

EXAMINATION PROCEDURE OUTLINE (EPO) NO. 16

Medium Capacity Scales (2,000 to 10,000 lb Capacity) BPC Div. 5, 4 CCR § 4000. 1.10. General Code, and 4 CCR § 4000. 2.20. Scales Code

The California Department of Food & Agriculture (CDFA) Division of Measurement Standards (DMS) recommends that this Examination Procedure Outline (EPO) be followed as the minimum criteria for examining Accuracy Class III and unmarked portable platform scales, warehouse scales, self-contained and built-in types, including the following types of indicating elements: beams, dials, and electronic digital-indicators with capacities from 2,000 lb to 10,000 lb.

This EPO does not cover test procedures for hopper scales, vehicle-mounted scales (including lift truck scales), monorail scales, crane scales, livestock/animal scales and scales with capacities from 2000 lb to 10,000 lb.

Requirements that apply only to scales marked with an accuracy class are indicated with an asterisk (*). Non-retroactive requirements are followed by the applicable date in parentheses, e.g., **REF: (NR 01/01/18)**.

NOTES:

1. Through Business and Professions Code (BPC) § 12107, the Secretary of CDFA adopts the most current edition of the National Institute of Standards and Technology Handbook 44 (HB 44) with additional language and exceptions.
2. Enforcement action notices (Notice of Violations, Administrative Actions, and Citations) must include the appropriate BPC authority section(s) and include the applicable California Code of Regulations (CCR) section(s) [note: DMS regulations are located in Title 4 of the CCR]. Please see the examples below.
 - Title 4 CCR § 4000.
 - Commercial weighing and measuring devices shall, except where noted, conform to the latest requirements set forth in the National Institute of Standards and Technology Handbook 44 “Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices”.
 - Example: Title 4 California Code of Regulations § 4000 [1.10.] G-UR.4.1. Maintenance of Equipment.
 - Title 4 CCR § 4002.
 - Language added to HB 44 is prefaced with CCR section (§) 4002.X.
 - Example: Title 4 California Code of Regulations § 4002.2.(b) Scales (2.20.) Class III, Class III L and Unmarked Devices Used for Recycling.

- Title 4 CCR § 4001.
 - Exceptions to HB 44 language are prefaced with CCR section (§) 4001.X.
 - Example: Title 4 California Code of Regulations § 4001. [1.10.] G-S.1.2. Remanufactured Devices and Remanufactured Main Elements.
- 3. Be aware of Title 4 CCR § 4000 [1.10.] General Code paragraph G-N.1. Conflict of Laws and Regulations.
- 4. Weighmaster information can be found at the DMS Weighmaster Program web page: <https://www.cdfa.ca.gov/dms/programs/wm/wm.html>
- 5. DMS issues Policy Letters and Notices to aid in clarification, provide instruction, and make recommendations to the County Sealers. Many of these notices can be found at: <https://www.cdfa.ca.gov/dms/notices/notices.html>
- 6. Safety Notes and Reminders have been included for reference. **It is essential that inspectors become familiar with their employer's safety policies. Some facilities have specific safety requirements that must be followed.**
- 7. Periodic changes to the procedures will be made to accommodate code changes and new developments in device technology. **Before issuing a Notice of Violation (NOV), It is imperative that inspectors verify the violations, including referencing updated requirements.**

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TABLE OF ABBREVIATIONS

| <u>Abbreviation</u> | <u>Meaning</u> |
|---------------------|--|
| A | Application requirements of a code |
| BPC | Division 5 of the California Business and Professions Code - Weights and Measures |
| CC | National Type Evaluation Certificate of Conformance |
| CCR or § 4000 | Title 4, Division 9 of the California Code of Regulations |
| CTEP | California Type Evaluation Program |
| EPO | Examination Procedure Outline |
| G | General Code paragraph |
| G-A | General Code Application paragraph |
| G-N | General Code Test paragraph |
| G-S | General Code Specifications paragraph |
| G-T | General Code Tolerances paragraph |
| G-UR | General Code User Requirements paragraph |
| HB 44 | NIST Handbook 44 |
| N | Notes for official test procedure paragraphs |
| NR | Non-retroactive |
| NTEP | National Type Evaluation Program |
| REF | Code Reference(s) used for enforcement of BPC and CCR |
| RSA | Registered Service Agency |
| S | Specification paragraphs – design requirements |
| T | Tolerance paragraphs- performance requirements |
| UR | User requirement paragraphs applicable to the selection, use installation and maintenance requirements |

SAFETY NOTES

The inspector is reminded of the importance of evaluating potential safety hazards prior to an inspection and taking adequate precautions to avoid personal injury or damage to property, equipment, or the device. As a minimum, the following safety precautions should be noted and followed during the inspection. Safety policies and regulations vary among jurisdictions. **It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies.** The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Personal Protection Equipment

e.g. – Safety Shoes, Safety Aprons, Gloves, Eye Protection, Hard Hat, etc. if necessary

Transportation of Equipment

Lifting

Location

Wet/Slick Conditions, Chemicals, Petroleum Product, Hazardous Materials, Obstructions.

Emergency Procedures

First Aid Kit

Electrical Hazards

Fire Extinguisher

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SAFETY REMINDER!

- Become familiar with and follow safety guidelines.
- Check the inspection site carefully for safety hazards and take appropriate precautions.
- If leaks, spills, exposed wiring, etc. cause hazardous testing conditions, it is recommended that the testing be discontinued until the unsafe conditions are corrected.
- Learn the nature of hazardous products used at, or near, the inspection site.
- Obtain and read copies of Safety Data Sheets (SDS) (formerly Material Safety Data Sheets).
- Use caution when moving in wet, slippery areas.
- Use personal protection equipment appropriate for the inspection site.
- Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.
- Remember the requirements in 4 CCR § 4000 [1.10.] General Code paragraph G-N.1. Conflict of Laws and Regulations. states that provisions of these specifications, tolerances, and other requirements are found to conflict with existing state laws, or with existing regulations or local ordinances relating to health, safety, or fire prevention, the enforcement of such provisions shall be suspended until conflicting requirements can be harmonized. Such suspension shall not affect the validity or enforcement of the remaining provisions of these specifications, tolerances, and other requirements.

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PRE-TEST CONSIDERATIONS

- ASTM E617 Class 6, OIML Class M₁ or NIST Class F Mass Standards – 105-1 (2019 Edition) or other suitable and designated standards or the tolerances expressed in Appendix A Fundamental Considerations in paragraph 3.2. Tolerance for standards. See also DMS Notice M-19-02.
 - Refer to: [NIST Handbook 105-1: Specifications and Tolerances for Field Standard Weights -Rev. 2019.](#)
- Mass standards (test weights) must be issued a current certificate of accuracy by laboratories in compliance with BPC Sections 12314 and 12534, and CCR Section 4086.
- Check to be sure the scale foundation is adequate to support the scale and test weights!
- Security Seals and seal press, if needed.
- Error Weights:
 - Should be no greater than 0.1e for zero-tracking and discrimination tests.
 - 0.5 e or 1.0 e can be used in conjunction with the 0.1 e or 0.2 e error weights.
 - NOTE: 0.2 e increments may be used if smaller weights are not available.

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PRE-TEST INSPECTION

1. Type Approval: [CTEP](#) or [NTEP](#) Certificate of Conformance. REF: BPC § 12500.5

- For devices with an NTEP CC, see Identification Markings.
 - CTEP devices are not required to be marked with CTEP Certificate of Approval number and must be verified using the make and model (e.g. CTEP database at <https://www.cdfa.ca.gov/dms/programs/ctep/ctep.html>).
- Unapproved devices are not to be tested or sealed by weights and measures officials. Yellow “unapproved device” tags are to be affixed to devices which are not approved.
REF: BPC § 12500.10

NOTE: Follow your County protocols regarding “non-commercial” devices (e.g. High School Wrestling scales).

2. Identification Markings:

- Lettering. **REF: § 4000. [1.10.] G-S.7.**
 - All required markings and instructions shall be distinct and easily readable and shall be of such character that they will not tend to become obliterated or illegible.
- Visibility of identification. **REF: § 4000. [1.10.] G-UR.2.1.1.**
- Name, initials, or trademark of manufacturer or distributor.
REF: § 4000. [1.10.] G-S.1.(a) Retroactive
- Model identifier. **REF: § 4000. [1.10.] G-S.1.(b) Retroactive**
- Model identifier prefix, acceptable abbreviations for “model” and “number”.
REF: § 4000. [1.10.] G-S.1.(b)(1)(NR 1/1/ 03)
- Nonrepetitive serial number. **REF: § 4000. [1.10.] G-S.1.(c) (NR 1/1/68)**
- Serial number prefix. **REF: § 4000. [1.10.] G-S.1.(c)(1) (NR 1/1/86)**
- Acceptable abbreviations for “Serial” and “Number”.
REF: § 4000. [1.10.] G-S.1.(c)(2) (NR 1/1/01)
- Current Software Version or Revision Identifier (for not-built-for-purpose software-based devices). **REF: § 4000. [1.10.] G-S.1.(d) (NR 1/1/04)**
 - Software version or identifier preface (for not-built-for-purpose software-based devices). **REF: § 4000. [1.10] G-S.1.(d), G-S.1.(d)(1) i (NR 1/1/07), G-S.1.(d)(1)ii (NR 1/1/16), and G-S.1.(d)(2) (NR 1/1/16)**
- Acceptable abbreviations for version, revision, and number.
REF: § 4000. [1.10.] G-S.1.d.(2) (NR 1/1/03)
- NTEP CC number (for devices that have an NTEP CC). **REF: § 4000. [1.10.] G-S.1.(e)**

- Prefix and acceptable abbreviations.
REF: § 4000. [1.10.] G-S.1.(e)(1) (NR 1/1/03)
- Accuracy Class. **REF: § 4000. [2.20] S.6.3. (NR 1/1/86)**

3. Additional Marking Requirements:

- Identification of Service Agency work. **REF: § 4085.(a)(4)**
 - Conspicuously located adhesive tag or label.
 - Name, registration number, business telephone, service agent license number, and date.
- Interchange or reversal of parts. **REF: § 4000. [1.10.] G-S.4.**
- Operational controls, indications, and features.
REF: § 4000. [1.10.] G-S.6. (NR 1/1/77)
- Weighing, load-receiving, and indicating element in same housing, point-of-sale-scales interfaced with POS systems, or covered on the same CC (in addition to marking for all devices). **REF: § 4000. [2.20] S.6., Tables S.6.3.(a) & (b)**
 - Nominal capacity. Retroactive
 - Value of scale division with nominal capacity, if not apparent. **(NR 1/1/83)**
 - Value of "e" (if different from "d"). **(NR 1/1/86)**
 - Temperature limits if narrower than and within – 10 °C to 40 °C (14 °F to 104 °F). **(NR 1/1/86)**
 - Scales designed for special purposes. **(NR 1/1/86)**
- Indicating element not permanently attached or covered on separate CC (in addition to marking for all devices). **REF: § 4000. [2.20] S.6., Tables S.6.3.(a) & (b)**
 - Nominal capacity. **Retroactive**
 - Value of scale division with nominal capacity, if not apparent. **(NR 1/1/ 83)**
 - Value of "e" (if different from "d"). **(NR 1/1/ 86)**
 - Temperature limits if narrower than and within – 10 °C to 40 °C (14 °F to 104 °F). **(NR 1/1/86)**
 - Scales designed for special purposes. **(NR 1/1/86)**
 - Maximum number of scale divisions (n_{max}). **(NR 1/1/88)**
- Weighing and load-receiving element not permanently attached or covered on separate CC (in addition to markings for all devices).
REF: § 4000. [2.20] S.6., Tables S.6.3.(a) & (b)
 - Nominal capacity. **Retroactive**
 - Temperature limits if narrower than and within – 10 °C to 40 °C (14 °F to 104 °F). **(NR 1/1/86)**

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- Scales designed for special purposes. **(NR 1/1/86)**
- Maximum number of scale divisions (n_{max}). **(NR 1/1/88)**
- Minimum verification scale division for which device complies with the requirements (e_{min} or d). **(NR 1/1/88)**
- Load cell with Certificate of Conformance (in addition to markings for all devices). **(NR 1/1/94) REF: § 4000. [2.20] S.6., Tables S.6.3.(a) & (b)**

Note: Requires information on a data plate attached to the load cell or in an accompanying document. If a document is provided, the serial number shall appear on the load cell AND in the document. **(NR 1/1/88)**

- Manufacturer's name or trademark, model designation, model prefix, and serial number and prefix shall also be marked on both the load cell and in any accompanying documents. **(NR 1/1/ 91)**
- Temperature limits if narrower than and within – 10 °C to 40 °C (14 °F to 104 °F). **(NR 1/1/86)**
- Maximum number of divisions. **(NR 1/1/88)**
- "S" or "M" for single or multiple cell applications. **(NR 1/1/88)**
- Direction of loading, if not obvious. **(NR 1/1/88)**
- Minimum dead load, maximum capacity, safe load limit, and load cell verification interval (v_{min}). **(NR 1/1/88)**
- v_{min} stated in mass units. **(NR 1/1/01)**

4. Selection:

- Suitability.
 - Commercial 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 computing capability, capacity, the character, number, size, and location of its indicating or recording elements, and the value of its smallest unit and unit prices. **REF: § 4000. [1.10.] G-UR.1.1., [2.20] UR.1., UR.1.1., UR.3.1., UR.3.2.**
 - Permanence. **REF: § 4000. [1.10.] G-S.3.**
 - Environment. **REF: § 4000. [1.10.] G-UR.1.2., [2.20] UR.2.3.**
 - Accuracy Class* – Designated by manufacturer & shall comply with parameters in Table 3. **REF: § 4000. [2.20.] S.5.2.(NR 1/1/86)**
- Installation.
 - Such that it does not facilitate fraud. **REF: § 4000. [1.10.] G-S.2.**
 - In accordance with manufacturer's instructions. **REF: § 4000. [1.10.] G-UR.2.1.**

- Supports, clearance, & foundation (if applicable).
REF: § 4000. [2.20] UR.2.1., UR.2.2., UR.2.4.
- Level indicating means and condition (i.e. portable scales).
REF: § 4000. [2.20] S.2.4., UR.4.2.
- Relationship of Minimum (NTEP) Load Cell Verification Interval
REF: § 4000. [2.20] S.5.4. (NR 1/1/94)
 - The 'Minimum Load Cell Verification Interval' (v_{min}) shall be less than or equal to 'd' divided by the square root of the number of load cells (N). (See equation below).

$$v_{min} \leq \frac{d^*}{\sqrt{N}}$$

Figure 1 - Equation to verify load cell suitability.

- For scales with load cell(s) and levers, the 'Minimum Load Cell Verification Interval' (v_{min}) shall be less than or equal to 'd' divided by the square root of the number of load cells (N) multiplied by the scales multiple (lever ratio).

$$v_{min} \leq \frac{d^*}{\sqrt{N} \times (\text{scale multiple})}$$

Figure 2 - Equations to verify load cell suitability for scales with both load cells and levers.

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

- Position of Equipment.
 - A device used for direct sales shall be placed so the indications and weighing operations may be seen from a reasonable "customer" and operator position.
REF: BPC § 12510(a)(6); § 4000. [1.10.] G-UR.3.3.
- Accessibility & Assistance.
 - A device shall be located, or such facilities for normal access thereto shall be provided, to permit testing and sealing. **REF: § 4000. [1.10.] G-UR.2.3.**
 - If the design, construction, or location of any device is such as to require a testing procedure involving special equipment or accessories or an abnormal amount of labor, such equipment, accessories, and labor shall be supplied by the owner or operator of the device as required by the weights and measures official. **REF: § 4000. [1.10.] G-UR.4.4.**

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- Use and Maintenance.
 - Equipment shall be operated only in the manner that is obviously indicated by its construction or that is indicated by instructions on the equipment. **REF: § 4000. [1.10.] G-UR.3.1.**
 - A device shall meet all performance requirements when associated or non-associated equipment is operated in its usual and customary manner and location. **REF: § 4000. [1.10.] G-UR.3.2.**
 - All equipment in service and all mechanisms and devices attached thereto or used in connection therewith shall be continuously maintained in proper operating condition throughout the period of such service. **REF: § 4000. [1.10.] G-UR.4.1.**
 - Cleanliness (lack of cleanliness, e.g., debris) may impact the performance of the scale.
 - Unstable indications or other abnormal equipment performance observed during operation shall be corrected and, if necessary, brought to the attention of competent service personnel. **REF: § 4000. [1.10.] G-UR.4.2.**
- Modifications **REF: § 4000. [2.20] UR.4.3.**
 - 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.

5. Indicating and Recording Elements:

- Primary Indication.
 - All weighing and measuring devices shall be provided with indicating or recording elements appropriate in design and adequate in amount. Primary indications and recorded representations shall be clear, definite, accurate, and easily read under any conditions of normal operation of the device. **REF: § 4000. [1.10.] G-S.5.1.**
- Values of Intervals.
 - The values of the graduated intervals or increments shall be uniform throughout the series. **REF: § 4000. [1.10.] G-S.5.3.**
 - On devices designed to indicate or record in more than one unit of measurement, the values indicated and recorded shall be identified with an appropriate word, symbol, or abbreviation. **REF: § 4000. [1.10.] G-S.5.3.1.**

- Value of the scale division. **REF: § 4000. [2.20] S.1.2.* (NR 1/1/ 86), S.1.2.1. (NR 1/1/87), S.1.2.2.1.*, S.5.3., UR.1.1.(b), G-S.5.3., G-S.5.3.1., UR.1.3. (NR 1/1/86)**
- Analog.
 - Graduations and a suitable indicator shall be provided in connection with indications designed to advance continuously. **REF: § 4000. [1.10.] G-S.5.2.1.**
- Digital. **REF: § 4000. [1.10.] G-S.5.2.2., [2.20] T.N.4.3.**
 - All digital values of like value agree with one another. Digital & associated analog values agree to the nearest minimum graduation. Digital values ‘round off’ to nearest minimum unit that can be indicated or recorded.
 - Zero indication includes display of zero for all places to right of decimal and at least one place to the left. **(NR 1/1/86)**
- For primary indicators separately located from their weighing elements:
 - A device shall be so installed that there is no obstruction between a primary indicating or recording element and the weighing or measuring element; otherwise there shall be convenient and permanently installed means for direct communication, oral or visual, between an individual located at a primary indicating or recording element and an individual located at the weighing or measuring element. **REF: § 4000. [1.10.] G-UR.2.2.**
- Tare
 - Tare operates in a backwards direction. Except of monorail scales and multi-interval and multiple range scales, the tare value shall be equal to the value if the scale division. Whenever gross and tare weights fall in different weighing ranges or segments on multi-interval or multiple range scales, (i.e. the scale divisions for the gross and tare weights differ), the net weight must be in mathematical agreement with the gross and tare weights that are indicated and recorded. **REF: § 4000. [2.20] S.2.3. (Partial NR 1/1/83)**
 - Scales with a combined zero-tare (“0/T”) key (not permitted on scales used for direct sales] must be marked ‘Not for Direct Sales’). **REF: § 4000. [2.20] S.2.1.6. (NR 1/1/86)**

6. Indicated & Recorded Representation of Units. REF: § 4000. [1.10.] G-S.5.6.1.

- For equipment manufactured on or after January 1, 2008, the appropriate defining symbols are shown in [NIST Special Publication SP 811](https://www.nist.gov/pml/special-publication-811) “Guide for the Use of International System of Units (SI)” [<https://www.nist.gov/pml/special-publication-811>] and Handbook 44 Appendix C – General Tables of Units of Measurement.
- The appropriate defining symbols on equipment manufactured prior to January 1, 2008, with limited character sets are shown in Table 1. Representation of SI Units on Equipment Manufactured Prior to January 1, 2008, with Limited Character Sets.

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7. Recorded Representations.

- Insofar as they are appropriate, the requirements for indicating and recording elements shall also apply to recorded representations. All recorded values shall be printed digitally. In applications where recorded representations are required, the customer may be given the option of not receiving the recorded representation. For systems equipped with the capability of issuing an electronic receipt, ticket, or other recorded representation, the customer may be given the option to receive any required information electronically (e.g., via cell phone, computer, etc.) in lieu of or in addition to a hard copy. **REF: § 4000. [1.10.] G-S.5.6. Retroactive**

8. Weighing Elements.

- Damping Means (Motion Detection). **REF: § 4000. [2.20] S.2.5.*, S.2.5.1.(b).**
- Antifriction Means (Prevention of interference between load-receiving element and scale frame). **REF: § 4000. [2.20] S.4.1.**
- Adjustable Components
 - Nose-irons, potentiometers, etc. shall be held securely in their adjustment. **REF: § 4000. [2.20] S.1.10., S.4.2.**
- Multiple Load-receiving Elements. **REF: § 4000. [2.20] S.4.3.**
- Drainage, if wet commodities are weighed. **REF: § 4000. [2.20] S.3.2., UR.3.6.**

9. Provision for Sealing.

- 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. **REF: § 4000. [1.10] G-S.8. (NR 1/1/90), [2.20] S.1.11.2(a) (NR 1/1/79) (formerly S.1.11.), S.1.11.2.(b) (NR 1/1/90), S.1.11.2.(c) (NR 1/1/ 95) (see Table S.1.11.)**
- 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. **REF: § 4000. [1.10.] G-S.8. Retroactive**
- Sealing multiple weighing elements with a common provision for sealing. **REF: § 4000. [1.10.] G-S.8.1. (NR 1/1/10)**
 - (a) A change to any metrological parameter (calibration or configuration) of any weighing or measuring element shall be individually identified. **(NR 1/1/10)**
 - (b) For devices that utilize an electronic form of sealing, in addition to the requirements in G-S.8.1., any appropriate audit trail requirements in an applicable specific device code also apply. Examples of identification of a

change to the metrological parameters of a weighing or measuring element include, but are not limited to:

- a. A broken, missing, or replaced physical seal on an individual weighing, measuring, or indicating element or active junction box;
 - b. A change in a calibration factor or configuration setting for each weighing or measuring element;
 - c. A display of the date of calibration or configuration event for each weighing or measuring element; or
 - d. Counters indicating the number of calibration and/or configuration events for each weighing or measuring element.
- Sealing removable digital storage device. **REF: § 4000. [1.10.] G-S.8.2., [2.20] S.1.11.1.**
 - Applies only to removable digital storage devices that remain in the device or system for it to be operational in which the configuration or calibration parameters can be changed by use of a, such as a secure digital (SD) card, USB flash drive, etc., security shall be provided for those parameters using either:
 - A category 3 method of sealing; or
 - A physical seal that must be broken in order to remove the digital storage device from the device
 - A security seal shall be appropriately affixed to any adjustment mechanism designed to be sealed. **REF: § 4000. [1.10.] G-UR.4.5.**
 - Scales that 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, adjacent to the weight display on both the operator's and customer's side whenever the scale is operating as a weight classifier. (A 'weight classifier' is a digital scale that rounds weight values up to the next scale division. These scales usually have a verification scale division (e) that is smaller than the displayed scale division, see CCR § 4000 Appendix 'D'). **REF: § 4000. [2.20.] S.1.8.4.1. (NR 1/1/01)**

PRE-TEST DETERMINATIONS

- 1. Applicability of Tolerances (Acceptance & Maintenance).**
REF: § 4000. [1.10.] G-T.1., only (a) & (e), G-T.2.
- 2. Application.** **REF: § 4000. [1.10] G-T.3.**
- 3. Tolerance values:** **REF: § 4000. [2.20] T.1. & T.N.3.**
 - a. If the scale is MARKED with an accuracy class, use Table 6.
REF: § 4000. [2.20] T.N.2.1., T.N.2.3., T.N.2.4., T.N.3.1., Table 6 (Class III), T.N.3.2., T.N.4.4., T.N.5., T.1.1., T.N.2.1., T.N.2.3., T.N.2.4., T.N.3.1./Table 6 (Class III), T.N.3.2., T.N.4.3., T.N.5.

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Determine the number (n) of verification scale divisions (e = d) of the test load by dividing the test load by the value of the verification scale division.

$$\text{EQUATION: } (n) = \frac{\text{Test load}}{\text{Value of the verification scale division}}$$

$$\text{EXAMPLE: } (n) = \frac{500 \text{ lb test load}}{1 \text{ lb/e}} = 500 \text{ (e=d)}$$

The following examples outline the tolerance breakpoints for two scales (Class III and Class III L), both with a nominal capacity of 10,000 lb and scale divisions of 5 lb.

To determine the weight at which the tolerance breakpoints on a Class III scale occur:

Maintenance Tolerance Values for Class III Scales from [2.20] Table 6:

- 1 d - up to 500 x minimum scale division
- 2 d - 501 to 2000 x minimum scale division
- 3 d - 2001 to 4000 x minimum scale division
- 5 d - 4001 (and above) x minimum scale division

| EXAMPLE | | | | |
|--|---|----------------------|-----------------------|---|
| Maintenance Tolerance for a 10,000 lb Class III Scale: e = d = 5 lb | | | | |
| Test Load (lb) | $n^* = \text{Test load} \div (d)$ | Tolerance (d) | Tolerance (lb) | Acceptable Range of Indications (lb) |
| 500 | 100 | 1 | 5 | 495 to 505 |
| 1,000 | 200 | 1 | 5 | 995 to 1,005 |
| 2,500 | 500 | 1 | 5 | 2,495 to 2,505 |
| 5,000 | 1,000 | 1 | 5 | 4,995 to 5,005 |
| 7,500 | 1,500 | 1 | 5 | 7,495 to 7,505 |
| 10,000 | 2,000 | 2 | 10 | 9,990 to 10,010 |

* Number of verification scales divisions (n) is test load divided by the verification scale interval (i.e. $n = \text{test load} / d$).

Figure 3. Example of Class III Tolerances on a 10,000 lb capacity scale with a 5 lb minimum division.

To determine the weight at which the tolerance breakpoints on a Class III L scale occur:

Maintenance Tolerance Values for Class III L Scales from [2.20] Table 6:

1 d – up to 500 x minimum scale division

Add a tolerance of 1 division for every additional 500 divisions or fraction thereof.

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| EXAMPLE | | | | |
|--|---|----------------------|-----------------------|---|
| Maintenance Tolerance for a 10,000 lb Class III L Scale: e = d = 5 lb | | | | |
| Test Load (lb) | $n^* = \text{Test load} \div (d)$ | Tolerance (d) | Tolerance (lb) | Acceptable Range of Indications (lb) |
| 500 | 100 | 1 | 5 | 495 to 505 |
| 1,000 | 200 | 1 | 5 | 995 to 1,005 |
| 2,500 | 500 | 1 | 5 | 2,495 to 2,505 |
| 5,000 | 1,000 | 2 | 10 | 4,990 to 5,010 |
| 7,500 | 1,500 | 3 | 15 | 7,485 to 7,515 |
| 10,000 | 2,000 | 4 | 20 | 9,980 to 10,020 |

*** Number of verification scales divisions (n) is test load divided by the verification scale interval (i.e. $n = \text{test load} / d$).**

Figure 4 - Example of Class III L Tolerances on a 10,000 lb capacity scale with a 5 lb minimum division.

If the scale is UNMARKED with an accuracy class, calculate the number of divisions on the scale. Determine the maximum number of scale divisions (n) by dividing the scale capacity by the value of the scale division in the following equation and example:

$$\text{EQUATION: } n = \frac{\text{Scale capacity}}{\text{Value of the scale division}}$$

$$\text{EXAMPLE: } n = \frac{10,000 \text{ lb}}{2 \text{ lb}} = 5000$$

- If n is greater than 5000 divisions, refer to [2.20] Table T.1.1. (see tolerances for ‘all other scales’ = 0.1% of test load)
- If n less than or equal to 5000 divisions, refer to [2.20] Table 6, Class III designation.

4. Shift Test Tolerance.

- On MARKED scales, any two results obtained during the shift test must be within absolute value of maintenance tolerance for that load (even when acceptance tolerance applies to the scale). **REF: § 4000. [2.20] T.N.3.1; T.N.4.4.**
- On UNMARKED scales, tolerance is the basic maintenance tolerance determined under pre-test determinations. **REF: § 4000. [2.20] T.1.1; Table T.1.1**

- 5. Discrimination.** Tests for Discrimination Near Zero and Near Capacity” should be performed during initial verification or after major repair when environmental factors will not affect the results. **REF: § 4000. [2.20] N.1.5. (NR 1/1/86), N.1.5.1**
- a. 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. (Also see N.1.5. Discrimination Test.) **REF: § 4000. [2.20] T.N.7.1**
 - b. 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. (Also see N.1.5.1. Digital Device.) **REF: § 4000. [2.20] T.N.7.2.**
 - c. See [Appendix C - Discrimination at Near Zero Load](#) and [Appendix D - Discrimination Test and Near Capacity](#) for more information on **Discrimination Test.**
- 6. Sensitivity (Weighbeam scales only).** A sensitivity test shall be conducted 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. Sensitivity Requirement (SR) or T.N.6. Sensitivity. **REF: § 4000. [2.20] N.1.4.**
- a. (Unmarked) General. – Except for scales specified in paragraphs T.2.3. Prescription Scales through T.2.8. Railway Track Scales: 2 d, 0.2 % of the scale capacity, or 40 lb, whichever is least. **REF: § 4000. [2.20] T.2.2.**
 - b. (Marked) Test Load. **REF: § 4000. [2.20] T.N.6.1.**
 - (a) Animal scales shall be 1 d for scales equipped with balance indicator, 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.
 - c. (Marked) Minimum Change of Indications. The addition or removal of the test load for sensitivity shall cause a minimum permanent change as follows **REF: § 4000. [2.20] T.N.6.2.:**
 - (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 III with a maximum capacity of more than 70 lb 0.20 in

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- (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.

7. Repeatability Tolerances.

- a. 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.

REF: § 4000. [1.10.] G-S.5.4., [2.20] T.N.5.

8. Accuracy of Field Standards. REF: § 4000. [2.20] N.2.

TEST NOTES

1. Conflict of Laws & Regulations.

- If any provisions of these specifications, tolerances, and other requirements are found to conflict with existing state laws, or with existing regulations or local ordinances relating to health, safety, or fire prevention, the enforcement of such provisions shall be suspended until conflicting requirements can be harmonized. Such suspension shall not affect the validity or enforcement of the remaining provisions of these specifications, tolerances, and other requirements. **REF: § 4000. [1.10.] G-N.1.**

2. Testing with Non-Associated Equipment. (e.g. RFI/EMI)

- Tests to determine conditions, such as radio frequency interference (RFI) that may adversely affect the performance of a device shall be conducted with equipment and under conditions that are usual and customary with respect to the location and use of the device. **REF: § 4000. [1.10.] G-N.2.**

3. Zero Load Balance. REF: § 4000. [1.10.] G-S.5.2.2. (d) (NR 1/1/ 86), [2.20.] S.1.1., S.2.1.1., S.2.1.2., UR.4.1.

- 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.
- 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.

4. Zero Return. Recheck zero load balance each time test load is removed. REF: § 4000. [1.10.] G-UR.4.2., [2.20.] N.1.9.

5. Recorded Representations. Print ticket or label (if equipped) to verify agreement between indicated and recorded representations. Consider printing tickets or labels for recorded representations that do not comply with applicable tolerances.

- Verify the following:
 - For scales equipped with a ticket printer, verify the effectiveness of motion detection. **REF: § 4000. [2.20.] S.2.5., S.2.5.1.(b)**
 - See “[APPENDIX A - MOTION DETECTION REQUIREMENTS](#)” for more information.
 - That the value of the scale division as recorded on the recorded representation is the same as the division value indicated. **REF: § 4000. [2.20.] UR.1.3. (NR 1/1/86)**
 - That any recorded representations for weight agree with their associated corresponding values that are displayed. **REF: § 4000. [1.10.] G-S.5.2.2., G-S.5.6., [2.20.] S.2.5.1.(b)**

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- Also verify that any options for obtaining a recorded representation are appropriate. The customer may be given the option of not receiving the recorded representation. If the system is equipped with the capability, the customer may also be given the option of receiving the recorded representation electronically in lieu of or in addition to a hard copy.

REF: § 4000. [1.10.] G-S.5.6.

6. Electronic scales only.

- If, during the conduct of the test, the performance of the device is questionable with respect to the zone of uncertainty or the width of zero, adequate tests should be conducted to determine compliance (see test procedure “Determining Width of Zero”).
REF: § 4000. [2.20.] S.1.1.1.(a), S.1.1.1.(b) (NR 1/1/93), N.1.5. (NR 1/1/86), N.1.5.1.
- If the device is equipped with operational features such as programmable tare, two scales with one printer, etc., check proper operation and appropriateness.
REF: § 4000. [1.10.] G-UR.4.1., G-UR.4.2., [2.20.] S.1.12. (NR 1/1/93 & 1/1/05), S.4.3., UR.3.9.

SAFETY REMINDER!!!

- Use Proper Lifting Techniques

TESTS

1. **Establish correct zero-load balance. REF: § 4000. [1.10.] G-UR.4.2., [2.20.] N.1.9.**
 - a. Re-check “zero” any time the test load is removed.
 - b. The zero-load balance should not change by more than the minimum tolerance applicable.
2. **Increasing-load test¹ (with the load approximately centered) at the following test loads: REF: § 4000. [2.20.] N.1.1.**
 - a. Class III scales: minimum load (20d), 500d, 2000d, 4000d and capacity.
 - b. Class III L scales: minimum load (20d), 500d, 1000d, 1500d and capacity.
 - c. Beam scales - at a minimum, test at or near half and full capacity on each weighbeam bar. Scales not equipped with a full capacity beam should be ratio tested by applying field standard weights, specifically designed for this purpose, on the counterpoise hanger. At each test load, test scale counterpoise weights by substituting them for field standard weights.
 - If there is a noticeable change in indication, remove the counterpoise weight from service. **REF: BPC § 12506**
 - d. Scales should be tested to capacity, where practical, on an initial verification and to at least used capacity on subsequent tests. In accordance with Table 4, not more than 3 substitutions shall be used during substitution testing, after which the tolerances for strain load tests apply. **REF: HB 44 [2.20] N.3., Table 4.**
3. **Test for over-capacity indication. REF: § 4000. [2.20.] S.1.7.**
 - Gross capacity (105 % of scale capacity). **REF: § 4000. [2.20.] S.1.7.(a)**
 - This requirement does not apply to these mechanical scales:
 - (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

¹ For scales that are not marked with an accuracy classification and have less than 1000 scale divisions, use the following procedure: begin test at 20d; then test at 0.50 lb and at each pound thereafter to capacity, including test loads at $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ capacity.

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4. Decreasing-load test.

- a. **For scales MARKED** with an accuracy class and having 1000 or more scale divisions (d), test with 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.
REF: § 4000. [2.20.] N.1.2., N.1.2.1.
- b. On **UNMARKED** Scales
- 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.
REF: § 4000. [2.20.] N.1.2.2.
 - Automatic Indicating Scales. **REF: § 4000. [2.20.] T.1.1., Table T.1.1.**
 - If the number of divisions is less than or equal to 5000, use Class III tolerances. **REF: § 4000. [2.20.] Table 6.**
 - If the number of divisions is greater than 5000, the decreasing load test tolerance is 1.5 times the applicable tolerance. (NOTE: tolerance is determined in Table T.1.1. “all other scales”).

Example 1:

- Scale Capacity: 6,000 lb capacity scale (1 lb divisions).
 - o Number of scale divisions = $6,000 \text{ lb} / 1 \text{ lb} = 6000 \text{ n}$
- Decreasing-Test load: maximum test load divided by 2
 - o Maximum test load: 6,000 lb
 - o Decreasing load test = $6,000 \text{ lb} / 2 = 3,000 \text{ lb}$
- In this example, the decreasing-load test multiplier is 1.5 because the number (n) of scale divisions is greater than 5000. The maintenance tolerance of the decreasing-load test is determined by the 3,000 lb multiplied by the applicable tolerance of 0.1 % of the test load.
 - o Maintenance tolerance = $3,000 \text{ lb} \times 0.001 (0.1 \%) = 3 \text{ lb}$
 - o The decreasing-load test tolerance = $3 \text{ lb} \times 1.5 = 4.5 \text{ lb}$ (5 lb rounded the nearest scale division)

Example 2:

- Scale Capacity: 10,000 lb capacity scale (2 lb divisions).
 - o Number of scale divisions = $10,000 \text{ lb} / 2 \text{ lb} = 5000 \text{ n}$
- Decreasing-Test load: maximum test load divided by 2
 - o Maximum test load: 10,000 lb
 - o Decreasing load test = $10,000 \text{ lb} / 2 = 5,000 \text{ lb}$
 - o Number of scale divisions at test load = $5,000 \text{ lb} / 2 \text{ lb} = 2,500 \text{ n}$

- In this example, the maintenance tolerance of the decreasing-load test is located in the Class III portion of Table 6 and is determined by the 2,500 scale divisions above.

- o The tolerance in Table 6 for Class III scales is 3 d (6 lb) at 2,500 n.

5. Shift Test. REF: § 4000. [2.20.] N.1.3.7.(b)

- a. The shift test can be conducted during the increasing, decreasing, or as a stand-alone test.

Note: If the shift test is performed during the increasing or decreasing load test and fails, repeat the shift test independent of the increasing/decreasing load tests.

- Use test weights equal to no less than 30 % of scale capacity, but not to exceed 35 % of scale capacity, centered as nearly as possible in each quadrant of the load-receiving element as shown in 'Example A' below.
- OR 25% capacity test load centered as nearly as possible over each corner of the load-receiving element as shown in 'Example B' below if available weights are less than 30% of scale capacity.

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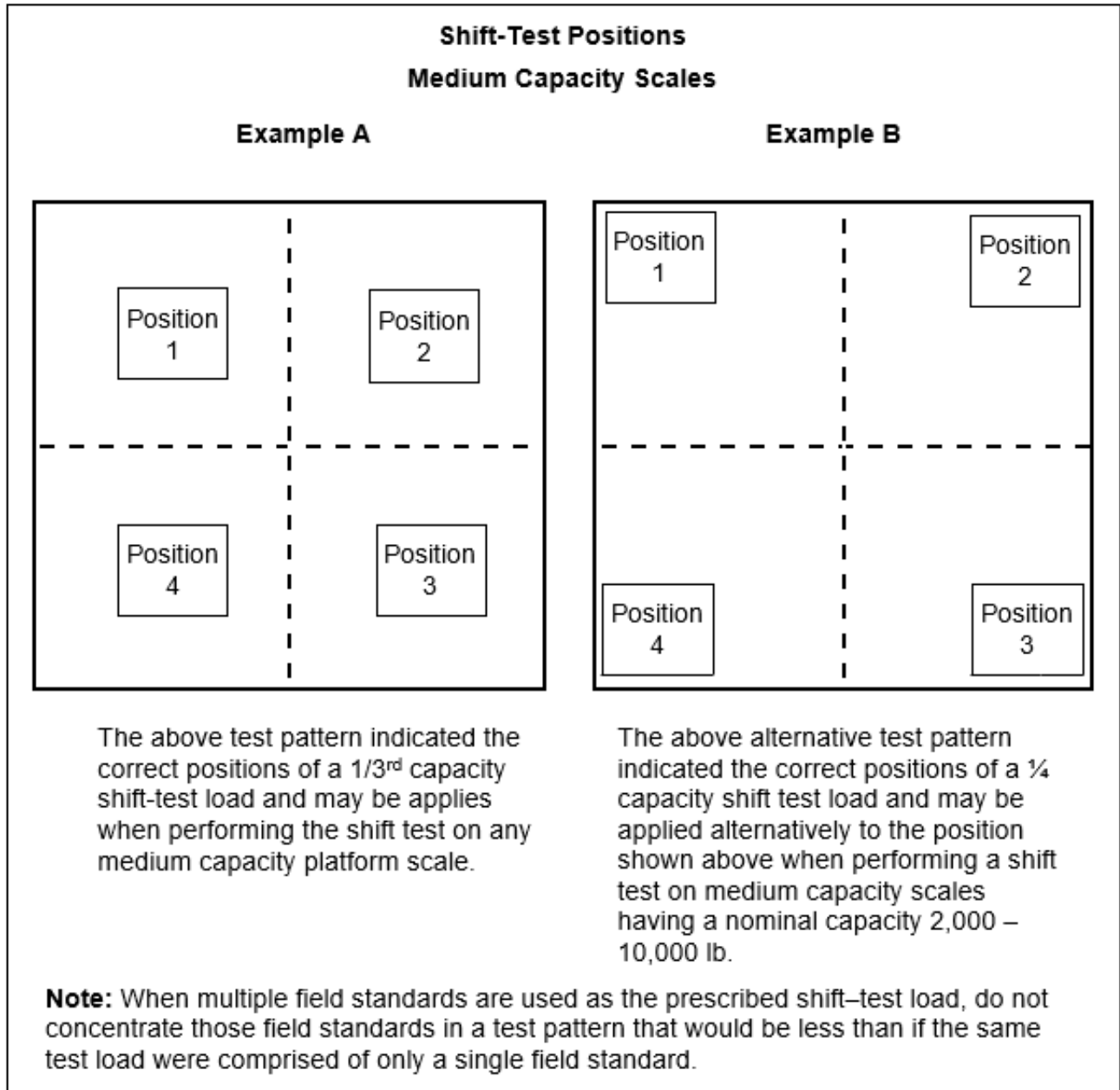


Figure 5 - Image of Shift Test Positions

Example: On a Class III 5,000 lb x 2 lb scale, the allowable maintenance tolerance at 1,500 - 1,750 pounds (30 -35% scale capacity) test load is ± 2 d. As shown in the following example, the scale is within ± 2 d; however, the range in error between position 1 and position 4 is 3 d (6 lb) and is in excess of 2 d absolute. The results do not meet the shift test tolerances in paragraph T.N.4.4.

- Position 1 indicates 1,496 lb using a 1,500 lb test load (30% scale capacity) resulting in a minus 2 division error.
- Position 2 indicates 1,500 lb using a 1,500 lb test load resulting in a zero-division error.
- Position 3 indicates 1,500 lb using a 1,500 lb test load resulting in a zero-division error.
- Position 4 indicates 1,502 lb using a 1,500 lb test load resulting in a positive 1 division error.

| Position | Weight Indication (lb) | Error (d) | Error (lb) |
|----------|------------------------|-----------|------------|
| 1 | 1496 | - 2 | - 4 |
| 2 | 1500 | 0 | 0 |
| 3 | 1500 | 0 | 0 |
| 4 | 1502 | + 1 | + 2 |

Figure 6 - Image of Shift Test, Indications and Errors

6. Radio Frequency Interference (RFI)/Electromagnetic Interference (EMI). Conduct test at or near capacity when RFI/EMI transmission sources are present or if a problem is suspected. **REF: § 4000. [1.10] G-UR.1.2., [2.20] G-N.2., G-UR.3.2., G-UR.4.2., N.1.6., T.N.9.**

7. Test for discrimination at or near capacity (if environmental conditions permit).

- a. For electronic indicating scales, a test load equivalent to 1.4d shall cause a change in the indicated or recorded value of at least 2.0d. (See Test for Discrimination). **REF: § 4000. [2.20] T.N.7.2.**
- b. For analog automatic indicating scales, a test load equivalent to 1.4 d shall cause a change in the indicated or recorded value of at least 1.0d. (See Test for Discrimination) **REF: § 4000. [2.20] N.1.5., T.N.7.1.**
- c. At near zero and at near capacity (if environmental conditions permit). **REF: [2.20] N.1.5. (NR 1/1/86), N.1.5.1., T.N.7.1.**

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8. Substitution or strain load test. REF: [2.20] See Table 4. and HB-44 Appendix D - Definitions

- Scales shall be tested using at least the minimum amount of test weights and to the minimum test loads specified in Table 4. In instances where the amount of test weight available for testing is equal to or greater than the minimum required by Table 4, but less than the amount of test load required, not more than 3 substitutions are to be performed to achieve a test load that equals at least the minimum required.

REF: [2.20] N.1.11. & N.1.12.

9. Recheck zero load balance. REF: [1.10], G-UR.4.2., [2.20] N.1.9.

10. Test for discrimination if environmental conditions permit, at or near capacity. For electronic indicating scales a test load equivalent to 1.4 d shall cause a change in the indicated or recorded value of at least 2.0 d. (See Discrimination Test)

REF: § 4000. [2.20.] T.N.7.2., N.1.5. (NR 1/1/ 86), N.1.5.1.

- For electronic indicating scales a test load equivalent to 1.4 d shall cause a change in the indicated or recorded value of at least 2.0 d. (See Discrimination Test)

REF: § 4000. [2.20.] T.N.7.2.

- For analog automatic indicating scales a test load equivalent to 1.4 d shall cause a change in the indicated or recorded value of at least 1.0d. (See Discrimination Test) **REF: § 4000. [2.20.] T.N.7.1.**

11. For nonautomatic indicating scales, perform a Sensitivity Test.

REF: § 4000. [2.20.] N.1.4., T.2., T.N.6.

12. Test for proper design of automatic zero-tracking mechanism, if the scale is so equipped.

REF: § 4000. [2.20.] S.2.1.3.1.(a) & (c), S.2.1.3.2.(b)

Under normal operating conditions the maximum load that can be “re-zeroed” when placed on or removed from the platform all at once, shall be:

For scales manufactured between January 1, 1981 and January 1, 2007

- 1.0 scale division.

For all scales covered in this EPO manufactured after January 1, 2007

- 0.5 scale division.

13. Conduct out-of-level test (portable scales without level-indicating means only).

REF: [2.20] S.2.4.

14. Check proper design of tare auto-clear, if scale is so equipped.

REF: [2.20] S.2.3. (NR 1/1/83) E only

- If scale is equipped with a semi-automatic zero-setting mechanism, test the effectiveness of motion detection. **REF: [2.20] S.1.2. E only**

- Establish correct zero-load balance. **REF: [1.10] G-UR.4.2., [2.20] N.1.9.**

POST-TEST TASKS

1. Security Means.

- Check for the presence of security seals on the device. Document missing seals on the official report and apply new ones as needed.

REF: § 4000. [1.10.] G S.8. (Portions NR 1/1/90), G-UR.4.5.

- Record audit trail information if the device is equipped with an audit trail.

REF: § 4000. [1.10.] G-S.8. (Portions NR 1/1/90)

NOTE: Do not seal a device if components which are intended to be inaccessible are accessible because of broken or missing glass, locks, etc. (maintenance of equipment)

REF: § 4000. [1.10.] G-UR.4.1., G-UR.4.3.

2. Results.

- Review results after all equipment at a location has been tested to determine compliance with specifications, tolerances, and other technical requirements.

NOTE: Predominance of error in direction favorable to device user. – Become familiar with your County Policy for interpretation and enforcement of this code section.

REF: § 4000. [1.10.] G-UR.4.1.

3. Clean up.

- Collect your equipment and tools.
- Return all product necessary for testing if applicable.
- Return all tools, equipment, keys, etc. to responsible personnel.

4. Documentation.

- Record the results, compliance actions, and disposition of the device(s) on the report.
- Consider documenting non-compliant devices, identification markings, missing security seals, etc. with photographs.
- Record audit trail information if the device is equipped with an audit trail
- Record Registered Service Agency (RSA) Information:
 - RSAs shall replace a security seal on any adjustment mechanisms where the seal was required to be removed. The RSA security seal shall show the registration number of the service agency and the year the security seal was placed on the device. **REF: §§ 4085(a)(3) & 4085(a)(4)**
 - Identification of Service Agent Work shall be adhesive tag or label in a conspicuous location on the device. **REF: § 4085(a)(4)**
 - Name, Registration Number, and business telephone number of the agency.
 - The license number of the service agent who performed the work and the date.

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- Certificate of Accuracy of Standards. On request from a sealer, a service agency shall show a copy of the certification of accuracy for the standards used to place a device into service. **REF: § 4085(a)(5)**
- Explain and provide the results to the device owner.

APPENDIX A: MOTION DETECTION REQUIREMENTS

Code References: CCR § 4000. [1.10] G-S.2., [2.20] S.2.1.2., S.2.5.1.

A digital electronic device must have a motion detection capability that prevents the device from recording (eg: printing), zeroing (semi-automatic zero), or taring (semi-automatic tare) part of a load when the semi-automatic zero or tare key is activated at the same time that a load is added, changed, or removed from the scale.

A digital electronic scale equipped with a printer must have a motion detection capability that prevents the scale from printing weight values before the weight display has stabilized within specified limits. This reduces the possibility of recording incorrect weight values. The limit for motion detection is small and medium capacity scales is plus or minus (\pm) 1 scale division.

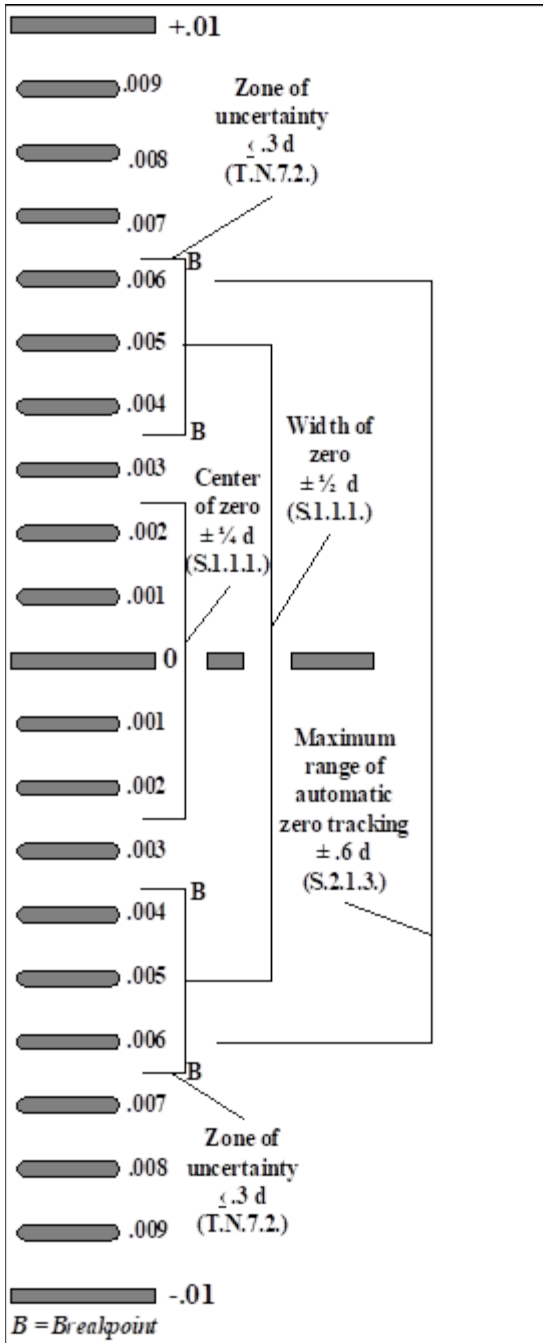
Example for a 5,000 x 1 lb scale:

Place a 5 lb test weight on the scale while simultaneously depressing the print key. The scale will either print a stabilized weight of 4 lb, 5 lb, or 6 lb (Tolerance = $\pm 1d = \pm 1$ lb) or give an error indication.

To the 5 lb test load, add 1 lb to the scale while depressing the print key. The scale will either print 5 lb, 6 lb, or 7 lb (Tolerance = $\pm 1d = \pm 1$ lb) or give an error indication.

APPENDIX B: AUTOMATIC ZERO-TRACKING & WIDTH OF ZERO

This example of Automatic Zero-Tracking and the Width of Zero test is based on a scale division of 0.01 lb. The principles used in this example can also be used to test scales with other division sizes, including scales indicating in metric units.



Automatic Zero-Tracking test:

| <u>Test action</u> | <u>Required Indication</u> |
|--------------------|----------------------------|
|--------------------|----------------------------|

- | | |
|---|-----------|
| a. Zero scale | 0.00 lb |
| b. Apply 0.007 lb ... | + 0.01 lb |
| (Repeat three times. Three failures will result in scale rejection.) | |
| a. Zero scale | 0.00 lb |
| b. Apply 0.007 lb ... | + 0.01 lb |
| c. Zero Scale..... | 0.00 lb |
| d. Remove 0.007 lb - 0.01 lb or a below zero indication | |
| (Repeat three times. Three successive failures will result in scale rejection. If scale passes go to the next test) | |

Width of Zero test:

| <u>Test action</u> | <u>Required Indication</u> |
|--------------------|----------------------------|
|--------------------|----------------------------|

- | | |
|--|-----------|
| a. Zero scale | 0.00 lb |
| b. Apply 0.007 lb | + 0.01 lb |
| c. Zero scale | 0.00 lb |
| d. Remove 0.007 lb - 0.01 lb or a below zero indication. | |
| e. Apply 0.015 lb+ 0.01 lb stable | |
| (Three successive failures will result in rejection.) | |

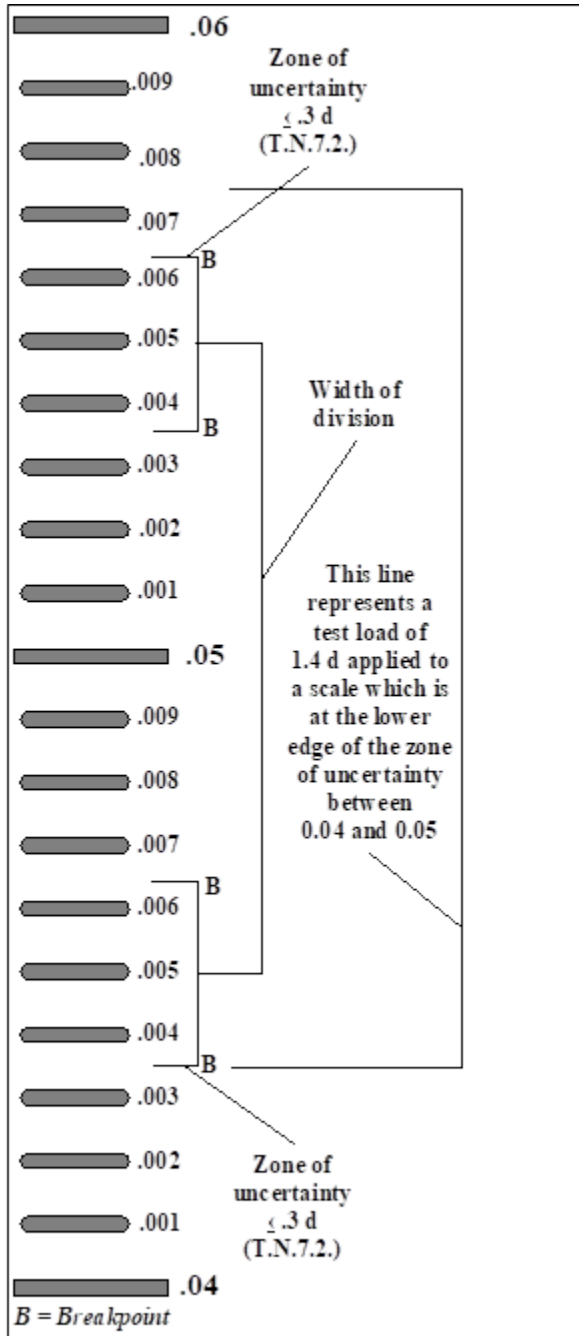
Note: The Width of Zero test is predecessor to the test for discrimination and may be performed on scales manufactured prior to 1986. For scales manufactured on or after 1/1/86, the test for discrimination applies.

Important: Apply or remove the test weights all at once in both tests. Use forceps if necessary.

Figure 7 - ILLUSTRATION OF AUTOMATIC ZERO-TRACKING TEST

APPENDIX C: DISCRIMINATION TEST AT OR NEAR ZERO LOAD

This example of a discrimination test at or near zero load is based on a scale division of 0.01 lb. The principles used in this example can also be used to test scales with other division sizes, including scales indicating in metric units.



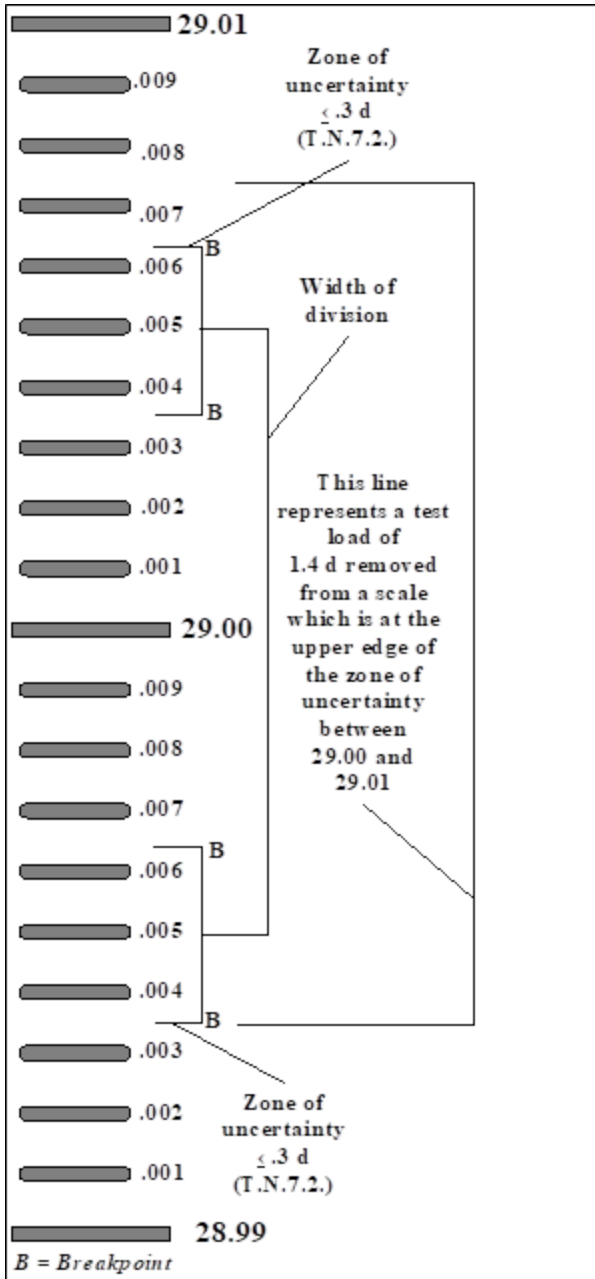
- a. With the device at zero, place error weights on scale equal to 1.4d (0.014 lb).
Example: 1 x 0.005 lb + 1 x .003 lb + 2 x .001 lb.
- b. Zero the scale and place a test load equal to 5d (0.05 lb) on the load receiving element.
- c. Remove the error weights in 0.1d (0.001 lb) increments until the indication flickers between 0.04 lb and 0.05 lb (**NOTE:** 0.2d increments may be used in smaller weights are not available). If the indication does not flicker but indicates a steady 0.04 lb, add 0.1d. If the scale indicates 0.05 lb, it is at the breakpoint in the zone of uncertainty. (Remove the 0.1d if it was used to verify the breakpoint.)
- d. Add a test load equal to 1.4d to the scale (0.014 lb)
- e. The indication should read a steady 0.06 lb.
- b. If the scale passes this test at a load near zero, the test should be performed near the maximum test load.

Figure 8 - ILLUSTRATION OF DISCRIMINATION TEST AT OR NEAR ZERO LOAD

**EPO No. 16 - Medium Capacity Scales (2,000 to 10,000 lb Capacity)
 BPC Div. 5, 4 CCR § 4000. 1.10. General Code and
 4 CCR § 4000. 2.20. Scales Code**

APPENDIX D: DISCRIMINATION TEST AT OR NEAR CAPACITY

This example of a discrimination test be near capacity is based on a scale division of 0.01 lb at a test load of 29.00 lb. The principles used in this example can also be used to test scales with other division sizes and capacities, including scales used in metric units.



With the scale at zero, add decimal weights equal to 1.4d and zero the device.

- Add test weights to make the scale indicate a weight value near capacity (e.g., 29.00 lb).
- With the scale stable, add decimal weights in 0.1d increments until the indication flickers between 29.00 lb and 29.01 lb. If the indication shows a steady 29.01 lb, remove 0.1d. If the scale indicates 29.00 lb it is at the breakpoint in the zone of uncertainty. (Replace the 0.1d if it was used to verify the breakpoint.)
- Remove the 1.4d test load (0.014 lb).
- The scale should indicate a steady 28.99 lb.
- If the test passes near the maximum capacity, the test should be performed near zero.

Figure 9 - ILLUSTRATION OF DISCRIMINATION TEST AT OR NEAR CAPACITY

APPENDIX E: TOLERANCE TABLES

| Table T.1.1. Tolerances for Unmarked Scales (extract) | | | | | |
|---|-------------|--|---------------------|--------------------|---|
| Type of Device | Subcategory | Min Tol. | Accept. Tol. | Maint. Tol. | Decreasing Load Multiplier ¹ |
| All other Scales | n > 5,000 | 0.5 d or 0.05% of capacity, whichever is less. | 0.05 % of test load | 0.1 % of test load | 1.5 |
| | n ≤ 5,000 | Class III, Table 6 | | | 1.0 |
| ¹ The decreasing load test applies only to automating indicating scales. | | | | | |

Figure 10 - Extract from Table T.1.1. Tolerance Values for Unmarked Scales

| Table 6. Maintenance Tolerances (All values in this table are in scale divisions.) | | | | |
|---|------------------------------|------------------|---|----------------|
| Class | Tolerance in Scale Divisions | | | |
| | 1d | 2d | 3d | 5d |
| | 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 - 4000 | 4,001 – 10,000 |
| III L | 0 - 500 | 501 – 1,000 | (Add 1d for each additional 500d of fraction thereof) | |
| IIII | 0 - 50 | 51 - 200 | 201 - 400 | 401 + |

Figure 11 - Table 6. Maintenance Tolerance Values

EPO No. 16 - Medium Capacity Scales (2,000 to 10,000 lb Capacity)
 BPC Div. 5, 4 CCR § 4000. 1.10. General Code and
 4 CCR § 4000. 2.20. Scales Code

Class III - Examples

| <u>d = 0.5 lb.</u> | |
|--------------------|------------------------------|
| Test Load (lb) | Maintenance Tolerance ± (lb) |
| 0.0 - 250.0 | 0.5 |
| 250.5 - 1,000.0 | 1.0 |
| 1,000.5 - 2,000.0 | 1.5 |
| 2,000.5 - 5,000.0 | 2.5 |

| <u>d = 1.0 lb.</u> | |
|--------------------|------------------------------|
| Test Load (lb) | Maintenance Tolerance ± (lb) |
| 0 - 500.0 | 1 |
| 501 - 2,000.0 | 2 |
| 2,001 - 4,000.0 | 3 |
| 4,001 - 10,000.0 | 5 |

| <u>d = 2 lb.</u> | |
|------------------|------------------------------|
| Test Load (lb) | Maintenance Tolerance ± (lb) |
| 0 - 1,000 | 2 |
| 1,002 - 4,000 | 4 |

| <u>d = 5 lb.</u> | |
|------------------|------------------------------|
| Test Load (lb) | Maintenance Tolerance ± (lb) |
| 0 - 2,500 | 5 |
| 2,505 - 10,000 | 10 |

Figure 12 - Tables Indicating Maintenance Tolerance Values Based on Given Divisions

Class III L - Example

| <u>d = 5 lbs.</u> | |
|--------------------------|-------------------------------------|
| Test Load (lb) | Maintenance Tolerance ± (lb) |
| 0 - 2,500 | 5 |
| 2,505 - 5,000 | 10 |
| 5,005 - 7,500 | 15 |
| 7,505 - 10,000 | 20 |

Figure 13 - Table Indicating Maintenance Tolerance Values Based on Given Divisions

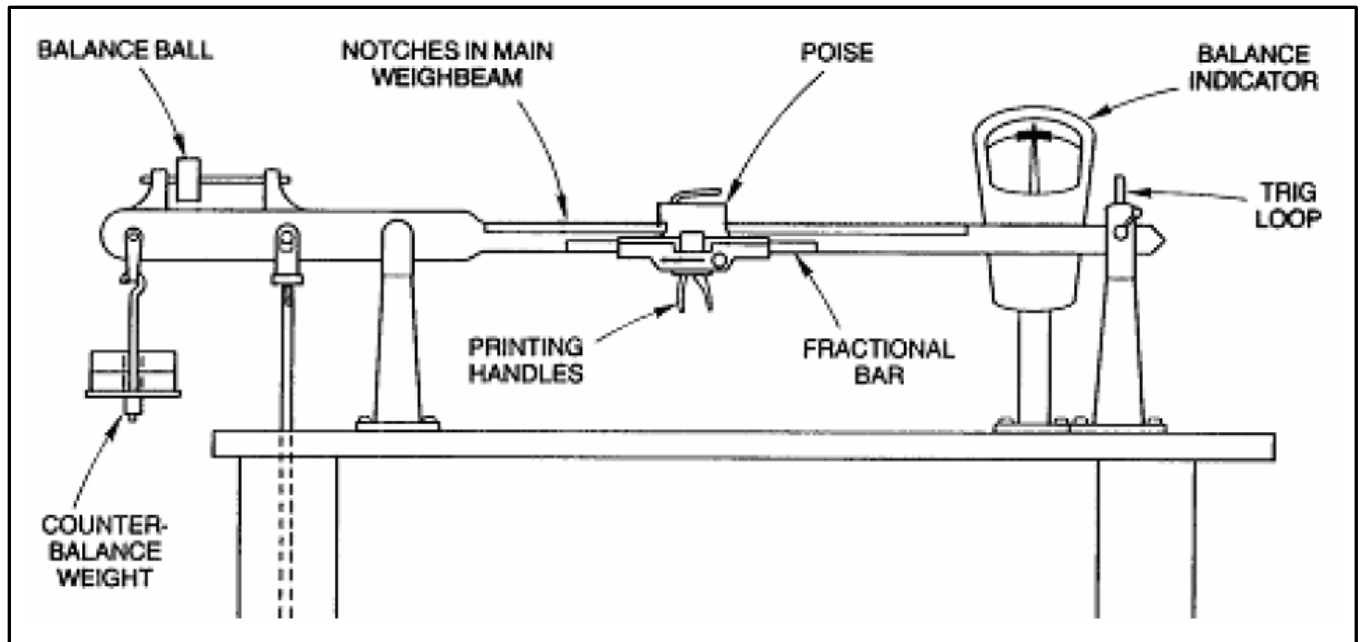


Figure 14 - Example Weighbeam Scale Components

**EPO No. 16 - Medium Capacity Scales (2,000 to 10,000 lb Capacity)
 BPC Div. 5, 4 CCR § 4000. 1.10. General Code and
 4 CCR § 4000. 2.20. Scales Code**

| Table S.1.11. Categories of Device and Methods of Sealing | |
|--|--|
| Categories of Device | Methods 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 10 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) | |

Figure 15 - Image of Table S.1.11. Categories of Device Methods of Sealing

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