

# 2015 NIST EPO No. 5

## Examination Procedure Outline for

### Prescription and Jeweler Scales Part 1 – Electronic

EPO No. 5 is divided into two parts. It is recommended that this outline be followed as minimum criteria for examining electronic digital indicating scales and balances used in prescription and jeweler applications. Included within Part 1, on pages 12 through 16, are procedures for verifying proper operation of a legal for trade counting feature on a Class I and Class II prescription scale. Part 2, which applies to mechanical equal arm scales and balances used in prescription and jeweler applications, begins on page 17.

Throughout the EPO, requirements that apply only to scales marked with an accuracy class designation are indicated with an asterisk (\*). Nonretroactive requirements are followed by the applicable date in parentheses.

Prescription scales are often located and used in areas where controlled substances are stored. Access to these areas, except by qualified personnel, is generally prohibited. Do not enter any restricted areas unless authorized to do so by personnel having proper authority to grant such access.

#### SAFETY NOTES

*When excerpting this Examination Procedure Outline for duplication, the NIST EPO Safety Annex (Safety Considerations and Glossary of Safety Key Phrases) should be duplicated and included with this outline.*

*Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in effect 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 of the importance in 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.*

Prior to beginning any inspection, the inspector should read and be familiar with the NIST EPO Safety Annex - "Safety Considerations and Glossary of Safety Key Phrases." The terms and key phrases in each safety reminder of this outline are found in the glossary of the EPO Safety Annex. 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 the device. As a minimum, the following safety precautions should be noted and followed during the inspection.

**Clothing**

**Personal Protection Equipment  
e.g., Safety Shoes**

**Electrical Hazards**

**Support – for Scale and Test Weights**

**First Aid Kit**

**Transportation of Equipment**

**Lifting**

**Also: Chemicals and Hazardous Materials or Obstructions**

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<b>Equipment List:</b>	
<u>Mass Standards Required</u> <sup>1</sup>	<b>Special Handling Equipment</b>
Class I Scales: OIML E-2, ASTM 1, or standards of greater accuracy.	Clean lint-free and dust-free gloves  Tweezers  Ash-free, acid-free filter paper
Class II Scales: OIML F-1, ASTM 3, or standards of greater accuracy.	
Class III Scales: NIST Class F, or standards of greater accuracy.	
Unmarked Scales: Use standards of the proper level of accuracy that comply with NIST Handbook 44 Fundamental Consideration as detailed in footnote 1.	
<b>Note:</b> The conversion tables for units of measurement commonly indicated on jewelers and prescription scales are listed in Appendix A to EPO No. 5. Verify the performance of the scale at multiple test points when different units of measurement are in commercial use for a particular application.	
Special care is required when handling mass standards to maintain the accuracy level needed to properly test most prescription and jewelers scales and scales marked Class I or Class II.	
<ol style="list-style-type: none"> <li>1. Never touch standards with bare hands or otherwise contaminate standards by placing them on dirty surfaces.</li> <li>2. Always wear suitable gloves or use tweezers when handling precision standards to prevent substances (oils, lint, moisture, etc.) from adhering to their metal surfaces.</li> <li>3. Special filter papers are available and should be used to prevent contact with dirty surfaces.</li> <li>4. Proper cleaning methods are to be used.</li> <li>5. Exercise care in storing and transporting standards to avoid physical damage.</li> </ol>	

**H-44 General Code and Scales Code References**

**Inspection:**

- 1. Accessibility for inspection, testing, and sealing..... G-UR.2.3
- 2. Zero-load balance as found..... UR.4.1.
  - Zero indication..... G-S.5.2.2.(d), (1/1/86), S.1.1.1., S.1.1.1.(a), S.1.1.1.(b), (1/1/93)
  - Zero-load adjustment ..... S.2.1.1., S.2.1.2.
    - Zero-tracking (scales manufactured between 1/1/81 and 12/31/06)..... S.2.1.3.1.(a)
    - Zero-tracking (scales manufactured on or after 1/1/07) ..... S.2.1.3.2.(b)

<sup>1</sup> In accordance with NIST Handbook 44, Fundamental Considerations Section 3 paragraph 3.2., the combined error and uncertainty of any standard used for testing must be less than one-third the applicable device tolerance. The use of the mass standards indicated for each of the scale accuracy classes listed will ensure conformance with this fundamental consideration.

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**Inspection (Cont.):**

3. Marking:

Identification (Refer to list of required markings provided in the table that follows)... G-S.1., S.6., S.6.3.,  
Table S.6.3.a,  
Table S.6.3.b.

<b>List of Required Markings for Jeweler and Prescription Scales</b>	
Manufacturer's ID or Name	Special Application (1/1/86)
Model Identifier	Nominal Capacity <sup>1</sup>
Acceptable Model Identifier Prefix (1/1/03)	Nominal Capacity and Value of Scale Division, "d" Displayed Together (1/1/83)
Serial Number (1/1/68)	Value of the Verification Scale Division, "e" if different from the value of the scale division "d" (1/1/86)
Serial Number Prefix (1/1/86)	Temperature Limits Class III Scales (1/1/86) <sup>2</sup>
Acceptable Abbreviations for "Serial" and "Number" (1/1/01)	Accuracy Class (1/1/86)
Certificate of Conformance (CC) Number or CC Addendum Number and Prefix (1/1/03)	
<sup>1</sup> The nominal capacity of a prescription scale that is not marked with an accuracy class designation can be assumed to be ½ apothecary ounce, unless otherwise marked. (Reference N.6.) <sup>2</sup> Applies only when the temperature range on the NTEP CC is narrower than and within -10 °C to 40 °C (14 °F to 104 °F).  <b>Note:</b> Be aware that the required marking information included in this table was extracted from the 2013 edition of NIST Handbook 44 and is susceptible to change in future editions.	

Marking (continued):

Devices or main elements remanufactured after January 1, 2002. .... G-S.1.2  
 Interchange or reversal of parts. .... G-S.4.  
 Operational controls, indications, and features. .... G-S.6. (1/1/77)  
 Lettering ..... G-S.7.  
 Visibility of identification ..... G-UR.2.1.1.

4. General Considerations:

Selection of equipment..... G-UR.1.1., G-UR.1.2.,  
UR.1.  
 Typical class for weighing applications. .... UR.1.1., Table 7a\*  
 Accuracy class designation and parameters. .... S.5.1.\* (1/1/86), S.5.2.\*  
(1/1/86)  
 Nominal capacity of Prescription Scale..... N.6.  
 Recommended Minimum Load..... UR.3.1.  
 Maximum load. .... U.R.3.2.  
 Permanence. .... G-S.3.

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**Inspection (Cont.):**

- 5. Installation ..... G-UR.2.1.
- Indicating or recording element..... G-UR.2.2.
- Position of equipment (not applicable to prescription scales) ..... G-UR.3.3.
- Initial zero-setting mechanism. .... S.2.1.5.(a), S.2.1.5.(b),  
(1/1/09)
- Supports..... UR.2.1.

<b>SAFTEY REMINDER</b>
<b>– Check to ensure that scale supports provide a firm foundation for the scale under all loading conditions, including loading of the platform to device capacity!</b>

- Level indicating means and condition ..... S.2.4., (1/1/86), UR.4.2.
- Customer Indications..... S.1.8.4.
- 6. Design of indicating and recording elements: ..... S.1.2. \* (1/1/86), S.1.2.1.  
(1/1/89), G-S.5.3.,  
G-S.5.3.1.
- Value of the scale division ..... UR.1.3. (1/1/86),  
UR.1.3.1. (1/1/86)
- Recorded representations, General ..... G-S.5.6.
- Indicated and recorded representation of units (Appropriate abbreviations): G-S.5.6.1. (a)
- Equipment manufactured on or after January 1, 2008..... G-S.5.6.1. (b)
- Equipment manufactured prior to January 1, 2008 ..... S.5.3.
- Multi-interval and multiple range scales ..... S.1.2.2.1., S.1.2.2.2.
- Value of the verification scale interval ..... S.2.3. (1/1/83)
- Value of the tare division ..... S.2.3.
- Tare mechanism ..... S.2.1.6.
- Combined Zero-Tare (“0/T”) key..... S.2.5.
- Damping means..... S.1.9.1., S.1.9.2.
- Prepackaging scales..... S.4.
- 7. Design of the weighing element. ....
- 8. Security and sealing: S.1.10.
- Adjustable components ..... G-UR.4.5.
- Adjustment mechanisms designed to be sealed..... G-S.8. (1/1/90),
- Provisions for sealing (does not apply to Class I) ..... S.1.11.(a) (1/1/79),  
S.1.11. (b) (1/1/90),  
S.1.11.(c) (1/1/95)

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**Inspection (Cont.):**

- 9. Maintenance, use, and environmental factors:
  - Facilitation of fraud ..... G-S.2.
  - Protection from environmental factors ..... UR.2.3.
  - Method of operation ..... G-UR.3.1.
  - (scales having special designs)..... UR.3.5.
  - Maintenance of equipment ..... G-UR.4.1.
  - Abnormal performance..... G-UR.4.2.
  - Use of adjustments ..... G-UR.4.3.
  - Scale modification..... UR.4.3.
  
- 10. Assistance ..... G-UR.4.4.

**Pretest Determinations:**

- 1. Verification scale interval (e) ..... S.1.2.2.1.\* , S.1.2.2.2.\*

For Class I and II scales equipped with a verification scale division (e) that does not equal the value of the displayed scale division (d), verify that the relationship between “e” and “d” conforms to the expression:

$$d < e \leq 10 d$$

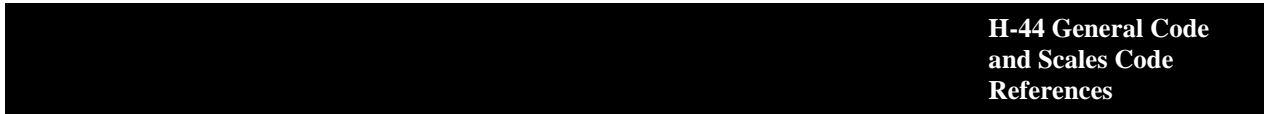
For Class III scales that are marked with a manufacturer’s designated verification scale division (e), verify that the value of “e” is less than or equal to the value of “d.”

- 2. Tolerances:
    - Acceptance/maintenance ..... G-T.1., G-T.2.
    - Application..... G-T.3., G-T.4.,  
T.N.2.1.\* , T.N.2.2.\* ,  
T.N.2.3.\*
- Tolerance values:  
Determine the number of scale divisions (n)<sup>2</sup> using the following formula:

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<sup>2</sup> In accordance with Handbook 44 Scales code Table 3, footnote 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 (i.e., do not add “n” for the ranges together). 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<sub>max</sub> for the summed element shall not exceed the maximum specified for the accuracy class. (Added to Table 3 in 1997)

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**Pretest Determinations (Cont.):**

$$n = \frac{\text{Scale capacity}}{\text{Value of the verification scale division (e)}}$$

Scales marked with an accuracy class .....	T.N.3.1., Table 6,
Scales not marked with an accuracy class .....	T.N.3.2., T.N.4, T.N.5
3. Discrimination .....	T.1.1., Table T.1.1.
4. Minimum test weights and test loads.....	T.N.7.2.*
	N.3., Table 4

**Test Notes:**

1. Scales equipped with Automatic Zero-Tracking (AZT) Mechanism:
  - manufactured between 1/1/81 and 1/1/07 ..... S.2.1.3.1.(a)
  - manufactured on or after 1/1/07..... S.2.1.3.2.(b)

To verify correct operation of an AZT feature on a scale in which the value of the scale division (d) is equal to the value of the verification scale division (e), (i.e., the scale manufacturer has not declared a verification scale division) complete step a. through step f. below.

- a. Zero the scale with no load on the platter.
- b. Apply all at once test weights equal to 0.7 d.
- c. Verify that the indicator is continuously displaying the value of 1 d.
- d. Zero the scale with the 0.7 d test weights remaining on the platter.
- e. Remove the 0.7 d test weights all at once.
- f. The scale must display a continuous behind zero indication using one of the following means:
  - display a value equal to minus 1 d;
  - blank the display; or
  - display error symbols that cannot be interpreted as a weight value.

If the scale is equipped with a verification scale division (e) that is not equal to the value of the scale division (d), the value of “d” rather than “e” is used to calculate the maximum permissible amount of weight that can be rezeroed during this test. However, in instances where multiplying the value of the scale division (d), whether or not the value of “d” and “e” are equal, by 0.7 results in a value that is smaller than the smallest available test standard, a field test of the AZT feature is not possible.

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**Test Notes (Cont.):**

Be aware that step a. through step c. verify the correct operation of an AZT feature on the positive side of zero while step d. through step f. verify the correct operation of an AZT feature behind zero. A continuous display of 1 d (in step c.) and a continuous display of a behind zero indication (i.e., in accordance with any of the means noted in step f.) confirms the correct operation of an AZT feature on both sides of zero. However, if the displayed indication is zero following the completion of step b. or step e., the AZT feature may not be functioning properly. In this case, verify the feature is not functioning properly by repeating the AZT test before rejecting the device.

2. If the scale is equipped with a semiautomatic zero-setting mechanism (i.e., pushbutton zero), a pushbutton tare feature, or a ticket printer, verify the correct operation of motion detection..... S.2.1.2.(b), S.2.5.1.(b)
3. If the scale is equipped with a ticket printer, print a ticket at several test loads. Verify that recorded values agree with corresponding indicated values and that all values are appropriately and correctly identified on the ticket. If scale is equipped with computing capability, verify correct money value agreement..... G-S.5.1, G-S.5.2.  
Also verify that any options for obtaining a recorded representation are appropriate. (except G-S.5.2.1.),  
The customer may be given the option of not receiving the recorded representation. G-S.5.3., G-S.5.3.1.,  
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 G-S.5.4., G-S.5.5.,  
to a hard copy. .... G-S.5.6.  
G-S.5.6.
4. Check proper design of tare auto-clear, if scale is so equipped..... S.2.3. (1/1/83)
5. Discrimination. .... N.1.5. (1/1/86), N.1.5.1.,  
T.N.7.2.\*

**Note:** A test for discrimination should be performed when environmental conditions permit and when the test standards available for testing are adequate in amount and are of suitable denominations. Steps a. through d., of the **Procedures for Testing Discrimination at or Near Zero Load and Procedures for Testing Discrimination Near Maximum Capacity** indicated below, specify the total amount and the minimum denominations of the test standards needed to properly perform a discrimination test.

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Test Notes (Cont.):

**Procedures for Testing Discrimination  
at or Near Zero Load for a Scale, where  $d = e$**

The procedures for testing discrimination near zero load on scales equipped with a scale division value ( $d$ ) that is equal to the value of the verification division ( $e$ ), (i.e.,  $d = e$ ) are indicated in step a. through step f. below and illustrated in Figure 1.

- With the scale on zero, place decimal weights on the scale equal to the value of 1  $d$ .
- Zero the scale and place a load equal to the value of 5  $d$  on the platter.
- Remove the decimal weights in 0.1  $d$  increments until the indication flickers between the values representing 4  $d$  and 5  $d$ . If the indication does not flicker but indicates a steady 4  $d$  value, add 0.1  $d$ . If the scale indicates 5  $d$ , it is at the breakpoint in the zone of uncertainty. (remove the 0.1  $d$  if it was added to the 4  $d$  value to verify the breakpoint)
- Add a test load equal to 1.4  $d$  to the scale.
- The indication should read a stable 6  $d$  (i.e., the addition of 1.4  $d$  should change the displayed indication 2  $d$ )
- If the scale passes the discrimination test at a load near zero, a discrimination test should also be performed near the maximum capacity of the scale.

**Example:** Discrimination Test near Zero Load for a Scale, where  $d = e$   
Scale capacity: 610 x 0.01 g

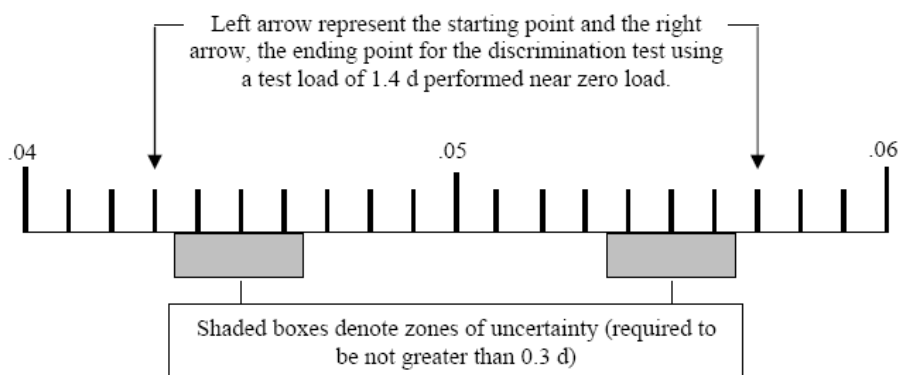


Figure 1





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**Test Notes (Cont.):**

The procedures for testing discrimination near zero load and near maximum scale capacity when the value of the minimum scale division (d) is not equal to the value of the minimum verification scale division (e), are as follows:

- a. Zero the scale with no load on the platter.
- b. Apply a test load equal to 2 e to the platter and observe the displayed indication.
- c. Apply an additional test load of 2 d to the platter and observe the displayed indication.
- d. The addition of 2 d in step c. must increase the displayed indication by 2 d.
- e. For the discrimination test at or near maximum capacity, apply a test load near scale capacity, then remove 2 d and observe the change in the displayed indication.
- f. The displayed indication must change by 2 d when a test load of 2 d is removed.
- g. The results of these tests confirm that a scale is able to detect small changes in weight being added or removed from the platter over the scale's entire weighing range.

**Tests:**

1. Level condition and Zero-load balance (verify before beginning the increasing-load test).
2. Increasing-load test (test loads approximately centered on the platter)..... N.1.1.

For scales marked with an accuracy class, test at several points in each tolerance range including at or near the highest test load that can be applied to the scale without the tolerance increasing to the next tolerance range. For scales not marked with an accuracy class, test at several points to capacity, including test loads at or near one-quarter, one-half, and three-quarters of scale capacity and at full capacity.

3. Shift test (one-third nominal capacity test load<sup>3</sup>)..... N.1.3.7.(a), T.N.4.4.\*

The shift test can be conducted during the increasing load test once one-third capacity test load is achieved.

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<sup>3</sup> NIST Handbook 44 Scales Code paragraph N.1.3.7.(a) defines one-third nominal capacity test load as test weights in amounts of at least 30% of scale capacity, but not to exceed 35% of scale capacity.

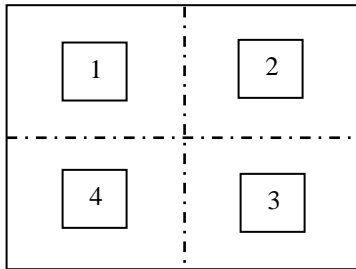
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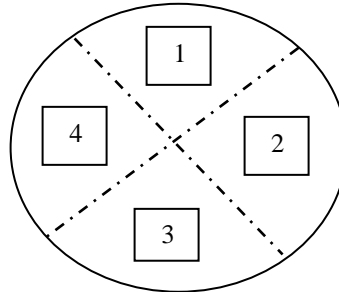
**Tests (Cont.):**

**Shift Test Pattern**  
(One-third capacity test load)

The numbered boxes identify the positions for placing the shift test load.



**Figure 3.** Rectangular Platter Shift Test Pattern.



**Figure 4.** Circular Platter Shift Test Pattern.

- |    |   |   |
|----|---|---|
| 4. | RFI/EMI (if a problem is suspected) Radio Frequency Interference Electromagnetic Interference. .... | G-N.2., G-UR.1.2.,<br>G-UR.3.2., G-UR.4.2.,<br>N.1.6., T.N.9* |
| 5. | Check repeatability of, and agreement between indications throughout the test. ....                 | G.S.5.2.2.(a), G-S.5.4.,<br>T.N.5.                            |
| 6. | Over-capacity test.....   | S.1.7 (a), S.1.7.(b)<br>(1/1/93)                              |
| 7. | Decreasing-load test .....  | N.1.2., N.1.2.1*,<br>N.1.2.2.                                 |

For scales marked with an accuracy class and having a total number of scale divisions (d) or verification scale divisions (e), if “e” has been declared, greater than or equal to 100 000 for Class I scales or 10 000 for Class II scales, test with loads equal or near the highest value of each tolerance band. For example, on a Class II scale, test at loads equal or near 20 000 d and 5000 d if a verification scale division has not been declared and at or near 20 000 e and 5000 e if a verification scale division has been declared. For all other scales, test at one-half maximum test load applied during the increasing-load test.

- |    |  |                   |
|----|--|-------------------|
| 8. | Return to zero – verify the scale returns to a zero indication after the entire test load has been removed ..... | N.1.9., G-UR.4.2. |
|----|--|-------------------|

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**It is recommended that the additional requirements in this outline be followed for a Class I or Class II prescription scale equipped with a legal for trade counting feature. The counting feature is based on commodity weight; therefore, accuracy of the weighing function must be verified before conducting a test of the counting feature.**

<b>Additional Tests for Prescription and Jeweler Scales with a Legal for Trade Counting Feature.</b>	<b>H-44 General Code and Scales Code References</b>
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**Inspection:**

- 1. Marking:
    - minimum individual piece weight and minimum sample piece count ..... S.6.6.
    - special application..... Table S.6.3.a.,
    - operational controls, indications, features ..... Table S.6.3.b. (note 13)  
G-S.6.
  
  - 2. Zero indication of count. .... S.1.1.
- A scale with a legal for trade counting feature shall be capable of indicating zero in the count mode of operation.
- 3. Tare mechanism ..... S.2.3.
    - Value of the tare division ..... S.2.3. (1/1/83)

**An operational counting feature is only legal for prescription filling applications on a compliant Class I or Class II device.**

A prescription scale with a legal for trade counting feature must be marked:

**“Counting Feature for Prescription Filling Only”**

Class I or Class II prescription scales equipped with an operational counting feature that does not comply with all applicable NIST Handbook 44 requirements for the count feature must be marked on both the customer and operator’s side:

**“The Counting Feature is Not Legal for Trade.”**

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Legal for Trade Counting Feature.**

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**Pretest Determinations:**

1. Tolerances for count ..... T.N.3.10.,  
Table T.N.3.10
2. Determine the scale’s maximum counting capacity (i.e., the maximum number of pieces the scale is capable of indicating) by inserting the appropriate corresponding values marked on the device into the following formula:

$$\frac{\text{nominal capacity}}{\text{minimum individual piece weight}}$$

For example: Given a scale marked as follows:

Capacity:	610 x 0.01 g
Minimum individual piece weight:	0.03 g
Minimum sample piece count:	10 pieces

Using the formula, the maximum count value in pieces is calculated as follows:

$$\frac{610 \text{ g}}{0.03 \text{ g/piece}} = 20\,333.3333 \text{ pieces}$$

Then truncate the result to the nearest whole number of 20 333 pieces.

3. Select at least three count values to verify the count accuracy of a legal for trade counting feature similar to that illustrated below:
  - A count value between 90 and 100 pieces inclusive;
  - A count value between 180 and 200 pieces inclusive; and
  - A count value equal or near the scale’s maximum counting capacity as determined in 2. above.

**Note:** When choosing the count value near a scale’s maximum counting capacity, select a whole number that is slightly lower than the maximum possible count. For example, one possible choice at the maximum end of the counting capacity for the scale described above is 20 300. The resulting value of 20 300 is slightly less than the actual truncated value of 20 333 and is less likely to introduce rounding errors when converted to a corresponding weight value. The result is also more practical when selecting denominations of test standards for use in testing the count accuracy than if 20 333 were used.<sup>4</sup>

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<sup>4</sup> When the 20 300 piece count is converted to weight by multiplying it by the scale’s marked “minimum individual piece weight” of 0.03 g, the resulting weight value equals 609 g. If 20 333 is multiplied by this same factor, the resulting weight value equals 609.99 g. It would be considered acceptable to perform the test at 20 333 pieces using a test load of 609.99 g, providing test standards were available in small enough denominations for converting this count value to its exact equivalent in weight; however, it is easier and more practical to use test standards in denominations of whole grams.

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**Pretest Determinations (Cont.):**

4. Convert the selected count values to weight by multiplying each count value by the minimum individual piece weight<sup>5</sup> marked on the device.

Given the same device for this example, convert selected count values of 100, 190, and 20 300 pieces to weight using the formula: piece count x minimum individual piece weight = amount of test weight to be applied.

$$\begin{aligned} 100 \times 0.03 \text{ g} &= 3 \text{ g} \\ 190 \times 0.03 \text{ g} &= 5.7 \text{ g} \\ 20\,300 \times 0.03 \text{ g} &= 609 \text{ g} \end{aligned}$$

**Test Notes:**

1. Accuracy of test standards ..... Fundamental Considerations

The combined error and uncertainty in any test standard used for testing must be less than one-third the applicable tolerance. Refer to the list of acceptable standards for use in testing precision scales on page 5E-2 of this EPO.

2. Special handling precautions for test standards:

Special care is required when handling mass standards to maintain the accuracy level needed to properly test most prescription and jewelers scales and scales marked Class I or Class II. Never touch standards with bare hands or otherwise contaminate standards by placing them on dirty surfaces. Always wear suitable gloves or use tweezers when handling precision standards to prevent substances (oils, lint, moisture, etc.) from adhering to their metal surfaces. Special filter papers are available and should be used to prevent contact with dirty surfaces. Proper cleaning methods are to be used. Exercise care in storing and transporting standards to avoid physical damage.

3. If scale is equipped with a ticket printer, print a ticket at several test loads. Verify that recorded values agree with corresponding indicated values and that all values are appropriately and correctly identified on the ticket. .... G-S.5.1., G-S.5.2. (except G-S.5.2.1.), G-S.5.3., G-S.5.3.1., G-S.5.4., G-S.5.5., G-S.5.6.

<sup>5</sup> Although the weight of an individual piece in any given prescription to be counted will often be greater than a scale's marked minimum individual piece weight, the sample used for the purpose of verifying count accuracy is established from minimum values (i.e., minimum individual piece weight and minimum sample piece count) marked on the device.

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Part 1 - Electronic

Additional Tests for Prescription and Jeweler Scales with a  
Legal for Trade Counting Feature.

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**Tests:**

Counting feature test ..... N.1.10.

The counting feature test requires the scale meet all three test criteria listed in 1. through 3. below. It is first necessary to determine the “*minimum sample size in weight*” using the formula:

$$\text{Minimum sample size in weight} = \text{minimum individual piece weight} \times \text{minimum sample piece count}$$

The values for “*minimum individual piece weight*” and “*minimum sample piece count*,” must be appropriately marked and identified on a prescription scale equipped with a legal for trade counting feature.

1. Minimum sample piece count..... S.1.2.3.(b), S.2.5.3.,  
N.1.10.

Verify that the scale’s counting feature will not accept a sample containing less than the “*minimum sample piece count*” by completing the following steps:

- a. Verify that the scale is in the counting mode of operation.
- b. With the scale operating in the counting mode, apply a sufficient load to the platter to cause the displayed indication to equal the “*minimum sample size in weight*.”
- c. Attempt to input a sample piece count less than the “*minimum sample piece count*” marked on the device.
- d. The counting feature must reject the entry.

2. Minimum individual piece weight of the sample ..... S.1.2.3.(a), S.2.5.3.,  
N.1.10.

Verify that a scale’s counting feature will not accept the entry of an individual piece weight that is less than the “*minimum individual piece weight*” by completing the following steps:

- a. Verify that the scale is in the counting mode of operation.
- b. With the scale operating in the counting mode, apply a sufficient load to cause the displayed indication to be less than the “*minimum sample size in weight*.”
- c. Attempt to enter the “*minimum sample piece count*” marked on the device.
- d. The counting feature must reject the entry.

3. Count accuracy verification..... N.1.10, T.N.3.10.

Complete the following steps in order to verify the accuracy of a legal for trade counting feature:

- a. Place the scale in the counting mode of operation.
- b. Zero the scale with no load on the platter.

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**Additional Tests for Prescription and Jeweler Scales with a  
Legal for Trade Counting Feature.**

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**Tests (Cont.):**

- c. Apply a load sufficient in amount to cause the displayed weight indication to equal the value of the “minimum sample size in weight” as marked on the device.
  - d. Enter the value of the “minimum sample piece count” as marked on the device using the keyboard or other input means.
  - e. Remove the sample load that was applied in step c.; scale must indicate zero pieces.
  - f. Apply test standards equivalent in value to each of the test points selected, including the test point near highest possible count.
  - g. Observe the displayed count indication after each test point load is applied and verify that no count errors exceed the applicable tolerances indicated in Table T.N.3.10.
  - h. Remove the entire test load; scale must indicate zero pieces.
  - i. Return the scale to the weigh mode, and verify a zero balance indication.
4. Display of total quantity ..... S.2.5.3.
5. Minimum count ..... UR.3.11
6. Correct stored piece weight ..... UR.3.12.



# 2015 NIST EPO No. 5

## Examination Procedure Outline for

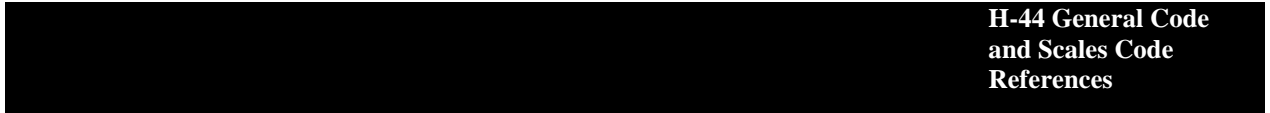
### Jeweler and Prescription Scales Part 2 – Mechanical Equal Arm

It is recommended that this outline be followed for mechanical equal arm scales and balances used in prescription and jeweler applications. Requirements that apply only to scales marked with an accuracy class designation are indicated with an asterisk (\*). Nonretroactive requirements are followed by the applicable date in parentheses.

Prescription scales are often located and used in areas where controlled substances are stored. Access to these areas, except by qualified personnel, is generally prohibited. Do not enter any restricted areas unless authorized to do so by personnel having proper authority to grant such access.

#### Safety Notes – See EPO 5 Part 1

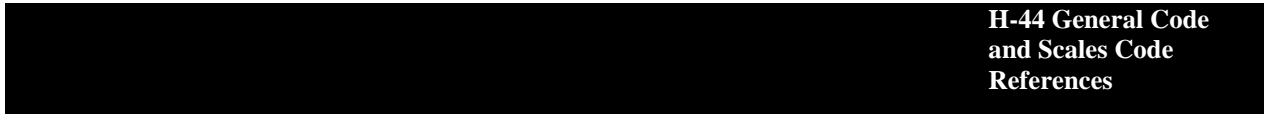
#### Equipment List – See EPO 5 Part 1



#### Inspection:

1. Accessibility for inspection, testing, and sealing ..... G-UR.2.3
2. Zero-load balance as found ..... UR.4.1.
  - Zero indication ..... S.1.1.
  - Zero-load adjustment ..... S.2.1.1.
  - Manual zero-setting mechanism (not applicable to Class I and Class II scales equipped with a balance ball) ..... S.2.1.2.
3. Marking:
  - Identification (Refer to list of required markings provided in EPO Part 1.) ..... G-S.1., S.6., S.6.3., Table S.6.3.a, Table S.6.3.b.
  - Devices or main elements remanufactured after January 1, 2002 ..... G-S.1.2
  - Interchange or reversal of parts. .... G-S.4.
  - Operational controls, indications, and features. .... G-S.6. (1/1/77)
  - Lettering ..... G-S.7.
  - Visibility of identification ..... G-UR.2.1.1.

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Part 2 – Mechanical Equal Arm**



**Inspection (Cont.):**

Marking (continued):

- 4. General Considerations:
  - Selection of equipment..... G-UR.1.1., G-UR.1.2., UR.1.
  - Typical class for weighing applications. .... UR.1.1., Table 7a\*
  - Accuracy class designation and parameters. .... S.5.1.\* (1/1/86), S.5.2.\* (1/1/86)
  - Recommended minimum load..... U.R.3.1.\*, Table 8\*
  - Maximum load. .... U.R.3.2.
  - Permanence. .... G-S.3.
  
- 5. Installation..... G-UR.2.1.
  - Position of equipment (not applicable to prescription scales) ..... G-UR.3.3.
  - Supports..... UR.2.1.
  - Level indicating means and condition ..... S.2.4. (1/1/86)
  - Level condition..... UR.4.2.

**SAFTEY REMINDER**

– **Check to ensure that scale supports provide a firm foundation for the scale under all loading conditions, including loading of the platform to device capacity!**

- 6. Design of indicating and recording elements:
  - Appropriateness..... G-S.5.1., G-S.5.2., (except G-S.5.2.2.)
  - Value of the scale division ..... S.1.2. \* (1/1/86), G-S.5.3., G-S.5.3.1.
  - Indicated and recorded representation of units (Appropriate abbreviations):
    - Equipment manufactured on or after January 1, 2008..... G-S.5.6.1. (a)
    - Equipment manufactured prior to January 1, 2008 ..... G-S.5.6.1. (b)
  - Value of the verification scale interval ..... S.1.2.2.1., S.1.2.2.2.
  - Value of the tare division ..... S.2.3. (1/1/83)
  - Tare mechanism ..... S.2.3.
  - Graduations and indications ..... S.1.3., S.1.4., G-S.5.7.
  - Weighbeams and poises ..... S.1.5., S.1.6.
  - Adjustable components ..... S.1.10.
  - Balance indicator..... S.2.2., S.2.2.1., S.2.2.2. (1/1/89)
  - Damping and arresting mechanism ..... S.2.5., S.2.5.2.
  
- 7. Design of the weighing element. .... S.4.
  
- 8. Security and sealing:
  - Adjustable components ..... S.1.10.
  - Adjustment mechanisms designed to be sealed..... G-UR.4.5.

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**Inspection (Cont.):**

- 9. Maintenance, use, and environmental factors:
  - Facilitation of fraud ..... G-S.2.
  - Protection from environmental factors ..... UR.2.3.
  - Method of operation ..... G-UR.3.1.
  - (scales having special designs)..... UR.3.5.
  - Maintenance of equipment ..... G-UR.4.1.
  - Abnormal performance..... G-UR.4.2.
  - Use of adjustments ..... G-UR.4.3.
  - Scale modification..... UR.4.3.
  
- 10. Assistance ..... G-UR.4.4.

**Pretest Determinations:**

- 1. Tolerances:
  - Acceptance/maintenance ..... G-T.1., G-T.2.
  - Application ..... G-T.3.
  - Intermediate values ..... G-T.4.
  - Tolerance values:
    - Determine the number of scale divisions (n) using the following formula:

$$n = \frac{\text{Scale capacity}}{\text{Value of the verification scale division (e)}}$$

Scales that are marked with an accuracy class designation

- Principles..... T.N.1.\*
- Tolerance application ..... T.N.2.\*, T.N.2.3.\*
- Maintenance tolerance values..... T.N.3.1.\* Table 6
- Acceptance tolerance values..... T.N.3.2.\*
- Ratio tests ..... T.N.2.5.
- Single indicating/recording element..... T.N.4.2.
- Repeatability of indications ..... G-S.5.4.
- Time dependence..... T.N.4.5.\*, T.N.4.5.1.\*

Scales that are not marked with an accuracy class designation

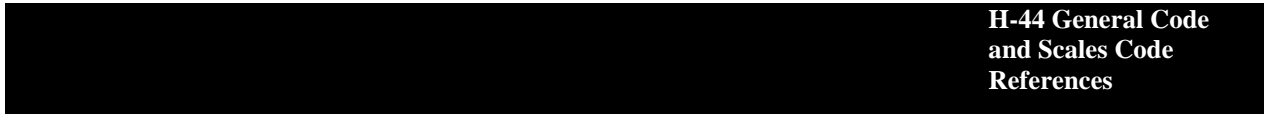
- Tolerance application ..... T.1.1., Table T.1.1.
- Ratio tests ..... T.N.2.5.
- Single indicating/recording element..... T.N.4.2.
- Repeatability of indications ..... G-S.5.4.

**Note:** Refer to Table T.1.1. Maintenance and acceptance tolerances are the same for unmarked prescription and jewelers scales.

2. Sensitivity Requirement (SR)

- Marked scales:
  - Application ..... T.N.6.\*

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Part 2 – Mechanical Equal Arm**



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**Pretest Determinations (Cont.):**

Test load .....	T.N.6.1.(b)*
Minimum change.....	T.N.6.2.*
Unmarked scales:	
Application .....	T.2.1.
Test load (prescription scales).....	T.2.3.
Test load (jewelers scales).....	T.2.4.
Minimum change.....	T.3.
3. Minimum test weights and test loads.....	N.3., Table 4

**Test Notes:**

1. Check repeatability of indications at a minimum of two different test loads during the test. .... G-S.5.4.,
2. Verify that scale returns to zero-load balance each time the entire test load is removed..... N.1.9., G-UR.4.2.
3. Verify scale accuracy.

For scales not marked with an accuracy class designation two different methods may be used to verify compliance with accuracy requirements, i.e., the tolerance testing method or the error-weight testing method. Each test method procedure starts with the scale in a zero-load balance condition.

Scales marked with an accuracy class designation should always be tested using the error-weight method since compliance with T.N.4.4. (shift test agreement) can only be determined if the precise amount of error in each shift test result is known.

**Tolerance Testing:** Tolerance testing determines whether or not a scale is performing to within applicable tolerances. This method of testing does not reveal the precise amount of error in a scale. To use the tolerance test method, standards equal to the value of tolerance are added at each test load to the pan of the lighter side and the balance indicator is observed. The addition of standards equal to the value of applicable tolerance must change the position of rest of the indicator back to the initial zero-load balance indication or beyond for a scale to perform within acceptable limits.

**Error-Weight Testing:** Error-weight testing determines the precise amount of error in a scale. To use the error-weight method, precision field standards (i.e., error weights) in minimum denominations equal to 0.1 d are added at each test load to the pan of the lighter side in the amount necessary to cause the position of rest of the indicator to return back to the initial zero-load balance indication. The weight values of the precision field standards (i.e., error weights) are then added together and summed, the total result being equal to the amount of error in the scale at that particular test load.

**Note:** In cases where precision field standards in denominations equal to 0.1 d are not readily available, the error-weight method of testing should not be performed.

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**Part 2 – Mechanical Equal Arm**

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**Test:**

*Commercial weights, (i.e., weights used in connection with commercial weighing devices) are not to be used in any of the performance tests described herein. Rather, performance testing of prescription and jewelers scales requires the sole use of suitable precision field standards. Guidelines for determining the necessary accuracy level of the precision field standards needed to properly test prescription and jewelers scales are included in the “Equipment List” section of this EPO.*

1. Sensitivity test at zero load and maximum test load. .... N.1.4
2. Ratio test ..... N.1.7.

*Ratio tolerances are to be applied whenever the multiple of the lever system is verified using suitable precision field standards of equal value applied to opposite pans.*

3. Increasing-load test ..... N.1.1.

For scales marked with an accuracy class, test at several points in each tolerance range including at or near the highest test load that can be applied to the scale without the tolerance increasing to the next tolerance range. For scales not marked with an accuracy class, test at several points to capacity, including test loads at or near one-quarter, one-half, and three-quarters scale capacity and at full capacity.

Testing weighbeams and dials: Verify the accuracy of each weighbeam or dial at a minimum of two points, (i.e., at or near half and full weighbeam or dial capacity). It is recommended that additional verifications be performed at test loads where these elements are regularly used.

4. Shift test (at one-half capacity test load) ..... N.1.3.2.

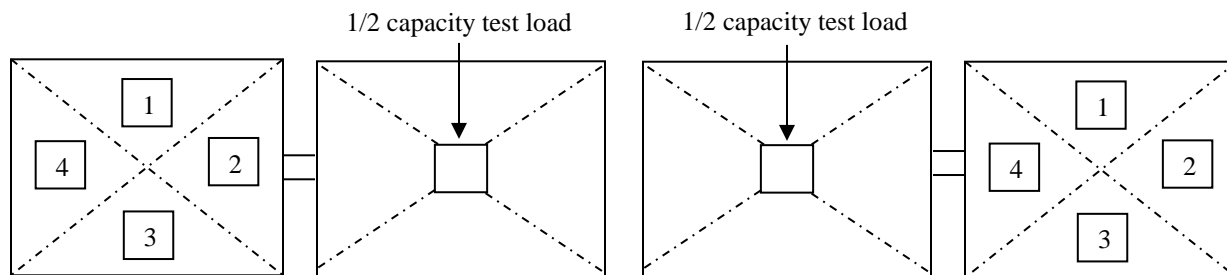
A shift test is to be conducted separately on each pan of an equal arm balance. The test is conducted with mass standards equal to one-half capacity centered on one pan and standards equal to one-half capacity centered successively at four points equidistant between the center and the front, left, back, and right edges of the opposite pan. Once the results of all four positions of the first pan have been determined, remove all test weight, and verify return to zero-load balance. Then conduct a shift test on the pan opposite the first pan, using these same loading procedures, except the test load is applied to the opposite pan.

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**Equal-Arm Scales  
Shift Test Patterns - Rectangular Platter**  
(one-half capacity test load)

The numbered boxes identify the various positions for placing the shift test load.

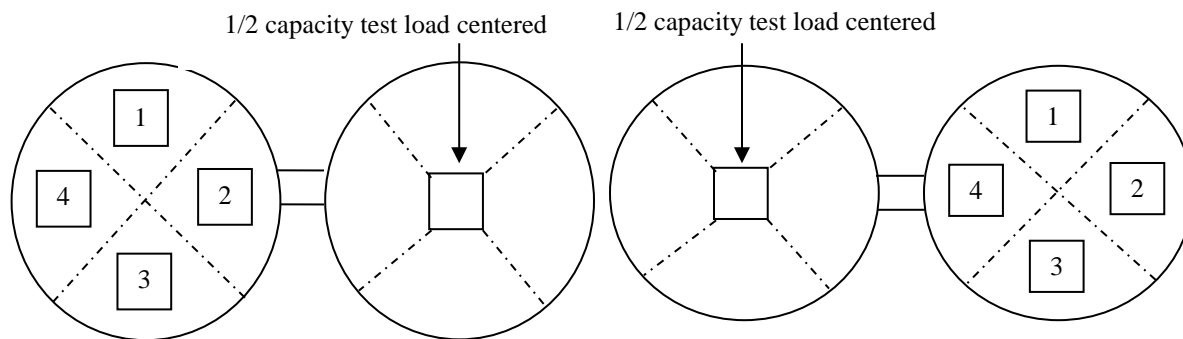


**Example: Shift Test Positions - Left Pan**

**Example: Shift Test Positions - Right Pan**

**Equal-Arm Scales  
Shift Test Patterns – Circular Platter**  
(one-half capacity test load)

The numbered boxes identify the various positions for placing the shift test load.



**Example: Shift Test Positions - Left Pan**

**Example: Shift Test Positions - Right Pan**

5. Return to zero-load balance (verify each time test load is removed) ..... N.1.9.
6. Commercial Weights..... H-44 Section 2.23.  
(Weights Code)

**Note:** Commercial weights should be tested on a precision balance using adequate standard weights, the errors of which, when used without correction, do not exceed one third of the smallest tolerance to be applied to the device under test. It may not be appropriate to apply the requirements in Section 2.23 to verify the accuracy of commercial weights used in connection with prescription and jewelers' scales in every field environment. In some instances, accuracy can only be verified in a laboratory that is formally accredited or recognized (i.e., a laboratory having the necessary qualifications to perform the necessary calibrations given the accuracy level of the standards being tested, e.g., OIML E-2, ASTM 1, etc.). In addition, it is recommended that commercial weights be calibrated (i.e., their accuracy verified) at a frequency interval necessary to ensure continued compliance with applicable tolerances and that the calibration frequency interval be based upon the collection of actual performance data.