, 30, 31
Accuracy 10, 11, 13, 14, 16, 17, 18, 26, 29, 36
Accuracy class 10, 13, 14, 16, 17, 26, 29, 36
Adjustable components 8, 12
Adjustment 8, 9, 12, 26, 41
Apportionment factor 33
Approaches 38
Audit trail 8
Automatic indicating scales 19, 22, 27
Automatic zero-setting mechanism 10, 13, 23
Axle-load scales 3, 11, 19, 27, 37, 38
Balance condition 3, 9, 11, 29, 35, 41
Balance indicator 3, 10, 11, 12, 28, 29, 34
Balance indicators 28, 29, 34
Balance position 5
Barometric pressure 30, 35
Capacity 6, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 24, 26, 27, 28, 30, 34, 36, 37, 38, 39, 41
Capacity indication 6
Center-of-zero 3
Certificate of Conformance 13
Class 4, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 23, 27, 30, 34, 35, 36, 37, 39
Class I 4, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 26, 27, 28, 29, 30, 34, 35, 36, 37, 39
Class II 4, 9, 10, 11, 12, 13, 14, 17, 18, 19, 26, 27, 28, 29, 30, 34, 35, 36, 39
Class III 4, 10, 13, 14, 17, 18, 19, 26, 27, 28, 29, 30, 34, 35, 36, 37, 39
Class III L 10, 13, 14, 17, 18, 26, 27, 28, 29, 30, 34, 35, 36, 37, 39
Class IIII 4, 13, 14, 17, 18, 19, 26, 28, 29, 30, 34, 35, 36, 39
CLC 15, 16, 17, 18, 20, 42
Clearance 5, 11, 38
Computing scale 7
Concentrated Load Capacity 16
Consecutive-car test 25, 26
Counting feature 4, 12, 15, 17, 23, 31, 40, 41
Coupled-in-motion 25, 30, 41
Coupled-in-motion railroad weighing systems 30, 41
Crane and hopper 30
Crane and hopper (other than grain hopper) 14
Crane scales 21, 37
Creep 33
Dairy-product-test 11, 19, 27, 28
Damping means 11
Decreasing load test 27, 30
Direct sales 6, 7, 9, 10, 12
Discrimination test 22, 23
Distributed-car test 25, 26
Electric power supply 35
Environmental factors 22, 38
Field standard 23, 24, 25
Foundation 38
Graduations 4, 5, 6, 7, 11
Grain test scales 27, 36
Grain-test 11, 37
Hanging scale 21, 38
Hanging scales 21
Hoists 38
Hopper scales 21, 30, 37
Index of an indicator 5
Indicating element 3, 11, 15, 16, 17, 30, 32, 38
Indicator 3, 4, 5, 6, 8, 10, 11, 12, 14, 17, 29, 32, 34, 41
Influence factors 30, 34
Initial verification 24, 25, 26
Initial zero-setting mechanism 6, 10
Installation requirements 38
Level 9, 11, 21, 38, 40, 41
Level condition 11, 40, 41
Level-indicating means 11
Livestock scales 10, 15, 17, 18, 38
Load cell 13, 15, 16, 17, 18, 33, 38
Load cell verification interval 13, 18, 33
Main elements 15, 30
Maintenance 27, 28, 30, 31, 32, 34, 38, 41
Maintenance requirements 41
Maintenance tolerance 27, 28, 30, 31, 32, 34
Manual weight entries 9, 40
Marking requirements 15, 16
Material test 23, 27
Maximum permissible error (mpe) 33
Minimum load 39, 40
Minimum test weights 23, 24
Money-value computation 7
Money-value graduations 7
Monorail scale 4, 10, 11, 21, 27
mpe 33
Multi-interval 13, 14, 17, 30
Multiple range 13, 30
No-load reference value 3
Nominal capacity 6, 15, 16, 17, 18, 19, 20, 26, 29, 39
Non-automatic 32, 33
On-board 9, 11, 21, 36
Operating temperature 29, 35
Parallax 5
Parcel post scales 26, 27, 28
Piece 4, 15, 31, 41
Point-of-sale 8, 40
Poise 6
Portable axle-load weighers 3, 21, 30, 36, 40
Postal 4, 6, 17, 26, 27, 28, 36, 40
Power interruption 35
Prepackaging scale 8, 40

Prescription 11, 12, 14, 15, 17, 23, 26, 27, 28, 31, 40, 41
Railway track scales..... 10, 12, 15, 18, 20, 23, 24, 27, 28, 36, 37
Ratio test 23, 30
Readability 6
Recorded representations 3, 8
Recording elements.....3, 11, 32
Repeatability 34
RFI 23, 29, 35, 38
Scale modification 41
Sealing 8, 9
Security seal 8
Sensitivity requirement 28
Sensitivity test.....22
Shift test 19, 20, 21, 32
Shift tests 25
Single-Draft 39
Stock racks.....38
Strain-load test 23, 24, 31
Subsequent verification.....25, 26, 30
Substitution 23, 24, 31
Supports 19, 38
Symmetry.....5
Tare 9, 10, 11, 29
Temperature 13, 16, 17, 29, 30, 34, 35
Test loads..... 19, 20, 21, 23, 24, 27, 28, 29, 31
Test pattern 19, 20, 21
Time dependence.....32
Tolerances..... 10, 12, 21, 23, 24, 26, 27, 28, 29, 30, 32, 34, 36, 40
Travel..... 5, 12, 26
Type evaluation 13, 15, 30, 31, 32, 33
Uncoupled-in-motion 26
Uncoupled-in-motion railroad weighing system 26
Unit prices 7
Unit weights..... 6, 18, 32
Use requirements 39
Vehicle on-board weighing system 9, 11, 21, 36
Vehicle scale..... 10, 15, 19, 36, 38, 39, 40
Vehicle scales 10, 19, 36, 38, 39
Verification scale interval.....4, 13
Weighing elements 12, 13, 20, 38
Weight classifier 6, 7, 17, 39, 40
Weight ranges 6, 18
Weight units.....4
Wheel-load weighers 3, 11, 21, 30, 37, 40
Zero indication..... 3, 35
Zero-load adjustment 9, 41
Zero-load balance 8, 9, 10, 11, 23, 35, 41
Zero-tracking 10