Examination Procedure Outlines For Commercial Weighing and Measuring Devices
A Manual for Weights and Measures Officials

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U.S. DEPARTMENT OF COMMERCE
Frederick B. Dent, Secretary
NATIONAL BUREAU OF STANDARDS
Richard W. Roberts, Director

Issued June 1973

Price: $1.10. Stock Number 0303-01162
Library of Congress Catalog Card Number:

National Bureau of Standards Handbook 112
Nat. Bur. Stand. (U.S.), Handb. 112, 89 pages (June 1973)
CODEN: NBSHAP
Foreword

This publication is one of a number of Handbooks of the National Bureau of Standards designed to present in compact form comprehensive technical guides for state and local weights and measures officials.


Authority for such activity on the part of the Bureau is found in basic legislation (64 Stat. 371), wherein the Bureau is authorized to undertake, among others, the following functions: “Cooperation with the states in securing uniformity in weights and measures laws and methods of inspection,” and “The compilation and publication of general scientific and technical data resulting from the performance of the functions specified herein or from other sources when such data are of importance to scientific or manufacturing interests or to the general public, and are not available elsewhere.”

This Handbook has been published in looseleaf form for insertion with Handbook 44 to further its usefulness to the official.

Although this Handbook is prepared primarily for use by weights and measures officials of the states, counties, and cities, it is believed that the information presented will be useful to manufacturers and commercial and industrial establishments interested in the examination of commercial weighing and measuring devices.
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INTRODUCTION TO EXAMINATION PROCEDURE OUTLINES

The Examination Procedure Outlines in this series were developed by the Office of Weights and Measures of the National Bureau of Standards as an aid to the weights and measures official in conducting examinations of commercial weighing and measuring devices. The series includes an outline for each of the most frequently encountered scales and measuring devices and for weights. Each outline sets forth, step by step, what should be considered a minimum examination preceding official action.

The official field examination must necessarily include (1) The Inspection to determine compliance with specifications and other requirements, (2) The Pre-Test determinations to insure proper tolerance application and other appropriate test factors, and (3) The Test to determine compliance with performance requirements. The points included under the inspection are items of design, installation, and operation that may be subject to change subsequent to installation. Many specifications and other requirements must be considered during the first official examination of a particular device and may be appropriate also during any later examination of the device. The test should be so conducted as to develop, as nearly as practicable, the performance characteristics of the particular device under examination as it may be anticipated that the device will be used commercially. The outlined test for a device of a given class should, assuming sufficient and accurate standards and careful test administration, provide adequate information as to the acceptability or nonacceptability of that device for commercial service.

When the official encounters for the first time a device in commercial service, it will be necessary to go beyond the procedure as outlined. He should refer to all of the technical requirements of the General Code and the appropriate specific code. The test should extend further than a study under ideal conditions. It should be carried to the point of establishing that the device will perform, in all probability, adequately under average conditions of use. It may also be necessary for the official to go beyond the technical requirements of the General Code and the appropriate specific code and consider the overall suitability (G-UR.1.1.) of a particular device in the service and in the environment in which the device is or will be commercially used.

All code citations refer to National Bureau of Standards Handbook 44, Fourth Edition, Specifications, Tolerances, and Other Technical Requirements for Commercial Weighing and Measuring Devices. A citation that begins with the letter “G” refers to the General Code, others to the appropriate specific code. Replacement Sheets for Handbook 44 are issued each year by the National Bureau of Standards to incorporate changes made by the National Conference on Weights and Measures. The H-44 references in the Examination Procedure Outlines should be checked against these Replacement Sheets annually, and such changes or corrections as are necessary should be made to keep the outlines up to date.
A thorough knowledge of the fundamentals of the design and operation of a weighing or measuring device is a prerequisite to a proper examination of the device.

Although the Examination Procedure Outlines were designed specifically for weights and measures officials in field examinations of commercial devices, they can be used as a guide when courtesy examinations are made, upon request, of noncommercial equipment. They should also be helpful to equipment manufacturers and to individuals involved in the installation or service of commercial weighing and measuring devices.

THE EXAMINATION OF A DEVICE MUST BE A PRECISE OPERATION BASED UPON PROVEN STANDARDS AND SO CONDUCTED AS TO DUPLICATE, AS NEARLY AS PRACTICABLE, SERVICE CONDITIONS OF OPERATION.
EPO No. 1
Examination Procedure Outline for
COMPUTING SCALES

It is recommended that this outline be followed for automatic-indicating computing scales of cylinder and fan types and for packaging scales.

INSPECTION:

1. Zero-load balance as found. (Do not adjust.)
   S.1.1., UR.4.1., S.2.1.

2. Support for scale
   G-UR.2.1., UR.2.1.

3. Level condition
   S.2.3., UR.4.2.
   If the device is out of level and/or not in a zero-balance condition (except prepackaging scales), the user should be made aware of paragraphs UR.4.1. and UR.4.2. and a warning issued if necessary. Before proceeding with the test, these conditions must be corrected.

4. Indicating and recording elements.
   Value of minimum graduated interval
   G-UR.1.1., UR.1.1.1.
   Money-value graduations
   S.1.5.1.
   Appropriateness
   G-S.5., S.1.6.1., S.1.6.2.
   Customer readability
   S.1.5.3., G-UR.3.2.
   Parallax
   S.1.3.4., S.1.3.5.
   Damping means
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5. Weighing elements
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   S.3.2., UR.3.3.
   Scoop counterbalance
   S.3.3.

6. Maintenance, use, and environmental factors (cleanliness, obstructions, modifications, etc.)
   G-S.2., G-UR.3., G-UR.4., UR.4.3.

7. Marking requirements
   G-S.1., G-S.6., S.6., UR.3.1.
PRE-TEST DETERMINATIONS:

1. Tolerances.
   Applicable requirements — G-T.
   Application — T.1., T.1.1., T.1.2., T.1.3.
   Minimum values — T.2.1.
   Basic values — T.3.1.

TEST:

Check repeatability of indications throughout test. Recheck zero-load balance each time test load is removed — G-S.5.4.

During an official test, a scale should not shift its zero-load indication by an amount greater than the minimum tolerance applicable.

If scale is equipped with ticket printer, print ticket at each test load and check weight and money values — G-S.5.5., G-S.5.6., S.1.5.2., S.1.6., T.1.2., T.1.3.

1. Increasing-load test—at 1, 3, 7, 15 ounces, or .05, .15, .45, .95 pounds centered; then at each pound to one-quarter capacity — N.1.1., T.1.5.

2. Shift test—one-half capacity load — N.1.3.1., T.1.4.

3. Continue increasing-load test—at three-quarters and capacity.


5. Recheck zero-load balance.

6. Money-value test—check chart or drum at several points — G-S.5.5., S.1.5.2.
EPO No. 2
Examination Procedure Outline for
HANGING SCALES

It is recommended that this outline be followed for dial and straight-face scales.

INSPECTION:

1. Zero-load balance as found. (Do not adjust.) If the device is not in a zero-balance condition, the user should be made aware of paragraph UR.4.1. and a warning issued if necessary. Before proceeding with the test, this condition must be corrected.

2. Suspension of scale

3. Indicating elements.
   - Value of minimum graduated interval
   - Appropriateness
   - Customer readability
   - Parallax
   - Damping means

4. Drainage—if wet commodities are weighed

5. Maintenance, use, and environmental factors (cleanliness, obstructions, modifications, etc.)

6. Marking requirements

PRE-TEST DETERMINATIONS:

1. Tolerances.
   - Applicable requirements
   - Application
   - Minimum values
   - Basic values

TEST:

Check repeatability of indications throughout test. Recheck zero-load balance each time test load is removed

H-44 General and Scale Code References

- S.1.1., UR.4.1., S.2.1.
- G-UR.2.1., UR.2.2.
- G-UR.1.1., UR.1.1.1.
- G-S.5.
- S.1.5.3., G-UR.3.2.
- S.1.3.4., S.1.3.5.
- S.2.4.
- S.3.2., UR.3.3.
- G-S.1., G-S.6., S.6.
- G-S.5.4.
During an official test, a scale should not shift its zero-load indications by an amount greater than the minimum tolerance applicable.

1. Increasing-load test ........ N.1.1., T.1.5.
   (a) 30 pounds capacity or less, test at 1, 3, 7, 15 ounces, centered; then each pound to one-quarter dial capacity, then half, three-quarters, and full dial capacity.
   (b) More than 30 pounds capacity, at least at each quarter of dial capacity and at each quarter of scale capacity.

2. Decreasing-load test — at one-half capacity ........ N.1.2., T.1.6.

EPO No. 3
Examination Procedure Outline for
EQUAL-ARM AUTOMATIC-INDICATING SCALES

It is recommended that this outline be followed for equal-arm automatic-indicating scales whether or not equipped with weighbeams.

INSPECTION:

1. Zero-load balance as found. (Do not adjust.) 
   S.1.1., UR.4.1., S.2.1.
2. Support for scale 
   G-UR.2.1., UR.2.1.
3. Level condition 
   S.2.3., UR.4.2.
   If the device is out of level and/or not in a zero-balance condition (except prepackaging or check-weighing scales), the user should be made aware of paragraphs UR.4.1. and UR.4.2. and a warning issued if necessary. Before proceeding with the test, these conditions must be corrected.
4. Indicating elements.
   Value of minimum graduated interval 
   G-UR.1.1., UR.1.1.1.
   Appropriateness 
   G-S.5.
   Customer readability—if applicable 
   S.1.5.3., G-UR.3.2.
   Parallax 
   S.1.3.5.
   Weighbeam 
   S.5.1.
   Poises 
   S.5.2.
   Tare mechanism 
   S.2.1.3.
   Damping means 
   S.2.4., G-UR.4.1.
5. Weighing elements 
   S.4.
   Drainage 
   S.3.2., UR.3.3.
   Scoop counterbalance 
   S.3.3.
6. Maintenance, use, and environmental factors (cleanliness, obstructions, modifications, etc.) 
   G-S.2., G-UR.3., G-UR.4., UR.4.3.
7. Marking requirements 
   G-S.1., G-S.6., S.6., UR.3.1.
PRE-TEST DETERMINATIONS:

1. Tolerances.
   Applicable requirements __  G-T.
   Application ___________ T.1., T.1.1., T.1.2.,
   T.1.3.
   Minimum values _________ T.2.1.
   Basic values ____________ T.3.1.

TEST:

Check repeatability of indications throughout test. Recheck zero-load balance each time test load is removed ____________ G-S.5.4.

During an official test, a scale should not shift its zero-load indication by an amount greater than the minimum tolerance applicable.

1. Increasing-load test ______ N.1.1., T.1.5.
   (a) Reading face at two points on each side of zero.
   (b) Weighbeam at two points on each side of zero or at one-half and full capacity.
   (c) Each pan at one-half and full capacity of scale (ratio test with standard weights) ___ T.1.7.

2. Shift test—one-half capacity and shift on each pan (ratio test with standard weights) ____________ N.1.3.3., T.1.4., T.1.7.

3. Decreasing-load test — at half capacity ____________ N.1.2., T.1.6.


5. Test equal-arm weights.
   If a balance is not available and the scale under test has proven suitable, these weights should be tested by substitution as explained in the EPO for weights—Equal-Arm.
Examination Procedure Outline for

EQUAL-ARM NONAUTOMATIC-INDICATING SCALES

It is recommended that this outline be followed for equal-arm nonautomatic-indicating scales, including those equipped with balance indicator.

INSPECTION:

1. Zero-load balance as found.
   (Do not adjust.)
2. Support for scale
3. Level condition
   If the device is out of level and/or not in a zero-balance condition (except prepackaging or check-weighing scales), the user should be made aware of paragraphs UR.4.1. and UR.4.2. and a warning issued if necessary. Before proceeding with the test, these conditions must be corrected.
4. Indicating elements.
   Value of minimum graduated interval
   Appropriateness
   Customer readability—if applicable
   Weighbeam
   Poises
   Tare mechanism
   Damping means
5. Weighing elements
   Pan travel
   Drainage
   Scoop counterbalance
6. Maintenance, use, and environmental factors (cleanliness, obstructions, modifications, etc.)
7. Marking requirements

H-44 General and Scale Code References

S.1.1., UR.4.1., S.2.1.
G-UR.2.1., UR.2.1.
S.2.3., UR.4.2.
G-UR.1.1., UR.1.1.1.
G-S.5.
S.1.5.3., G-UR.3.2.
S.5.1.
S.5.2.
S.2.1.3.
S.2.4., G-UR.4.1.
S.4.
S.3.1.
S.3.2., UR.3.3.
S.3.3.
G-S.2., G-UR.3., G-UR.4., UR.4.3.
G-S.1., G-S.6., S.6., UR.3.1.
PRE-TEST DETERMINATIONS:

1. Tolerances.
   - Applicable requirements __ G-T.
   - Application ___________ T.1., T.1.1, T.1.2, T.1.3.
   - Minimum values _________ T.2.1.
   - Basic values ____________ T.3.1.

TEST:

Error weights—balance small weights on one pan, the smallest weight being equal to the minimum tolerance value and the total value of the weights being equal to the tolerance value at maximum test load. Scales not equipped with full capacity beams should be ratio tested using standard weights on counter-poise hanger ________ N.1.5, T.1.7.

Check repeatability of indications throughout test. Recheck zero-load balance each time test load is removed ____________ G-S.5.4.

During an official test, a scale should not shift its zero-load indication by an amount greater than the minimum tolerance applicable.

1. SR at zero load ____________ SR.1, SR.2, N.1.4, (b), (d), (e).
2. Increasing-load test _________ N.1.1, T.1.5.
   - (a) Weighbeam at two points on each side of zero or at one-half and full capacity.
   - (b) Each pan at one-half and full capacity of scale (ratio test with standard weights) ___ T.1.7.
3. Shift test—one-half capacity and shift on each pan (ratio test with standard weights) ____________ N.1.3.3, T.1.4.
4. SR at capacity load _______ T.1.7.,
   SR.1., SR.2.,
5. Recheck zero-load balance. N.1.4.(b), (d), (e).
6. Test equal-arm weights. If a balance is not available and the scale under test has proven suitable, these weights should be tested by substitution as explained in the EPO for Weights—Alternate Procedure.
Examination Procedure Outline for

PRESCRIPTION, JEWELERS, CREAM-TEST, MOISTURE-TEST, AND GRAIN MOISTURE-TEST SCALES

It is recommended that this outline be followed when the scales named are of conventional design.

INSPECTION:

1. Zero-load balance as found. (Do not adjust.) ___________ S.1.1., UR.4.1.
2. Support for scale ___________ G-UR.2.1., UR.2.1.
3. Level condition ___________
   If the device is out of level and/or not in a zero-balance condition, the user should be made aware of paragraphs UR.4.1. and UR.4.2. and a warning issued if necessary. Before proceeding with the test, these conditions must be corrected.
4. Indicating and recording elements.
   Value of minimum graduated interval ___________ G-UR.1.1.
   Balance indicator ___________ S.2.5.1.
   Arresting or damping means ___________ S.2.4., S.2.6.1.
   Weighbeam ___________ S.5.1.
   Poises ___________ S.5.2.
5. Maintenance, use, and environmental factors (cleanliness, obstructions, modifications, etc.) ___________ G-S.2., G-UR.3., G-UR.4., UR.4.3.

H-44 General and Scale Code References
PRE-TEST DETERMINATIONS:

1. Tolerances.
   Applicable requirements — G-T.
   Application — T.1., T.1.1., T.1.2., T.1.3.
   Minimum values — T.2.2., T.2.3., T.2.4., T.2.5.
   Basic values — T.3.

TEST:

Check repeatability of indications throughout test. Recheck zero-load balance each time test load is removed — G-S.5.4.

During an official test, a scale should not shift its zero-load indication by an amount greater than the minimum tolerance applicable.

On a cream-test scale, balance on each pan 2 ounces for each bottle the pan is designed to accommodate.

1. SR at zero load — N.1.4., SR.1., SR.2., SR.3., SR.4., SR.5.
2. Shift test — N.1.3.1., N.1.3.2., N.1.3.3., T.1.4.
   Shift on each pan, using half capacity load for prescription, jewelers, and grain moisture-test scales, and 18-gram load for a cream-test or moisture-test scale.
3. Ratio test (equality of arms) at half and full capacity — T.1.7., T.3.1., T.3.2., T.3.3., T.3.4., N.1.5.
5. Weighbeam test—at half and full capacity on each bar — N.1.1., T.1.5.
7. Test equal-arm weights. See EPO for Weights.
NOTE: Weights of 2 grams and larger may be tested on the scale under test, providing the scale has met all of the requirements. Weights of less than 2 grams must be tested with standard weights better than NBS Class F and on a more appropriate balance.
Examination Procedure Outline for

ANALYTICAL BALANCES—EQUAL ARM

It is recommended that this outline be followed when making courtesy examinations of balances and for those balances used commercially.

Although there are few specific requirements in Handbook 44 relating to balances, the same general consideration is given these devices as any others in commercial use. It is recommended that the official making the examination have a thorough working knowledge of the design and method of operation of balances.

INSPECTION: 


2. Level condition


4. Environmental factors—
cleanliness, etc. ___________ G-UR.4.1., G-S.2.

PRE-TEST DETERMINATIONS:

1. Tolerances—Applicable requirements.
   For balances used commercially for weighing commodities such as precious metals, apply the tolerance set forth in Handbook 44 as follows:
   T.3.3.—Basic tolerance values for jewelers scales.
   T.2.3.—Minimum tolerance values for jewelers scales.
   SR.3.—Sensitivity requirements for jewelers scales.

When conducting courtesy examinations of devices not used commercially, the test will determine compliance with the performance capabilities as set forth by the manufacturer of the balance. In the absence of such information, the test will determine the performance capabilities of the device.
TEST:

1. Test scale divisions for linearity.
   1.1. Release arrestments and balance instrument so that the indicator coincides with the center division on the scale with no load on the pans.
   1.2. Without arresting, add small weights necessary to change equilibrium five divisions and record weight value. To determine sensitivity (weight necessary to change equilibrium one division from rest point), divide the value obtained by 5.
   1.3. Add additional small weights necessary to change equilibrium ten divisions. If the reading scale is linear, the weights added should equal twice the weights added in step 2.

NOTE: If the device is not equipped with ten divisions on both sides of midpoint, these tests can be conducted by using first one-half the number of divisions in a single direction and then all the divisions, and the sensitivity would be determined by dividing by the appropriate value.

Arrest the instrument—remove weights.

2. Test arm length at half capacity. Use weights on both sides of balance that are exactly equal.
   2.1. Reestablish zero-load balance to midpoint of scale divisions.
   2.2. Load each pan with test weights equal to one-half the capacity of the balance.
   2.3. Add small weights necessary to establish equilibrium to determine error. Information obtained in step 1.2. may be used to determine weight needed to achieve midpoint balance.
   2.4. Repeat scale division linearity test as described in step 1.

Arrest the instrument—remove weights.

3. Test arm length at full capacity.
   3.1. Reestablish zero-load balance to midpoint of scale divisions.
   3.2. Load each pan with test weights equal to full capacity of the balance.
   3.3. Add small weights necessary to establish equilibrium to determine error.
   3.4. Repeat scale division linearity test as described in step 1.

Arrest the instrument—remove weights.

5. Test all riders, chains, or other beams or poises for accuracy.

6. Weight test—Test the weights used with the balance as set forth further in the EPO for Weights—Recommended Procedure. If the weights are better than Class F, the weight test should be conducted in the laboratory with more appropriate standards.
EPO No. 7
Examination Procedure Outline for
AUTOMATIC-INDICATING SCALES—
UNEQUAL ARM

It is recommended that this outline be followed for counter, portable, floor, and built-in scales except livestock and vehicle.

**INSPECTION:**

1. Zero-load balance as found.  
   (Do not adjust.)  
   **H-44 General and Scale Code References**
   
<table>
<thead>
<tr>
<th>Code References</th>
</tr>
</thead>
<tbody>
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<td>G-UR.2., G-UR.3.2., G-UR.4.3., UR.2.1., UR.2.3., UR.2.4.</td>
</tr>
<tr>
<td>S.2.3., UR.4.2.</td>
</tr>
</tbody>
</table>

2. Support or installation  

3. Level condition  
   If the device is out of level and/or not in a zero balance condition (except prepackaging or check-weighing scales), the user should be made aware of paragraphs UR.4.1. and UR.4.2. and a warning issued if necessary. Before proceeding with the test, these conditions must be corrected.

4. Indicating and recording elements.
   Value of minimum graduated interval  
   *G-UR.1.1., UR.1.1.1., UR.1.1.8.*
   appropriateness  
   *G-S.5.*
   Customer readability—if applicable  
   *G-UR.3.2.*
   Weighbeam  
   *S.5.1.*
   Poises  
   *S.5.2.*
   Tare mechanism  
   *S.2.1.3.*
   Damping means  
   *S.2.4.*

5. Weighing elements  
   Drainage  
   *S.3.2., UR.3.3.*
   Scoop counterbalance  
   *S.3.3.*

6. Maintenance, use, and environmental factors (cleanliness, obstructions, modifications, etc.)  
   *G-S.2., G-UR.3., G-UR.4., UR.4.3.*
   *G-S.1., G-S.6., S.6., UR.3.1.*

7. Marking requirements
PRE-TEST DETERMINATIONS:

1. Tolerances.
   Applicable requirements __ G-T.
   Application ____________ T.1., T.1.1., T.1.2., T.1.3.
   Minimum values _________ T.2.1.
   Basic values ____________ T.3.1.

Check repeatability of indications throughout test. Recheck zero-load balance each time test load is removed ____________ G-S.5.4.

During an official test, a scale should not shift its zero-load indication by an amount greater than the minimum tolerance applicable.

If scale is equipped with ticket printer, print ticket at each test load ____________ G-S.5.5., G-S.5.6., S.1.5.2., S.1.6., T.1.2., T.1.3.

1. Increasing-load test ________ N.1.1., T.1.4.

   Small scales at several loads to capacity; larger scales at several loads to used capacity. Weigh-beams at one-half and total test load.

2. Shift test (can be conducted at appropriate test load during increasing-load test).

   Use quarter capacity load over each main load support or half capacity load centered successively in each quarter of platform ___ N.1.3.1., N.1.3.6. T.1.4.

3. Decreasing-load test — at one-half capacity ________ N.1.2., T.1.6.

4. Remove all test weights and determine any zero-load balance shift.
5. Strain-load test—if appropriate. Use tolerances for test-weight loads only N.1.1., T.1.5., T.3.2. (See Handbook 94.)

It is recommended that this outline be followed for counter, portable, floor, and built-in beam scales except livestock and vehicle.

**INSPECTION:**

1. Zero-load balance as found.  
   (Do not adjust.) ________ S.1.1., UR.4.1., S.2.1., S.5.1.1.  
   G-UR.2., G-UR.3.2., G-UR.4.3., UR.2.1., UR.2.3., UR.2.4.  
   S.2.3., UR.4.2.

2. Support or installation ______

3. Level condition ________  
   If the device is out of level and/or not in zero balance condition (except prepackaging or check-weighing scales), the user should be made aware of paragraphs UR.4.1. and UR.4.2. and a warning issued if necessary. Before proceeding with the test, these conditions must be corrected.

4. Indicating elements.  
   Value of minimum graduated interval ________ G-UR.1.1., UR.1.1.1., UR.1.1.8.

   Appropriateness ________ G-S.5.

   Customer readability—if applicable ________ G-UR.3.2.

   Weighbeam ________ S.5.1.

   Poises ________ S.5.2.


   Drainage ________ S.3.2., UR.3.3.

   Scoop counterbalance ________ S.3.3.

6. Maintenance, use, and environmental factors (cleanliness, obstructions, modifications, etc.) ________  
   G-S.2., G-UR.3., G-UR.4., UR.4.3.

   G-S.1., G-S.6., S.6., UR.3.1.

7. Marking requirements ________
PRE-TEST DETERMINATIONS:

1. Tolerances.
   Applicable requirements __ G-T.
   Application ____________ T.1., T.1.1., T.1.2.
   Minimum values __________ T.2.1.
   Basic values ____________ T.3.1.

TEST:

Error weights—Balance small weights on platform, the smallest weight being equal to the minimum tolerance value and the value of the weights being equal to the tolerance value at maximum test load.

Check repeatability of indications throughout test. Recheck zero-load balance each time test load is removed ____________ G-S.5.4.

During an official test, a scale should not shift its zero-load indication by an amount greater than the minimum tolerance applicable.

1. SR at zero load ____________ N.1.4., SR.1., SR.2.
2. Increasing-load test ____________ N.1.1., T.1.5.
   (a) Small scales at several loads to capacity; larger scales at several loads to used capacity.
   (b) Scales not equipped with full capacity beam should be ratio tested using standard weights on counterpoise hanger ____________ T.1.7., N.1.5.
   (c) Test weighbeams at one-half and maximum test load. When ratio testing, without removing maximum test load, substitute poise position with the removal of appropriate standard weights on counterpoise hanger ____________ T.3.1.
3. Shift test (can be conducted at appropriate test load during increasing-load test). Use quarter capacity test load over each main load support or half capacity load centered successively in each quarter of platform _________ N.1.3.1., N.1.3.6., T.1.4.

4. SR at maximum load ______ N.1.4., SR.1., SR.2.

5. Recheck zero-load balance.

6. Test counterpoise weights, if any. If a balance is not available and the scale under test has a suitable sensitivity, these weights may be tested by substitution with the standard weights on the counterpoise hanger, as explained in the EPO for Weights—Alternate Procedure.

7. Remove all weights and establish correct zero-load balance.
Examination Procedure Outline for

MONORAIL SCALES AND MEAT BEAMS
BEAM AND AUTOMATIC INDICATING
STATIC AND IN-MOTION

INSPECTION:

1. Zero-load balance as found __ S.1.1., S.2.1., S.5.1.1., UR.4.1.
   If the device is not in balance, the user should be made aware of paragraph UR.4. and a warning issued if necessary.

2. Installation ________________ UR.2.3., UR.2.4., UR.2.5., G-UR.2.

3. Indicating and recording elements.
   Value of minimum graduated interval ____________ G-UR.1.1., UR.1.1.8.
   Appropriateness _______________ G-S.5.
   Customer readability (if applicable) __________ G-UR.3.2.
   Weighbeam ________________ S.5.1.
   Poises ________________ S.5.2.
   Tare mechanism ____________ S.2.1.3.
   Damping means ___________ S.2.4.


5. Maintenance, use, and environmental factors (cleanliness, obstructions, modifications, etc.) __________ G-S.2., G-UR.3., G-UR.4., UR.4.3.


7. Assistance _______________ G-UR.4.3.

PRE-TEST DETERMINATIONS:

1. Tolerances.
   Applicable requirements __ G-T.
   Application _______________ T.1., T.1.1., T.1.2., T.1.3.
   Minimum values __________ T.2.1.
   Basic values ____________ T.3.5.

2. Select trolleys, trees, chains, or other auxiliary gear necessary to suspend test
weights on rail or meat hook. If more than one trolley and tree combination is used, they should be uniform in weight (within plus or minus two ounces).

TEST:

Auxiliary gear (trolleys, trees, chains)—Suspend from live rail or hook as required.

Error weights—Place small weights on or suspend from the live rail or hook equal to the minimum tolerance value and the total value of the weights being equal to the tolerance value at maximum test load.

Balance in error weights and auxiliary gear.

Check repeatability of indications throughout test. Recheck zero-load balance each time test load is removed __________________________ G-S.5.4.

During an official test, a scale should not shift its zero-load indication by an amount greater than the minimum tolerance applicable.

If the scale is equipped with a ticket printer, print ticket at each test load __________________________ G-S.5.6., T.1.2., T.1.3.

BEAM SCALES—STATIC TEST

1. SR at zero load ____________ N.1.4., SR.1., SR.2.
2. Increasing-load test ________ N.1.1., T.1.5.
   (a) Small scales at several loads to capacity; larger scales at several loads to used capacity.
   (b) Scales not equipped with full capacity beam should be ratio tested using standard weights on counterpoise hanger ________ T.1.7., N.1.5.
(c) Test weighbeams at not less than two points or at one-half and maximum test load. When ratio testing, without removing maximum test load, substitute poise position with the removal of appropriate standard weights on counterpoise hanger — T.3.1.

3. Shift test. (Can be conducted at appropriate test load during increasing-load test.) Use one-half capacity load at each end of live rail.

4. SR at maximum test load — N.1.4., SR.1., SR.2.

5. Counterpoise weight test. (See EPO for Weights.)

6. Remove all test weights and determine any zero-load balance shift.

7. Remove error weights and auxiliary gear and establish correct zero-load balance.

AUTOMATIC INDICATING SCALES—STATIC TEST

1. Increasing-load test.
   (a) Small scales at several loads to capacity; larger scales at several loads to used capacity.
   (b) Test at not less than three points on reading face, including all possible quarters of capacity. Test all unit weights possible.
   (c) If equipped with tare bars, test at half and full capacity of each bar.
2. Shift test. (Can be conducted at appropriate test load during increasing-load test.)
   Use one-half capacity load at each end of live rail.

3. Decreasing-load test — at one-half of maximum test load (at no less than one-half dial face capacity) N.1.2., T.1.6.

4. Counterpoise weight test (if scale is so equipped). See EPO for Weights.

5. Remove all test weights and determine any zero-load balance shift.

**AUTOMATIC INDICATING SCALES—**
**IN-MOTION TEST**

1. Conduct static test as previously indicated.

2. Conduct dynamic test.
   2.1. Suspend trolleys and trees on dead rail and place test weights in varying amounts on each.

   *Example:* Five trolley and tree combinations with test weights in 100-pound increments, thus providing five test weight values of 100 pounds, 200 pounds, 300 pounds, 400 pounds, and 500 pounds.

   2.2. With the scale adjusted for the appropriate tare for trolleys and trees, start conveyor system and run test loads across weigh rail in the same manner that product is weighed. If the device is equipped with a recording system, test with system operative.

   2.3. Run the test weight combination across the weigh rail at least five times, recording the errors at each load that is indicated visually.

   2.4. The zero-load balance should be checked after each test run.

   2.5. Obtain a printout from the recording system and compare recorded values with indicated values.
3. Tolerance application.

The acceptance and maintenance tolerance value for each test load indicated and recorded digitally for devices of 1,000-pound capacity with a 1-pound operating minimum graduated interval is ±1 pound. The acceptance and maintenance tolerance value for each test load indicated and recorded digitally for devices of 500-pound capacity with a $\frac{1}{2}$-pound operating minimum graduated interval is ±$\frac{1}{2}$ pound.

However, on a dynamic test with 20 or more test drafts, as previously described, 10 percent of the individual test drafts may be two times basic tolerances, providing the error on the total test load of all drafts does not exceed 0.2 percent.
Examination Procedure Outline for 

HOPPER SCALES

INSPECTION: 

1. Zero-load balance as found... 
   If the device is not in balance, the user should be made aware of paragraph UR.4. and a warning issued if necessary. 
   S.1.1., S.2.1., S.5.1.1., UR.4.1. 

2. Installation 
   UR.2.3., UR.2.4., G-UR.2., G-UR.4.3. 

3. Indicating and recording elements. 
   Value of minimum graduated interval ___________ 
   G-UR.1.1., UR.1.1.4., UR.1.1.8. 
   Appropriateness ___________ 
   G-S.5. 
   Customer readability (if applicable) ___________ 
   G-UR.3.2. 
   Weighbeam ___________ 
   S.5.1. 
   Poises ___________ 
   S.5.2. 
   Tare mechanisms ___________ 
   S.2.1.3. 
   Damping means ___________ 
   S.2.4. 

4. Weighing elements ___________ 
   S.4. 

5. Maintenance, use, and environmental factors (cleanliness, obstructions, modifications, etc.) ___________ 
   G-S.2., G-UR.3., G-UR.4., UR.4.3. 

6. Marking requirements _______ 
   G-S.1., G-S.6. 

7. Assistance ___________ 
   G-UR.4.3. 

PRE-TEST DETERMINATIONS: 

1. Tolerances. 
   Applicable requirements _ G-T. 
   Application ___________ 
   T.1., T.1.1., T.1.2., T.1.3. 
   Minimum values _________ 
   T.2.1. 
   Basic values ___________ 
   T.3.1., T.3.5.
**TEST:**

*Error weights—If beam scale, balance small weights on platform, the smallest weight being equal to the minimum tolerance value and the total value of the weights being equal to the tolerance value at maximum test load.*

*Check repeatability of indications throughout test. Recheck zero-load balance each time test load is removed.*

*During an official test, a scale should not shift its zero-load indication by an amount greater than the minimum tolerance applicable.*

*If the scale is equipped with a ticket printer, print ticket at each test load.*

1. SR at zero load—if appropriate

2. Ratio test—if applicable

3. Increasing-load test.
   (a) If beam scale, test at not less than two points on each weigh-beam bar.
   (b) If automatic-indicating scale, test at not less than three points on reading face, including all possible quarters of reading-face capacity. Test all unit weights possible

4. Decreasing-load test—one-half maximum test load

5. Strain-load test—if appropriate. Use tolerances for test-weight loads only

(See NBS Handbook 94.)
6. SR at maximum test load — N.1.4., SR.1., SR.2.
7. Counterpoise-weight test (if scale is so equipped). See EPO for Weights.
8. Remove all test weights and determine any zero-load balance shift.

TEST PROCEDURE FOR PORTABLE OR TRUCK-MOUNTED HOPPER SCALES

These are recommended test procedures for those devices used for the delivery of feed in feed lots. As is the case in the examination of all devices, the application of proven standards is the most acceptable and best method for determinations of performance capabilities. However, because of the construction and design of some of these devices and the available testing apparatus, it may be impossible to apply standard test weights. In those cases a carefully conducted comparison test is the next most acceptable method.

TEST PROCEDURE WITH STANDARD TEST WEIGHTS:

Check repeatability of indications throughout test. Recheck zero-load balance each time test load is removed.

During an official test, a scale should not shift its zero-load indication by an amount greater than the minimum tolerance applicable.

If scale is equipped with ticket printer, print ticket at each test load.

1. Increasing-load Test—Basic Tolerance
   Apply test weights distributed evenly on the load receiving element and test at several different loads to used capacity.

2. Shift Test—Basic Tolerance
   Conduct shift test only on those devices that are so designed that off-center loads are actually weighted. Use half capacity test load over each section. The shift test may be conducted during the increasing-load test when the half capacity test load has been applied.

3. Decreasing-load Test—Basic Tolerance
   Since these devices are designed to weigh out, this test is conducted in a manner similar to service conditions of operation. Consequently, the decreasing-
load test tolerance is not applied. With maximum test load applied, place control switch in weigh-out position and remove all test weights, maintaining a distributed load, in increments of, for example, 1,000 pounds or 2,000 pounds, or 2,500 pounds, taking a reading at each point.

NOTE: The combined errors should not exceed the individual tolerance times one-half the number of observations.

4. Check Zero-load Balance

As is the case in the examination of any device, if the information obtained is not sufficient to provide a reasonable determination of the disposition of the device (approved, rejected, condemned), repeat all or any part of the test.

COMPARISON TEST PROCEDURE:

1. Select Proper Scale—Select a motor vehicle scale that meets all of the requirements of Handbook 44 and has the following features or characteristics:

   1.1. A reading capability to the closest 5 pounds, preferably a beam scale with a 5-pound minimum graduation and which meets or exceeds the sensitivity requirements.

   1.2. Adequately protected to prevent the adverse effects of environmental conditions such as wind.

2. Test Comparison Test Scale

   2.1. Since the scale will be used for comparison only, it will be necessary to apply test weights in amounts equal to or nearly the weight of the empty truck and all other values at which test observations will be made. Record all indications for each test load so corrections can be made during the comparison test.

   2.2. The test weights should be located on the scale platform in the same position the truck under test will occupy.

3. Increasing-load Test—Basic Tolerance

   3.1. Place empty truck on scale in proper location as previously determined and obtain weight. Correct if necessary, and record.

   3.2. Load empty truck to capacity with product, determine gross weight and corrected net weight. Compare corrected net weight with indication of scale under test, and record all observations and resultant error, if any.
4. Decreasing-load Test—Basic Tolerance

4.1. On scale under test, control switch to weigh out position to establish zero indication.

4.2. Discharge product from truck in amounts equal to average drafts (approximately 2,000 pounds). Compare scale indications with previously obtained observations and record errors. It is preferable that the discharge of product occurs with the truck on the scale. However, if it is necessary to remove the truck, care should be exercised to eliminate or take into consideration all of the variables involved—that is, truck weight variations caused by gas consumption, the pickup or loss of mud, etc.

5. Check Zero-load Balance
EPO No. 11

Examination Procedure Outline for

AUTOMATIC GRAIN HOPPER SCALES

INSPECTION:

1. Zero-load balance as found __ S.1.1., S.2.1., S.5.1.1., UR.4.1.
2. Installation ___________ UR.2.3., UR.2.4., G-UR.2.
3. Indicating and recording elements.
   Value of minimum graduated interval __________ G-UR.1.1., UR.1.1.8.
   Appropriateness __________ G-S.5.
   Weighbeam __________ S.5.1.
   Poises __________ S.5.2.
5. Maintenance, use, and environmental factors (cleanliness, obstructions, modifications, etc.) __________ G-S.2., G-UR.3., G-UR.4., UR.4.3.
7. Assistance __________ G-UR.4.3.

PRE-TEST DETERMINATIONS:

1. Tolerances.
   Applicable requirements __ G-T.
   Application __________ T.1., T.1.1., T.1.2.
   Minimum values __________ T.2.1.
   Basic values __________ T.3.1.

TEST:

1. SR at zero load __________ N.1.4., SR.1., SR.2.
2. Ratio test (multiple of lever system) at one-half and maximum test loads, using standard weights in the weight box against standard weights in or upon the weigh hopper __________ N.1.5., T.1.7., T.3.1.
3. SR at maximum test load __ N.1.4., SR.1., SR.2.
4. Scale-weight test ________ N.1.1., T.1.5.
Test each scale weight separately by placing it in the weight box and checking for accurate scale balance against test weights in or upon the weigh hopper.

5. Residue-weighbeam test (if scale is so equipped) ________ N.1.1., N.1.4., SR.1., SR.2., T.1.5.
Lock main weighbeam, then determine SR and test accuracy of residue beam at one-half and full capacity of this beam.


7. Test drafts: As a final check, test the operation of the entire scale installation by checkweighing several drafts of grain that have been weighed by the scale. Repeat the test draft procedure if the scale is used for more than one type of grain by first checkweighing with a heavy grain such as wheat and then checkweighing with a light grain such as oats.
Examination Procedure Outline for

LIVESTOCK AND ANIMAL SCALES
BEAM AND AUTOMATIC INDICATING

H-44 General and Scale Code References

1. Zero-load balance as found __
   If the device is not in balance, the user should be made aware of paragraph UR.4. and a warning issued if necessary.

2. Installation ______________

3. Indicating and recording elements.
   Value of minimum graduated interval ____________
   Appropriateness ____________
   Customer readability (if applicable) ____________
   Weighbeam _________________
   Poises _________________
   Damping means ____________

4. Weighing elements ____________
5. Stock rack ________________
6. Pit ________________
7. Environmental factors—
   (cleanliness, obstruction, modifications, etc.) ____________
8. Marking requirements ____________
9. Assistance ________________

PRE-TEST DETERMINATIONS:

1. Tolerances.
   Applicable requirements __ G-T.
   Application ____________ T.1., T.1.1., T.1.2., T.1.3.

If livestock or animal scales are being tested in a cooperative program with the U.S. Department of Agriculture, note the directives of "Scales and Weighing Memorandum No. 1, Instructions for Testing Livestock Scales," copies of which are available from the U.S. Department of Agriculture, Packers and Stockyards Division, Consumer and Marketing Service, Washington, D.C. 20250.
Minimum values ________ T.2.6., T.2.7.
Basic values ________ T.3.5.

2. Determine "used" capacity—Multiply square feet of platform area by 110 pounds for cattle, 70 pounds for calves and hogs, 50 pounds for sheep.

**TEST:**

*Error weights.* If beam scale, balance small weights on platform, the smallest weight being equal to the minimum tolerance value and the total value of the weights being equal to the tolerance value at maximum test load.

Check repeatability of indications throughout test. Recheck zero-load balance each time test load is removed ________ G-S.5.4.

*During an official test, a scale should not shift its zero-load indication by an amount greater than the minimum tolerance applicable.*

*If the scale is equipped with a ticket printer, print ticket at each test load ________ G-S.5.6., T.1.2., T.1.3.*

1. SR at zero load, if beam scale ________ N.1.4., SR.1., SR.6.
2. Increasing-load test ________ N.1.1., T.1.2., T.1.3., T.1.5.
   (a) Test to "used" capacity, with test load distributed.
   (b) Scales not equipped with a full capacity beam should be ratio tested using standard weights on counterpoise hanger ________ T.1.7., N.1.5.
(c) If beam scale, test at half and full capacity on the fractional bar, 100-pound increments to 1,000 pounds, and at least at three other points on main weighbeam bar, including "used" capacity. When ratio testing without removing maximum test load, substitute poise position with removal of appropriate standard weights on counterpoise hanger.

(d) If automatic indicating scale, test at 100-pound increments to 1,000 pounds and at each quarter of dial capacity. Test all unit or drop weights normally used.

3. Shift test. (Can be conducted at appropriate test load during increasing-load test.) ________________ T.1.4.
   Use quarter capacity load successively at each corner of platform, or, if lever system has more than two sections, centered successively over each section.

4. SR at maximum load, if beam scale ________________ N.1.4., SR.1., SR.6.

5. Decreasing-load test, if automatic indicating scale, at one-half of maximum test load (at no less than one-half dial face capacity) ___ N.1.2., T.1.6.

6. Test counterpoise weights, if any.

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2 In acknowledgement of differences among jurisdictions in denominations of test weights, this constitutes a minimum increasing-load test of a livestock beam scale as recommended by the Packers and Stockyards Division of the U.S. Department of Agriculture.
7. Remove all test weights and determine any zero-load balance shift.

8. If beam scale, remove error weights and establish correct zero-load balance; if automatic indicating scale, establish correct zero-load balance.
EPO No. 13
Examination Procedure Outline for VEHICLE SCALES

INSPECTION:

1. Zero-load balance as found __ S.1.1., S.2.1., S.5.1.1., UR.4.1.
   If the device is not in balance, the user should be made aware of the paragraph UR.4. and a warning issued if necessary.

2. Installation ___________ UR.2.3., UR.2.4., UR.2.5., G-UR.2.,

3. Indicating and recording elements.
   Value of minimum graduated interval ___________ G-UR.1.1., UR.1.1.6.
   Appropriateness ___________ G-S.5.
   Customer readability (if applicable) ___________ G-UR.3.2.
   Weighbeam ___________ S.5.1.
   Poises ___________ S.5.2.
   Tare mechanism ___________ S.2.1.3.
   Damping means ___________ S.2.4.


5. Pit ___________ G-UR.4.1., UR.2.5.


8. Assistance ___________ G-UR.4.3.

PRE-TEST DETERMINATIONS:

1. Tolerances.
   Applicable requirements __ G-T.
   Application ___________ T.1., T.1.1., T.1.2., T.1.3.
   Minimum values ___________ T.2.1.
   Basic values ___________ T.3.5.

2. Determine maximum test load to be applied during test.
(a) On a two-section scale, a test load of 100 percent of nominal capacity may be applied to either section or distributed over the entire platform.

(b) On scales having more than two sections, a test load of 50 percent of nominal capacity may be applied to any section, or a test load of 100 percent of nominal capacity may be distributed over the entire platform.

**TEST:**

*Error weights—If beam scale, balance small weights on platform, the smallest weight being equal to the minimum tolerance value and the total value of the weights being equal to the tolerance value at maximum test load.*

Check repeatability of indications throughout test. Recheck zero-load balance each time test load is removed. G-S.5.4.

During an official test, a scale should not shift its zero-load indication by an amount greater than the minimum tolerance applicable.

If the scale is equipped with a ticket printer, print ticket at each test load. G-S.5.6., T.1.2., T.1.3.

1. SR at zero load—if beam scale N.1.4., SR.1., SR.6.
2. Increasing-load and shift test.
(a) Use not less than two loads successively over each section of lever system and on a two-section scale centered on the platform.

(b) If beam scale, test at not less than two points on each weigh-beam bar.

(c) If automatic-indicating scale, test at not less than three points on reading face, including all possible quarters of reading-face capacity. Test all unit weights possible

3. Decreasing-load test, if automatic-indicating scale at one-half of maximum test load (at no less than $\frac{1}{2}$ dial-face capacity)

4. Strain-load test—use tolerances for test weight loads only

5. SR at maximum test load— if beam scale

6. Counterpoise-weight test (if scale is so equipped). See EPO for Weights.

7. Remove all test weights and determine any zero-load balance shift.


N.I.4., SR.1., SR.6.

(See NBS Handbook 94.)
Examination Procedure Outline for
BELT-CONVEYOR SCALES

H-44 General and Scale Code References

INSPECTION:

1. Installation ________ G-UR.2., UR.2.
2. Indicating and recording elements.
   Value of the smallest unit ________ S.1.4., G-UR.1.1.
   Appropriateness ________ G-S.5., S.1.
6. Assistance ________ G-UR.4.3.

PRE-TEST DETERMINATIONS:

1. Tolerances.
   Applicable requirements ________ G-T.
   Application ________ T.1.
   Zero-test load ________ N.3.1.
3. Simulated test conditions ________ N.3.3.
4. Material test conditions ________ N.3.2.

TEST:

2. Simulated test ________ N.3.3.
3. Material test ________ N.3.2.
4. Simulated test ________ N.3.3.
Examination Procedure Outline for

WEIGHTS—EQUAL-ARM AND COUNTERPOISE

H-44 General and Weight Code References

INSPECTION:

7. Suitability—type and multiple of scale with which weights are used ______ G-UR.1.1., S.4.

PRE-TEST DETERMINATIONS:

1. Tolerance requirements applicable — acceptance or maintenance values ______ G-T., T.

TEST:

Recommended Procedure

Use an equal-arm balance with SR, accuracy, and repeatability at least as good as one-tenth the acceptance tolerance on the smallest weight of the group of weights under test.

1. Place on the left pan of the balance the weight to be tested, and on the other pan place a standard weight (or an accumulation of standard weights) of the same nominal value.

2. If the pans do not balance exactly (or the indicator does not oscillate equally on both sides of the center of the graduated scale), place on the high pan a standard weight equal to the tolerance on the weight under test. If this brings the high pan to balance position or lower, the weight under test may be considered acceptable; if not, the weight is unacceptable.
Alternative Procedure

If the scale with which the weight under test is used conforms to official requirements, it may be used (although certainly not with the confidence with which the precise balance is used) to test its equal-arm or counterpoise weights.

For Equal-Arm Weights

3. Balance the equal-arm scale with a standard weight equal in nominal value to the weight under test on the left pan and with any appropriate balancing material on the right pan.
4. Replace the standard weight on the left pan with the weight under test.
5. If the pans do not now exactly balance, place on the high pan a standard weight equal to the tolerance on the weight under test. If this brings the high pan to balance position or lower, the weight under test may be considered acceptable; if not, the weight is unacceptable.

For Counterpoise Weights

6. Place a standard weight equal in nominal value to the weight under test plus a standard weight equal to the tolerance on that weight on the counterpoise hanger of the compound-lever scale.
7. Place any appropriate balancing material on the load-receiving element of the scale, and, utilizing the balance ball, bring the weighbeam into a position of equilibrium at the very top, but not actually touching the top, of the trig loop or other limiting stop.
8. Replace the standard weight with the weight under test. (Do not remove the "tolerance" weight.)
9. Should the weighbeam now be lower than it was when balanced in step 7, remove the tolerance weight from the counterpoise hanger. Then, if the weighbeam is restored to its high balance position or actually touches the trig loop or other limiting stop, the weight under test may be considered acceptable; if not, it is unacceptably heavy.
10. If, following step 8, the weighbeam is actually touching the trig loop or other limiting stop, add to the counterpoise a second "tolerance" weight. If this additional load lowers the weighbeam so that it no longer touches the top of the trig loop or other limiting stop, the weight under test may be considered acceptable; if not, it is unacceptably light.
The following three pages illustrate the test weight positions, the test load, and the tolerance to be applied for shift tests as described in the Notes section of the Scale Code.

The numerical designations for the test weight positions are universally accepted and are based on the assumption that the individual conducting the test is facing the load-receiving element in the same manner that he would generally read the indicating element.
N.I.3.1. Shift Test
Bench or Counter Scales

Test Load - 1/2 Capacity
Tolerance - Basic

N.I.3.3. Shift Test
Equal Arm Scales

Test Load - 1/2 Capacity
Test Each Pan Independently
Tolerance - Basic
N.I.3.4. Shift Test
Vehicle Scales - 2 Section

Test Load - 2 Different Test Loads Including Maximum Available Not To Exceed Sectional Capacity

Tolerance - Basic

Test Load - 2 Different Test Loads Including Maximum Available Not To Exceed Sectional Capacity

Tolerance - Basic
N.I. 3.4. Shift Test
Vehicle Scales - 4 Section

Test Load - 2 Different Test Loads Including Maximum Available Not To Exceed Sectional Capacity
Tolerance - Basic

N.I. 3.6. Shift Test
Other Scales

Test Load - 1/4 Capacity
Tolerance - Basic

Test Load - 1/2 Capacity
Tolerance - Basic
Examination Procedure Outline for

RETAIL MOTOR-FUEL DISPENSERS—SINGLE PRODUCT

It is recommended that this outline be followed for conventional, single-product, power-operated retail dispensers—"gasoline pumps."

H-44 General and Liquid Measuring Device Code References

INSPECTION:

1. Indicating and recording elements.
   Design ___________________ S.1.1.
   Readability ________________ G-S.5., G-S.6.,
                              G-UR.3.2.
   Unit Price and Product
   Identity _________________ S.1.4.3., S.1.4.4.,
                             UR.3.2.
   Advancement and Return
   to Zero _________________ S.1.1.4., S.1.4.2., UR.3.1.

   Air eliminator vent (if self-contained pump) ___ S.2.1.
   Security seal on adjusting mechanism ______ G-UR.4.4., S.2.2.


4. Marking requirements ______ G-S.1., S.4.1., G-UR.3.3.

5. General considerations.
   Selection __________________ G-UR.1.1.
   Maintenance ________________ G-UR.3.1., G-UR.4.1.
   Installation ________________ G-UR.2.1., UR.2.1.,
                              UR.2.4.
   Accessibility ______________ G-UR.2.3.
   Assistance ________________ G-UR.4.3.

RE-TEST DETERMINATIONS:

1. Tolerances.
   Applicable requirements __ G-T., T.1.
   Basic values _____________ T.2.1., T.2.4.
TEST:

*If test measure is dry, add one cubic inch to gage reading to allow for amount of liquid required to “wet” measure.*

Allow 10-second drain period each time test measure is emptied.

*To determine proper operation of totalizers, observe and record the totalizer indications before and after all test drafts.*

1. Normal test—full flow—basic tolerance \_

If first test is well within tolerance, proceed to 2; otherwise, repeat this test.

2. Check computed price on both sides of dispenser \_

(See Price Computation Table.)

3. Special test—slow flow basic tolerance \_

4. Check effectiveness of zero-set-back interlock \_

On equipment with remote pumping systems, activate one dispenser and check all others operated by the same pump to make certain they will not operate without activating the individual starting levers.

5. Check effectiveness of anti-drain valve \_

6. Elapsed time-test (if necessary) \_

Security seal—Apply lead-and-wire seal to secure adjusting mechanism.

Note on the official report the number of gallons of product dispensed during test.
Examination Procedure Outline for

RETAIL MOTOR-FUEL DISPENSERS—BLENDED PRODUCT

It is recommended that this outline be followed for blending-type, power-operated retail dispensers—“gasoline pumps.”

INSPECTION:

1. Indicating and recording elements.
   - Design ___________________ S.1.1.
   - Readability _______________ G-S.5., G-S.6., G-UR.3.2.
   - Unit Price and Product Identity _______________ S.1.4.3., UR.3.2., S.1.4.4.
   - Advancement and Return to Zero _______________ S.1.1.4., S.1.4.2., UR.3.1.

   - Air eliminator vent _______ S.2.1.
   - Security seal on adjusting mechanism __________ G-UR.4.4., S.2.2.


4. Marking requirements _______ G-S.1., S.4.1., G-UR.3.3.

5. General considerations.
   - Selection ___________________ G-UR.1.1.
   - Installation _______________ G-UR.2.1., UR.2.1., UR.2.4.
   - Accessibility ______________ G-UR.2.3.
   - Assistance ________________ G-UR.4.3.

PRE-TEST DETERMINATIONS:

1. Tolerances.
   - Applicable requirements ___ G-T., T.1.
   - Basic values _______________ T.2.1., T.2.4.

TEST:

If test measure is dry, add one cubic inch to gage reading to allow for amount of liquid required to “wet” measure.
Allow 10-second drain period each time test measure is emptied.
To determine proper operation of totalizers, observe and record the totalizer indications before and after all test drafts.
1. Test at lowest octane. Set selector control so that lowest octane product is dispensed. Normal test—full flow—basic tolerance ______ N.1., N.2., N.3.4., N.4.1.

If the first test is well within tolerance, proceed to 2; otherwise repeat this test.
2. Check computed price on both sides of dispenser ______ G-S.5.5.
   (See Price Computation Table.)
3. Test at highest octane. Set selector control so that highest octane product is dispensed. Normal test—full flow—basic tolerance ______ N.1., N.2., N.3.4., N.4.1.

If test is well within tolerance, proceed to 4; otherwise repeat this test.
4. Check computed price on both sides of dispenser ______ G-S.5.5.
5. Test at blend—Set selector control at an intermediate blend. Special test—slow-flow—basic tolerance ______ N.2., N.4.2., N.4.2.2.
If test is well within tolerance and the error is less than or equals the average error of the previous two tests, proceed to 6; otherwise slow-flow test at first grade above lowest octane and first grade beneath highest octane.
6. Check computed price on both sides of dispenser ______ G-S.5.5.
7. Set money-value computation on other blends. Set selector control at each of the remaining blends and dispense one indicated gallon to check computed price____ G-S.5.5.
8. Check effectiveness of zero-set-back interlock __________ S.2.5.1., UR.3.4.


10. Elapsed-time test (if necessary) ____________ N.4.3., T.2.4.

Security seal—Apply lead-and-wire seal to each meter to secure adjusting mechanisms.

Note on the official report the number of gallons of each blend or product dispensed during test.
Examination Procedure Outline for
POWER-OPERATED VEHICLE-
TANK METERS

It is recommended that this outline be followed for all power-operated vehicle-tank meters; for gravity discharge meters, see EPO No. 24.

INSPECTION:

1. Indicating and recording elements.
   Design ___________________________ S.1.1.
   Unit price _________________________ S.1.4.1., S.1.4.3.,
                                           UR.1.2.
   Advancement and Return to Zero __________ S.1.1.4.
   Air eliminator vent _______ S.2.1.
   Security seal on adjusting mechanism ___ G-UR.4.4., S.2.2.
3. Piping.
   Discharge line and valves ______ S.2.3., S.3.
   Antidrain valve ____________ S.3.6.
   Leaks _________________________ G-UR.4.1., S.3.1.
   Fraud _________________________ G-S.2.
5. General considerations.
   Selection _________________________ G-UR.1.1.
   Installation ________________________ G-UR.2.1., UR.1.1.
   Accessibility _____________________ G-UR.2.3.
   Assistance _________________________ G-UR.4.3.

PRE-TEST DETERMINATIONS:

1. Determine that the test fluid in the tank compartments is similar in character to the fluid to be measured commercially _______ N.1.
2. Tolerances.
   Applicable requirements __ G-T., T.1.
   Basic values _____________ T.2.
3. Note totalizer reading.
**TEST:**

*Wet prover:* Allow 30-second drain period each time prover is emptied.

*If meter is equipped with recording element, print a ticket after each test run.*

*If computing type, check computation*  

1. **Normal test—full flow—** basic tolerance  
   **2. Special test—slow flow—** special tolerance  
   If either the normal or special test result is close to or outside the applicable tolerance, repeat that test.  

3. **Special test—split-compartment—special tolerance**  
   3.1. Start test (normal flow rate) from a compartment containing less test fluid than one-half the capacity of the prover and with pump in operation and pressure to the discharge nozzle.  
   3.2. Permit test to continue until lack of fluid supply causes meter register to stop absolutely.  
   3.3. With pump in operation, shut manifold valve (or disconnect whip-hose connection) from now empty compartment.  
   3.4. Open valve from compartment with adequate supply of fluid to complete test.  

4. **Check automatic-stop mechanism**  
   **No tolerance.**
5. Check effectiveness of anti-drain valve with pump pressure off line ___________ S.3.6., N.4.3.

Security seal: Apply lead-and-wire seal to secure adjusting mechanism. Also seal register to meter.

Note on the official report the number of gallons of product dispensed during test.
Examination Procedure Outline for GRAVITY-DISCHARGE VEHICLE-TANK METERS

It is recommended that this outline be followed for all gravity-discharge vehicle-tank meters; for power-operated meters, see EPO No. 23.

INSPECTION:

1. Indicating and recording elements.
   - Design __________________ S.1.1.
   - Unit price ________________ S.1.4.1., S.1.4.3., UR.1.2.
   - Advancement and Return to Zero __________ S.1.1.4.

   - Air eliminator vent _______ S.2.1.
   - Security seal on adjusting mechanism ______ G-UR.4.4., S.2.2.

3. Piping.
   - Discharge line and valves ___ S.2.3., S.3.
   - Antidrain valve ____________ S.3.6.
   - Leaks _____________________ G-UR.4.1., S.3.1.
   - Fraud _____________________ G-S.2.


5. General considerations.
   - Selection __________________ G-UR.1.1.
   - Installation _______________ G-UR.2.1., UR.1.1.
   - Accessibility _____________ G-UR.2.3.
   - Assistance ________________ G-UR.4.3.

PRE-TEST DETERMINATIONS:

1. Determine that the test fluid in the tank compartment is similar in character to the fluid to be measured commercially ______________ N.1.

2. Tolerances.
   - Applicable requirements __ G-T., T.1.
   - Basic values ____________ T.2.

3. Note totalizer reading.
TEST:

Inlet to prover must be lower than the meter outlet.

Wet prover: Allow 30-second drain period each time prover is emptied.

If meter is equipped with recording element, print a ticket after each test run.

If computing type, check computation —— G-S.5.6., S.1.4.2., S.1.4.3., S.1.4.4.

1. Normal test—full flow—
   basic tolerance high head
   (full compartment) —— N.4.1., T.2.

2. Normal test—full flow—
   basic tolerance medium head (one-half full compartment) —— N.4.1., T.2.

3. Normal test—full flow—
   basic tolerance low head
   (compartment to contain 1½ times prover capacity) —— N.4.1., T.2.

   4.1. Start test (normal flow rate) from compartment containing less test load than one-half prover capacity.
   4.2. Permit test to continue until lack of fluid supply causes meter register to stop.
   4.3. Shut manifold valve (or disconnect whip-hose connection) from now empty compartment.
   4.4. Open valve from compartment with adequate supply of fluid to complete test.
5. Check automatic stop mechanism. No tolerance G-UR.4.1.

Security seal: Apply lead-and-wire seal to secure adjusting mechanism. Also seal register to meter.

Note on the official report the number of gallons of product dispensed during test.
Examination Procedure Outline for
LOADING-RACK METERS

It is recommended that this outline be followed for all power-operated and gravity discharge loading-rack meters.

INSPECTION:

1. Indicating and recording elements.
   Design ______________________ S.1.1.
   Readability ___________________ G-S.5., S.1.2., S.1.3.
   Advancement and Return to Zero ___________________ S.1.1.4.

   Air eliminator vent _______ S.2.1.
   Automatic temperature compensation ________ S.2.6.
   Security seals, adjusting mechanism, and automatic temperature compensator _______________ G-UR.4.4., S.2.2., S.2.6.3.

3. Piping.
   Discharge line and valves ______ S.2.3., S.3.
   Leaks ______________________ G-UR.4.1., S.3.1.
   Fraud ______________________ G-S.2.


5. General considerations.
   Selection ____________________ G-UR.1.1., S.1.1.3.
   Installation _________________ G-UR.2.1., UR.2.2.
   Accessibility ________________ G-UR.2.3.
   Assistance __________________ G-UR.4.3.

PRE-TEST DETERMINATIONS:

1. Determine that the test liquid available is the same liquid to be commercially measured or a liquid of the same general physical characteristics.

2. Tolerances.
   Applicable requirements __ G-T., T.1.
   Basic values ____________ T.2.3.

3. Note totalizer reading.
TEST:

Wet prover. Allow 30-second drain period each time prover is emptied.

If meter is equipped with recording element, print a ticket after each run.

If computing type, check computation ________________ G-S.5.6., S.1.5.2.

1. Nontemperature-compensated meters

1. Normal test—full flow—
   basic tolerance ___________ N.2., N.4.1.1., N.5., T.2.3.

2. Special test—slow flow—
   special tolerance ___________ N.2., N.4.2.4., N.5., T.2.3.

If any of the test results are close to or outside the applicable tolerances, repeat that test.

2. Temperature-compensated meters that indicate or record both gross gallons (uncompensated) and net gallons (compensated)

1. To determine the accuracy of the gross gallons, follow the test procedure for nontemperature-compensated meters.

2. To determine the accuracy of the net gallons, proceed as follows:
   2.1. Calculate average temperature for each test run. During each test run conducted when determining the accuracy of the gross gallons, read temperature of product at meter at one-third and two-thirds prover capacity. Add the two temperatures obtained together and divide by 2.
   2.2. Find factor for reducing volume to 60° F. It is necessary that either the specific gravity or the API gravity of the product is specified by the terminal operator. Dependent on which gravity is known, select either ASTM Petroleum Measurement Table No. 6 or No. 24 to find the appropriate factor.
   2.3. Correct volume in prover to 60° F. Multiply the factor obtained by the prover reading.
Example:  (specific gravity known)

What is the volume at 60° F of 1000.2 gallons (prover reading) at an average temperature of 45° F of an oil whose specific gravity is .725?

Table 24

<table>
<thead>
<tr>
<th>Observed Specific Gravity 60/60° F.</th>
<th>0.720</th>
<th>0.725</th>
<th>0.730</th>
<th>0.735</th>
<th>0.740</th>
<th>0.745</th>
<th>0.750</th>
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<td>Temperature, °F.</td>
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<td>1.0069</td>
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</tbody>
</table>

1.0097 (factor from Table 24) X 1000.2 (prover reading) = 1009.9 gallons

The error is the difference between the net gallon representation and 1009.9 gallons.

Example:  (API gravity known)

What is the volume at 60° F of 749.7 gallons (prover reading) at an average temperature of 80° F of a gasoline whose API gravity is 2?

Table 6

<table>
<thead>
<tr>
<th>Observed Temperature, °F.</th>
<th>API Gravity at 60° F.</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor for Reducing Volume to 60° F.</td>
<td></td>
<td>0.9° API</td>
<td>50-100° F</td>
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<td>.9915</td>
<td>.9914</td>
</tr>
</tbody>
</table>

.9933 (factor from Table 6) X 749.7 (prover reading) = 744.7 gallons

The error is the difference between the net gallon representation and 744.7 gallons.

If any of the test results are close to or outside the applicable tolerances, repeat that test.
3. Temperature-compensated meters

1. Normal test—full flow—
   basic tolerance ____________ N.2., N.4.1.1., N.5., T.2.3.
   (Do not deactivate temperature compensator.)
   Deactivate temperature compensator. ________________ N.4.1.

2. Normal test—full flow—
   basic tolerance ____________ N.2., N.4.1., N.5., T.2.3.

3. Special test—slow flow—
   special tolerance ____________ N.2., N.4.2., N.5., T.2.3.

If any of the test results are close to or outside the applicable tolerances, repeat that test.

Reactivate temperature compensator.

4. All devices

   Check effectiveness of valve at nozzle if wet-hose system; otherwise check for complete drainage of discharge line.

2. Check automatic-stop mechanism ________________ G-UR.4.1.
   Security seal: Apply lead-and-wire seal to secure adjusting mechanism. Also seal register to meter.

Note final totalizer reading and record on the official report the number of gallons of product dispensed during test.
Examination Procedure Outline for

LIQUEFIED PETROLEUM GAS MOTOR-FUEL DEVICE

For a more complete description, refer to NBS Handbook 99.

H-44 General and LPG Liquid-Measuring Device Code References

INSPECTION:

1. Indicating and recording elements.
   Design ______________________ S.1.1.
   Readability __________________ G-S.5., G-S.6.,
   G-UR.3.2.
   Unit Price and Product Identity __________________ S.1.4.3.
   Advancement and Return to Zero __________ S.1.1.4., S.1.4.2.,
   UR.2.1.

   Vapor elimination __________ S.2.1., S.2.4.
   Automatic temperature compensation __________ S.2.6.1.
   Thermometer well __________ S.2.5.
   Security seals __________ G-UR.4.4., S.2.2.,
   S.2.6.2.


5. General considerations.
   Selection ____________________ G-UR.1.1.
   Installation __________________ G-UR.2.1., G-UR.2.2.,
   UR.1.1.
   Accessibility ________________ G-UR.2.3.
   Assistance ________________ G-UR.4.3.

PRE-TEST DETERMINATIONS:

1. Tolerances.
   Applicable requirements __ G-T., T.1.
   Basic values ____________ T.2.
TEST:

To determine proper operation totalizers, observe and record the totalizer indication before and after all test drafts.

Wet prover (fill to nominal capacity). Allow 30-second drain period each time prover is emptied.

Read temperature and pressure of product in prover immediately following each test draft ____________ N.5.

If dispenser is equipped with a recording element, print ticket after each test run ____________ G-S.5.6., UR.2.5.

If computing type, check computation ____________ G-S.5.5., S.1.4.4

Nontemperature-compensated devices

Read temperature of product at meter at one-third and two-thirds prover capacity ____________ N.5.


2. Repeat normal test.


If any of the test results are close to or outside the applicable tolerance, repeat that test.

Temperature-compensated devices

1. Normal test—full flow—basic tolerance ____________ N.2., N.4.1.1., N.5., T.2. (Do not deactivate temperature compensator.)

Deactivate temperature compensator ____________ N.4.1.

3. Special test—slow flow—
special tolerances _________ N.2., N.4.2.1., N.4.2.2.,
N.5., T.2.

If any of the test results are close to or outside the applicable tolerance, repeat the test.

Reactivate temperature compensator.

4. Check effectiveness of zero-
set-back-interlock _________ S.2.7.1.

Security seal—Apply lead-and-
wire seals to secure meter and temperature adjusting mechanisms. Also seal register to meter.

Note final totalizer reading and record on the official report the number of gallons of product dispensed during test.
Examination Procedure Outline for
LIQUEFIED PETROLEUM GAS
LIQUID-MEASURING DEVICES

It is recommended that this outline be followed for all LP Gas liquid meters except motor-fuel dispensers.

For a more complete description, refer to NBS Handbook 99.

H-44 General and LPG Liquid-Measuring Device Code References

INSPECTION:

1. Indicating and recording elements.
   - Design  ____________________  S.1.1.
   - Unit Price and Product Identity  ____________  S.1.4.3.
   - Advancement and Return to Zero  ________________  S.1.1.4., S.1.4.1., S.1.4.2.

   - Vapor elimination  ________  S.2.1., S.2.4.
   - Security seals  _____________  G-UR.4.4., S.2.2., S.2.6.2.
   - Thermometer well  __________  S.2.5.
   - Automatic temperature compensation  __________  S.2.6.1.

3. Piping.
   - Discharge line and valves  ______ S.2.3., S.3.
   - Fraud  ________________  G-S.2., S.3.1.


5. General considerations.
   - Selection  ________________  G-UR.1.1.
   - Installation  ________________  G-UR.2.1., UR.1.1.
   - Accessibility  ________________  G-UR.2.3.
   - Assistance  ________________  G-UR.4.3.

PRE-TEST DETERMINATIONS:

1. Determine that the test liquid in the tank compartments is similar in character to the liquid to be measured commercially  ______ N.1.
2. Tolerances.
   Applicable requirements  --  G-T., T.1.
   Basic values  ---------  T.2.

3. Note totalizer reading.

**TEST:**

Wet prover (fill to nominal capacity). Allow 30-second drain period each time prover is emptied.

Read temperature and pressure of product in prover immediately following each test draft  --  N.5.

If meter is equipped with a recording element, print ticket after each test run  ---------  G-S.5.6., UR.2.5.

If computing type, check computation  ------------------  S.1.1.5., S.1.4.4.

**Nontemperature-compensated meters**

Read temperature of product at meter at one-third and two-thirds prover capacity  --------  N.5.

1. Normal test—full flow—
   basic tolerance  ---------  N.2., N.3., N.4.1.
   N.5., T.2.

2. Repeat normal test.

3. Special test—slow flow—
   special tolerance  ---------  N.2., N.4.2.2.,
   N.4.2.3., N.5., T.2.

If any of the test results are close to or outside the applicable tolerance, repeat the test.
Temperature-compensated meters

1. Normal test—full flow—
   basic tolerance ___________ N.2., N.4.1.1., N.5., T.2.
   Do not deactivate temperature compensator.
   Deactivate temperature compensator ________________ N.4.1.

2. Normal test—full flow—
   basic tolerance ___________ N.2., N.3., N.5., T.2.

3. Special test—slow flow—
   special tolerance ___________ N.2., N.4.2.2., N.4.2.3., N.5., T.2.

If any of the test results are close to or outside the applicable tolerance, repeat that test.

Reactivate temperature compensator.

Security seal—Apply lead-and-wire seals to secure meter and temperature adjusting mechanisms. Also seal register to meter.

Note final totalizer reading and record on the official report the number of gallons of product dispensed during test.
Supplement to Examination Procedure Outlines

Nos. 21 and 22

Price Computation Table

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The half-cent computed values shown above, as 1.255, should appear on an analog type register as halfway between appropriate whole cent indications.
### Price Computation Table

A = Price per gallon (cents)  
B = Price per five gallons (dollars)

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