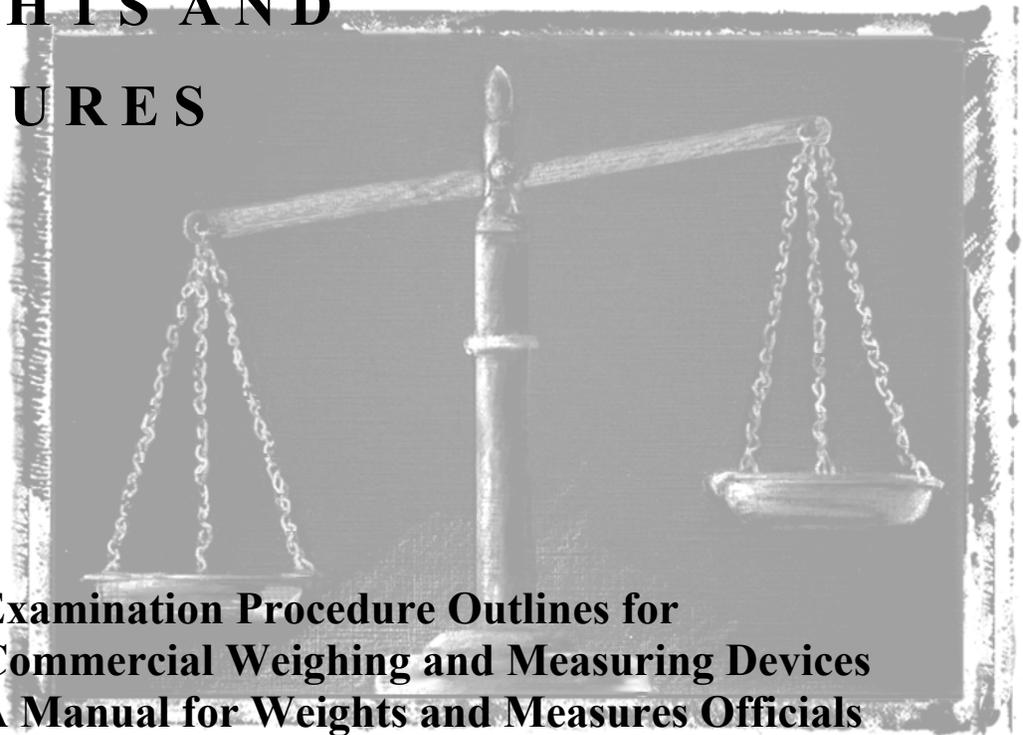


**OFFICE OF
WEIGHTS AND
MEASURES**



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

NIST
Handbook 112
2002 Edition

FOREWORD

National Institute of Standards and Technology (NIST) Handbook (HB) 112, "Examination Procedure Outlines (EPOs) For Commercial Weighing and Measuring Devices," was first published in 1973 by the National Bureau of Standards, Weights and Measures Program, which is now the NIST Office of Weights and Measures (OWM). NIST developed these EPOs and compiled them into this handbook to serve as a guide for the field examination of commercial weighing and measuring devices. It includes inspection and test procedures, with code references to NIST HB 44, "Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices."

The EPOs in this document have been updated to include references to the 2002 edition of NIST HB 44 and to recognize electronic equipment. A new EPO for compressed natural gas retail motor fuel dispensers has been added. Some of the EPOs that appeared in the original version of NIST HB 112 have not been updated and are not included in this document.

Although this publication was prepared primarily for use by weights and measures officials of the Federal, State, and local jurisdictions, it should also be useful to manufacturers and other commercial and industrial organizations and individuals involved in the design, sale, service, or use of weighing and measuring devices.

This handbook conforms to the concept of primary use of SI (metric) measurements recommended in the Omnibus Trade and Competitiveness Act of 1988 by citing SI units before inch-pound units where both units appear together and placing separate sections containing requirements in SI units before corresponding sections containing requirements in inch-pound units. In some cases, however, common trade practice is currently restricted to the use of inch-pound units; therefore, some examples in this Handbook will continue to specify only inch-pound units until the industry achieves a broad consensus on the permitted SI units.

In accord with NIST policy, the meter/liter spellings are used in this document.

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INTRODUCTION

This handbook contains Examination Procedure Outlines (EPOs) for the field examination of commercial weighing and measuring devices. It includes inspection and test procedures, with code references to National Institute of Standards and Technology Handbook 44 “Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices”, 2002 Edition. A reference that begins with the letter “G” refers to the General Code; all others refer to the specific code noted at the beginning of the EPO.

Each outline contains five sections: (1) **Safety notes** and safety key words or phrases; (2) an **Inspection** section, which covers design, installation, and user requirements that must be met; (3) a **Pretest Determinations** section, which addresses the determination of tolerances and other factors that should be established prior to testing; (4) a **Test Notes** section, which covers actions to be taken throughout the test or testing information of a general nature; and (5) a **Test** section, which gives a step-by-step procedure for determining a device’s compliance with applicable performance requirements. An **Equipment** section is included in the EPO for compressed natural gas (CNG) only. Similar sections may be added to other EPOs as they are updated in future editions of this Handbook.

EPO users should remember that each outline describes the minimum examination preceding official action. An official may perform additional test not described in this handbook, or may repeat any or all tests as part of the examination process. Many factors influence the nature and extent of an examination. Some cases might require a more extensive examination, such as the first examination of a device after it has been placed into commercial service. Consequently, users of these EPOs should thoroughly familiarize themselves with all of the requirements in Handbook 44 that are applicable to a device under inspection to ensure a thorough inspection.

SAFETY CONSIDERATIONS

NOTE: When excerpting an Examination Procedure Outline for duplication, this section and the "Glossary" located in the back of this publication should also be duplicated and included with the outline.

The importance of safety in the weights and measures workplace cannot be overemphasized. During the inspection and testing of weighing and measuring equipment, the issue of safety should be foremost in the inspector's or serviceperson's mind. It is only through conscientious adherence to safety regulations and procedures on a regular basis that the inspector or serviceperson can decrease the likelihood of causing serious personal injury, injury to individuals in and around the inspection area, or damage to property and equipment. Safety-consciousness must also extend to the selection and maintenance of testing equipment and other equipment used by an inspector or serviceperson.

Weighing and measuring equipments differ in design, and the safety of their use may be affected by other factors in the workplace such as ignition sources, environmental influences and characteristics of the individual installation. Because of this variability, it is impractical to make specific recommendations that will identify or address safety hazards that may be present in a particular jurisdiction. In order to properly address the safety hazards that may be present during an inspection activity, a jurisdiction should consider the following steps in working to minimize the hazards: (1) conduct a job hazard analysis; (2) determine what safety and health training is needed; (3) determine the control (administrative, engineering, and personal protective) needed; (4) provide a written safety and health program; and (5) enforce the policy.

Before proceeding with the inspection and testing of a weighing or measuring device, the inspector or serviceperson should be completely familiar with all safety regulations and policies in effect at the inspection location. Such regulations and policies include state, Federal, or local Occupational Safety and Health Administration (OSHA) regulations, safety policies established by the firm in which the inspection is taking place or established by the inspector's or serviceperson's employer.

The Examination Procedure Outlines (EPOs) in this publication address a wide variety of activities involving the inspection and testing of various types of weighing and measuring equipment. Each of these inspection activities requires knowledge of safety information specific to the inspection of that device. A brief paragraph at the beginning of each EPO reminds the inspector or serviceperson of some of the basic safety precautions, which should be taken prior to proceeding with the inspection procedure. Also, safety reminders are included at various points throughout the body of the EPO. The safety reminders use "key phrases" to prompt the inspector or serviceperson to remember particular safety precautions. A glossary of these key phrases is included at the back of this publication. The glossary provides a brief explanation of the intent of the safety precaution and, in some cases, provides a listing of a source or sources where additional information might be obtained pertaining to a particular safety concern.

The safety reminders included in this publication are not intended to cover all possible safety precautions that should be taken before proceeding with the inspection of a weighing or measuring device. (Similarly, the safety information and contacts are not a complete listing of all possible sources of information and guidance in the area of safety.) The safety reminders are intended to raise the awareness of the weights and measures inspector or serviceperson, and to serve as a reminder to make safety an integral part of all inspection and testing procedures. The safety reminders are also intended to encourage the inspector or serviceperson to thoroughly investigate the safety requirements in effect at an inspection site and to identify and practice the safety procedures necessary to prevent personal injury, injury to others, or damage to equipment and property during the inspection.

For additional information on safety in the weights and measures workplace and the development of a safety program, see the July 1991 Final Report of the NCWM Task Force on Safety.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

REFERENCES

National Institute of Standards and Technology (NIST) Handbook (HB) 44, 2002, *Specifications, Tolerances and Other Technical Requirements For Weighing and Measuring Devices*, Tina Butcher, Terry Grimes, Richard Suiter, Juana Williams

National Conference on Weights and Measures (NCWM) Publication 14, latest version, *National Type Evaluation Program Administrative Procedures, Technical Policy, Checklist, and Test Procedures*

National Bureau of Standards HB 94, 1965, *The Examination of Weighing Equipment*, Malcolm W. Jensen and Ralph W. Smith

EPO No. 1

**Examination Procedure Outline for
Retail Computing Scales**

It is recommended that this outline be followed for electronic digital indicating and mechanical analog-indicating retail computing scales and prepackaging scales. Requirements that apply only to scales marked with an accuracy class are indicated with an asterisk. Non-retroactive requirements are followed by the applicable date in parentheses.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety "Safety Considerations" found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Electrical Hazards

First Aid Kit

Lifting

Location

also: **Wet/Slick Conditions
Chemicals, Petroleum Products, and Hazardous Materials
Obstructions**

Personal Protection Equipment
e.g., Safety Shoes

Support – for Scale and Test Weights

Transportation of Equipment

EPO No. 1

Inspection:

Safety First!!!

Check the inspection site carefully for safety hazards and take appropriate precautions.

Learn the nature of hazardous products used at or near the inspection site.

Use personal protection equipment appropriate for the inspection site.

Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.

H-44 General Code and Scales Code References

- 1. Zero-load balance as found. For pre-packaging scale, check to determine if tare is being taken..... S.1.1., UR.4.1., S.2.1.1., S.2.1.2.,G-S.5.2.2.(d) (1/1/86)
- 2. General Considerations
 - Selection G-UR.1.1.
 - Installation..... G-UR.2.1.,G-UR.2.2., UR.2.2.
 - Supports and clearance..... UR.2.1., UR.2.4.

Check to be sure the scale supports are adequate to support the scale and test weights equal to the capacity of the scale !

- Accessibility for inspection, testing, and sealing..... G-UR.2.3.
- Testing devices at a central location..... G-UR.4.6.
- Assistance..... G-UR.4.4.
- Position, customer readability G-UR.3.3., S.1.8.3.
- Level indicating means and condition S.2.4., UR.4.2.
- Maintenance, use, and environmental factors (cleanliness, obstructions, modifications, etc.)..... G-S.2.,G-UR.1.2., G-UR.3.1., G-UR.3.2., UR.3.5.,G-UR.4., UR.2.3., UR.4.3.
- 3. Marking S.6.3., G-S.5.2.4, S.5.1., S.6.2
 - a. Marking requirements - all devices
 - Identification G-S.1.
 - Name or ID of manufacturer..... Retroactive
 - Model designation Retroactive
 - Model prefix (1/1/03)
 - Nonrepetitive serial number (1/1/68)

Inspection (cont.):

EPO No. 1

Marking requirements - all devices (cont.)	
Identification (cont.).....	G-S.1.
Serial number prefix.....	(1/1/86)
NTEP CC prefix and number.....	(1/1/03)
(for devices that have an NTEP CC)	
Remanufacturer information, as appropriate.....	G-S.1.1.
name and ID of remanufacturer.....	(1/1/02)
model number if different from original model number.....	(1/1/02)
Lettering.....	G-S.7.
Operational controls, indications, and features.....	G-S.6. (1/1/77)
Visibility of identification.....	G-UR.2.1.1.
Interchange or reversal of parts.....	G-S.4.
b. Marking requirements - weighing and indicating elements in same housing or covered on the same CC (in addition to marking for all devices).....	S.6.3.
Accuracy class.....	(1/1/86)
Nominal capacity.....	Retroactive
Value of scale division with nominal capacity, if not apparent.....	(1/1/83)
Value of "e" (if different from "d").....	(1/1/86)
Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F).....	(1/1/86)
Scales designed for special purposes.....	(1/1/86)
c. Marking requirements - indicating element not permanently attached or covered on separate CC (in addition to marking for all devices).....	S.6.3.
Accuracy class.....	(1/1/86)
Nominal capacity.....	Retroactive
Value of scale division with nominal capacity, if not apparent.....	(1/1/83)
Value of "e" (if different from "d").....	(1/1/86)
Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F).....	(1/1/86)
Scales designed for special purposes.....	(1/1/86)
Maximum number of scale divisions (n_{max}).....	(1/1/88)
d. Marking requirements - weighing and load receiving element not permanently attached or covered on separate CC (in addition to marking for all devices).....	S.6.3.
Accuracy class.....	(1/1/86)
Nominal capacity.....	Retroactive
Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F).....	(1/1/86)
Scales designed for special purposes.....	(1/1/86)
Maximum number of scale divisions (n_{max}).....	(1/1/88)
Minimum verification scale division for which device complies with the requirements (e_{min} or d).....	(1/1/88)
e. Marking requirements - load cell with Certificate of Conformance (in addition to marking for all devices).....	S.6.3. S.5.4. (1/1/94)
Note: Requires information on a data plate attached to the load cell or in an accompanying document. If a document is provided, the serial number shall appear on the load cell and in the document.....	(1/1/88)
Manufacturer's name or trademark, model designation, model prefix, and serial number and prefix shall also be marked on both the load cell and in any accompanying documents.....	(1/1/91)

Inspection (cont.):

EPO No. 1

Marking requirements - load cell with Certificate of Conformance (cont.).....	S.6.3. S.5.4. (1/1/94)
Accuracy class.....	(1/1/88)
Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F).....	(1/1/86)
Maximum number of divisions.....	(1/1/88)
“S” or “M” for single or multiple cell applications	(1/1/88)
Direction of loading, if not obvious.....	(1/1/88)
Minimum dead load, maximum capacity, safe load limit, and load cell verification interval, v_{\min}	(1/1/88)
 4. Indicating and recording elements.	
Value of scale division	S.1.2.* (1/1/86), S.1.2.1. (1/1/89), S.1.2.2., S.5.3., UR.1.1.(b), G-S.5.3., G- S.5.3.1.,U.R.1.3. (1/1/86)
Prepackaging scales only.....	S.1.9.1.
Value of tare division	S.2.3. (1/1/83)
Tare mechanism	S.2.3.
Combined zero-tare (“0/T”) key.....	S.2.1.6.
Appropriateness of design	G-S.3., G-S.5., S.1.3., S.1.4.,S.1.8.1., S.1.8.2.,S.5.2.*(1/1/86), S.1.8.3.1 (1/10/01), S.5.4 S.1.9.2.
Prepackaging scales only.....	S.1.9.2.
Suitability for use	UR.1.,UR.1.1., UR.3.1.*, UR.3.2.,G-UR.1.1.
Damping means.....	S.2.5.
Adjustable components	S.1.10.
Provisions for sealing	S.1.11.(a) (1/1/79), S.1.11.(b) (1/1/90), S.1.11(c) (1/1/95), G- UR.4.5.,G-S.8.(1/1/90), S.1.8.3.1. (1/1/01)
 5. Weighing elements	
Antifriction means.....	S.4.1.
Adjustable components	S.4.2.
Multiple load-receiving elements	S.4.3.
Drainage, if wet commodities are weighed	S.3.2., UR.3.6.
Scoop counterbalances	S.3.3.

Pretest Determinations:

Tolerances.

1. Acceptance/maintenance G-T.1., G-T.2.
2. Application..... G-T.3.

EPO No. 1**Pretest Determinations (cont.):**

3. Tolerance values:	
Determine number of scale divisions (n) ¹	n = <u>Scale capacity</u> Value of scale division
If scale is marked with an accuracy designation.....	T.N.2.1.,T.N.2.3., T.N.2.4., T.N.3.1./ Table 6 (Class III), T.N.3.2., T.N.4.4., T.N.5.
If scale is unmarked but n equals 5000 or less	T.1.1.,T.N.2.1., T.N.2.3., T.N.2.4.,T.N.3.1./Table 6 (Class III),T.N.3.2., T.N.4.3., T.N.5.
Unmarked postal & parcel post scales.....	T.1.2.
Discrimination.....	T.N.7.1, T.N.7.2., N.1.5.(1/1/86), N.1.5.1

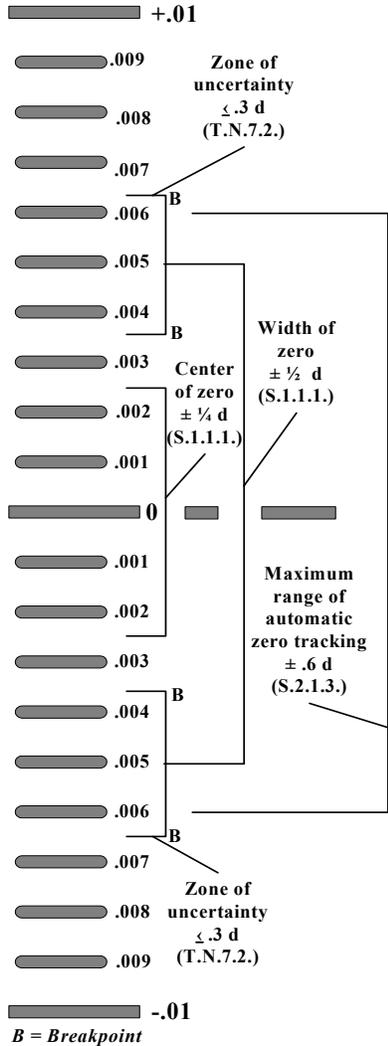
Test Notes:

1. Check repeatability of, and agreement between, indications throughout test	G-S.5.2.2.(a), T.N.5., G-S.5.4.
2. Recheck zero-load balance each time test load is removed.	N.1.9., G-UR.4.2.
3. If scale is equipped with a printer, print ticket or label at each test load. Check effectiveness of motion detection, and check labels and weight and money value agreement.....	G-S.5.2.2.,G-S.5.5., G-S.5.6.,S.2.5.1.(b), S.1.8.2.,S.1.8.4., UR.1.3. (1/1/86)
4. Electronic scales only - If, during the conduct of the test, the performance of the device is questionable with respect to the zone of uncertainty or the width of zero (see test procedure below), adequate tests should be conducted to determine compliance.....	N.1.5. (1/1/86), N.1.5.1., S.1.1.1.(a), S.1.1.1.(b)(1/1/93)

¹ 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_{max} for the summed element shall not exceed the maximum specified for the accuracy class. (Table 3 footnote added 1998).

EPO No. 1

Test Notes (cont.):



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

Auto zero:

<u>Test action</u>	<u>Indication</u>
a. Zero scale	.00
b. Apply 0.007	+ .01
(Repeat three times. Three failures will result in scale rejection.)	
c. Zero scale	.00
d. Apply 0.007	+ .01
e. Zero Scale	.00
f. Remove 0.007	- .01 or a below zero indication
(Repeat three times. Three successive failures will result in scale rejection. If scale passes go to the next test)	

Width of zero:

<u>Test action</u>	<u>Indication</u>
a. Zero scale	.00
b. Apply 0.007	+ .01
c. Zero scale	.00
d. Remove 0.007	- .01 or a below zero indication.
e. Apply 0.015	+ .01 Stable
(Note: The scale should pass this test with 0.013. The 0.002 is added to recognize field environments. Three successive failures will result in rejection.)	
Apply or remove weights all at once in both tests. Use forceps if necessary.	

5. **Electronic scales only** - If the device is equipped with operational features such as programmable tare and/or unit prices, multiplier keys, sales accumulation, manual weight entries, price retention, or two scales with one printer, check proper operation and appropriateness G-UR.4.1., G-UR.4.2., S.4.3.,S.1.12.(1/1/93), UR.3.9.

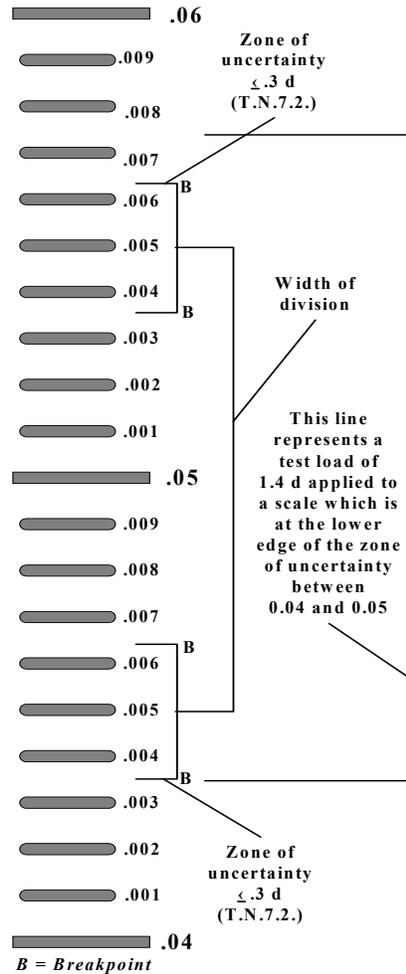
Test for Electronic Scales:

**WEAR SAFETY SHOES !
USE PROPER LIFTING TECHNIQUES !**

EPO No. 1

Test for Electronic Scales (cont.):

1. Test for discrimination at zero load (if environmental conditions permit)..... N.1.5. (1/1/86), N.1.5.1.



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

- a. With the devices at zero, place decimal weights on scale equal to 1 d.
- b. Zero the scale and place a test load equal to 5 d on the load receiver.
- c. Remove the decimal weights in 0.1 d increments until the indication flickers between 0.04 lb. and 0.05 lb. If the indication does not flicker but indicates a steady 0.04 lb, add 0.1 d. If the scale indicates 0.05 lb, it is at the breakpoint in the zone of uncertainty. (remove the 0.1 d if it was used to verify the breakpoint.)
- d. Add a test load equal to 1.4 d. to the scale (0.014 lb)
- e. The indication should read a steady 0.06 lb.
- f. If the scale passes this test at a load near zero, the test should be performed near the maximum test load.

2. Increasing-load test² (with the load centered)

at the following minimum test loads (20d):

For scales indicating in metric units:

100 grams; then at each 500 grams to 2.5 kilograms; at 2.5-kilograms intervals thereafter to one-half scale capacity (include 500d, 2000d, and 4000d)..... N.1.1.

For other scales:

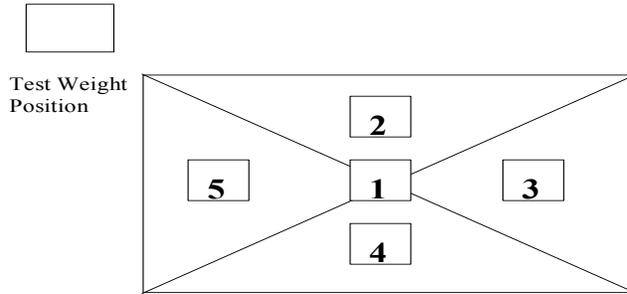
0.50 pound; then at each pound to 5 pounds; at 5 pound intervals thereafter to one-half scale capacity (include 500d, 2000d, and 4000d)..... N.1.1.

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

EPO No. 1

Test for Electronic Scales (cont.):

3. Shift test--one-half capacity load..... N.1.3.1.

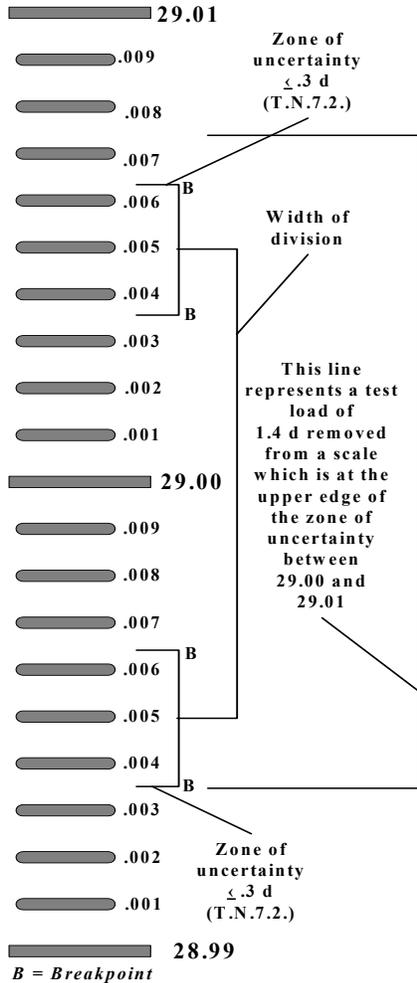


Bench and Counter Scale

4. Continue increasing-load test:
 For scales indicating in metric units - at 2.5-kilograms to capacity
 For other scales – at 5-pound intervals to capacity.
5. RFI/EMI tests (if a problem is suspected)
 Radio Frequency Interference (RFI)
 Electromagnetic Interference (EMI) at capacity..... G-UR.1.2.,G-N.2., G-UR.3.2.,
 G-UR.4.2.,
 N.1.6., T.4., T.N.9.*
6. Test for over-capacity indication..... S.1.7.
7. Test for discrimination at capacity (if environmental conditions permit)..... N.1.5. (1/1/86), N.1.5.1.
- A test load equivalent to 1.4d shall cause a change in the
 indicated or recorded value of at least 2.0d. T.N.7.2.

EPO No. 1

Test for Electronic Scales (cont.):



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

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

8. Decreasing-load test--for scales marked with an accuracy class and having 1000 or more scale divisions (d), test with loads equal to the maximum test load at each tolerance value. For example, on a Class III scale, at test loads equal to 4000d, 2000d, and 500d; for scales with n less than 1000d, the test load shall be equal to one-half of the maximum load applied in the increasing-load test. N.1.2., N.1.2.1., or N.1.2.2.
9. Recheck zero-load balance N.1.9., G-UR.4.2.
10. Test for proper design of automatic zero-setting mechanism, if scale is so equipped..... S.2.1.3.(a) (1/1/81)
Under normal operating conditions the maximum load that can be “rezeroed” when placed on or removed from the platform all at once, shall be 0.6 scale division.
11. Check proper design of tare auto-clear, if scale is so equipped..... S.2.3. (1/1/83)

Test for Electronic Scales (cont.):

EPO No. 1

- 12. If scale is equipped with a semi-automatic zero-setting mechanism, test effectiveness of motion detection..... S.2.1.2.(b)
- 13. Establish correct zero-load balance N.1.9., G-UR.4.2.

Test for Mechanical Scales:



- 1. Increasing-load test (include test loads of 500d, 2000d, and 4000d as part of this test)..... N.1.1

For scales that indicate in metric units: test loads of 30, 100, 200, and 500 grams
 For other scales: test loads of 1, 3, 7, and 15 ounces or 0.05, 0.15, 0.45, and 0.95 pounds centered,

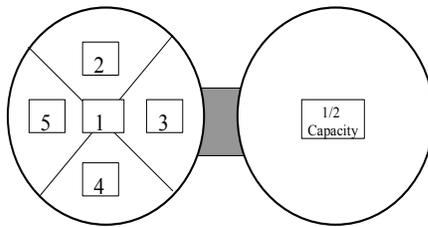
Then check:

For scales that indicate in metric units - at each 500 grams to one quarter capacity
 For other scales – at each pound to one-quarter capacity.

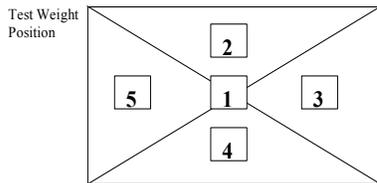
- 2. Shift test--one-half capacity load..... N.1.3.1.

Shift Test Pattern

1/2 Capacity Test Load



Equal Arm Balance



Bench and Counter Scale

- 3. Continue increasing-load test at three-quarters and capacity..... N.1.1.

Test for Mechanical Scales (cont.):

- 4. Test for discrimination at capacity

EPO No. 1

(if environmental conditions permit)..... N.1.5.(1/1/86), N.1.5.1.

A test load equivalent to 1.4d shall cause a change in the indicated or recorded value of at least 1.0d..... T.N.7.1.

- 5. Decreasing-load test N.1.2.
 For scales marked with an accuracy class and having 1000 or more scale divisions, test with loads equal to the maximum test load at each tolerance value. For example, on a Class III scale, at test loads equal to 4000d, 2000d, and 500d; for scales with n less than 1000, the test load shall be equal to one-half of the maximum load applied in the increasing-load test..... N.1.2.1.

All other scales. One-half of the maximum load applied in the increasing-load test N.1.2.2

- 6. Recheck zero-load balance G-UR.4.2, N.1.9.

- 7. Money-value test. Check chart or drum at several points G-S.5.1.

The money value computation does not exceed: S.1.8.

Maximum Money Value Interval	Price / Kilogram	Price / Pound
\$0.01	\$0.55 or less	\$0.25 or less
\$0.02	\$0.56 to \$2.75	\$0.26 to \$1.25
\$0.05	\$2.76 to \$7.50	\$1.26 to \$3.40
\$0.10	greater than \$7.50	greater than \$3.40

- 8. Establish correct zero-load balance G-UR.4.2., N.1.9.

Secure all test equipment when transporting it to next location.

EPO No. 7/8

**Examination Procedure Outline for
Medium-Capacity Scales**

It is recommended that this outline be followed for medium-capacity portable platform scales and warehouse scales, including self-contained and built-in types, with the following types of indicating elements: beams, dials, and electronic digital-indicators. Nonretroactive requirements are followed by the applicable date in parentheses.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Electrical Hazards

First Aid Kit

Lifting

Location

also: **Wet/Slick Conditions
Chemicals, Petroleum Products, and Hazardous Materials
Obstructions**

Personal Protection Equipment

e.g., Safety Shoes, Hard Hat

Support – for Scale and Test Weights

Transportation of Equipment

EPO No. 7/8

Inspection:

Safety First!!!

Check the inspection site carefully for safety hazards and take appropriate precautions.

Learn the nature of hazardous products used at or near the inspection site.

Use personal protection equipment appropriate for the inspection site.

Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.

	H-44 General Code and Scales Code References	Comments¹
1. Zero-load balance as found.		
Digital zero indication.....	G-S.5.2.2.(d) (1/1/86)	ME only
Zero indication	S.1.1.	
Normal balance position.....	S.1.5.1.	B only
Adjustment of zero-load balance.....	S.2.1.1.	
Manual and semiautomatic zero-setting.....	S.2.1.2.	
Balance condition.....	UR.4.1.	
2. General considerations		
Selection of equipment	G-UR.1.1., UR.1.1.	
Installation		
In accordance with manufacturers instructions.....	G-UR.2.1.	
Indicating and recording elements.....	G-UR.2.2.	
Foundation, supports, and clearance.....	UR.2.1., UR.2.4.(1/1/73)	
<div style="border: 3px double black; padding: 5px; margin: 0 auto; width: 80%;"> <p style="margin: 0;">Check to be sure the scale supports are adequate to support the scale <u>and</u> test weights equal to the capacity of the scale !</p> </div>		
Accessibility for inspection, testing, and sealing.....	G-UR.2.3.	
Assistance in testing.....	G-UR.4.4.	
Position of equipment	G-UR.3.3.	
Customer indications	S.1.8.3.	
Level indicating means	S.2.4.	
Level condition.....	UR.4.2.	

¹ Key to abbreviations in Comments Column:

B = Beam Scales

E = Electronic digital scales

M = Scales marked with an accuracy designation

D = Dial Scales

U = Unmarked scales

EPO No. 7/8

Inspection (cont.):

Use		
Facilitation of fraud.....	G-S.2.	
Method of operation.....	G-UR.3.1.	
Associated and nonassociated equipment	G-UR.3.2.	E only
Special designs or marked for special applications	UR.3.5.	
Environment		
Suitable for the environment in which it is used	G-UR.1.2.	
Protection from environmental factors	UR.2.3.	
Maintenance requirements	G-UR.4.1.	
Scale modification.....	UR.4.3.	
3. Marking	S.6.3.	
a. Marking requirements - all devices		
Identification	G-S.1.	
Name or ID of manufacturer.....	Retroactive	
Model designation	Retroactive	
Model prefix	(1/1/03)	
Nonrepetitive serial number	(1/1/68)	
Serial number prefix	(1/1/86)	M only
NTEP CC prefix and number	(1/1/03)	
(for devices that have an NTEP CC)		
Remanufacturer information, as appropriate:		
name and ID of remanufacturer	(1/1/02)	
model number if different from original model number ..	(1/1/02)	
Lettering.....	G-S.7.	
Operational controls, indications, and features	G-S.6. (1/1/77)	
Visibility of identification	G-UR.2.1.1.	
Interchange or reversal of parts.....	G-S.4.	
b. Marking requirements - weighing and indicating elements in same housing or covered on the same CC (in addition to marking for all devices).....	S.6.3.	
Accuracy class	(1/1/86)	M only
Nominal capacity	Retroactive	
Value of scale division with nominal capacity, if not apparent	(1/1/83)	
Value of "e" (if different from "d").....	(1/1/86)	
Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F)	(1/1/86)	M only
Scales designed for special purposes.....	(1/1/86)	M only
c. Marking requirements - indicating element not permanently attached or covered on separate CC (in addition to marking for all device)	S.6.3.	
Accuracy class	(1/1/86)	M only
Nominal capacity	Retroactive	
Value of scale division with nominal capacity, if not apparent	(1/1/83)	
Value of "e" (if different from "d").....	(1/1/86)	
Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F)	(1/1/86)	M only
Scales designed for special purposes.....	(1/1/86)	M only
Maximum number of scale divisions (n _{max}).....	(1/1/88)	

Inspection (cont.):

EPO No. 7/8

- d. Marking requirements - weighing and load receiving element not permanently attached or covered on separate CC (in addition to marking for all devices) S.6.3.
 - Accuracy class (1/1/86) M only
 - Nominal capacity Retroactive
 - Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F) (1/1/86) M only
 - Scales designed for special purposes (1/1/86) M only
 - Maximum number of scale divisions (n_{max}) (1/1/88)
 - Minimum verification scale division for which device complies with the requirements (e_{min} or d) (1/1/88)
- e. Marking requirements - load cell with Certificate of Conformance (in addition to marking for all devices)..... S.6.3., S.5.4. (1/1/94) E only

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

 - Manufacturer’s name or trademark, model designation, model prefix and serial number and prefix shall also be marked on both the load cell and in any accompanying documents..... (1/1/91)
 - Accuracy class (1/1/88)
 - Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F) (1/1/86)
 - Maximum number of divisions (1/1/88)
 - “S” or “M” for single or multiple cell applications..... (1/1/88)
 - Direction of loading, if not obvious..... (1/1/88)
 - Minimum dead load, maximum capacity, safe load limit, and load cell verification interval, v_{min}..... (1/1/88)
- 4. Design of weighing devices.....S.5. M only
 - Designation of accuracy class.....(1/1/86)
 - Parameters of accuracy class.....(1/1/86)
 - Multi-interval/multiple-range scale division value
- 5. Indicating and recording elements
 - Value of scale division S.1.2. (1/1/86) M only
 - Weight units S.1.2.1.(1/1/89) E only
 - Values of graduated intervals or increments G-S.5.3.
 - Devices that indicate or record in more than one unit G-S.5.3.1.
 - Prepackaging scales only..... S.1.9.1.

Tare

 - Value of tare division S.2.3. (1/1/83)
 - Tare mechanism..... S.2.3. (1/1/83)
 - Combined zero-tare (“0/T”) key S.2.1.6.

Appropriateness of design

 - Indicating and recording elements G-S.5.
 - Capacity indication, weight ranges, and unit weights..... S.1.7.

Inspection (cont.):

Appropriateness of design (cont.)

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Recommended minimum load	UR.3.1.	M only
Maximum Load	UR.3.2.	
Weighbeams	S.1.5. ex S.1.5.5.	B&D only
Poises	S.1.6.	B&D only
Dials and balance indicators with graduations having a specific value.		
Graduations	S.1.3.	B&D only
Indicators	S.1.4.3., S.1.4.2.	B&D only
Clearance	S.1.4.4.	B&D only
Parallax	S.1.4.5.	B&D only
Damping		
Damping means	S.2.5.	
Electronic elements	S.2.5.1. (b)	E only
Adjustable components	S.1.10.	
Provision for sealing	S.1.11. (a) (1/1/79)	
	S.1.11. (b) (1/1/90)	E only
	S.1.11. (c) (1/1/95), G.S.8.	E only
Security seal	G-UR.4.5.	
6. Weighing elements		
Antifriction means	S.4.1.	
Adjustable components	S.4.2.	
Multiple load-receiving elements	S.4.3.	
Drainage, if wet commodities are weighed	S.3.2., UR.3.6.	

Pretest Determinations:

1. Tolerances.		
Acceptance/maintenance	G-T.1., G-T.2.	
Application	G-T.3.	
Principles	T.N.1.	M only
Tolerance values:		
Determine number of scale divisions (n) ²	$n = \frac{\text{Scale capacity}}{\text{Value of scale division}}$	
If scale is marked with an accuracy designation or for unmarked scales with 5000 or fewer scale divisions.		
Tolerance application – unmarked	T.1.1.	U only
Tolerance application - marked	T.N.2.1.	M only
Subsequent verification examinations	T.N.2.3.	M only
Multirange scales	T.N.2.4.	M only

Pretest Determinations (cont.):

Tolerance Values (cont.)		
Ratio tests	T.N.2.5.	MB only
Maintenance tolerance values	T.N.3.1./Table 6 (Class III)	
Acceptance tolerance values	T.N.3.2.	

² 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_{max} for the summed element shall not exceed the maximum specified for the accuracy class. (Table 3 footnote added 1998).

EPO No. 7/8

Multiple indicating/recording elements	T.N.4.1.	M only
Single indicating/recording elements.....	T.N.4.2	M only
Single indicating element/multiple indications.....	T.N.4.3	M only
Shift or section test	T.N.4.4.	M only
Repeatability.....	T.N.5.	M only
2. Sensitivity.		
Application.....	T.2.1.	UB only
General.....	T.2.2.	UB only
Sensitivity requirement, equilibrium change.....	T.3.1.	UB only
Sensitivity	T.N.6.	MB only
3. Discrimination.		
Analog automatic indicating (includes balance indicators with graduations having specific values).....		
	T.N.7.1.	MD only
Digital automatic indicating.....	T.N.7.2.	ME only
4. Minimum test weights and test loads.....		
	N.3.	

Test Notes:

1. Error weights. Balance small error weights on the platform, the smallest weight being equal to the minimum tolerance value at maximum test load.
2. Check repeatability and agreement between indications throughout the test.
 - Repeatability of indications..... G-S.5.4.
 - Digital indication and representation G-S.5.2.2.
3. Recheck zero-load balance each time test load is removed.
 - Zero-load balance change N.1.9.
 - Abnormal performance G-UR.4.2.
4. If scale is equipped with a ticket printer or type-recording beam, print ticket at each test load. Check effectiveness of motion detection.
 - Digital indication and representation G-S.5.2.2.
 - Recorded representations G-S.5.6.
 - Money value, mathematical agreement..... G-S.5.5.
 - Motion detection S.2.5.1.(b) E only
 - Value of the indicated and recorded scale division..... UR.1.3.(1/1/86) M only
5. If, during the conduct of the test, the performance of the device is questionable with respect to the zone of uncertainty or the width of zero,

Test Notes (cont.):

adequate tests should be conducted to determine compliance; however, they must be conducted under controlled conditions.

Digital indicating elements.....	S.1.1.1.(1/1/93)	E only
Discrimination test	N.1.5.	MD/Eonly
Digital device	N.1.5.1.	ME only

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6. If the device is equipped with operational features such as programmable tare, multiple tare memory, weigh-in/weigh-out, or multiple weighing elements, check proper operation and appropriateness. E only
- Maintenance of equipment G-UR.4.1.
 - Abnormal performance G-UR.4.2.
 - Multiple load-receiving elements S.4.3.
 - Manual gross weight entry S.1.12.(1/1/93), UR.3.9.

Test:



1. Sensitivity test at zero load N.1.4. B only
2. Discrimination test at zero load, if applicable N.1.5.(1/1/86) MD/E
 Digital Device..... N.1.5.1. E only
3. Increasing-load test (with the load centered) N.1.1.
 Initial verification – to capacity N.3.
 Subsequent verification
- a. Small Scales - at minimum load (20d), 500d, 2000d, 4000d to capacity
 - b. Larger scales – at minimum load (20d), 500d, 2000d, 4000d to capacity or, at tolerance intervals to table 4 values.
 - c. Beam scales - at a minimum, test at half and full capacity on weighbeam. Scales not equipped with a full capacity beam should be ratio tested using standard weights on counterpoise hanger. At each test load, test scale counterpoise weights by substituting them for standard weights. If there is a noticeable change in indication, remove the counterpoise weight from service until it can be determined that it meets the requirements in the Weight Code of NIST Handbook 44. N.1.7. B only

Test (cont.):

4. Shift test Use quarter-capacity test load centered successively over each main load support or half-capacity load centered successfully at the center of each quarter of the load-receiving element (can be conducted during increasing-load test)..... N.1.3.8.
5. Sensitivity test at maximum test load N.1.4. B only
 Discrimination test at maximum test load..... N.1.5. MD&Eonly

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(if applicable)

- 6. RFI/EMI tests (if a problem is suspected)
 - Radio Frequency Interference (RFI)
 - Electromagnetic Interference (EMI)
 - Testing with nonassociated equipment..... G-N.2. E only
 - Environment..... G-UR.1.2.
 - Associated and nonassociated equipment G-UR.3.2. E only
 - Abnormal performance G-UR.4.2. E only
 - Presence of RFI verified..... N.1.6.
 - Tolerance
 - Unmarked scales..... T.4. U only
 - Marked Scales T.N.9. M only
- 7. Test for over-capacity indication. S.1.7.
- 8. Decreasing-load test..... N.1.2. D&Eonly
 - Scales marked I, II, III, or IIII N.1.2.1. M only
 - Tests shall be conducted with test loads equal to the maximum test load at each tolerance value. For example, on a Class III scale, at test loads equal to 4000d, 2000d, and 500d; for scales with n less than 1000, the test load shall be equal to one-half of the maximum load applied in the increasing-load test.
 - All other scales..... N.1.2.2.
 - The test load shall be equal to one-half of the maximum load applied in the increasing-load test.
- 9. Recheck zero-load balance.....N.1.9., G-UR.4.2.
- 10. Substitution or strain load test Table 4.
 - The scale shall be tested from zero to at least 12.5 percent of scale capacity using known test weights and then to at least 25 percent of scale capacity using either a substitution or strain load test that utilizes known test weights of at least 12.5 percent of scale capacity. Not more than three substitutions shall be used during substitution testing. Whenever practical, a strain load test should be conducted to the used capacity of the scale. Tolerance applies only to the known test load.
- 11. Recheck zero-load balance..... N.1.9., G-UR.4.2.

Test (cont.):

- 12. Conduct out-of-level test (portable scales without level-indicating means only)..... S.2.4.
- 13. Test for proper design of automatic zero-setting mechanism, if scale is so equipped. S.2.1.3.(c) (1/1/81) E only

Under normal operating conditions the maximum load that can be “rezeroed” when placed on or removed from the platform all at once, shall be 1.0 scale division.

EPO No. 7/8

- 14. Check proper design of tare auto-clear,
if scale is so equipped. S.2.3. (1/1/83) E only

- 15. If scale is equipped with a semi-automatic
zero-setting mechanism, test effectiveness. S.2.1.2. E only
of motion detection

- 16. Establish correct zero-load balance. N.1.9., G-UR.4.2.

After all equipment at a location has been tested, review
results to determine compliance with equipment
maintenance and use of adjustments. G-UR.4.1., G-UR.4.3.

EPO No. 9

**Examination Procedure Outline for
Mechanical Meat Beams and Monorail Scales**

It is recommended that this outline be followed for meat beams and monorail scales equipped with weigh-beams or mechanical dials. Requirements that apply only to scales marked with an accuracy class are indicated with an asterisk. Nonretroactive requirements are followed by the applicable date in parentheses.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Clothing

First Aid Kit

Lifting

Location

also: **Wet/Slick Conditions**
Overhead Hazards
Obstructions

Personal Protection Equipment

e.g., **Safety Shoes**

Hardhat – for protection from overhead hazards
(e.g., meat hooks)

Eye Protection – for protection from hanging
meat hooks

Support – for scales, test weights, and meat hooks, or
test platform

Transportation of Equipment

EPO No. 9

Inspection:

Check the inspection site carefully for safety hazards and take appropriate precautions.

Use caution in moving in wet, slippery areas.

Use personal protection equipment appropriate for the inspection site.

Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.

H-44 General Code and Scales Code References

- 1. Zero-load balance as found S.1.1., S.2.1.1., S.2.1.2., UR.4.1.
 If the device is not in balance, the user should be made aware of paragraph UR.4.1., and a warning issued if necessary. If device is set for tare, check accuracy of the tare being taken.

- 2. Indicating and recording elements.
 - Scale division, value (d) and number (n) S.1.2.*; G-UR.1.1., UR.1., UR.1.1.(b), G-S.5.3.
 - Tare division value S.2.3.(1/1/83)
 - Tare mechanism S.2.3.
 - Weighbeams S.1.5. except S.1.5.5.
 - Poises S.1.6.
 - Dials and balance indicators S.1.3., S.1.4., S.2.2.
 - Appropriateness G-S.5., S.1.7., UR.1.1.(a)*, UR.3.1.*, S.5.*, UR.3.2.
 - Damping means S.2.5.
 - Customer readability, if applicable G-UR.3.3.
 - Adjustable components S.1.10.

- 3. Marking S.6.3., S.6.2
 - a. Marking requirements - all devices
 - Identification G-S.1.
 - Name or ID of manufacturer Retroactive
 - Model designation Retroactive
 - Model prefix (1/1/03)
 - Nonrepetitive serial number (1/1/68)

Inspection (cont.):

EPO No. 9

Marking requirements - all devices (cont.)

Identification G-S.1.

 Serial number prefix (1/1/86)

 NTEP CC prefix and number (1/1/03)

 (for devices that have an NTEP CC)

 Remanufacturer information, as appropriate:

 name and ID of remanufacturer (1/1/02)

 model number if different from original model number (1/1/02)

 Lettering G-S.7.

 Operational controls, indications, and features G-S.6. (1/1/77)

 Visibility of identification G-UR.2.1.1.

 Interchange or reversal of parts G-S.4.

b. Marking requirements - weighing and indicating elements in same housing or covered on the same CC
(in addition to marking for all devices) S.6.3.

 Accuracy class (1/1/86)

 Nominal capacity Retroactive

 Value of scale division with nominal
 capacity, if not apparent (1/1/83)

 Value of "e" (if different from "d") (1/1/86)

 Temperature limits if other than
 -10 °C to 40 °C (14 °F to 104 °F) (1/1/86)

 Scales designed for special purposes (1/1/86)

c. Marking requirements - indicating element not permanently attached or covered on separate CC
(in addition to marking for all device) S.6.3.

 Accuracy class (1/1/86)

 Nominal capacity Retroactive

 Value of scale division with nominal
 capacity, if not apparent (1/1/83)

 Value of "e" (if different from "d") (1/1/86)

 Temperature limits if other than
 -10 °C to 40 °C (14 °F to 104 °F) (1/1/86)

 Scales designed for special purposes (1/1/86)

 Maximum number of scale divisions (n_{max}) (1/1/88)

d. Marking requirements - weighing and load receiving element not permanently attached or covered on separate
CC (in addition to marking for all devices) S.6.3.

 Accuracy class (1/1/86)

 Nominal capacity Retroactive

 Temperature limits if other than
 -10 °C to 40 °C (14 °F to 104 °F) (1/1/86)

 Scales designed for special purposes (1/1/86)

 Maximum number of scale divisions (n_{max}) (1/1/88)

 Minimum verification scale division for which
 device complies with the requirements (e_{min} or d) (1/1/88)

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

Inspection (cont.):

EPO No. 9

- 5. Design of balance, tare, level, damping, and arresting mechanisms S.2.1.4, S.2.1.5, S.2.1.6
- 6. Design of weighing elements S.4

Check to be sure the scale supports are adequate to support the scale, test weights equal to the capacity of the scale, and test platforms or chains used to suspend test weights!

- 7. Maintenance, use, and environmental factors (cleanliness, obstructions, modifications, etc.)..... G-S.2., G-UR.1.2., G-UR.3.1., G-UR.4., UR.4.3.
- 8. Assistance G-UR.4.4.

Pretest Determinations:

- 1. Tolerances.
 - Acceptance/maintenance..... G-T.1., G-T.2.
 - Application..... T.N.2.1., T.N.2.3., T.N.2.5.
 - Tolerance values:
 - Scales marked with an accuracy class..... T.N.3.1. Table 6 (Class III), T.N.3.2., T.N.4., T.N.5.
 - Scales not marked T.1.1., T.N.3.1. Table 6 (Class III), T.N.3.2., T.N.4.1., T.N.4.2., T.N.4.3., T.N.5.
 - Discrimination T.N.7.1.*
 - Sensitivity:
 - Scales marked T.N.6.1.(b), T.N.6.2.
 - Scales not marked T.2.1., T.2.2., T.3.
- 2. Select trolleys, trees, chains, or other auxiliary gear necessary to suspend test weights on rail or meat hook. If two or more trolley-and-tree combinations are used, they should be uniform in weight within ± 57 grams (± 2 ounces).

EPO No. 9

Pretest Determinations (cont.):

Wear appropriate personal protection equipment such as hard hats and eye protection to prevent injury from overhead meat hooks and hanging carcasses.

Wear safety shoes to prevent possible injury from falling weights and slipping on slick surfaces.

3. Minimum test weights and test load..... N.3.

Test Notes:

1. Suspend auxiliary gear (trolleys, trees, chains) from live rail or hook as required.
2. If beam scale, place small error weights on or suspend from the live rail or hook. The Value of the smallest weight should be equal to the minimum tolerance value and the total of all the weights should be equal to the tolerance at maximum test load.
3. Balance in auxiliary gear and error weights.
4. Check repeatability of and agreement between indications throughout test..... G-S.5.2.2.(b), T.N.5.
5. Recheck zero-load balance each time test load is removed..... N.1.9., G-UR.4.2.
6. If scale is equipped with a type-recording beam or printer, print a ticket at each test load..... G-S.5.6.

Test:

**WEAR SAFETY SHOES!
USE PROPER LIFTING TECHNIQUES !**

1. Sensitivity test at zero-load (weighbeams only) N.1.4.
Discrimination at zero load (dials only)..... N.1.5.
2. Increasing-load test..... N.1.1.
 - a. Beam scales. Test at not less than three graduations or notches on weigh-beam. Scales not equipped with a full capacity beam should be ratio tested using standard weights on counterpoise hanger. When ratio testing, test poise and beam by substituting poise position with the removal of standard weights from counterpoise hanger. N.1.7.
 - b. Dial scales. Test at not less than three points on reading face, including all possible quarters of capacity. Test all unit weights possible. If equipped with tare bars, test at one-half and full capacity of each bar.

Test (cont.):

EPO No. 9

- 3. Shift test. Use test load equal to the largest load that can be anticipated, but never less than one-half capacity. Apply load successively on the right end, the left end and the center of the live rail. This can be conducted during the increasing-load test N.1.3.6.
- 4. Beams and balance indicators only, SR at maximum test load..... N.1.4.
Dials only, discrimination at maximum test load. N.1.5.
- 5. Dials only. Decreasing-load test at one-half of maximum test load (at no less than one-half dial face capacity)..... N.1.2.1.* , N.1.2.2.
- 6. Beams only. Counterpoise weight test (see EPO for Weights).
- 7. Remove all test weights and determine any zero-load balance change N.1.9., G-UR.4.2.
- 8. Remove error weights and/or auxiliary gear and establish correct zero-load balance.

EPO No. 9E

**Examination Procedure Outline for
Monorail Scales Equipped with
Electronic Digital Indicators**

It is recommended that this outline be followed for monorail scales equipped with electronic digital indicators used to weigh statically or dynamically. Requirements that apply only to scales marked with an accuracy class are indicated with an asterisk. Nonretroactive requirements are followed by the applicable date in parentheses.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Clothing

First Aid Kit

Lifting

Location

also: **Wet/Slick Conditions**
Overhead Hazards
Obstructions

Personal Protection Equipment

e.g., **Safety Shoes**

Hardhat – for protection from overhead hazards
(e.g., meat hooks)

Eye Protection – for protection from hanging
meat hooks

Support – for scales, test weights, and meat hooks, or
test platform

Transportation of Equipment

EPO No. 9E

Inspection:

Safety First !!!

<p>Check the inspection site carefully for safety hazards and take appropriate precautions.</p> <p>Use caution in moving in wet, slippery areas.</p> <p>Use personal protection equipment appropriate for the inspection site.</p> <p>Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.</p>
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H-44 General Code and Scales Code References

- 1. Zero-load balance as found. If the device is not in balance, the user should be made aware of paragraph UR.4.1., and a warning issued if necessary. If device is set for tare, check accuracy of the tare being taken. S.1.1., S.1.1.1., S.2.1.1., S.2.1.2., S.2.1.4., UR.4.1., G-S.5.2.2(d)*
- 2. Indicating and recording elements.
 - Scale division, value (d) and number (n) S.1.2.*, S.1.2.1. (1/1/89), S.1.2.2. S.5.*, G-UR.1.1., UR.1.1., UR.1.1.(b), G-S.5.3., UR 1.3.1(a), UR.3.10.
 - Tare division value S.2.3. (1/1/83), S.2.3.1.
 - Tare mechanism S.2.3.
 - Appropriateness G-S.5., S.1.7., S.5.2.*; UR.1.1.(a)*, UR.3.1.*
 - Customer readability, if applicable G.UR.3.3.
 - Damping means S.2.5., S.2.5.1.
 - Adjustable components S.1.10.
 - Provision for sealing S.1.11. (1/1/90), G-UR. 4.5., G.S.8.

Inspection (cont.):

EPO No. 9E

3. Marking	S.6.3., S.6.2.
a. Marking requirements - all devices	
Identification	G-S.1.
Name or ID of manufacturer	Retroactive
Model designation	Retroactive
Model prefix	(1/1/03)
Nonrepetitive serial number	(1/1/68)
Serial number prefix	(1/1/86)
NTEP CC prefix and number (for devices that have an NTEP CC)	(1/1/03)
Remanufacturer information, as appropriate:	
name and ID of remanufacturer	(1/1/02)
model number if different from original model number	(1/1/02)
Lettering	G-S.7.
Operational controls, indications, and features	G-S.6. (1/1/77)
Visibility of identification	G-UR.2.1.1.
Interchange or reversal of parts	G-S.4.
b. Marking requirements - weighing and indicating elements in same housing or covered on the same CC (in addition to marking for all devices)	S.6.3.
Accuracy class	(1/1/86)
Nominal capacity	Retroactive
Value of scale division with nominal capacity, if not apparent	(1/1/83)
Value of "e" (if different from "d")	(1/1/86)
Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F)	(1/1/86)
Scales designed for special purposes	(1/1/86)
c. Marking requirements - indicating element not permanently attached or covered on separate CC (in addition to marking for all device)	S.6.3.
Accuracy class	(1/1/86)
Nominal capacity	Retroactive
Value of scale division with nominal capacity, if not apparent	(1/1/83)
Value of "e" (if different from "d")	(1/1/86)
Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F)	(1/1/86)
Scales designed for special purposes	(1/1/86)
Maximum number of scale divisions (n_{max})	(1/1/88)
d. Marking requirements - weighing and load receiving element not permanently attached or covered on separate CC (in addition to marking for all devices)	S.6.3.
Accuracy class	(1/1/86)
Nominal capacity	Retroactive
Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F)	(1/1/86)
Scales designed for special purposes	(1/1/86)
Maximum number of scale divisions (n_{max})	(1/1/88)
Minimum verification scale division for which device complies with the requirements (e_{min} or d)	(1/1/88)

Inspection (cont.):

e. Marking requirements - load cell with Certificate of Conformance	S.6.3., S.5.4. (1/1/94)
(in addition to marking for all devices)	

EPO No. 9E

Note: Requires information on a data plate attached to the load cell or in accompanying document. If a document is provided, the serial number shall appear on the load cell and in the document..... (1/1/88)
 Manufacturer’s name or trademark, model designation, model prefix, and serial number and prefix shall also be marked on both the load cell and in any accompanying documents..... (1/1/91)
 Accuracy class..... (1/1/88)
 Temperature limits if other than -10°C to 40°C (14°F to 104°F)..... (1/1/86)
 Maximum number of divisions..... (1/1/88)
 “S” or “M” for single or multiple cell applications..... (1/1/88)
 Direction of loading, if not obvious..... (1/1/88)
 Minimum dead load, maximum capacity, safe load limit, and load cell verification interval, v_{\min} (1/1/88)

- 4. Design of weighing elements..... S.4.
- 5. Installation UR.2.3., UR.2.4., G-UR.2.

Check to be sure the scale supports are adequate to support the scale, test weights equal to the capacity of the scale and test platforms or chains used to suspend test weights !

- 6. Maintenance, use, and environmental factors (cleanliness, obstructions, modifications, etc.)..... G-S.2., G-UR.1.2., G-UR.3.1., G-UR.3.2., G-UR.4., UR.4.3.
- 7. Assistance..... G-UR.4.4.
- 8. Provisions for testing and accessibility..... UR.2.9., G-UR.2.3.
- 9. Determination of Load Cell Suitability (applicable to load cells with an NTEP Certificate of Conformance):
 - a. The number of scale divisions (n) of the scale is less than or equal to the n_{\max} of the indicator or the load cells, whichever is less; e.g., if the indicator has an n_{\max} of 10,000 and the load cells have an n_{\max} of 5,000, then the scale may use up to 5,000 divisions.
 - b. The load cell is approved for the required accuracy class. **Note:** A Class II load cell may be used in a Class III application; however the opposite is not true.
 - c. The load cell is rated Single (S) or Multiple (M) use as appropriate to the application. **Note:** A load cell rated for single use may be used in a single or multiple load cell application; however, a load cell rated for multiple use cannot be used in a single load cell application.

Inspection (cont.):

- d. The load cell complies with the requirements for temperature effect on zero-load balance S.5.4., T.N.8.1.3.

EPO No. 9E

Note: Testing to determine the effect of temperature on zero-load balance cannot be performed in the field; however, for purposes of field inspection, a load cell is considered to comply with T.N.8.1.3. if the v_{min} value marked on the load cell is less than or equal to the v_{min} value as calculated below based upon the “d” and “N” for the scale; if it is not, the scale does not comply with T.N.8.1.3.

Full electronic scale with more than one load cell: The verification scale division v_{min} , for the load cells must be less than or equal to the scale division, “d,” divided by the square root of the number of load cells, N, used in the scale:

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

For Example:

A monorail scale with two load cells and a displayed scale division of 1 lb, the maximum value permitted for each load cell is 0.71 lb. The calculation is shown below. If the value marked on the load cell is less than or equal to the value computed for the v_{min} , then the load cell is considered to comply with T.N.8.1.3.

$$v_{min} \leq \frac{d}{\sqrt{N}} = \frac{1 \text{ lb}}{\sqrt{2}} = \frac{1 \text{ lb}}{1.414} = 0.71 \text{ lb}$$

For scales with mechanical lever systems:

$$v_{min} \leq \frac{d}{\sqrt{N} \times \text{scale multiple}}$$

Pretest Determinations:

1. Tolerances.
 - Acceptance/Maintenance..... G-T.1., G-T.2.
 - Application T.N.2.1., T.N.2.3., T.N.2.4.
 - Tolerance values:
 - Scales marked with an accuracy T.N.3.1. Table 6 (Class III), T.N.3.2., T.N.3.8., T.N.4.1., T.N.4.4., T.N.4.5., T.N.5.
 - Scales not marked..... T.1.1., T.N.3.1. Table 6 (Class III), T.N.3.2., T.N.3.8., T.N.4.1., T.N.5.
 - Discrimination T.N.7.2.

Pretest Determinations:

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

Wear appropriate personal protection equipment such as hard hats and eye protection to prevent injury from overhead meat hooks and hanging carcasses falling weights and slipping on slick surfaces.

EPO No. 9E

- 3. Minimum test weights and test loads..... N.3.

Test Notes:

- 1. Suspend auxiliary gear (trolleys, trees, chains) from live rail.
- 2. Balance in auxiliary gear.
- 3. Check repeatability and agreement between indications throughout test. T.N.5., G-S.5.2.2.(a)
- 4. Check zero-load balance each time test load is removed..... N.1.9., G-UR.4.2.
- 5. If the scale is equipped with a printer, print a ticket at each test load; check effectiveness of motion detection. G-S.5.6., S.2.5.1., UR.1.3.(1/1/86)
- 6. If, during the conduct of the test, the performance of the device is questionable with respect to the zone of uncertainty or the width of zero, adequate tests should be conducted to determine compliance. N.1.5., N.1.5.1., S.1.1.1.
- 7. If the device is equipped with operational features such as automatic zero-setting mechanism, programmable tare,*manual weight entries, or two scales with one printer, check proper operation and appropriateness.

*Note: See UR.3.9. The use of manual gross weight entries, are not allowed on monorail scales.

EPO No. 9E

Static Test:

**WEAR SAFETY SHOES !
USE PROPER LIFTING TECHNIQUES !**

- 1. Increasing-load test. Test at not less than three points to maximum capacity test load. N.1.1.
- 2. Shift test. Use test load equal to the largest load that can be anticipated to be weighed at the installation, but never less than one-half capacity. Apply load successively on the right end, the left end, and the center of the live rail. This can be conducted during the increasing-load test..... N.1.3.6.
- 3. RFI/EMI test (if a problem is suspected)..... G-N.2., G-UR.3.2., G-UR.4.2., G-UR.1.2., N.1.6., T.4., T.N.9.*

Radio Frequency Interference (RFI)
Electromagnetic Interference (EMI)
- 4. Over-capacity test, if deemed necessary S.1.7., S.2.1.5.
- 5. Decreasing-load test. Test at one-half of maximum test load. N.1.2.
- 6. Remove all test weights and determine any zero-load balance change. N.1.9., G-UR.4.2.
- 7. Test for proper design of automatic zero-setting mechanism, if device is so equipped S.2.1.3.(c) (1/1/81)
- 8. If device is equipped with a semi-automatic zero-setting mechanism (push button), test effectiveness of motion detection. S.2.1.2.(b)
- 9. Establish correct zero-load balance.

Dynamic test N.1.3.6.1.

On a dynamic test with 20 or more test drafts, 10 percent of the individual test drafts may be two times the basic tolerances, providing the error on the total of all test load drafts does not exceed 0.2 percent.

- 1. Conduct dynamic test w/livestock carcasses
- 2. Test no less than 20 test loads using carcasses or portions of carcasses of the type normally weighed. (two additional test loads may be included in the test run in the event that one or two of the test load are rendered unusable.

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Dynamic test (cont.) N.1.3.6.1.

3. Position the test carcasses far enough ahead of the scale so the swaying motion settles to duplicate the normal sway of a continuously running plant chain.
4. If the plant conveyor chain does not space or prevent the carcasses from touching one another, the dynamic test should not be conducted until this condition is corrected.
5. Individually weigh (statistically) the carcasses on the same scale being tested or another monorail scale in close proximity with the same or smaller divisions.
 - a) The scale selected for weighing the carcasses must be tested statically with test weights.
6. If the scale being tested is used for weighing freshly slaughtered animals, a static weighing of the carcasses must be taken as quickly as possible before or following the Dynamic weighing to avoid loss due to shrinkage.
7. If multiple dynamic tests are conducted using the same carcasses, obtain static weights before and after multiple dynamic tests.
8. If the carcass changes weight between static tests, the amount of weight change should be taken into account, or the carcass should be discarded for tolerance purposes.

EPO No. 12

**Examination Procedure Outline for
Livestock and Animal Scales
Mechanical – Analog Indicating**

It is recommended that this outline be followed for livestock and animal scales equipped with weighbeams or dials. Requirements that apply only to scales marked with an accuracy class are indicated with an asterisk. Nonretroactive requirements are followed by the applicable date in parentheses.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Clothing	Personal Protection Equipment
Electrical Hazards	e.g., Safety Shoes Hard Hat
First Aid Kit	Safety Cones/Warning Signs
Lifting	Support – for Scale and Test Weights
Location	Transportation of Equipment
also: Wet/Slick Conditions Overhead Hazards, Obstructions	

EPO No. 12

Inspection:

Safety First!!!

<p>Check the inspection site carefully for safety hazards and take appropriate precautions.</p> <p>Use caution in moving in wet, slippery areas.</p> <p>Use personal protection equipment appropriate for the inspection site.</p> <p>Position safety cones and warning signs if necessary.</p> <p>Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.</p>
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H-44 General Code and Scales Code References

- 1. Zero-load balance as found..... S.1.1., S.2.1.1., S.2.1.2., S.1.5.1., UR.4.1.
- 2. General Considerations
 - Selection G.S.3., G-UR.1.1, UR.1.
 - Installation..... G-UR.2.,
 - Supports for portable scale UR.2.1
 - Protection from environment UR.2.3.
 - Foundation, supports, and clearance..... UR.2.4.
 - Access to weighing elements..... UR.2.5.
 - Stock racks UR.2.7.

<p>Check to be sure the scale supports are adequate to support the scale <u>and</u> test weights equal to the capacity of the scale !</p>
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- Accessibility for inspection, testing, and sealing..... G-UR.2.3.
- Assistance..... G-UR.4.4.
- Position, customer readability G-UR.3.3.
- Maintenance, use, and environmental factors.
- Facilitation of fraud G-S.2.
- Environment G-UR.1.2.
- Operation..... G-UR.3.1.
- Maintenance G-UR.4.
- Maximum load UR.3.2.
- Minimum load for livestock UR.3.8.
- Scale modification UR.4.3.
- 3. Marking S.6.3., S.6.2
 - Nominal capacityS.6.1. (1/1/86) (livestock only)
 - Nominal capacity must satisfy the relationship of:
nominal capacity \leq CLC x (N - 0.5), where N = the number of sections in the scale

Inspection (cont.):

EPO No. 12

- a. Marking requirements - all devices
 - Identification G-S.1.
 - Name or ID of manufacturer..... Retroactive
 - Model designation Retroactive
 - Model prefix (1/1/03)
 - Nonrepetitive serial number (1/1/68)
 - Serial number prefix (1/1/86)
 - NTEP CC prefix and number
(for devices that have an NTEP CC) (1/1/03)
 - Remanufacturer information, as appropriate:
 - name and ID of remanufacturer (1/1/02)
 - model number if different from original model number (1/1/02)
 - Lettering G-S.7.
 - Operational controls, indications, and features..... G-S.6. (1/1/77)
 - Visibility of identification G-UR.2.1.1.
 - Interchange or reversal of parts G-S.4.
- b. Marking requirements - weighing and indicating elements in same housing or covered on the same CC
(in addition to marking for all devices) S.6.3.
 - Accuracy class (1/1/86)
 - Nominal capacity..... Retroactive
 - Value of scale division with nominal capacity, if not apparent (1/1/83)
 - Value of "e" (if different from "d")..... (1/1/86)
 - Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F)..... (1/1/86)
 - Scales designed for special purposes..... (1/1/86)
- c. Marking requirements - indicating element not permanently attached or covered on separate CC
(in addition to marking for all device)..... S.6.3.
 - Accuracy class..... (1/1/86)
 - Nominal capacity..... Retroactive
 - Value of scale division with nominal
capacity, if not apparent (1/1/83)
 - Value of "e" (if different from "d")..... (1/1/86)
 - Temperature limits if other than
-10 °C to 40 °C (14 °F to 104 °F) (1/1/86)
 - Scales designed for special purposes..... (1/1/86)
 - Maximum number of scale divisions (n_{max})..... (1/1/88)
- d. Marking requirements - weighing and load receiving element not permanently attached or covered on separate
CC (in addition to marking for all devices) S.6.3.
 - Accuracy class (1/1/86)
 - Nominal capacity..... Retroactive
 - Nominal capacity on load receiving element..... (1/1/89) (livestock only)
 - Concentrated Load Capacity (CLC) on the load-
receiving element (for scales manufactured prior
to 1989, the Section Capacity may be used as the
CLC; except that, the CLC marking must be
added at the time of modification to any scale
not previously marked)..... (1/1/89) (livestock only)

EPO No. 12

Inspection (cont.):

Marking requirements (cont.) - weighing and load receiving element not permanently attached or covered on separate CC (in addition to marking for all devices) S.6.3.
 Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F) (1/1/86)
 Scales designed for special purposes (1/1/86)
 Maximum number of scale divisions (n_{max}) (1/1/88)
 Minimum verification scale division for which device complies with the requirements (e_{min} or d) (1/1/88)

4. Indicating and recording elements. S.1.2.* (1/1/86)
 Value of Scale Division S.1.2.* (1/1/86)
 Designation of accuracy class S.5.*, UR.1.1.
 Weighbeams S.1.5. except S.1.5.5.
 Poles S.1.6.
 Dials and balance indicators¹ S.1.3., S.1.4.
 Damping means S.2.5. except S.2.5.1. and S.2.5.2.

Appropriateness.
 Indicating and recording elements G.S.5. except G-S.5.2.2.
 Parameters for Accuracy Class S.5.2.(1/1/86)*
 Selection UR.1.1.
 Suitability G-UR.1.1.
 Recommended minimum load UR.3.1.*
 Maximum load UR.3.2.
 Adjustable components S.1.10.

5. Design of weighing elements S.4.

Pretest Determinations:

1. Tolerances.
 Acceptance/maintenance G-T.1., G-T.2.
 Application G-T.3., G-T.4., T.N.2.1., T.N.2.3.
 Ratio tests T.N.2.5.

Tolerance values: Scale capacity
 Determine number of scale divisions (n) n = $\frac{\text{Value of scale capacity}}{\text{Value of scale division}}$
 if scale is marked with an accuracy designation.
 Maintenance tolerance T.N.3.1./Table 6
 Acceptance tolerance T.N.3.2.
 Agreement of indications T.N.4
 Repeatability T.N.5.
 Unmarked scales T.1.1.
 Repeatability T.N.5.
 Discrimination T.N.7.1.*

Pretest Determinations (cont.):

¹ A balance indicator with graduations having specific values shall be considered a dial.
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EPO No. 12

Tolerances (cont).

Sensitivity:

Marked scales..... T.N.6.1.(a), T.N.6.2.

Unmarked scales..... T.2.1., T.2.7., T.3.1.(a) or (c)

- 2. Determine “used capacity.”

For calculation in metric units:

Multiply area of platform in square meters (length x width = area) by: 540 kilograms for cattle, 340 kilograms for calves and hogs, and 240 kilograms for sheep.

For calculation in inch pound units:

Multiply area of platform in square feet (length x width = area) by: 110 pounds for cattle, 70 pounds for calves and hogs, and 50 pounds for sheep.

- 3. Minimum test weights and test loads..... N.3./Table 4

Carefully inspect electrical supply lines for test equipment for wear or damage; correct potentially hazardous conditions before use; protect lines from damage during use.

Test Notes:

Wear appropriate personal protection equipment such as safety shoes to prevent possible injury from falling weights and slipping on slick surfaces and a hard hat to prevent injury from overhead hazards.

- 1. For beam scales, balance small error weights on platform, the smallest weight equal to the minimum tolerance applicable, and the total value of the weights equal to the tolerance at maximum test load.
- 2. Check repeatability of, and agreement between, indications throughout test. G-S.5.2.2.(b), T.N.5.
- 3. Recheck zero-load balance each time test load is removed. N.1.9., G-UR.4.2.
- 4. If the scale is equipped with a type-registering (TR) beam or printer, print ticket at each test load G-S.5.6., UR.1.3.(1/1/86)

Test:

**WEAR SAFETY SHOES !
USE PROPER LIFTING TECHNIQUES !**

- 1. Sensitivity test at zero load (for weighbeams only)..... N.1.4.
Discrimination test at zero load (dials and balance indicators only)..... N.1.5.(1/1/86)

EPO No. 12

Test (cont.):

- 2. Increasing-load test.
Test to used capacity with the test load distributed N.1.1.

- a. Beam scales. At a minimum, test at half and full capacity on fractional beam, 100-pound increments to 1000 pounds, and three other points on main weighbeam, including used capacity.

Scales not equipped with a full capacity beam should be ratio tested using standard weights on counterpoise hanger. At each test load, test scale counterpoise weights by substituting them for standard counterpoise weights. If there is any noticeable change in the indication, remove the scale weight from service until it can be determined that it meets requirements in the Weight Code of NIST Handbook 44.

When ratio testing, test poise and beam by the removal of standard weights from the counterpoise hanger N.1.7.

- b. Dial scales. Test at 100-pound increments to 1000 pounds and at each quarter of dial capacity. Test all unit or drop weights normally used.

- 3. Shift test. Can be conducted during increasing-load test.
Livestock scale with more than two sections..... N.1.3.4.

For Livestock scales with more than two sections, conduct at least one shift test with a Minimum test load of 12.5 percent of scale capacity anywhere on the load-receiving element using the prescribed test patterns and maximum test loads specified below

Prescribe test pattern: An area of 1.2 meters (4 feet) in length and 3.0 meters (10 feet) in width or the width of the scale platform, whichever is less, shall be loaded to no more than half of the concentrated load capacity before loading the other side.

For test patterns less than 1.2 meters (4 feet) in length, determine the maximum loading by the formula [(wheel base of test cart or length of test load divided by 48 in) x 0.9 x CLC].

For test patterns that exceeds 1.2 meters (4 feet), the maximum test load applied shall not exceed CLC x the largest r factor in table UR.3.2.1.

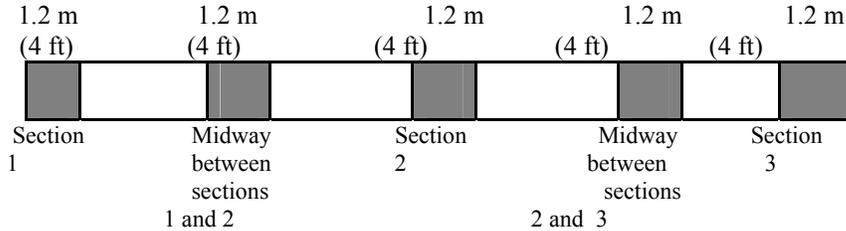
For weighing elements installed prior to January 1, 1989, the rated section capacity may be substituted for concentrated load capacity to determine maximum loading.

Multiple pattern loading: To test to the nominal capacity, multiple patterns may be simultaneously loaded in a manner consistent with the method of use.

Other designs: Special design scales and those that are wider than 3.7 meters (12 feet) shall be tested in a manner consistent with the method of use, but following the principles described above.

EPO No. 12

Test (cont.):



Test load: The maximum test load applied to the prescribed test pattern shall not exceed the concentrated load capacity (or for scales manufactured prior to January 1, 1989, the rated section capacity).

Note: When testing scales manufactured prior to January 1, 1989, caution should be exercised when loading test weights equivalent to the rated section capacity onto areas between sections.

Note: When loading the first section to be tested, it is recommended that observations be made at each increment of test weight application.

Note: When loading the scale for testing one side of the test pattern shall be loaded to no more than half of the concentrated load capacity or test load before loading the other side.

- Two-section livestock scales and animal scales N.1.3.8.
- 4. Sensitivity test at maximum test load (weighbeams and balance indicators only)..... N.1.4.
Discrimination test at maximum test load (dials and balance indicators only) N.1.5.
- 5. Decreasing-load test (dials only) at one-half of maximum test load (at no less than one-half dial face capacity) N.1.2.
- 6. Remove all test weights and determine any zero-load balance change N.1.9., G-UR.4.2.
- 7. Remove error weights and establish correct zero-load balance.

EPO No. 12E

**Examination Procedure Outline for
Livestock and Animal Scales
Equipped with Electronic Digital Indicators**

It is recommended that this outline be followed for livestock and animal scales equipped with electronic digital indicators. Requirements that apply only to scales marked with an accuracy class are indicated with an asterisk. Nonretroactive requirements are followed by the applicable date in parentheses.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Clothing

Electrical Hazards

First Aid Kit

Lifting

Location

also: **Wet/Slick Conditions**
Overhead Hazards, Obstructions

Personal Protection Equipment

e.g., **Safety Shoes**
Hard Hat

Safety Cones/Warning Signs

Support – for Scale and Test Weights

Transportation of Equipment

EPO No. 12E

Inspection:

Safety First!!!

<p>Check the inspection site carefully for safety hazards and take appropriate precautions.</p> <p>Use caution in moving in wet, slippery areas.</p> <p>Use personal protection equipment appropriate for the inspection site.</p> <p>Position safety cones and warning signs if necessary.</p> <p>Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.</p>
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H-44 General Code and Scales Code References

- 1. Zero-load balance as found. If the device is not in balance, the user should be made aware of paragraph UR.4.1. and a warning issued if necessary. If a ring scale and a tare has been taken for a ring man, check accuracy of the tare taken S.1.1., S.2.1.1., S.2.1.2. UR.4.1.,G-S.5.2.2.(d) (1/1/86)*
- 2. General Considerations
 - Selection G.S.3., G-UR.1.1, UR.1.
 - Installation..... G-UR.2.,
 - Supports for portable scale UR.2.1.
 - Protection from environment..... UR.2.3.
 - Foundation, supports, and clearance..... UR.2.4.
 - Access to weighing elements..... UR.2.5.
 - Stock racks UR.2.7.

<p>Check to be sure the scale supports are adequate to support the scale <u>and</u> test weights equal to the capacity of the scale!</p>

- Accessibility for inspection, testing, and sealing..... G-UR.2.3.
- Assistance..... G-UR.4.4.
- Position, customer readability G-UR.3.3.
- Maintenance, use, and environmental factors.
 - Facilitation of fraud G-S.2.
 - Environment G-UR.1.2.
 - Operation..... G-UR.3.1.
 - Maintenance G-UR.4.

Inspection (cont.):

EPO No. 12E

Maintenance, use, and environmental factors (cont.).	
Maximum load.....	UR.3.2.
Minimum load for livestock	UR.3.8.
Manual gross weight entries	UR.3.9, S.1.12.
Scale modification	UR.4.3.
3. Marking	S.6.3., S.6.2.
Nominal capacity	S.6.1. (1/1/86) (livestock only)
Nominal capacity must satisfy the relationship of:	
nominal capacity \leq CLC x (N - 0.5), where N = the number of sections in the scale.	
a. Marking requirements - all devices	
Identification	G-S.1.
Name or ID of manufacturer.....	Retroactive
Model designation	Retroactive
Model prefix	(1/1/03)
Nonrepetitive serial number	(1/1/68)
Serial number prefix	(1/1/86)
NTEP CC prefix and number	(1/1/03)
(for devices that have an NTEP CC)	
Remanufacturer information, as appropriate:	
name and ID of remanufacturer	(1/1/02)
model number if different from original model number	(1/1/02)
Lettering	G-S.7.
Operational controls, indications, and features.....	G-S.6. (1/1/77)
Visibility of identification	G-UR.2.1.1.
Interchange or reversal of parts	G-S.4.
b. Marking requirements - weighing and indicating elements in same housing or covered on the same CC (in addition to marking for all devices)	S.6.3
Accuracy class.....	(1/1/86)
Nominal capacity.....	Retroactive
Value of scale division with nominal capacity, if not apparent	(1/1/83)
Value of "e" (if different from "d")	(1/1/86)
Temperature limits if other than -10°C to 40°C (14°F to 104°F).....	(1/1/86)
Scales designed for special purposes.....	(1/1/86)
c. Marking requirements - indicating element not permanently attached or covered on separate CC (in addition to marking for all device).....	S.6.3
Accuracy class.....	(1/1/86)
Nominal capacity.....	Retroactive
Value of scale division with nominal capacity, if not apparent	(1/1/83)
Value of "e" (if different from "d")	(1/1/86)
Temperature limits if other than -10°C to 40°C (14°F to 104°F).....	(1/1/86)
Scales designed for special purposes.....	(1/1/86)
Maximum number of scale divisions (n_{max}).....	(1/1/88)

EPO No. 12E

Inspection (cont.):

- d. Marking requirements - weighing and load receiving element not permanently attached or covered on separate CC (in addition to marking for all devices)..... S.6.3.
 Accuracy class..... (1/1/86)
 Nominal capacity..... Retroactive
 Nominal capacity on load receiving element..... (1/1/89) (livestock only)
 Concentrated Load Capacity (CLC) on the load-receiving element (for scales manufactured prior to 1989, the Section Capacity may be used as the CLC; except that, the CLC marking must be added at the time of modification to any scale not previously marked)..... (1/1/89) (livestock only)
 Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F)..... (1/1/86)
 Scales designed for special purposes..... (1/1/86)
 Maximum number of scale divisions (n_{max})..... (1/1/88)
 Minimum verification scale division for which device complies with the requirements (e_{min} or d)..... (1/1/88)
- e. Marking requirements - load cell with Certificate of Conformance (in addition to marking for all devices)..... S.6.3., S.5.4. (1/1/94)
Note: Requires information on a data plate attached to the load cell or in accompanying document. If a document is provided, the serial number shall appear on the load cell and in the document..... (1/1/88)
 Manufacturer’s name or trademark, model designation, model prefix and serial number and prefix shall also be marked on both the load cell and in any accompanying documents..... (1/1/91)
 Accuracy class..... (1/1/88)
 Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F)..... (1/1/86)
 Maximum number of divisions..... (1/1/88)
 “S” or “M” for single or multiple cell applications (1/1/88)
 Direction of loading, if not obvious..... (1/1/88)
 Minimum dead load, maximum capacity, safe load limit, and load cell verification interval, v_{min} (1/1/88)
- 4. Determination of Load Cell Suitability (applicable to load cells with an NTEP Certificate of Conformance):
 - a. The number of scale divisions (n) of the scale is less than or equal to the n_{max} of the indicator or the load cells, whichever is less; e.g., if the indicator has an n_{max} of 10,000 and the load cells have an n_{max} of 5,000, then the scale may use up to 5,000 divisions.
 - b. The load cell is approved for the required accuracy class. Note: A Class III load cell may be used in a Class III L application; however the opposite is not true.
 - c. The load cell is rated Single (S) or Multiple (M) use as appropriate to the application.
Note: A load cell rated for single use may be used in a single or multiple load cell application; however, a load cell rated for multiple use cannot be used in a single load cell application.

EPO No. 12E

Inspection (cont.):

Determination of Load Cell Suitability (cont.)

- d. The load cell complies with the requirements for temperature effect on zero-load balance..... S.5.4., T.N.8.1
Appendix to EPO 12-E

Note: Testing to determine the effect of temperature on zero-load balance cannot be performed in the field; however, for purposes of field inspection, a load cell is considered to comply with T.N.8.1.3. if the v_{min} value marked on the load cell is less than or equal to the v_{min} value as calculated below based upon the d and N for the scale; if it is not, the scale does not comply with T.N.8.1.3.

Full electronic scale with more than one load cell: The verification scale division v_{min} , for the load cells must be less than or equal to the scale division, d, divided by the square root of the number of load cells, N, used in the scale:

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

Note: Maximum values of v_{min} for commonly encountered multiple load cell scales are listed in the Appendix to EPO 12-E.

For scales with mechanical lever systems:

$$v_{min} \leq \frac{d}{\sqrt{N} \times \text{scale multiple}}$$

- 5. Indicating and recording elements.
 - Value of scale division S.1.2. (1/1/86)
 - Weight units S.1.2.1. (1/1/89)
 - Designation of accuracy class S.5.*
 - Value of graduated interval G-S.5.3.
 - Marked devices UR.1.1.(a)
 - Unmarked devices UR.1.1.(b)(animal only)
 - Recorded scale division UR.1.3.
 - Tare division value, if equipped with a keyboard¹ S.2.3.(1/1/83)
 - Tare mechanism S.2.3.(1/1/83)
 - Appropriateness G-UR.1.1.
 - Indicating and recording elements G.S.5.
 - Parameters for accuracy class S.5.2.(1/1/86)*
 - Selection UR.1.
 - Recommended minimum load UR.3.1.*

¹ Generally, tare is not considered appropriate on these scales. If the device is located in an auction market and is a ring scale, a tare capability may be considered appropriate.

EPO No. 12E

Inspection (cont.):

Indicating and recording elements (cont.)	
Maximum load.....	UR.3.2.
Damping means	S.2.5., S.2.5.1.
Adjustable components.....	S.1.10.
Provision for sealing.....	S.1.11, G-S.8.(1/1/90), G-UR.4.5.
Manual gross weight entries.....	S.1.12.(1/1/93), UR.3.9.(livestock)
6. Design of weighing elements.....	S.4.

Pretest Determinations:

1. Tolerances.	
Acceptance/maintenance	G-T.1., G-T.2.
Application.....	G-T.3., G-T.4., T.N.2.1., T.N.2.3., T.N.2.4.
Tolerance values:	<u>Scale Capacity</u>
Determine number of scale divisions (n).....	n = Value of scale division
If scale is marked with an accuracy designation.	
Maintenance tolerance.....	T.N.3.1./Table 6 (Class III L–livestock scales, Class III – animal scales)
Acceptance tolerance.....	T.N.3.2.
Agreement of indications.....	T.N.4.1
Shift or section test	T.N.4.4.
Repeatability.....	T.N.5.
Unmarked scales	
Livestock scales.....	T.1.1.
Maintenance tolerance	T.N.3.1./Table 6 (Class III L)
Acceptance tolerance	T.N.3.2.
Agreement of indications.....	T.N.4.1.
Shift or section test	T.N.4.4.
Repeatability	T.N.5.
Animal scales with 5000 or less scale divisions	T.1.1.
Maintenance tolerance	T.N.3.1./Table 6 (Class III)
Acceptance tolerance	T.N.3.2.
Agreement of indications.....	T.N.4.1.
Repeatability	T.N.5.
Discrimination.....	T.N.7.2.

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Pretest Determinations (cont.):

- 2. Determine “used capacity.”
 For calculation in metric units:
 Multiply area of platform in square meters (length x width = area) by: 540 kilograms for cattle, 340 kilograms for calves and hogs, and 240 kilograms for sheep.

 For calculation in inch pound units:
 Multiply area of platform in square feet (length x width = area) by: 110 pounds for cattle, 70 pounds for calves and hogs, and 50 pounds for sheep.
- 3. Minimum test weights and test loads..... N.3./Table 4

Carefully inspect electrical supply lines for test equipment for wear or damage; correct potentially hazardous conditions before use; protect lines from damage during use.

Test Notes:

Wear appropriate personal protection equipment such as safety shoes to prevent possible injury from falling weights and slipping on slick surfaces and a hard hat to prevent injury from overhead hazards.

- 1. Check repeatability of, and agreement between, indications throughout test G-S.5.2.2.(a), T.N.5.
- 2. Recheck zero-load balance each time test load is removed. N.1.9., G-UR.4.2.
- 3. If the scale is equipped with a printer, print a ticket at each test load..... G-S.5.6., UR.1.3.(1/1/86)*
 Check effectiveness of motion detection
 Animal Scales > 2000 kg (5000 lb) capacity in service
 prior to January 1, 1981 and all livestock scales S.2.5.1.(a)
 All other animal scales S.2.5.1.(b)
- 4. If, during the conduct of the test, the performance of the device is questionable with respect to the zone of uncertainty and the width of zero, tests may be conducted to determine compliance..... N.1.5.(1/1/86)*, N.1.5.1., S.1.1.1.
- 5. If the device is equipped with operational features such as manual weight entries or a scoreboard indication of average weight, unit price, total prices, etc.; check proper operation and appropriateness..... G-UR.4.1., G-UR.4.2.

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Test:



1. Discrimination test at zero-load, if deemed necessary and if environmental conditions can be controlled..... N.1.5.(1/1/86)*, N.1.5.1.*
2. Increasing-load test.
Depending on test weights available, test as close to tolerance breakpoints as possible N.1.1.
3. Shift test. Can be conducted during increasing-load test.
Livestock scale with more than two sections..... N.1.3.4.
For Livestock scales with more than two sections, conduct at least one shift test with a minimum test load of 12.5 percent of scale capacity anywhere on the load-receiving element using the prescribed test patterns and maximum test loads specified below

Prescribe test pattern: An area of 1.2 meters (4 feet) in length and 3.0 meters (10 feet) in width or the width of the scale platform, whichever is less, shall be loaded to no more than half of the concentrated load capacity before loading the other side.

For test patterns less than 1.2 meters (4 feet) in length, determine the maximum loading by the formula [(wheel base of test cart or length of test load divided by 48 in) x 0.9 x CLC].

For test patterns that exceeds 1.2 meter (4 feet), the maximum test load applied shall not exceed CLC x the largest r factor in table UR.3.2.1.

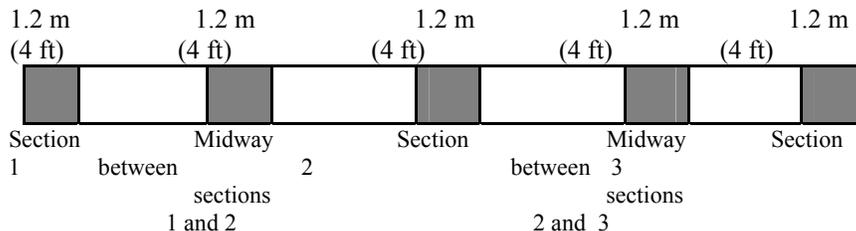
For weighing elements installed prior to January 1, 1989, the rated section capacity may be substituted for concentrated load capacity to determine maximum loading.

Multiple pattern loading: To test to the nominal capacity, multiple patterns may be simultaneously loaded in a manner consistent with the method of use.

Other designs: Special design scales and those that are wider than 3.7 meters (12 feet) shall be tested in a manner consistent with the method of use, but following the principles described above.

EPO No. 12E

Test (cont.):



Test load: The maximum test load applied to the prescribed test pattern shall not exceed the concentrated load capacity (or for scales manufactured prior to January 1, 1989, the rated section capacity).

Note: When testing scales manufactured prior to January 1, 1989, caution should be exercised when loading test weights equivalent to the rated section capacity onto areas between sections.

Note: When loading the first section to be tested, it is recommended that observations be made at each increment of test weight application.

Note: When loading the scale for testing one side of the test pattern shall be loaded to no more than half of the concentrated load capacity or test load before loading the other side.

- Two-section livestock scales and animal scales N.1.3.8.
- 4. RFI/EMI test (if a problem is suspected)..... G-N.2, G-UR.3.2., G-UR.4.2,G-UR.1.2., N.1.6., T.4., T.N.9.*
 Radio Frequency Interference (RFI)
 Electromagnetic Interference (EMI)
- 5. Discrimination test at maximum test load, if deemed necessary and if environmental conditions can be controlled N.1.5.(1/1/86)*, N.1.5.1.
- 6. Over capacity test (if practical)..... S.1.7.
- 7. Decreasing-load test N.1.2.
 Marked animal scales only N.1.2.1.*
 Livestock scales and unmarked animal scales N.1.2.2.
- 8. Remove all test weights and determine any zero-load balance change N.1.9., G-UR.4.2.
- 9. Test for proper design of automatic zero-setting mechanism, if device is so equipped
 Livestock scales S.2.1.3.(a)(1/1/81)
 Animal scales S.2.1.3.(c)(1/1/81)

EPO No. 12E

Test (cont.):

- 10. If device is equipped with a semi-automatic zero-setting mechanism (push button),
test effectiveness of motion detection
 - Scales > 2000 kg (5000 lb) capacity in service prior to January 1, 1981..... S.2.1.2.(a)
 - All other livestock and animal scales S.2.1.2.(b)

- 11. Establish correct zero-load balance.

EPO No. 12E

Appendix to EPO No. 12E

**Maximum Values of v_{min}
Multiple Load Cell Scales
(Table values are in pounds.)**

Load	Scale Division						
	<u>1 lb</u>	<u>2 lb</u>	<u>5 lb</u>	<u>10 lb</u>	<u>20 lb</u>	<u>50 lb</u>	<u>100 lb</u>
2	0.71	1.41	3.54	7.07	14.1	35	70
4	0.50	1.00	2.50	5.00	10.0	25	50
6	0.41	0.82	2.04	4.08	8.2	20.4	41
8	0.35	0.71	1.77	3.54	7.1	17.7	35
10	0.32	0.63	1.58	3.16	6.3	15.8	32
12	0.29	0.58	1.44	2.89	5.8	14.4	29
14	0.27	0.53	1.34	2.67	5.4	13.4	27

Full electronic scales

Example: For a livestock scale with two sections (four load cells) and a displayed scale division of 5 lb, the maximum value permitted for each load cell is 2.5 lb. The calculation is shown below. If the value marked on the load cell is less than or equal to the value computed for the v_{min} , then the load cell is considered to comply with T.N.8.1.3.

$$v_{min} \leq \frac{d}{\sqrt{N}} = \frac{5 \text{ lb}}{\sqrt{4}} = \frac{5 \text{ lb}}{2} = 2.5 \text{ lb}$$

Electromechanical Scales

Example: Calculate the multiple of the lever system from the ratios marked on the levers. Suppose the multiple for a livestock scale is 400:1 and that the scale has a scale division of 5 lb. Then the maximum value for the v_{min} of the load cell is 0.0125 lb. The calculation is shown below. If the load cell is marked with a v_{min} less than or equal to the calculated value, then the load cell is considered to comply with T.N.8.1.3.

$$v_{min} \leq \frac{d}{\text{scale multiple}} = \frac{5 \text{ lb}}{4} = 0.0125 \text{ lb}$$

EPO No. 13

Examination Procedure Outline for

**Vehicle and Axle-Load Scales
Mechanical - Analog Indicating
(Weighbeams and Dials)**

It is recommended that this outline be followed for vehicle and axle-load scales equipped with weighbeams and/or mechanical dials. Requirements that apply only to scales marked with an accuracy class are indicated with an asterisk. Nonretroactive requirements are followed by the applicable date in parentheses.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Clothing	Personal Protection Equipment
	e.g., Safety Shoes
Electrical Hazards	Hard Hat – for protection from overhead hazard
First Aid Kit	
Lifting	Safety Cones/Warning Signs
Location	Support – for scale, test weights, and test equipment
	Transportation of Equipment
also:	Wet/Slick Conditions
	Chemicals, Petroleum Products, and Hazardous Materials
	Overhead Hazards
	Obstructions

EPO No. 13

Inspection:

Safety First

<p>Check the inspection site carefully for safety hazards and take appropriate precautions.</p> <p>Learn the nature of hazardous products used at or near the inspection site.</p> <p>Use caution in moving in wet, slippery areas.</p> <p>Use personal protection equipment appropriate for the inspection site.</p> <p>Position safety cones and warning signs if necessary.</p> <p>Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.</p>
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H-44 General Code and Scales Code References

- 1. Zero-load balance as found.
 If the device is not in balance, the user should be made aware of paragraph UR.4.1. and a warning issued if necessary. S.1.1., S.2.1.1., S.2.1.2., S.1.5.1., UR.4.1.
- 2. Indicating and recording elements.
 - Scale division, value (d) and number(n)..... S.1.2.*, S.5.*, UR.1., UR.1.1.(b), UR.1.3. (1/1/86)
 - Tare division value S.2.3. (1/1/83)
 - Tare mechanism S.2.3.
 - Appropriateness of design
 - General G-S.5.
 - Weighbeams S.1.5. except S.1
 - Poises..... S.1.6.
 - Dials and balance indicators¹ S.1.3., S.1.4., S.1.7.
 - Damping means S.2.5.
 - Suitability S.5.2. (1/1/86)*, UR.1.1.(a)*, UR.3.1.*, UR.3.2., UR.3.2.1, UR.3.3.
 - Customer readability, if applicable G-UR.3.3.

¹A balance indicator with graduations having a specific value shall be considered a dial.

EPO No. 13

Inspection (cont.):

Adjustable components	S.1.10.
3. Marking	S.6.3., S.6.2
Nominal capacity	S.6.1. (1/1/86)
Nominal capacity must satisfy the relationship of:	
nominal capacity \leq CLC x (N - 0.5), where N = the number of sections in the scale	
a. Marking requirements - all devices	
Identification	G-S.1.
Name or ID of manufacturer	Retroactive
Model designation	Retroactive
Model prefix	(1/1/03)
Nonrepetitive serial number	(1/1/68)
Serial number prefix	(1/1/86)
NTEP CC prefix and number	(1/1/03)
(for devices that have an NTEP CC)	
Remanufacturer information, as appropriate:	
name and ID of remanufacturer	(1/1/02)
model number if different from original model numbe.....	(1/1/02)
Lettering	G-S.7.
Operational controls, indications, and features.....	G-S.6. (1/1/77)
Visibility of identification	G-UR.2.1.1.
Interchange or reversal of parts	G-S.4.
b. Marking requirements - weighing and indicating elements in same housing or covered on the same CC (in addition to marking for all devices)	S.6.3.
Accuracy class	(1/1/86)
Nominal capacity	Retroactive
Value of scale division with nominal capacity, if not apparent	(1/1/83)
Value of "e" (if different from "d").....	(1/1/86)
Temperature limits if other than -10 °C to 40 °C (14°F to 104 °F).....	(1/1/86)
Scales designed for special purposes.....	(1/1/86)
c. Marking requirements - indicating element not permanently attached or covered on separate CC (in addition to marking for all device)	S.6.3.
Accuracy class	(1/1/86)
Nominal capacity	Retroactive
Value of scale division with nominal capacity, if not apparent	(1/1/83)
Value of "e" (if different from "d").....	(1/1/86)
Temperature limits if other than -10 °C to 40 °C (14°F to 104 °F).....	(1/1/86) N/A
Scales designed for special purposes.....	(1/1/86)
Maximum number of scale divisions (n_{max}).....	(1/1/88)
d. Marking requirements - weighing and load receiving element not permanently attached or covered on separate CC (in addition to marking for all devices)	S.6.3.
Accuracy class	(1/1/86)
Nominal capacity	Retroactive
Nominal capacity on load receiving element.....	(1/1/89)
Concentrated Load Capacity (CLC) on the load-receiving element (for scales manufactured prior to 1989, the Section Capacity may be used as the	

Inspection (cont.):

Marking requirements - weighing and load receiving element not permanently attached or covered on separate CC

EPO No. 13

(in addition to marking for all devices - cont.)..... S.6.3.
 CLC; except that, the CLC marking must be added at the time of modification to
 any scale not previously marked) (1/1/89)
 For combination vehicle/railway scales, marking must include both the nominal capacity
 and the CLC for vehicle weighing and the nominal capacity and section capacity for
 railway weighing (1/1/00)
 Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F)..... (1/1/86) N/A
 Scales designed for special purposes (1/1/86)
 Maximum number of scale divisions (n_{max})..... (1/1/88)
 Minimum verification scale division for which
 device complies with the requirements (e_{min} or d) (1/1/88)

4. Weighing and load-receiving elements..... S.4, UR.2.8.
 Access..... UR.2.5.

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

**Check to be sure the scale supports are adequate
 to support the scale, test equipment, and test
 weights equal to the capacity of the scale.**

6. Approaches
 Vehicle scales..... UR.2.6.1. (1/1/76)
 Axle-load scales UR.2.6.2.

7. Maintenance, use, and environmental factors.
 Facilitation of fraud G-S.2.
 Environment G-UR.1.2.
 Operation G-UR.3.1.
 Maintenance G-UR.4.
 Maximum load UR.3.2.
 Single draft vehicle weighing UR.3.3.
 Minimum load UR.3.7.
 Scale modification UR.4.3.

8. Assistance G-UR.4.4.

Pretest Determinations:

1. Tolerances.
 Acceptance/maintenance G-T.1., G-T.2.
 Application T.N.2.1., T.N.2.3.

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Pretest Determinations (cont.):

Tolerances values:

Scales marked with an accuracy class T.N.3.1./Table 6 (Class III L),
T.N.3.2., T.N.4. (except
T.N.4.5.), T.N.5.

Scales not marked with an accuracy class..... T.1.1., T.N.3.1./Table 6
(Class III L), T.N.3.2.,
T.N.4. (except T.N.4.5.),
T.N.5.

Discrimination T.N.7.1.*

Sensitivity:

Scales marked T.N.6.1.(a), T.N.6.2.

Scales not marked T.2.1., T.2.7., T.3.(a) or (c)

Note: Some TN tolerances apply to unmarked vehicle scales (See NIST HB 44 Table T.1.1.)

2. Determine maximum test load to be applied during test: a test load not to exceed marked Concentrated Load Capacity (or for scales manufactured prior to January 1, 1989, the marked Section Capacity) may be applied to any section or between any two sections. A test load of 100 percent of capacity may be distributed over the entire platform.
3. Minimum test weights and test loads..... N.3., Table 4

Carefully inspect electrical supply lines and test equipment for wear or damage; correct potentially hazardous conditions before use; protect lines from damage during use.

Test Notes:

Wear appropriate personal protection equipment such as safety shoes to prevent possible injury from falling weights and slipping on slick surfaces and a hard hat to prevent injury from overhead hazards.

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

Test Notes (cont.):

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- 2. Check repeatability of, and agreement between, indications throughout the test T.N.5., G-S.5.2.2.(b)
- 3. Recheck zero-load balance each time test load is removed..... N.1.9., G-UR.4.2.
- 4. If the scale is equipped with a type-registering (T.R.) beam or a printer, print ticket at each test load..... G-S.5.6., UR.1.3. (1/1/86)*, G-S.5.2.2.(b)

Test:

<p>WEAR SAFETY SHOES!</p> <p>USE PROPER LIFTING TECHNIQUES!</p>

- 1. Sensitivity test at zero load (for weighbeams and balance indicators only) N.1.4.
Discrimination (dials and balance indicators with graduations having a specific value only)..... N.1.5. (1/1/86)*
- 2. Increasing-load and shift (section) test. N.1.1.
 - a. If beam scale, test at not less than two points on each weighbeam.
 - b. If automatic-indicating scale, test at not less than three points on reading face, including all possible quarters of the reading-face capacity. Test all unit weights possible.
 - c. For vehicle scales with more than two sections, conduct at least one shift test with a minimum test load of 12.5 percent of scale capacity anywhere on the load-receiving element using the prescribed test patterns and maximum test loads specified below. N.1.3.4.

Prescribe test pattern: An area of 1.2 meters (4 feet) in length and 3.0 meters (10 feet) in width or the width of the scale platform, whichever is less, shall be loaded to no more than half of the concentrated load capacity before loading the other side.

For test patterns less than 1.2 meters (4 feet) in length, determine the maximum loading by the formula [(wheel base of test cart or length of test load divided by 48 in) x 0.9 x CLC].

For test patterns that exceeds 1.2 meters (4 feet), the maximum test load applied shall not exceed CLC x the largest r factor in table UR.3.2.1.

For weighing elements installed prior to January 1, 1989, the rated section capacity may be substituted for concentrated load capacity to determine maximum loading.

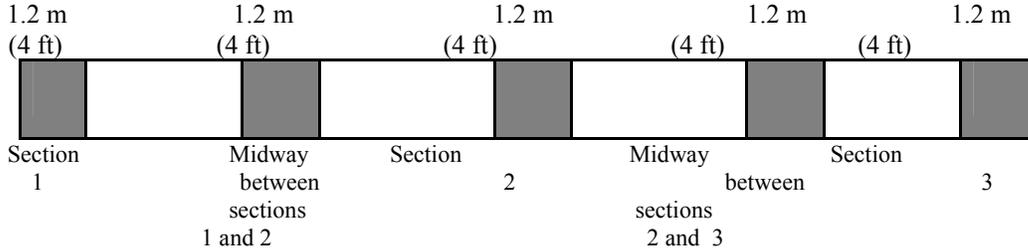
Multiple pattern loading: To test to the nominal capacity, multiple patterns may be simultaneously loaded in a manner consistent with the method of use.

Test (cont.):

Other designs: Special design scales and those that are wider than 3.7 meters (12 feet) shall

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be tested in a manner consistent with the method of use, but following the principles described above.



Test load: The maximum test load applied to the prescribed test pattern shall not exceed the concentrated load capacity (or for scales manufactured prior to January 1, 1989, the rated section capacity).

Note: When testing scales manufactured prior to January 1, 1989, caution should be exercised when loading test weights equivalent to the rated section capacity onto areas between sections.

Note: When loading the first section to be tested, it is recommended that observations be made at each increment of test weight application.

Note: When loading the scale for testing the side of the test pattern shall be loaded to no more than half of the concentrated load capacity or test load before loading the other side.

3. Decreasing-load test (dials only), at one-half of maximum test load (at no less than one-half dial-face capacity). N.1.2., N.1.2.2.
4. Strain-load test on at least two sections N.1.1. (See Appendix B)

Position vehicle on one end of scale; bring scale to balance by addition or removal of weights. Note this as reference point. Distribute test weights on other end of scale.

Determine error using the reference point noted above. The tolerances are selected based upon the value of the test-weight load only.
5. Sensitivity test at maximum test load (weighbeams and balance indicators only)..... N.1.4.

Discrimination (dials and balance indicators with graduations having a specific value only). N.1.5. (1/1/86)*
6. Counterpoise-weight test, if device is so equipped..... NIST Handbook 44 Weights Code

Test (cont.):

7. Remove test load and determine any zero-load balance change. N.1.9., G-UR.4.2.

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8. Remove error weights and establish correct zero-load balance.

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Appendix B to EPO No. 13

Strain-Load Method of Testing
(Excerpts from NBS Handbook 94)

Description of Test. When the supply of test weights is inadequate, the principle involved in the use of strain loads is that the known test load is first applied when the scale is carrying no other load (this is frequently referred to as the "light test"), and is subsequently applied one or more times when the scale is under some additional, but unknown, load that stresses the parts as they are normally stressed under ordinary operating conditions. Under this method, the actual values of the strain loads - which may consist of miscellaneous material, loaded vehicles, grain in a hopper, and the like - are immaterial and are not determined, the strain loads being simply "balanced out" by any convenient means. (The regular balancing means of the scale could be utilized when arriving at the final balance for a strain load, but this has the disadvantage that the scale cannot then be checked at the conclusion of the test for a possible shift of its zero-load balance; for this reason, use of the regular balancing means is not recommended here.) Thus, after carrying the light test of a motor-truck scale, for instance, as far as may be done with the test weights available, and assuming that it is next desired to make a test in the region up to one-half the nominal scale capacity, the test weights would be removed and a vehicle would be driven onto the platform and the scale brought to a balance; this vehicle would have been so selected that the sum of its gross weight and the total value of the test weights would approximate one-half the nominal capacity of the scale. The test weights would then be added, in one or in several increments, and it would be observed whether or not the scale properly indicated the value of each increment of test weights added. Following this, another strain load would be added, of such a value that the combined weight of the strain load and test weights would approximate the value in the region of which it is desired to make the next test; this strain load would then be balanced out and the test weights subsequently added as in the earlier part of the test. This operation may be repeated any desired number of times as long as the gross load does not exceed the weighing capacity of the scale; however, assuming that a reasonably satisfactory amount of test weights is available, not more than two strain loads will ordinarily be utilized, the scale being tested light and when loaded to approximately one-half and full capacities.

Tolerance Application on Strain-Load Tests. In the strain-load method, observed errors are errors on the "test-weight load only," since before each application of the test weight load the strain load of unknown value has been balanced out; accordingly, the tolerances to be applied are to be selected according to the value of the "test-weight load" in each instance of an accuracy observation under the strain-load method.

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**Examination Procedure Outline for
Vehicle and Axle-Load Scales
Equipped with Electronic Digital Indicators**

It is recommended that this outline be followed for vehicle and axle-load scales equipped with electronic digital indicators. Requirements that apply only to scales marked with an accuracy class are indicated with an asterisk. Nonretroactive requirements are followed by the applicable date in parentheses.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Clothing

Electrical Hazards

First Aid Kit

Lifting

Location

also: **Wet/Slick Conditions**
Chemicals, Petroleum Products
& Hazardous Materials
Overhead Hazards
Obstructions

Personal Protection Equipment

e.g., Safety Shoes
Hard Hat – for protection from
overhead hazards

Safety Cones/Warning Signs

Support – for scale, test weights, & test
equipment

Transportation of Equipment

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Inspection:

Safety First

<p>Check the inspection site carefully for safety hazards and take appropriate precautions.</p> <p>Learn the nature of hazardous products used at or near the inspection site.</p> <p>Use caution in moving in wet, slippery areas.</p> <p>Use personal protection equipment appropriate for the inspection site.</p> <p>Position safety cones and warning signs if necessary.</p> <p>Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.</p>
--

H-44 General Code and Scales Code References

- 1. Zero-load balance as found. If the device is not in balance, the user should be made aware of paragraph UR.4.1. and a warning issued if necessary. G-S.5.2.2.(d)(1/1/86)*, S.1.1., S.2.1.1., S.2.1.2., UR.4.1., S.2.1.3.1. (1/1/01)
- 2. Indicating, and recording elements.
 - Scale division, value (d) and number (n)..... G-S.5.3., S.1.2.*, S.1.2.1. (1/1/89), S.5*, S.5.4. (1/1/94), UR.1., UR.1.1.(b) UR.1.3. (1/1/86)
 - Rounding G-S.5.2.2.(c)
 - Tare division value S.2.3. (1/1/83)
 - Tare mechanism S.2.3.(1/1/83)
 - Damping means S.2.5., S.2.5.1.(a)
 - Appropriateness..... G-S.5., S.5.2. (1/1/86)*, UR.1.1.(a)*, UR.3.1.*, UR.3.2., UR.3.3.
 - Customer readability, if applicable..... G-UR.3.3.
 - Adjustable components S.1.10.
 - Provision for sealing..... S.1.11. (1/1/90), G-S.8. (1/1/90), G-UR.4.5.

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Inspection (cont.):

- 3. Marking S.6.3., S.6.2.
 - Nominal capacity S.6.1. (1/1/86)
 - Nominal capacity must satisfy the relationship of:
 nominal capacity \leq CLC x (N - 0.5), where N = the number of sections in the scale
 - a. Marking requirements - all devices
 - Identification G-S.1.
 - Name or ID of manufacture Retroactive
 - Model designation Retroactive
 - Model prefix (1/1/03)
 - Nonrepetitive serial number (1/1/68)
 - Serial number prefix (1/1/86)
 - NTEP CC prefix and number (1/1/03)
 (for devices that have an NTEP CC)
 - Remanufacturer information, as appropriate:
 - name and ID of remanufacturer (1/1/02)
 - model number if different from original model number (1/1/02)
 - Lettering G-S.7.
 - Operational controls, indications, and features..... G-S.6. (1/1/77)
 - Visibility of identification G-UR.2.1.1.
 - Interchange or reversal of parts G-S.4.
 - b. Marking requirements - weighing and indicating elements in same housing or covered on the same CC
 (in addition to marking for all devices) S.6.3.
 - Accuracy class (1/1/86)
 - Nominal capacity Retroactive
 - Value of scale division with nominal capacity, if not apparent (1/1/83)
 - Value of "e" (if different from "d")..... (1/1/86)
 - Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F)..... (1/1/86)
 - Scales designed for special purposes (1/1/86)
 - c. Marking requirements - indicating element not permanently attached or covered on separate CC
 (in addition to marking for all device) S.6.3.
 - Accuracy class (1/1/86)
 - Nominal capacity Retroactive
 - Value of scale division with nominal capacity, if not apparent (1/1/83)
 - Value of "e" (if different from "d")..... (1/1/86)
 - Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F)..... (1/1/86)
 - Scales designed for special purposes (1/1/86)
 - Maximum number of scale divisions (n_{max})..... (1/1/88)
 - d. Marking requirements - weighing and load receiving element not permanently attached or covered on separate
 CC (in addition to marking for all devices) S.6.3.
 - Accuracy class (1/1/86)
 - Nominal capacity Retroactive
 - Nominal capacity on load receiving element..... (1/1/89) (livestock only)

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Inspection (cont.):

- Marking requirements - weighing and load receiving element not permanently attached or covered on separate CC (in addition to marking for all devices - cont.) S.6.3.
 - Concentrated Load Capacity (CLC) on the load-receiving element (for scales manufactured prior to 1989, the Section Capacity may be used as the CLC; except that, the CLC marking must be added at the time of modification to any scale not previously marked) (1/1/89) (livestock only)
 - Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F)..... (1/1/86)
 - Scales designed for special purposes (1/1/86)
 - Maximum number of scale divisions (n_{max})..... (1/1/88)
 - Minimum verification scale division for which device complies with the requirements (e_{min} or d) (1/1/88)
- e. Marking requirements - load cell with Certificate of Conformance (in addition to marking for all devices) S.6.3., S.5.4. (1/1/94)
 - Note:** Requires information on a data plate attached to the load cell or in accompanying document. If a document is provided, the serial number shall appear on the load cell and in the document..... (1/1/88)
 - Manufacturer’s name or trademark, model designation, model prefix and serial number and prefix shall also be marked on both the load cell and in any accompanying documents (1/1/91)
 - Accuracy class (1/1/88)
 - Temperature limits if other than -10 °C to 40 °C (14 °F to 104 °F)..... (1/1/86)
 - Maximum number of divisions (1/1/88)
 - “S” or “M” for single or multiple cell applications..... (1/1/88)
 - Direction of loading, if not obvious (1/1/88)
 - Minimum dead load, maximum capacity, safe load limit, and load cell verification interval, v_{min} (1/1/88)
- 4. Installation UR.2.3., UR.2.4., G-UR.2.

Check to be sure the scale supports are adequate to support the scale, test equipment, and test weights equal to the capacity of the scale !

- 5. Weighing and load receiving elements S.4., UR.2.8.
 - Access UR.2.5.
- 6. Load cell installation
 - Full electronic scale T.N.8.1.3., S.5.4. (1/1/94)
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Inspection (cont.):

Number of scale divisions, n , $\leq n_{max}$ of the indicator or load cells, whichever is less.

Verification scale division, v_{min} , for the load cells must be less than or equal to the scale division, d , divided by the square root of the number of load cells, N , used in the scale:

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

NOTE: Compliance with T.N.8.1.3. cannot be determined in the field. The v_{min} value on the load cell is used to determine compliance with T.N.8.1.3. The v_{min} value marked on the load cell must be less than or equal to the v_{min} value in the table of Appendix A of this EPO based upon the d and N for the scale; if it is not, the scale does not comply with T.N.8.1.3. (See also 1988 OWM paper on "Device Regulation Under the New Scales Code.")

For mechanical lever systems with a single load cell:

$$v_{min} \leq \frac{d}{\text{scale multiple}}$$

Note: Maximum values of v_{min} for commonly encountered multiple load cell scales are listed in the Appendix to EPO 13E.

- 7. Approaches
 - Vehicle scales UR.2.6.1. (1/1/76)
 - Axle-load scales UR.2.6.2.
- 8. Maintenance, use, and environmental factors.
 - Facilitation of fraud G-S.2.
 - Environment G-UR.1.2.
 - Operation G-UR.3.1.
 - Maintenance G-UR.4.
 - Maximum load UR.3.2.
 - Single draft vehicle weighing UR.3.3.
 - Manual gross weight entries UR.3.9, S.1
 - Minimum load UR.3.7.
 - Scale modification UR.4.3.
- 9. Assistance G-UR.4.4.

Pretest Determinations:

- 1. Tolerances:
 - Acceptance/maintenance G-T.1., G-T.2.
 - Application:
 - Scales marked with an accuracy class T.N.2.1., T.N.2.3., T.N.2.4.

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Pretest Determinations (cont.):

Tolerance values:

Scales marked with an accuracy class..... T.N.3.1./Table 6 (Accuracy Class III L), T.N.3.2.

Scales not marked with an accuracy class..... T.1.1., T.N.3.1./Table 6 (Class III L), T.N.3.2., T.N.4.1., T.N.4.4., T.N.5.

Note: Some TN tolerances apply to unmarked vehicle scales, see NIST HB 44 Table T.1.1.)

Discrimination..... T.N.7.2.

2. Determine maximum test load to be applied during test: A test load not to exceed marked concentrated load capacity (or for scales manufactured prior to January 1, 1989, the marked section capacity) may be applied to any section or between any two sections. A test load of 100 percent of capacity may be distributed over the entire platform.

3. Minimum test weights and test loads..... N.3., Table 4

Carefully inspect electrical supply lines for test equipment for wear or damage; correct potentially hazardous conditions before use; protect lines from damage during use.

Test Notes:

Wear appropriate personal protection equipment such as safety shoes to prevent possible injury from falling weights and slipping on slick surfaces and a hardhat to prevent injury from overhead hazards.

1. Check repeatability of, and agreement between, indications throughout test. T.N.5., G-S.5.2.2.(a), G-S.5.2.2.(c)

2. Recheck zero-load balance each time test load is removed N.1.9., G-UR.4.2.

3. If the scale is equipped with a printer, print ticket at each test load. If the device will print only one load without returning to "zero," check printer with at least four different loads at convenient times during test. Check effectiveness of motion detection. G-S.5.6., S-2.5.1.(a), UR.1.3. (1/1/86)*

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Test Notes (cont.):

- 4. If, during the conduct of the test, the performance of the device is questionable with respect to the zone of uncertainty and the width of zero, additional tests may be conducted to determine compliance. N.1.5. (1/1/86)*, N.1.5.1.*, S.1.1.1.
- 5. If the device is equipped with operational features such as programmable tare, multiple tare memory, weigh-in/weigh-out, or multiple weighing elements, check proper operation and appropriateness. Type Evaluation Handbook

Test:

**WEAR SAFETY SHOES !
USE PROPER LIFTING TECHNIQUES !**

- 1. Discrimination test at or near zero load, if deemed necessary and if environmental Conditions can be controlled N.1.5. (1/1/86)*, N.1.5.1.*
- 2. Test for proper configuration of automatic zero-setting mechanism, if device is so equipped S.2.1.3.(b) (1/1/81)
S.2.1.3.1. (1/1/01)
- 3. If equipped with a semi-automatic zero-setting mechanism (push button), test effectiveness of motion detection Type Evaluation Handbook;
S.2.1.2.(a)
- 4. Check proper design of tare auto-clear, if device is so equipped..... S.2.3. (including note for auto clear 1/1/83)
- 5. Establish correct zero-load balance.
- 6. Increasing-load and shift (section) test N.1.1., N.1.3.4.

For vehicle scales with more than two sections, conduct at least one shift test with a minimum test load of 12.5 percent of scale capacity anywhere on the load receiving element using the prescribed test patterns and maximum test loads specified below.

Prescribed Test pattern: An area of 1.2 meters (4 feet) in length and 3.0 meters (10 feet) in width or the width of the scale platform, whichever is less. When loading the scale for testing, one side of the test pattern shall be loaded to no more than one-half of the concentrated load capacity before loading the other side.

For test patterns less than 1.2 meters (4 feet) in length, determine the maximum loading by the formula:
[(wheelbase of test cart or length of test load ÷ 48 in) x 0.9 x CLC]

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Test (cont.):

For test patterns that exceed 1.2 meters (4 feet), the maximum test load applied shall not exceed CLC x the largest r factor in Table UR.3.2.

Multiple pattern loading: To test to the nominal capacity, multiple patterns may be simultaneously loaded in a manner consistent with the method of use.

Other designs: Special design scales and those that are wider than 3.7 meters (12 feet) shall be tested in a manner consistent with the method of use but following the principles described above.

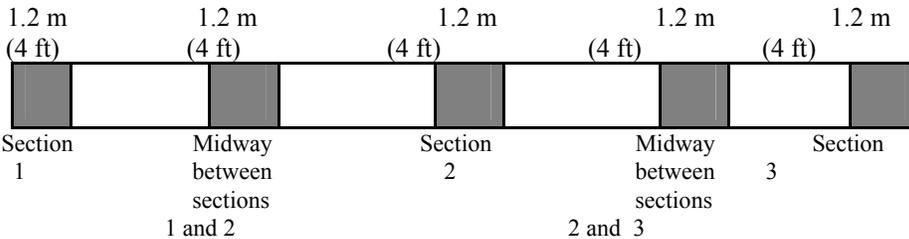
Test load: The maximum test load applied to the prescribed test pattern shall not exceed the concentrated load capacity (or for scales manufactured prior to January 1, 1989, the rated section capacity).

Note: When testing scales manufactured prior to January 1, 1989, caution should be exercised when loading test weights equivalent to the rated section capacity onto areas between sections.

Note: When loading the first section to be tested, it is recommended that observations be made at each increment of test weight application.

Note: For weighing elements installed prior to 1/1/89, the rated section capacity may be substituted for concentrated load capacity to determine maximum loading.

Note: When loading the scale for testing, one side of the test pattern shall be loaded to no more than half of the concentrated load capacity or test load before loading the other side.



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Test (cont.)

- 7. RFI/EMI Test.
 To test for EMI, use procedures outlined in SMA Test Procedures¹. To test for effects of RFI, use equipment found at the site in a manner that is usual and customary G-N.2., G-UR.3.2., G-UR.4.2., G-UR.1.2., N.1.6., T.4., T.N.9.*

 Radio Frequency Interference (RFI)
 Electromagnetic Interference (EMI)
- 8. Decreasing-load test, at one-half of maximum test load..... N1.2., N.1.2.2.
- 9. Strain-load test on at least two sections; tolerance on test weight load only N.1.1. (See Appendix B at the end of this EPO)

 Position vehicle on one end of scale; Using error weights, determine reference point within the displayed division. Distribute test weights on other end of scale. Determine error-using reference point noted above. The tolerances are selected based upon the value of the test load only.
- 10. Discrimination test at maximum test load, if deemed necessary and if environmental conditions are controlled N.1.5. (1/1/86)*, N.1.5.1.*
- 11. Over-capacity test (if practical) S.1.7.
- 12. Recheck zero-load balance change..... N.1.9., G-UR.4.2.

¹These procedures, developed by the Scale Manufacturers Association, were adopted by the National Conference on Weights and Measures as part of the Final Report of the Committee on Specifications and Tolerances 63rd annual meeting, 1978 (copies of the 1978 procedures are available). Also reference SMA Recommendation on Electrical Disturbance – SMA RED-0499 (copies of SMA RED-0499 are available at www.scalemanufacturers.org)

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Appendix A to EPO No. 13E

**Maximum Values of
Multiple Load Cell Scales
(Table values are in pounds.)**

Load Cells	Scale Division						
	<u>1 lb</u>	<u>2 lb</u>	<u>5 lb</u>	<u>10 lb</u>	<u>20 lb</u>	<u>50 lb</u>	<u>100 lb</u>
2	0.71	1.41	3.54	7.07	14.1	35	70
4	0.50	1.00	2.50	5.00	10.0	25	50
6	0.41	0.82	2.04	4.08	8.2	20.4	41
8	0.35	0.71	1.77	3.54	7.1	17.7	35
10	0.32	0.63	1.58	3.16	6.3	15.8	32
12	0.29	0.58	1.44	2.89	5.8	14.4	29
14	0.27	0.53	1.34	2.67	5.4	13.4	27

Full electronic scales

Example: For a vehicle scale with four sections (eight load cells) and a displayed scale division of 20 lb, the maximum value permitted for each load cell is 7.1 lb. The calculation is shown below. If the value marked on the load cell is less than or equal to the value computed for the v_{\min} , then the load cell is considered to comply with T.N.8.1.3.

$$v_{\min} \leq \frac{d}{\sqrt{N}} = \frac{20 \text{ lb}}{\sqrt{8}} = \frac{20 \text{ lb}}{2.83} = 7.07 \text{ lb} \sim 7.1 \text{ lb}$$

Mechanical Scales with single load cell

Example: Calculate the multiple of the lever system from the ratios marked on the levers. Suppose the multiple for a vehicle scale is 400:1 and that the scale has a scale division of 20 lb. Then the maximum value for the v_{\min} of the load cell is 0.05 lb. The calculation is shown below. If the load cell is marked with a v_{\min} less than or equal to the calculated value, then the load cell is considered to comply with T.N.8.1.3.

$$v_{\min} \leq \frac{d}{\text{scale multiple}} = \frac{20 \text{ lb}}{400} = 0.05 \text{ lb}$$

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Appendix B to EPO No. 13E

Strain-Load Method of Testing
(Excerpts from NBS Handbook 94)

Description of Test. When the supply of test weights is inadequate, the principle involved in the use of strain loads is that the known test load is first applied when the scale is carrying no other load (this is frequently referred to as the "light test"), and is subsequently applied one or more times when the scale is under some additional but unknown load that stresses the parts as they are normally stressed under ordinary operating conditions. Under this method, the actual values of the strain loads - which may consist of miscellaneous material, loaded vehicles, grain in a hopper, and the like - are immaterial and are not determined, the strain loads being simply "balanced out" by any convenient means. (The regular balancing means of the scale could be utilized when arriving at the final balance for a strain load, but this has the disadvantage that the scale cannot then be checked at the conclusion of the test for a possible shift of its zero-load balance; for this reason, use of the regular balancing means is not recommended here.) Thus, after carrying the light test of a motor-truck scale, for instance, as far as may be done with the test weights available, and assuming that it is next desired to make a test in the region up to one-half the nominal scale capacity, the test weights would be removed and a vehicle would be driven onto the platform and the scale brought to a balance; this vehicle would have been so selected that the sum of its gross weight and the total value of the test weights would approximate one-half the nominal capacity of the scale. The test weights would then be added, in one or in several increments, and it would be observed whether or not the scale properly indicated the value of each increment of test weights added. Following this, another strain load would be added, of such a value that the combined weight of the strain load and test weights would approximate the value in the region of which it is desired to make the next test; this strain load would then be balanced out and the test weights subsequently added as in the earlier part of the test. This operation may be repeated any desired number of times as long as the gross load does not exceed the weighing capacity of the scale; however, assuming that a reasonably satisfactory amount of test weights is available, not more than two strain loads will ordinarily be utilized, the scale being tested light and when loaded to approximately one-half and full capacities.

Tolerance Application on Strain-Load Tests. In the strain-load method, observed errors are errors on the "test-weight load only," since before each application of the test weight load the strain load of unknown value has been balanced out; accordingly, the tolerances to be applied are to be selected according to the value of the "test-weight load" in each instance of an accuracy observation under the strain-load method.

EPO No. 21

**Examination Procedure Outline for
Retail Motor-Fuel Dispensers
Single, Dual and Multi-Product
(Except Blenders)**

It is recommended that this outline be followed for conventional, single and dual product, power-operated retail dispensers--"gasoline pumps," analog or digital, and consoles. This outline may also be used for multi-product dispensers that share a single hose but not including those that dispense blended products. Nonretroactive requirements are followed by the applicable date in parentheses.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

- | | |
|--|---|
| Clothing | Material Safety Data Sheets (MSDS) |
| Electrical Hazards | Nature of Product |
| Emergency Procedures | Personal Protection Equipment
e.g., Safety Shoes, Safety Aprons, Gloves,
Barrier Cream, etc. if deemed necessary |
| Eye Protection | |
| Fire Extinguisher | Safety Cones/Warning Signs |
| First Aid Kit | Static Discharge |
| Grounding | Switch Loading |
| Ignition Sources | Traffic |
| Lifting | Transportation of Equipment |
| Location
also: Wet/Slick Conditions, Chemicals, Hazardous Materials,
Petroleum Products, Obstructions | |

EPO No. 21

Inspection:

Safety First !!!

Check the inspection site carefully for safety hazards and take appropriate precautions.

Learn the nature of hazardous products used at or near the inspection site – obtain and read Copies of MSDS’s.

Know emergency procedures and location and operation of fire extinguisher and emergency shut-offs.

Post safety cones/warning signs and be aware of vehicular and pedestrian traffic patterns.

Use caution in moving in wet, slippery areas.

Use personal protection equipment and clothing appropriate for the inspection site.

Open both sides of dispenser to allow fumes to dissipate before proceeding with the inspection of the dispenser.

If leaks, spills, or exposed wiring cause hazardous testing conditions it is recommended that the testing be discontinued until the unsafe conditions are corrected.

Be sure that a first aid kit is available and that it is appropriate for the type of inspection activity.

**H-44 General Code and
Liquid-Measuring Devices
Code References**

- 1. General considerations
 - Selection..... G-S.3., G-UR.1.1., G-UR.1.2., G-UR.1.3.
 - Installation..... G-S.2.,G-UR.2.1.,G-UR.2.2., UR.2.1., UR.2.4.
 - Position of equipment..... G-UR.3.3.
 - Accessibility..... G-UR.2.3.
 - Assistance..... G-UR.4.4.
 - Use and maintenance..... G-UR.3.1., G-UR.4.1., G-UR.4.2., UR.3.5.

- 2. Indicating and recording elements.
 - Design..... S.1.1.
 - Units S.1.2.1., S.1.2.3.(a)
 - Readability G-S.5., G-S.6.(1/1/77), G-S.7., S.1.4., S.1.5.
 - Values of intervals G-S.5.3., G-S.5.3.1.
 - Indication of delivery..... S.1.6.1.,
 - Money-value divisions
 - Analog..... S.1.6.5.1.
 - Digital..... S.1.6.5.2.
 - Auxiliary indications S.1.6.5.3. (1/1/85)
 - Unit Price and product identity S.1.6.4.1.(a), S.1.6.4.2., UR.3.2.
 - Multiple unit price dispensers S.1.6.4.1.(b) (1/1/91), S.1.6.5.(a) (1/1/91), S.1.6.5.4. (1/1/91), UR.3.3.

EPO No. 21**Inspection (cont.):**

Advancement and return to zero	S.1.3., S.1.6.3., UR.3.1.
Recorded representations, point of sale systems	S.1.6.7. (1/1/86)
Provision for sealing.....	G-S.8. (1/1/90), G-UR.4.5., S.2.2.(a&b), S.2.2.(c) (1/1/5)
3. Marking.....	G-S.1.,G-UR.2.1.1.,G-UR.3.4., S.4.1., S.4.4. (1/1/85)
4. Measuring elements.	
Air eliminator vent, if self-contained dispenser.....	S.2.1.
Security seal on adjusting mechanism	G-UR.4.5.
5. Discharge hose-retail	S.3.1., S.3.2., S.3.3., S.3.5.(b), S.3.6., UR.1.1.
Marinas and Airports.....	UR.1.1.2.
6. Totalizers.....	S.5. (1/1/95)

Pretest Determinations:

1. Tolerances.	
Applicable requirements	G-T., T.1.
Basic values.....	T.2.1.
2. Product storage identification	UR.2.5.

Test Notes:

Wear appropriate personal protection equipment such as petroleum-resistant, nonskid safety shoes (to prevent possible injury from spills or slipping on slick surfaces), protective clothing, and eye protection to prevent injury from splashed product.

Do not leave an activated dispenser unattended !

1. If test measure is dry, add 16.4 milliliter (one cubic inch) to gauge reading to allow for amount of liquid required to "wet" measure.
2. Hand held test measures require a 30-second (± 5 s) pour followed by a 10-second drain, with the measure held at a (10 to 15) degree angle from vertical. (see NIST HB 105-3, Specifications and Tolerances for Graduated Neck Type Volumetric Field Standards, 1997, Section 7).

EPO No. 21

Test Notes (cont.):

Ground test measure properly and only use a metal funnel when returning product to storage.

- 3. To determine proper operation of totalizers, read and record the totalizer indications before and after all test drafts.....S.5. (1/1/95)
- 4. After each test draft:
 - a. print ticket if device is so equipped.....G-S.5.6., S.1.6.7. (1/1/86), UR.3.4.
 - b. check price computations on all indicators (including consoles) and on recorded representations.....S.1.6.5.(a) (1/1/91)
 - digital equipment.....G-S.5.5.
 - analog equipment.....S.1.6.5.(b), N.4.3.2.
 - c. check for agreement between indicators.....G-S.5.2.2., S.1.6.6.(a), S.1.6.6.(b) (1/1/88)
 - d. check display of quantity and total priceS.1.6.5.5. (1/1/94)

Test:

Use proper lifting techniques when lifting test measure !

Be aware of and attempt to eliminate potential ignition sources in or near the inspection site.

Be aware of vehicular and pedestrian traffic when moving between dispenser and storage tanks.

- 1. Normal test--full flow, basic tolerance.....N.1.1., N.2., N.3.4., N.4.1., T.2.1., UR.2.2.
- At the beginning of the first delivery, check for suppressed values.....S.1.6.1.
- If first test result is at or near the tolerance limit, repeat this test.....T.2.1.3., N.4.1.2.

Petroleum Product Sampling¹

¹ When taking gasoline samples from single hose multi-product dispensers, the samples should be collected after an observed sale of the particular grade or product to be tested, or sufficient product should be purged from the hose to ensure the sample is representative of the grade or product being sampled. The National Conference on Weights and Measures policy on procedures for taking samples for octane verification is as follows: **“A minimum of a liter (0.3 gallon) of engine fuel shall be flushed from the dispensers before taking a sample for octane verification. This flush shall be returned to the storage tank containing the lowest octane.”** (see NCWM Publication 21, Petroleum Products Sampling Procedures and Safety Manual, August 1997).

EPO No. 21

Test (cont.):

- 2. Special test--slow flow, basic toleranceN.4.2., N.4.2.2., T.2.1.
- 3. RFI/EMI test (electronic equipment only)G-N.2., G-UR.1.2.,
G-UR.3.2., G-UR.4.2.
Radio Frequency Interference (RFI)
Electromagnetic Interference (EMI)
- 4. Check effectiveness of anti-drain meansS.3.7.
- 5. Check effectiveness of zero-setback interlockS.2.5.
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.
- 6. Power loss testS.1.6.2.1.(1/1/83), S.1.6.2.2.
(1/1/83)
Check with your supervisor before requiring shutdown of power to equipment under test.
- 7. Security sealG-UR.4.5.

Record on the official report the number of gallons of product dispensed during test.

Avoid switch loading!
Test devices dispensing low-vapor pressure products (e.g., diesel fuel, kerosene)
before testing devices dispensing high-vapor pressure products (e.g., gasoline).

After all equipment at a location has been tested, review results to determine compliance with equipment maintenance and use of adjustmentsG-UR.4.1., G-UR.4.3.

Take precautions to isolate equipment when transporting it to avoid exposure to hazardous fumes.

EPO No. 22

**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," analog or digital, and consoles. Nonretroactive requirements are followed by the applicable date in parentheses.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Clothing	Material Safety Data Sheets (MSDS)
Electrical Hazards	Nature of Product
Emergency Procedures	Personal Protection Equipment
Eye Protection	e.g., Safety Shoes, Safety Aprons, Gloves, Barrier Cream, etc. if deemed necessary
Fire Extinguisher	Safety Cones/Warning Signs
First Aid Kit	Static Discharge
Grounding	Switch Loading
Ignition Sources	Traffic
Lifting	Transportation of Equipment
Location	
also:	Wet/Slick Conditions, Chemicals, Hazardous Materials, Petroleum Products, Obstructions

EPO No. 22

Inspection:

Safety First !!!

Check the inspection site carefully for safety hazards and take appropriate precautions.

Learn the nature of hazardous products used at or near the inspection site – obtain and read copies of MSDS’s.

Know emergency procedures and location and operation of fire extinguisher and emergency shut-offs.

Post safety cones/warning signs and be aware of vehicular and pedestrian traffic patterns.

Use caution in moving in wet, slippery areas.

Use personal protection equipment and clothing appropriate for the inspection site.

Open both sides of dispenser to allow fumes to dissipate before proceeding with the inspection of the dispenser.

If leaks, spills, or exposed wiring cause hazardous testing conditions it is recommended that the testing be discontinued until the unsafe conditions are corrected.

Be sure that a first aid kit is available and that it is appropriate for the type of inspection activity.

**H-44 General Code and
Liquid-Measuring Devices
Code References**

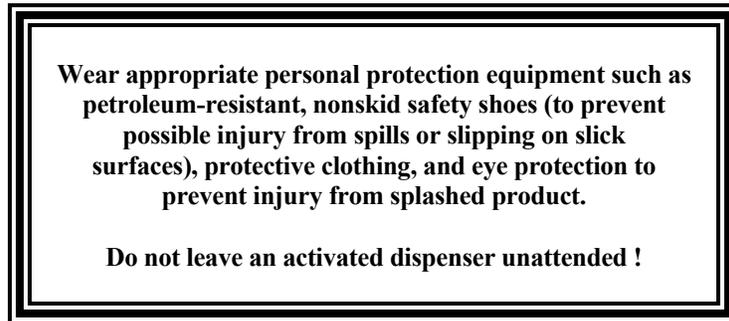
1. General considerations.	
Selection.....	G-S.3., G-UR.1.1., G-UR.1.2., G-UR.1.3.
Installation.....	G.S.2, G-UR.2.1., G-UR.2.2., UR.2.1., UR.2.4.
Position of equipment	G-UR.3.3.
Accessibility.....	G-UR.2.3.
Assistance.....	G-UR.4.4.
Use and maintenance	G-UR.3.1., G-UR.4.1., G-UR.4.2., UR.3.5.
2. Indicating and recording elements.	
Design.....	S.1.1.
Units.....	S.1.2.1., S.1.2.3.(a)
Readability.....	G-S.5., G-S.6. (1/1/77), G-S.7., S.1.4., S.1.5.
Values of intervals.....	G-S.5.3., G-S.5.3.1.
Indication of delivery	S.1.6.1.
Money-value divisions	
Analog	S.1.6.5.1.
Digital	S.1.6.5.2.
Auxiliary indications	S.1.6.5.3. (1/1/85)
Unit Price and product identity	S.1.6.4.1.(a), S.1.6.4.2., U.R.3.2.

EPO No. 22**Inspection (cont.):**

Multiple unit price dispensers	S.1.6.4.1.(b) (1/1/91), S.1.6.5.(a) (1/1/91), S.1.6.5.4. (1/1/91), UR.3.3.
Advancement and return to zero	S.1.3., S.1.6.3., UR.3.1.
Recorded representations, point of sale systems	S.1.6.7. (1/1/86)
Provision for sealing.....	G-S.8.(1/1/90), G-UR.4.5., S.2.2.(a&b), S.2.2.(c) (1/1/95)
3. Marking	G-S.1., G-UR.2.1.1., G-UR.3.4., S.4.1., S.4.4. (1/1/85)
4. Measuring elements.	
Air eliminator vent, if self-contained dispenser.....	S.2.1.
Security seal on adjusting mechanism	G-UR.4.5.
5. Discharge hose-retail	S.3.1., S.3.2., S.3.3., S.3.5., S.3.6., UR.1.1.
Marinas and airports.....	UR.1.1.2.
6. Totalizers.....	S.5. (1/1/95)

Pretest Determinations:

1. Tolerances.	
Applicable requirements	G-T., T.1.
Basic tolerance values	T.2.1.
2. Product storage identification	UR.2.5.

Test Notes:

1. If test measure is dry, add 16.4 milliliters (one cubic inch) to gauge reading to allow for amount of liquid required to "wet" measure.
2. Hand held test measures require a 30-second (± 5 s) pour followed by a 10-second drain, with the measure held at a (10 to 15) degree angle from vertical.

EPO No. 22**Test Notes (cont.):**

(see NIST HB 105-3, Specifications and Tolerances for Graduated Neck Type Volumetric Field Standards, 1997, section 7).

Ground test measure properly and only use a metal funnel when returning product to storage.

3. To determine proper operation of totalizers, read and record the totalizer indications before and after all test drafts.S.5. (1/1/95)
4. After each test draft:
 - a. print ticket if device is so equipped.....G-S.5.6., S.1.6.7. (1/1/86),
UR.3.4.
 - b. check price computations on all indicators.....S.1.6.5.(a) (1/1/91)
(including consoles) and on recorded representations.
digital equipment.....G-S.5.5.
analog equipmentS.1.6.5.(b), N.4.3.2.
 - c. check for agreement between indications.....G-S.5.2.2., S.1.6.6.(a),
S.1.6.6.(b) (1/1/88)
 - d. check display of quantity and total priceS.1.6.5.5. (1/1/94)

Test:

Use proper lifting techniques when lifting test measure !

Be aware of and attempt to eliminate potential ignition sources in or near the inspection site.

Be aware of vehicular and pedestrian traffic when moving between dispenser and storage tanks.

1. Test at lowest grade. Set selector control so that lowest grade product is dispensed.
Normal test—full flow, basic toleranceN.1.1., N.2., N.3.4., N.4.1.,
T.2.1., UR.2.2.
At the beginning of the first delivery, check for suppressed values.....S.1.6.1.
If first test result is at or near the tolerance limit, repeat this test.T.2.1.3., N.4.1.2.

Petroleum Product Sampling¹ Lowest Octane.

¹ When taking gasoline samples from blended product dispensers, the samples should be collected after an observed sale of the particular grade or product to be tested, or sufficient product should be purged from the hose to ensure the sample is representative of the grade or product being sampled. The National Conference on Weights and Measures policy on procedures for taking samples for octane verification is as follows: **“A minimum of a liter (0.3 gallon) of engine fuel shall be flushed from the dispensers before taking a sample for octane verification. This flush shall be returned to the storage tank containing the lowest octane.”** (see NCWM Publication 21, Petroleum Products Sampling Procedures and Safety Manual, August 1997).

EPO No. 22**Test (cont.):**

2. Test at highest grade. Set selector control so that highest grade product is dispensed.
 Normal test—full flow, basic toleranceN.3.4., N.4.1., T.2.1.
 If this test is at or near tolerance limit, repeat this test.....T.2.1.3.
- Petroleum Product Sampling² Highest Octane
3. Test at blend. Set selector control at intermediate blend. Special test--slow flow, basic
 Tolerance.....N.4.2., N.4.2.2., T.2.1.
- If this test result is at or near the tolerance limit and the error is the same as or greater
 then the average error of the previous tests, repeat this test.....T.2.1.3.
 Otherwise, slow flow test at first blend above lowest grade and first blend beneath
 highest grade.
- Petroleum Product Sampling² Blended Product

Return blended product to the storage tank containing the lowest octane

4. Check money-value computations on other blends. Set selector control at each of the
 remaining blends and dispense 1 indicated liter/gallon to check computed priceUR.3.2.
 Digital equipmentG-S.5.5.
 Analog equipmentS.1.6.5.(b), N.4.3.2.
5. RFI/EMI test (electronic equipment only)G-N.2., G-UR.1.2.,
 G-UR.3.2., G-UR.4.2.
- Radio Frequency Interference (RFI)
 Electromagnetic Interference (EMI)
6. Check effectiveness of anti-drain meansS.3.7.
7. Check effectiveness of zero-setback interlock.....S.2.5.
 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.
8. Power loss test.....S.1.6.2.1.(1/1/83),
 S.1.6.2.2. (1/1/83)
 Check with your supervisor before requiring shutdown of power to equipment under test.
9. Security sealG-UR.4.5.

Record on the official report the number of gallons of product dispensed during test.

² When taking gasoline samples from blended product dispensers, the samples should be collected after an observed sale of the particular grade or product to be tested, or sufficient product should be purged from the hose to ensure the sample is representative of the grade or product being sampled. The National Conference on Weights and Measures policy on procedures for taking samples for octane verification is as follows: **“A minimum of a liter (0.3 gallon) of engine fuel shall be flushed from the dispensers before taking a sample for octane verification. This flush shall be returned to the storage tank containing the lowest octane.”** (see NCWM Publication 21, Petroleum Products Sampling Procedures and Safety Manual, August 1997).

EPO No. 22

Test (cont.):

**Avoid switch loading!
Test devices dispensing low-vapor pressure products (e.g., diesel fuel, kerosene)
before testing devices dispensing high-vapor pressure products (e.g., gasoline).**

After all equipment at a location has been tested, review results to determine compliance with equipment maintenance and use of adjustments.....G-UR.4.1., G-UR.4.3.

**Take precautions to isolate equipment when
transporting it to avoid exposure to hazardous fumes.**

EPO No. 23

**Examination Procedure Outline for
Vehicle-Tank Meters
Power-Operated**

It is recommended that this outline be followed for all power-operated vehicle-tank meters – analog or digital. Nonretroactive requirements are followed by the applicable date in parentheses. Do not use this outline for testing milk metering systems, or gravity-discharge vehicle tank meters.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

- | | |
|-----------------------------|--|
| Clothing | Material Safety Data Sheets (MSDS) |
| Electrical Hazards | Nature of Product |
| Emergency Procedures | Personal Protection Equipment
e.g., Safety Shoes, Safety Aprons, Gloves,
Hard Hat, etc. if deemed necessary |
| Eye Protection | |
| Fire Extinguisher | Safety Cones/Warning Signs |
| First Aid Kit | Static Discharge |
| Grounding | Switch Loading |
| Ignition Sources | Traffic |
| Lifting | Transportation of Equipment |
| Location | |
| also: | Wet/Slick Conditions, Chemicals, Hazardous Materials,
Petroleum Products, Obstructions |

EPO No. 23

Inspection:

Safety First !!!

Check the inspection site carefully for safety hazards and take appropriate precautions.

Check to be certain that the ground surface of the inspection site is sufficiently strong and rigid to support the prover when it is filled with product – don't forget to chock the wheels of the prover.

Learn the nature of hazardous products used at or near the inspection site – obtain and read copies of MSDS's.

Know emergency procedures and location and operation of fire extinguisher and emergency shut-offs.

Post safety cones/warning signs and be aware of vehicular and pedestrian traffic patterns.

Use caution in moving in wet, slippery areas and climbing on prover, storage tanks, and vehicles.

Use personal protection equipment and clothing appropriate for the inspection site.

If leaks, spills, or exposed wiring cause hazardous testing conditions it is recommended that the testing be discontinued until the unsafe conditions are corrected.

Be sure that a first aid kit is available and that it is appropriate for the type of inspection activity.

**H-44 General Code and
Vehicle-Tank Meters
Code References**

1. General considerations.

Selection	G-S.3., G-UR.1.1., G-UR.1.2., G-UR.1.3.
Installation	G-S.2., G-UR.2.1., G-UR.2.2., UR.1.1.
Position of equipment.....	G-UR.3.3.
Accessibility	G-UR.2.3.
Assistance	G-UR.4.4., G-UR.4.6
Use and maintenance.....	G-UR.3.1., G-UR.4.1., G-UR.4.2., UR.2.3.

2. Indicating and recording elements.

Design	S.1.1.1.
Units.....	S.1.1.2.(a), S.1.1.3.(b) and (c)
Readability.....	G-S.5., G-S.6. (1/1/77), G-S.7., S.1.2., S.1.3.
Values of intervals.....	G-S.5.3.
Computing-type devices	
Display of unit price	S.1.4.1, UR.1.2.
Printed ticket.....	S.1.4.2., UR.2.2.
Exceptions for the sale of aviation fuel.....	UR.2.2.1.
Money-value computations.....	S.1.4.3.
Advancement and return to zero	S.1.1.4., S.1.1.5., UR.2.1.
Provision for sealing.....	G-S.8. (1/1/90), G-UR.4.5.

EPO No. 23

Inspection (cont.):

- 3. MarkingG-S.1., G-UR.2.1.1.,
S.5.1, S.5.2.
- 4. Measuring elements.
 - Vapor eliminationS.2.1.
 - Security seal on adjusting mechanismG-UR.4.5., S.2.2.
- 5. Piping.
 - Directional flow valves and discharge line and valvesS.2.3., S.3.
 - Antidrain valveS.3.6.
 - LeaksG-UR.4.1.
 - Facilitation of fraudG-S.2.

Pretest Determinations:

- 1. Determine that the test fluid in the tank compartment is similar in character to the fluid to be measured N.1.
- 2. Test drafts: determine if the prover size is adequate N.3.
- 3. Tolerances.
 - Applicable requirementsG-T., T.1.
 - Tolerance valuesT.2.
 - Agri-chemicalsT.3.
 - RepeatabilityT.4.
- 4. Note totalizer reading

Test Notes:

Wear appropriate personal protection equipment such as petroleum-resistant, nonskid safety shoes (to prevent possible injury from spills or slipping on slick surfaces), protective clothing, eye protection (to prevent injury from splashed product), and a hard hat (to prevent injury from overhangs and projections).

Use proper grounding procedures.

Be sure that prover is equipped with an explosion proof motor.

Carefully inspect electrical supply lines to test equipment for wear and damage; correct potentially hazardous conditions before use.

Device operator should be present at all times during test – the operator (not the inspector) should operate the device under test.

Never leave equipment unattended while it is in operation.

- 1. Wet prover. Allow a 30-second drain period each time the prover is emptied.
- 2. Evaporation and volume change: exercise care so the product temperature is the same in the prover as at the meterN.2.

EPO No. 23

Test Notes (cont.):

3. Record totalizer(s) indication before and after each draft to determine proper operation
4. After each test draft:
 - a. Print a ticket (if so equipped)G-S.5.6.
 - b. If computing type, check price computation on indicator and on recorded representations..... G.S.5.6., S.1.4.2., S.1.4.3., S.1.4.4.
 - c. Check for agreement between indicators.....G-S.5.2.2.

Test:

If supply or return lines are not coupled at their discharge ends, they must be held in place continuously while product flows through the line

Use proper lifting techniques to lift and move equipment

Be aware of and attempt to eliminate potential ignition sources in or near the inspection site

Be aware of vehicular and pedestrian traffic in the area

1. Normal test--full flow, basic toleranceN.4.1., T.2.
2. Special test--slow flow, special toleranceN.4.2.(a), T.2.
 If either test result is close to or outside the applicable tolerance, repeat the test..... N.4.1.2.
3. Special test – split compartment, special toleranceS.2.1., N.4.2.(b), T.2.
 - a. 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.
 - b. Permit test to continue until lack of fluid supply causes meter register to stop absolutely.
 - c. With pump in operation, shut manifold valve (or disconnect whip-hose connection) from now empty compartment.
 - d. Open valve from compartment with adequate supply of fluid to complete test.
4. RFI/EMI test (electronic equipment only)..... G-N.2., G-UR.1.2., G-UR.3.2., G-UR.4.2.
 Radio Frequency Interference (RFI)
 Electromagnetic Interference (EMI)
5. Check automatic stop mechanismG-UR.4.1.
 The device should stop the flow within one-half the minimum interval indicated
6. Check effectiveness of antidrain valve.....S.3.6., N.4.3.
 (with pump pressure off line)

EPO No. 23

Test (cont.):

7. Security sealG-UR.4.5.

Record the number of gallons of product dispensed during test on the official report.

Avoid switch loading!
Test devices dispensing low-vapor pressure products (e.g., diesel fuel, kerosene)
before testing devices dispensing high-vapor pressure products (e.g., gasoline).

After all equipment at a location has been tested, review results to determine compliance with equipment maintenance and use of adjustmentsG-UR.4.1., G-UR.4.3.

Take precautions to isolate equipment when
Transporting it to avoid exposure to hazardous fumes.

EPO No. 24

Examination Procedure Outline for

**Vehicle-Tank Meters
Gravity-Discharge**

It is recommended that this outline be followed for all gravity-discharge vehicle-tank meters – analog or digital. Nonretroactive requirements are followed by the applicable date in parentheses. Do not use this outline for testing milk metering systems, or power-operated vehicle tank meters.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Clothing	Material Safety Data Sheets (MSDS)
Electrical Hazards	Nature of Product
Emergency Procedures	Personal Protection Equipment e.g., Safety Shoes, Safety Aprons, Gloves, Hard Hat, etc. if deemed necessary
Eye Protection	
Fire Extinguisher	Safety Cones/Warning Signs
First Aid Kit	Static Discharge
Grounding	Switch Loading
Ignition Sources	Traffic
Lifting	Transportation of Equipment
Location	
also:	Wet/Slick Conditions, Chemicals, Hazardous Materials, Petroleum Products, Obstructions

EPO No. 24

Inspection:

Safety First !!!

Check the inspection site carefully for safety hazards and take appropriate precautions.

Check to be certain that the ground surface of the inspection site is sufficiently strong and rigid to support the prover when it is filled with product – don't forget to chock the wheels of the prover.

Learn the nature of hazardous products used at or near the inspection site – obtain and read copies of MSDS's.

Know emergency procedures and location and operation of fire extinguisher and emergency shut-offs.

Post safety cones/warning signs and be aware of vehicular and pedestrian traffic patterns.

Use caution in moving in wet, slippery areas and climbing on prover, storage tanks, and vehicles.

Use personal protection equipment and clothing appropriate for the inspection site.

If leaks, spills, or exposed wiring cause hazardous testing conditions it is recommended that the testing be discontinued until the unsafe conditions are corrected.

Be sure that a first aid kit is available and that it is appropriate for the type of inspection activity.

**H-44 General Code and
Vehicle-Tank Meters
Code References**

1. General considerations.

Selection	G-S.3., G-UR.1.1., G-UR.1.2., G-UR.1.3.
Installation	G-S.2., G-UR.2.1., G-UR.2.2., UR.1.1.
Position of equipment.....	G-UR.3.3.
Accessibility	G-UR.2.3.
Assistance	G-UR.4.4., G-UR.4.6.
Use and maintenance.....	G-UR.3.1., G-UR.4.1., G-UR.4.2., UR.2.3.

2. Indicating and recording elements.

Design	S.1.1.1.
Units.....	S.1.1.2.(a) , S.1.1.3.(b) and (c)
Readability.....	G-S.5., G-S.6. (1/1/77), G-S.7., S.1.2., S.1.3.
Values of intervals.....	G-S.5.3.
Computing-type devices	
Display of unit price	S.1.4.1, UR.1.2.
Printed ticket.....	S.1.4.2., UR.2.2.
Exceptions for the sale of aviation fuel	UR.2.2.1.
Money-value computations	S.1.4.3.
Advancement and return to zero.....	S.1.1.4., S.1.1.5., UR.2.1.

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Inspection (cont.):

- Provision for sealingG-S.8. (1/1/90), G-UR.4.5.
- 3. MarkingG-S.1., G-UR.2.1.1.,
S.5.1, S.5.2.
- 4. Measuring elements.
 - Vapor elimination.....S.2.1.
 - Security seal on adjusting mechanismG-UR.4.5., S.2.2.
- 5. Piping.
 - Directional flow valves and discharge line and valves.....S.2.3., S.3.
 - Leaks.....G-UR.4.1.
 - Facilitation of fraudG-S.2.

Pretest Determinations:

- 1. Determine that the test fluid in the tank compartment is similar in character to the fluid to be measured N.1.
- 2. Determine that a compartment or compartments have a sufficient amount of product to conduct “high head” and “low head” tests.
- 3. Test drafts: determine if the prover size is adequate and that the prover inlet is lower than the meter outlet N.3.
- 4. Tolerances.
 - Applicable requirementsG-T., T.1.
 - Tolerance valuesT.2.
 - Agri-chemicalsT.3.
 - Repeatability.....T.4.
- 5. Note totalizer reading

Test Notes:

Wear appropriate personal protection equipment such as petroleum-resistant, nonskid safety shoes (to prevent possible injury from spills or slipping on slick surfaces), protective clothing, eye protection (to prevent injury from splashed product), and a hard hat (to prevent injury from overhangs and projections).

Use proper grounding procedures.

Be sure that prover is equipped with an explosion proof motor.

Carefully inspect electrical supply lines to test equipment for wear and damage; correct potentially hazardous conditions before use.

Device operator should be present at all times during test – the operator (not the inspector) should operate the device under test. Do not leave equipment unattended while in operation.

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Test Notes (cont.):

1. Wet prover. Allow a 30-second drain period each time prover is emptied.
2. Evaporation and volume change: exercise care so that the product temperature is the same in the prover as at the meter.....N.2.
3. Record totalizer (s) indication before and after each draft to determine proper operation
4. After each test draft:
 - a. Print a ticket (if so equipped).....G-S.5.6.
 - b. If computing type, check price computation on indicator and on recorded representations.....G.S.5.6., S.1.4.2., S.1.4.3., S.1.4.4.
 - c. Check for agreement between indicators.....G-S.5.2.2.

Test:

If supply or return lines are not coupled at their discharge ends, they must be held in place continuously while product flows through the line.

Use proper lifting techniques to lift and move equipment.

Be aware of and attempt to eliminate potential ignition sources in or near the inspection site.

Be aware of vehicular and pedestrian traffic in the area.

1. Normal test--full flow (high head, full compartment), basic toleranceN.4.1., T.2.
2. Normal test – full flow (medium head, one-half full compartment), basic toleranceN.4.1., T.2.
3. Normal test – full flow (low head, one and one-half times prover capacity in compartment), basic tolerance.....N.4.1., T.2.
4. Special test – split compartment, special tolerance.....S.2.1., N.4.2. (b) , T.2.
 - a. Start test (normal flow rate) from a compartment containing less test load than one-half prover capacity.
 - b. Permit test to continue until lack of fluid supply causes meter register to stop absolutely.
 - c. Shut manifold valve (or disconnect whip-hose connection) from now empty compartment.
 - d. Open valve from compartment with adequate supply of fluid to complete test.
5. RFI/EMI test (electronic equipment only).....G-N.2., G-UR.1.2., G-UR.3.2., G-UR.4.2.
 Radio Frequency Interference (RFI)
 Electromagnetic Interference (EMI)
6. Check automatic stop mechanismG-UR.4.1.
 The device should stop the flow within one-half the minimum interval indicated.
7. Security sealG-UR.4.5.

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Test (cont.):

Record on the official report the number of gallons of product dispensed during test.

Avoid switch loading!
Test devices dispensing low-vapor pressure products (e.g., diesel fuel, kerosene)
before testing devices dispensing high-vapor pressure products (e.g., gasoline).

After all equipment at a location has been tested, review results to determine compliance with equipment maintenance and use of adjustmentsG-UR.4.1., G-UR.4.3.

Take precautions to isolate equipment when
transporting it to avoid exposure to hazardous fumes.

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**Examination Procedure Outline for
Loading-Rack Meters**

It is recommended that this outline be followed for examining loading-rack meters used to measure petroleum products sold at wholesale. The outline may be applied to devices with or without Automatic Temperature Compensating Systems. Non-retroactive and retroactive requirements are followed by the applicable date in parentheses.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Clothing	Material Safety Data Sheets (MSDS)
Electrical Hazards	Nature of Product
Emergency Procedures	Personal Protection Equipment
Eye Protection	e.g., Safety Shoes
Fire Extinguisher	Safety Aprons, Respirators, Gloves, Barrier Cream, Etc., if deemed necessary.
First Aid Kit	Hard Hat -- for protection from overhang in rear of vehicle tank truck
Grounding	Safety Cones/Warning Signs
Ignition Sources	Static Discharge
Lifting	Support -- for prover
Location	Switch Loading
also: Wet/Slick Conditions	Obstructions and Overhead Hazards
Chemicals, Petroleum Products, And Hazardous Materials	

EPO No. 25

Pretest Determinations:

Safety First !!!

Check the inspection site carefully for safety hazards and take appropriate precautions.

Check to be certain that the ground surface of the inspection site is sufficiently strong and rigid to support the prover when it is filled with product ---don't forget to chock the wheels of the prover.

Learn the nature of hazardous products used at or near the inspection site--obtain and read copies of MSD's.

Know emergency procedures and location and operation of fire extinguishers and emergency shut-offs.

Post safety cones/warning signs and be aware of vehicular and pedestrian traffic patterns.

Use caution moving around in wet, slippery areas and in climbing on prover, storage tanks, and vehicles.

Use personal protection equipment and clothing appropriate for the inspection site.

Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.

**H-44 General Code and
Liquid Measuring devices
Code References**

1. Prover must have valid calibration certificate and security seals must be intact on sight gauge.
2. Prover capacity must be sufficient to hold the amount of product that would be delivered by the meter to be tested during 1 minute of flow at its maximum discharge rate and in no case be less than 200 liters (50 gallons)N.3.5.
3. Prover and system design must be compatible (top loading/bottom loading).

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Pretest Determinations (cont.):

Be sure the prover is equipped with an explosion-proof motor.

Carefully inspect electrical supply lines for test equipment for wear or damage; correct potentially hazardous conditions before use; protect lines from damage during use.

4. Thermometers are to be accurate to within:
 - a. $\pm 0.5\text{ }^{\circ}\text{C}$, have a range of at least $0\text{ }^{\circ}\text{C}$ to $50\text{ }^{\circ}\text{C}$, and be divided in increments of no greater than $0.5\text{ }^{\circ}\text{C}$ for liquid-in-glass thermometers and $0.1\text{ }^{\circ}\text{C}$ for digital thermometers or
 - b. $\pm 1\text{ }^{\circ}\text{F}$, have a range of at least $0\text{ }^{\circ}\text{F}$ to $120\text{ }^{\circ}\text{F}$, and be divided in increments of no greater than $1\text{ }^{\circ}\text{F}$ for liquid-in-glass thermometers and $0.1\text{ }^{\circ}\text{F}$ for digital thermometers.

Thermometers may be of the partial immersion or digital type.
5. Inspect prover's interior surface for dents, product clingage, rust, water, or other foreign material.
6. Prover sight glass must be clean and fittings must not leak.
7. Available test fluid must be of the same general physical characteristics as that of the liquid to be commercially measured by the device N.1.1.
8. For top loading provers, the prover inlet must be lower than the outlet of the meter discharge line.
9. Determine applicable tolerance values:

Applicable requirements.....	G-T, T.1.
Basic values.....	T.2.3.3.
a. On normal tests:	
Acceptance tolerance	0.2 percent
Maintenance tolerance	0.3 percent
b. On special tests:	
Acceptance tolerance and maintenance tolerance	0.5 percent

Inspection:

1. Indicating and recording elements.

Design:

Device must be equipped with indicating elements and MAY be equipped with a recording element. S.1.1.

Units:

Units are to be in terms of liters, gallons, quarts, pints, or binary-sub-multiples or decimal subdivisions of the liter or gallon. S.1.2., S.1.2.3.(b)

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Inspection (cont.):

Readability:

Indicating and recording elements must be clear, definite, and easily read..... G-S.5., S.1.4., S.1.5.

Required markings shall be distinct, easily readable, and of a permanent nature..... G-S.6.(1/1/77), G-S.7.

Values of intervals:

Values of the graduated intervals must be uniform throughout the series of indicating elements or, if equipped, recording elements. G-S.5.3.

For devices indicating or recording in more than one unit, the values must be appropriately identified. G-S.5.3.1. (1/1/90)

Advancement and return to zero:..... S.1.3.

Indicating and recording elements may only be **advanced** to zero by the mechanical operation of the device, UNLESS:

- a. Advancement can not be stopped until zero is reached, OR
- b. The indicating elements are automatically obscured until the elements reach a correct zero position.

Provision for sealing:

Provision must be made for sealing electronic adjustable components G-S.8. (1/1/90)

A security seal must be affixed to any adjustment mechanism designed to be sealed..... G-UR.4.5.

2. Measuring elements.

Determine that system has an effective vapor elimination system and that vent lines are suitably rigid. S.2.1.

Verify that means are provided for determination of product temperature..... S.2.6. (1/1/85)

Determine that provision is made for applying security seals to the meter and to the automatic temperature compensating system, and that security seals are intact on both..... G-UR.4.5., S.2.2., S.2.7.3.

3. Marking.

Device is to be permanently marked with a make, model and serial number G-S.1.(a),
G-S.1.(c)(1/1/03),
G-S.1.(d)(1/1/68),
G-S.1.(e)(1/1/86),
G-S.1.(f)(1/1/01)

Inspection (cont.):

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All switches, lights, displays, pushbuttons, and other operational controls and features must be clearly and definitely identified. G-S.6. (1/1/77)

The limitation on a device's use shall be clearly and permanently marked on any device intended to measure accurately: S.4.1.

- a. only products having particular properties,
- b. only under specific installation conditions, or
- c. only when used in conjunction with specific accessory equipment.

Designed minimum and maximum discharge rates must be clearly and permanently marked on meter. Minimum discharge rate shall not exceed 20 percent of the maximum discharge rate..... S.4.3.1.

4. Installation.

Device must be readily accessible for purposes of testing. Assistance shall be provided by the firm if needed. G-UR.2.3., G-UR.4.4.

Examine discharge line and valves to insure that measured liquid cannot be diverted from the measuring chamber or discharge line and that any directional flow valves are automatic in operation. S.2.3., S.3.1.

No leaks should exist in the system on the outlet side of the meter..... G-UR.4.1., S.3.1.

Note: If leaks are detected on the inlet side of the meter, a notation should be made on the inspection report and the firm should be made aware of the location of the leak for purposes of safety.

Examine the system and any associated equipment to insure that the assembly, installation, and construction do not facilitate fraud..... G-S.2.

The details of the installation must be proper and must not adversely affect system performance. The actual maximum discharge rate must not exceed that specified by the manufacturer. G-UR.2.1., UR.2.1., UR.2.2.

5. Selection and use.

Device must be suitable for the service in which it is used with respect to the elements of design, including flow rate, computing capability, the details of its indicating and recording elements, and the value of its smallest unit and unit prices. Device must also be suitable for use in the environment in which it is installed. G-UR.1.1., G-UR.1.2

Device and any associated equipment are to be operated and maintained as intended by the manufacturer G-UR.3.1., G-UR.4.1.

Inspection (cont.):

If a device is equipped with a mechanical automatic temperature compensator, it shall be connected, operable, and in use at all times. UR.3.6.1.1.

6. Devices equipped with automatic temperature compensating systems.

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Provision must be made to deactivate the automatic temperature compensating system so that the meter may indicate and record, if equipped to record, in terms of the uncompensated volume. S.2.7.2.

Thermometer well must be provided for determination of the temperature of the liquid..... S.2.7.4.

Primary indicating and recording elements on devices equipped with automatic temperature compensating systems shall be marked to show that the volume delivered has been adjusted to 15.5 °C (60 °F)..... S.4.3.2.

Test Notes:

<p>Wear appropriate personal protection equipment such as petroleum-resistant, non-skid safety shoes (to prevent possible injury from spills or slipping on slick surfaces), protective clothing, eye protection (to prevent injury from splashed product), and a hard hat (to prevent injury from overhangs and projections on vehicle tank truck).</p> <p>Use proper grounding procedures!</p> <p>Device operator should be present at all times during testing.</p>

1. Check for the proper operation of the level indicators on the prover and level the prover.
2. Connect safety interlock and ground cable. If applicable, connect the vapor recovery hose.
3. Verify that all valves in the proving system are closed and that the prover pumping mechanism is functional.
4. Note the totalizer reading. Totalizer should be checked before and after each draft to determine its proper operation.

Test Notes (cont.):

5. Care should be exercised to insure that the temperature difference between product in the prover and in the meter is small. N.2.
6. For top-loading provers, take precautions to minimize splashing and to maintain the spout fill in a consistent position.
7. Examine printed tickets and invoices:

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- a. Print a ticket after each test draft, if device is so equipped..... G-S.5.6.
 - b. For devices of the computing type:
 - 1) Check price computations on indicator and on printed indications. S.1.7.2.
 - 2) On any printed ticket containing the total computed price, the total volume of the delivery and the price per gallon or liter shall be shown either machine printed or in clear handscript. UR.3.4.
 - c. Check all indicated and recorded values for proper comparability..... G-S.5.2.2.
 - d. For systems equipped with automatic temperature compensation, check invoices to determine if:
 - 1) deliveries which are adjusted to 15.5 °C (60 °F) show that the volume has been adjusted to 15.5 °C (60 °F)..... UR.3.6.1.2.(a)
 - 2) in the case of an electronic wholesale device equipped with an automatic temperature compensating system, the API gravity, specific gravity, or coefficient of expansion; product temperature; and gross reading are also indicated. UR.3.6.1.2.(b)
 - e. For devices with nonautomatic temperature compensating systems, check invoices to determine that: if the volume of the product delivered is adjusted to 15.5 °C (60 °F), this is stated on the invoice along with the product temperature used in making the adjustment..... UR.3.6.2.1., UR.3.6.2.2.
 - f. In addition to tickets printed during inspection and testing, several examples of actual used tickets are to be examined. This serves to verify the format of and information on actual printed tickets.
8. Prover readings are to be determined by reading the bottom of the meniscus for transparent liquids, and the top of the meniscus for opaque liquids.
9. When monitoring drainage of the prover, one of the following methods should be followed depending on prover design. Precautions should be taken to insure that drainage procedure is followed in a consistent manner for each test.
- a. If the prover has a lower neck equipped with a drain sight glass, close the drain valve prior to the liquid level reaching the zero mark indicator. After 30 seconds drain time, open the small drain-off valve and lower the liquid level to the zero mark. (Do not adjust the liquid level again,

Test Notes (cont.):

- a. even if continued drainage raises the liquid level above the zero mark before the test is started.)
 - b. If the prover is not equipped with a lower sight glass, leave the drain valve open until continuous flow ceases and dripping commences. Close drain valve after 30 seconds.
10. Temperature readings are to be taken to the nearest 0.25 °C or 0.5 °F or for digital thermometers, to the nearest increment. Take the temperature of the test liquid in the prover immediately following each

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accuracy test. For provers equipped with more than one thermometer, the temperature of the test liquid is the mathematical average of the individual readings.

A thermometer placed in the thermowell adjacent to the meter is to be used to determine meter temperature. Meter temperature is to be taken at 1/3 and 2/3 prover capacity during each delivery and averaged.

- 11. Automatic-stop-mechanism must stop flow within one-half the minimum interval indicated S.2.4.

Test Procedure:

<p>Use proper lifting techniques to lift and move equipment!</p> <p>Be aware of and attempt to eliminate potential ignition sources in or near the inspection site.</p> <p>Be aware of vehicular and pedestrian traffic in the area.</p>

- 1. Wet prover.
- 2. Empty prover. Allow a 30-second drain period each time the prover is emptied, using one of the methods outlined in the **Test Notes**. The amount of time between wetting the prover and the first test draft should be minimal.
- 3. Insert a meter ticket and set preset stop mechanism for the rated capacity of the prover.

Reset the meter to zero.
- 4. Start the pump, then open the prover delivery valve.

Test Procedures (cont.):

If any test result is close to or outside of applicable tolerance, then repeat the test.

If two consecutive tests are found to exceed applicable tolerance values, discontinue accuracy test and proceed to next portion of EPO.

For Repair Personnel:

Two test runs should be performed to insure repeatability. The difference between the high and low readings of these two consecutive runs should not exceed 0.05 percent of the prover's certified volume.

If test results exceed applicable tolerance values, the meter should be adjusted at this point. Repair

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personnel should follow company policy regarding adjustment of meter; for meters equipped with a temperature compensator, it may be necessary to first deactivate the temperature compensator prior to making any adjustment.

A check for the performance of the temperature sensor should be performed at the end of each accuracy test. Utilize the section at the end of each worksheet to analyze the performance of the sensor. Should a variation of 1 °C or 2 °F exist for two consecutive runs, the normal operating thermometer must be recalibrated against a National Institute of Standards and Technology traceable thermometer.

5. Accuracy tests.

a. Nontemperature-compensated meters.

Temperature corrections are to be made for accuracy tests to account for any difference between the temperature of the liquid passing through the meter and the liquid in the prover..... N.5.

1) Normal test--full flow..... N.4.1., N.4.1.1., N.4.1.2., T.2.3.

a) Fill prover in a manner simulating actual use and determine actual flow rate. Test should be run at the maximum discharge rate anticipated under the conditions of the installation. Actual rate of flow should be within manufacturer's ratings of minimum and maximum flow..... G-UR.3.1., UR.2.2.

b) Verify that all valves are closed and that prover remains level. Examine prover piping to insure that there is no entrapment of air and that there are no leaks.

c) Disconnect the bottom loading coupler or remove the loading spout from the liquid.

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Test Procedure (cont.):

- d) Allow time for product settling and foam dissipation prior to taking prover reading.
 - e) Read the thermometers as described in **Test Notes**, and record the reading to the nearest 0.25 °C or 0.5 °F or for digital thermometers, to the nearest increment.
 - f) For an analog device, record ending meter reading to the nearest 0.1 gallon. For a digital-indicating device, record the meter indication to the smallest quantity division available, e.g., test mode indication. Check totalizer against actual amount dispensed.
 - g) Disconnect vapor recovery hose and then drain prover.
 - h) Use appropriate worksheet to determine meter error.
- 2) Special test--slow flow..... N.4.2., N.4.2.4., T.2.3.
- a) Reconnect vapor recovery hose, if applicable.
 - b) Fill prover at the minimum discharge rate marked on the device
 - c) Repeat steps (b) through (h) of part 5.a.(1) above.
- b. Temperature compensated meters.
- For meters that indicate in "net" gallons. With temperature compensator activated:
- 1) Normal test--full flow (do not deactivate temperature compensating system). N.4.1., N.4.1.1., N.4.1.2., T.2.3.
- a) Fill prover as described in part 5.a.(1) above.
 - b) Obtain temperature of product at meter at 1/3 and 2/3 prover capacity. Determine the average.
 - c) Follow remaining steps in part 5.a.(1) above, using the worksheet for compensated meters to determine meter error.
- Deactivate temperature compensator:
- 1) Normal test--full flow N.4.1., N.4.1.1., N.4.1.2., T.2.3.
- Follow testing procedure described in part 5.a. above for normal test, uncompensated meters, determine meter error using worksheet for uncompensated meters.
- 2) Special test--slow flow..... N.4.2., N.4.2.4., T.2.3.
- Follow testing procedure described in part 5.a.(2) above for special test,

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Test Procedure (cont.):

uncompensated meters. Determine meter error using worksheet for uncompensated meters.

Reactivate temperature compensator.

c. Temperature compensated meters.

For meters that indicate or record in "gross" gallons (uncompensated) and "net" gallons (compensated).

1) Accuracy of "gross" gallons is to be determined following the test procedure for non-temperature compensated meters in part 5.a.(1) and (2) above to perform both normal and special tests.

2) Accuracy of "net" gallons is to be determined as follows:

a) For each test run in part c.(1) above, obtain the temperature of product at meter at 1/3 and 2/3 capacity of prover.

b) Correct prover volume reading to 15.5 °C (60 °F), using the worksheet for compensated meters.

6. For automatic temperature compensating systems. The difference between the meter error for tests performed with and without the automatic temperature compensating system activated shall not exceed 0.2 percent for mechanical ATCS and 0.1 percent for electronic ATCS of the test draft. The results of each test shall be within applicable tolerances..... T.2.3.5.(1/1/88)

7. Security seal:

Adequate provision shall be made for applying a security seal..... S.2.2

Affix a security seal to the adjustment mechanism, as appropriate. G-UR.4.5.

8. For a wet-hose system, check the effectiveness of the anti-drain valve..... S.3.9.

9. For a dry-hose system, check for complete drainage of the hose. S.3.4.(b)

10. Radio Frequency Interference (RFI)/Electromagnetic Interference (EMI) (only if a problem is suspected). using only equipment on site in the vicinity of the metering system, perform a test for radio frequency/electromagnetic interference. Results of this test must indicate that use of such equipment does not adversely affect performance of the metering system..... G-N.2., G-UR.1.2., G-UR.3.2., G-UR.4.2.

Test Procedure (cont.):

EPO No. 25

**Use extreme caution when switch-loading product!
Take precautions to isolate equipment when
transporting it to avoid exposure to hazardous fumes.**

EPO No. 26

**Examination Procedure Outline for
Liquefied Petroleum Gas Motor-Fuel Dispensers**

It is recommended that this outline be followed for all LP gas motor-fuel dispensers. Examination procedures for other types of LP gas liquid meters are given in EPO No. 27.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

- | | |
|---|--|
| Clothing | Material Safety Data Sheets (MSDS) |
| Electrical Hazards | Nature of Product |
| Emergency Procedures | Personal Protection Equipment
e.g., Safety Shoes |
| Eye Protection | Safety Aprons, Respirators, Gloves, Barrier Cream, Etc., if deemed necessary. |
| Fire Extinguisher | Hard Hat -- for protection from overhang in rear of vehicle tank truck |
| First Aid Kit | |
| Grounding | Safety Cones/Warning Signs |
| Ignition Sources | Static Discharge |
| Lifting | Support -- for prover |
| Location | Switch Loading |
| | Traffic |
| also: Wet/Slick Conditions | Transportation of Equipment |
| Chemicals, Petroleum Products, And Hazardous Materials | |
| Obstructions | |

EPO No. 26

Inspection:

Safety First !!!

Check the inspection site carefully for safety hazards and take appropriate precautions pay particular attention to the condition of the product storage tank and valves.

Check to be certain that the ground surface of the inspection site is sufficiently strong and rigid to support the prover when it is filled with product don't forget to chock the wheels of the prover.

Learn the nature of hazardous products used at or near the inspection site; obtain and read copies of MSDS.

Know emergency procedures (particularly for this location) and the location and operation of fire extinguisher and emergency shut-offs.

Be sure that a constant supply of water is available for cooling tanks in an emergency Post safety cones/warning signs and be aware of vehicular and pedestrian traffic patterns.

Use caution moving around in wet, slippery areas and in climbing on prover, storage tanks, and vehicles.

Use personal protection equipment and clothing appropriate for the inspection site.

If exposed wiring or other factors cause hazardous testing conditions, it is recommended that the testing be discontinued until the unsafe conditions are corrected.

Be sure that a first aid kit is available and that the kit.

H-44 General Code and LPG and AA Liquid-Measuring Devices Code References

- 1. Indicating and recording elements.
 - Design S.1.1.
 - Readability G-S.5., G-UR.3.3., S.1.2., S.1.3.
 - Unit price and product identity..... S.1.5.1.
 - Advancement and return to zero..... S.1.1.4., S.1.4.1., S.1.4.2., UR.2.1.
 - Provision for sealing..... G-S.8. (1/1/90), G-UR.4.5.
- 2. Measuring elements.
 - Vapor elimination..... S.2.1., S.2.4.
 - Security seals..... G-UR.4.5., S.2.2., S.2.6.2.
 - Thermometer well S.2.5.
 - Automatic temperature compensation..... S.2.6., S.2.6.1., UR.2.4.

EPO No. 26

Inspection (cont.):

3. Marking requirements	G-S.1., G-S.6.(1/1/77), G-S.7., S.4.
4. Discharge line and valves	S.2.3., S.3., UR.1.2., UR.2.2., UR.2.3.
Facilitation of fraud	G-S.2.
5. General considerations.	
Selection	G-UR.1.1.
Use and maintenance	G-UR.3.1., G-UR.4.1.
Installation	G-UR.2.1., G-UR.2.2., UR.1.1., G-S.2., G-S.3.
Accessibility	G-UR.2.3.
Assistance	G-UR.4.4.
Testing devices at a central location	G-UR.4.6.(a)

Pretest Determinations:

1. Determine that the test liquid is similar in character to the liquid to be measured commercially	N.1.
2. Tolerances.	
Applicable requirements	G-T., T.1.
Tolerance values	T.2.
Repeatability	T.3.
Automatic temperature-compensating systems	T.4.

Test Notes:

Wear appropriate personal protection equipment such as static-resistant, nonskid safety shoes (to avoid potential ignition source and to prevent possible injury from slipping on slick surfaces), protective clothing, eye protection (to prevent injury from product), and a hard hat (to prevent injury from overhangs and projections on the prover and at the test site).

Use proper grounding procedures !

Be sure that prover is equipped with an explosion-proof motor.

Carefully inspect electrical supply lines for test equipment for wear or damage; correct potentially hazardous conditions before use; protect lines from damage during use.

Remove fire extinguisher from storage receptacle and set out for easy access.

EPO No. 26

Test Notes (cont.):

1. Wet prover (fill to nominal capacity). Allow 30-second drain period each time prover is emptied.
2. Read temperature and pressure of product in prover immediately following each test draft. N.5.
3. If dispenser is equipped with a recording element, print ticket after each test run..... G-S.5.6., S.1.1.6., UR.2.5.
4. If computing type, check computation G-S.5.5., S.1.1.5., S.1.5.2.
5. To determine proper operation of totalizers, observe and record the totalizer indication before and after all test drafts.

Test:

Use proper lifting techniques to lift and move equipment !

Be aware of and attempt to eliminate potential ignition sources in or near the inspection site.

Be aware of vehicular and pedestrian traffic in the area.

Nontemperature-compensated meters

- Read temperature of product at meter at one-third and two-thirds prover capacity..... N.5.
1. Normal test--full flow, normal 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.4.2.1., N.5., T.2.

If the result of any test is close to or outside the applicable tolerance, repeat that test.

Temperature-compensated meters

1. Normal test--full flow, normal tolerance. (Do not deactivate temperature compensator.) N.2., N.3., N.4.1.1., N.5., T.2.
2. Deactivate temperature compensator and repeat normal test N.2., N.3., N.4.1., N.5., T.2., T.4.
3. Special test--slow flow, special tolerance..... N.2., N.4.2.1., N.5., T.2.

If the result of any test is close to or outside the applicable tolerance, repeat that test.

Test (cont.):

EPO No. 26

Reactivate temperature compensator.

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

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

EPO No. 27

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.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Clothing	Material Safety Data Sheets (MSDS)
Electrical Hazard	Nature of Product
Emergency Procedures	Personal Protection Equipment e.g., Safety Shoes
Eye Protection	Safety Aprons, Respirators, Gloves, Barrier Cream, etc. if deemed necessary
Fire Extinguisher	Hard Hat – for protection from overhead hazards
First Aid Kit	Safety Cones/Warning Signs
Grounding	Static Discharge
Ignition Sources	Support – for prover
Lifting	Switch Loading
Location	Traffic
	Transportation of Equipment
also: Wet/Slick Conditions	
Chemicals, Petroleum Products, and Hazardous Materials	
Obstructions and Overhead Hazards	

EPO No. 27

Inspection:

Safety First !!!

Check the inspection site carefully for safety hazards and take appropriate precautions pay particular attention to the condition of the product storage tank and valves.

Check to be certain that the ground surface of the inspection site is sufficiently strong and rigid to support the prover when it is filled with product don't forget to chock the wheels of the prover.

Learn the nature of hazardous products used at or near the inspection site obtain and read copies of MSDS.

Know emergency procedures (particularly for this location); post safety cones/warning signs and be aware of the location and operation of fire extinguisher and emergency shut-offs.

Be sure that a constant supply of water is available for cooling tanks in an emergency.

Post safety cones/warning signs and be aware of vehicular and pedestrian traffic patterns.

Use caution moving around in wet, slippery areas and in climbing on prover, storage tanks, and vehicles.

Use personal protection equipment and clothing appropriate for the inspection site.

If exposed wiring or other factors cause hazardous testing conditions, it is recommended that the testing be discontinued until the unsafe conditions are corrected.

Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.

**H-44 General Code and LPG
and AA Liquid-Measuring
Devices Code References**

1. Indicating and recording elements.	
Design	S.1.1.
Readability	G-S.5., G-UR.3.3., S.1.2., S.1.3.
Ticket Printer (vehicle-mounted systems).....	UR.2.6.
Unit price and product identity.....	S.1.5.1.

EPO No. 27

Inspection (cont.):

Advancement and return to zero.....	S.1.1.4., S.1.4.1., S.1.4.2., UR.2.1., S.1.6.1.
Provision for sealing.....	G-S.8. (1/1/90), G-UR.4.5.
2. Measuring elements.	
Vapor elimination.....	S.2.1., S.2.4.
Security seals.....	G-UR.4.5., S.2.2., S.2.6.2.
Thermometer well.....	S.2.5.
Automatic temperature compensation.....	S.2.6., S.2.6.1., UR.2.4.
3. Marking requirements	
	G-S.1., G-S.6.(1/1/77), G-S.7., S.4.
4. Piping.	
Discharge line and valves.....	S-2.3., S.3., UR.2.2., UR.2.3.
Facilitation of fraud.....	G-S.2.
5. General considerations.	
Selection.....	G-UR.1.1.
Use and maintenance.....	G-UR.3.1., G-UR.4.1.
Installation.....	G-UR.2.1., G-UR.2.2., UR.1.1., G-S.3.
Accessibility.....	G-UR.2.3.
Assistance.....	G-UR.4.4.
Testing devices at a central location.....	G-UR.4.6.(a)

Pretest Determinations:

1. Determine that the test liquid is similar in character to the liquid to be measured commercially.....		N.1.
2. Tolerances.		
Applicable requirements.....	G-T., T.1.	
Tolerance values.....	T.2.	
Repeatability	T.3.	
Automatic temperature-compensating system.....	T.4.	

EPO No. 27

Test Notes:

Wear appropriate personal protection equipment such as static-resistant, nonskid safety shoes (to avoid potential ignition source and to prevent possible injury from slipping on slick surfaces), protective clothing, eye protection (to prevent injury from product), and a hard hat (to prevent injury from overhangs and projections on the prover and at the test site).

Use proper grounding procedures!

Be sure that prover is equipped with an explosion-proof motor.

Carefully inspect electrical supply lines for test equipment for wear or damage; correct potentially hazardous conditions before use; protect lines from damage during use.

**Device operator should be present at all times during testing
the operator (not the inspector) should operate the device under test.**

Remove fire extinguisher from storage receptacle and set out for easy access.

1. Wet prover (fill to nominal capacity). Allow 30-second drain period each time prover is emptied.
2. Read temperature and pressure of product in prover immediately following each test draft N.5.
3. If dispenser is equipped with a recording element, print ticket after each test run G-S.5.6., S.1.1.6., UR.2.5., UR.2.6.
4. If computing type, check computation G-S.5.5., S.1.1.5., S.1.5.2.
5. To determine proper operation of totalizers, observe and record the totalizer indication before and after all test drafts.

Test:

Use proper lifting techniques to lift and move equipment !

Be aware of and attempt to eliminate potential ignition sources in or near the inspection site.

Be aware of vehicular and pedestrian traffic in the area.

EPO No. 27

Test (cont.):

Nontemperature-compensated meters

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

1. Normal test--full flow, normal 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.5., T.2., N.4.2.3.

If the result of any test is close to or outside the applicable tolerance, repeat that test.

Temperature-compensated meters

1. Normal test--full flow, normal tolerance. (Do not deactivate temperature compensator.) N.2., N.3., N.4.1.1., N.5., T.2.
2. Deactivate temperature compensator and repeat normal test N.2., N.3., N.4.1., N.5., T.2., T.4., N.4.2.3.
3. Special test--slow flow, special tolerance N.2., N.4.2.2., N.5., T.2., N.4.2.3.

If the result of any test is 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 the meter.

Note audit trail information, if applicable.

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

EPO No. 28

**Examination Procedure Outline for
Compressed Natural Gas (CNG)
Retail Motor-Fuel Dispensers**

It is recommended that this outline be followed for examining retail motor-fuel dispensers used to measure compressed natural gas. Non-retroactive requirements are followed by the applicable date in parentheses.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the “Safety Considerations” section and the “Glossary of Safety Key Phrases” should be duplicated and included with the outline.

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the “Glossary of Safety Key Phrases” at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer’s safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Asphyxiation

Lifting

Chemicals, Petroleum Products, and Hazardous Materials

Location

Clothing

Material Safety Data Sheet (MSDS)

Electrical Hazards

Nature of Product

Emergency Procedures

Personal Protection Equipment

Eye Protection

Safety Shoes

Fire Extinguisher

Safety Cones/Warning Signs

First Aid Kit

Static Discharge

Grounding

Traffic

High Pressure Gas

Transportation of Equipment

Ignition Source

EPO No. 28**Equipment List:**

The following criteria should be considered when selecting equipment for the test.

Scale

- ▶intrinsic safety - scale meets Underwriters Laboratory (UL) Area Classification Class 1 Division 2 Group D (scale equipment must be located outside of classified area which is five feet from hose connection to dispenser)
- ▶capacity
- ▶appropriate division size
- ▶type of power source

See the Appendix to EPO 28 for information on Scale Selection Criteria and Verifying Scale Accuracy.

Mass Standards

- ▶Class F

Test Cylinder

- ▶ rating - must be equivalent to or greater than the service pressure marked on the device under test as required by the ANSI/IAS NGV 4.1/CSA 12.5 “NGV Dispensing Systems,” Standard for Natural Gas Vehicle Dispensing Systems
- ▶compatible fittings
- ▶bleed valve
- ▶pressure gauge
- ▶drain hose

Note: Service pressure is the settled pressure at a uniform gas temperature of 21 °C (70 °F) and full gas content. It is the pressure for which the equipment has been constructed under normal conditions. This is different from the maximum working pressure.

Optional Equipment:

- ▶quick connect ground strap
- ▶cart
- ▶test cylinder supports (chocks)
- ▶weather shield/wind screen (for the weighing operation)

**H-44 General Code and
Mass Flow Metering Devices
Code References**

Pretest Determinations:

1. Select a site in the vicinity of the dispenser that is level and protected from wind and weather to locate the scale. Ensure that the scale is given a sufficient warm-up time.
2. Determine the scale error.
Sufficient test weights should be available to verify the gross load to be applied During testing. The scale should be sensitive to 0.03 percent or less of the total net weight of the product in the test cylinder. The value of the scale division should not exceed one-tenth of the tolerance applied to the device.

EPO No. 28

Pretest Determinations (cont.):

- 3. Scale capacity must be sufficient to weigh the test cylinder, optional chocks, and cart when filled to capacity with product.
- 4. Tolerances.
 - Applicable requirements G-T., T.1.
 - Applicable tolerances in NIST Handbook 44.
 - Basic values..... T.2.
 - Applicable tolerances for CNG application.

Inspection:

Safety First !!!

Check the inspection site carefully for safety hazards and take appropriate precautions pay particular attention to the condition of the test tank high pressure fitting and hoses.

Learn the nature of hazardous products used at or near the inspection site; obtain and read copies of Material Safety Data Sheet (MSDS).

Know emergency procedures and location and operation of fire extinguisher and emergency shut-off system.

Post safety cones/warning signs and be aware of vehicular and pedestrian traffic patterns.

Use personal protection equipment and clothing appropriate for the inspection site.

Make sure there is adequate ventilation to permit fumes to dissipate before proceeding with the inspection of the dispenser.

If product is leaking (most CNG contains an odorant), or inadvertently released, or exposed wiring cause hazardous testing conditions it is recommended that the testing be immediately discontinued until the unsafe conditions are corrected.

Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.

Use proper grounding procedures!

Use proper low resistance grounding strap with recommended minimum conductance rating and correct connections consistent with the device under test.¹

¹See the National Electrical Code or your local Occupational Safety and Health Administration (OSHA) for these requirements.

EPO No. 28**Inspection (cont.):**

1. General considerations.
 - Selection G-UR.1.1.
 - Equipment suitable for service
 - Installation..... G-UR.2.1., G-UR.2.2., UR.2.1.
 - Installed in accordance with manufacturer's instructions does not adversely affect operation nor impede communications between indicator/recorder
 - Position..... G-UR.3.3.
 - During direct sales, indications are readable from a reasonable customer and operator position.
 - Accessibility G-UR.2.3.
 - Located or such facilities provided for access to permit inspection, testing, and sealing
 - Assistance..... G-UR.4.4.
 - If required, operator to provide assistance in testing.
 - Use and maintenance..... G-UR.3.1., G-UR.4.1.
 - Proper operation and maintenance of equipment

2. Marking G-S.1., S.5., G-UR.2.1.1.
 - Visible markings of the following information:
 - Pattern approval mark.
 - Name and address of manufacturer.
 - Model designation.
 - Model prefix (1/1/03)
 - Nonrepetitive serial number.
 - Serial number prefix (1/1/01)
 - Accuracy class (1/1/95)
 - Maximum and minimum flow rates (quantity/unit time).
 - Maximum working pressure.
 - Applicable temperature range (if other than -10 °C to 50 °C).
 - Minimum measured quantity.
 - Product limitations, if applicable.
 - Remanufacturer information as appropriate
 - Name and ID of manufacturer (1/1/02)
 - Model number if different from original model number (1/1/02)
 - Gasoline volume equivalent conversion factor S.5.1

3. Indicating and recording elements.
 - Design G-S.5.1., S.1.1.
 - Shall have clear accurate indicator
 - Computing type² S.1.2.
 - Mass display for inspection and testing
(pound displayed ÷ 5.660 = Gasoline Gallon Equivalent (GGE) displayed or kilograms displayed ÷ 0.678 = Gasoline Liter Equivalent (GLE) displayed)
 - Units S.1.3.1.1.
 - Quantity indications in GLE or GGE

²Indicates an exception to this requirement for dispensers used exclusively for fleet sales, other price contract sales and truck refueling.

EPO No. 28

Inspection (cont.):

Readability	G-S.5., G-S.6. (1/1/77), G-S.7.
Appropriate and accurate indicator and recorder	
Clear and identified operational controls and indicator	
Lettering is clear and tends not to become obliterated.	
Values of intervals.....	G-S.5.3.
Values of graduated intervals shall be uniform.	
Maximum value of quantity-value divisions.....	S.1.3.3.(b)
Value of GLE is not greater than 0.01 GLE.	
Value of GGE is not greater than 0.001 GGE.	
Mass division shall not be greater than 0.001 kg or 0.001 lb.	
Auxiliary indications.....	S.2.6.1.
All money value and quantity divisions are identical to those of the primary element.	
Unit price and product identity.....	S.2.5.1., S.2.5.2., S.2.5.3., UR.3.1.
Display on each side.	
Post information in direct sale ² .	
Selection of unit price ²	
Advancement and return to zero.....	S.2.1., S.2.2., S.2.8., UR.3.7.
Return indication to zero.	
Does not return beyond zero position.	
Reset not operable during delivery.	
Return primary indicator to zero prior to delivery.	
Provision for sealing.....	S.8., G-UR.4.5., S.3.5.
Metrological integrity protected by means of security.	
Affix a seal to adjustment mechanisms.	
Recorded representations, point of sale systems.....	S.2.7.
Interface with cash register shall record :	
Total volume	
Unit price	
Total computed price	
Product identity	
4. Measuring elements.	
Means of security on adjusting mechanism.....	S.8., G-UR.4.5., S.3.5.
Adequate security or sealing for:	
Measurement element.	
Adjustable elements that affect accuracy	
Zero adjustment mechanism.	
Directional flow valves.....	S.4.3.
Prevent flow reversal if it adversely affects device.	
5. Discharge hose	S.4.1., S.4.4., UR.1.1.
No means of product diversion from measuring element.	
It is apparent if there are two or more delivery outlets.	

²Indicates an exception to this requirement for dispensers used exclusively for fleet sales, other price contract sales and truck refueling.

EPO No. 28

Inspection (cont.):

Discharge valve may be installed on wet-hose type.

Other shutoffs are automatic or semiautomatic predetermined stop type or operable by a separate tool or sealed open by means of security.

Length UR.1.1. (1/1/98)

Pressurizing the discharge hose..... S.3.7.

Discharge hose shall automatically pressurize prior to registration of delivery.

6. Automatic Density Correction..... S.3.6.

Test Notes:

Wear appropriate personal protection equipment such as nonskid safety shoes (to prevent possible injury from spills or slipping on slick surfaces), protective clothing, and eye protection to prevent injury from discharged product or propelled objects.

**Be certain the scale is intrinsically safe!
Scale meets Underwriters Laboratory (UL)
Area Classification Class 1 Division 2 Group D
(Equipment location is outside of classified area which is five feet from hose connection to dispenser).**

Do not leave an activated dispenser unattended!

Ground test tank and scale properly during return of product.

1. Connect grounding cables to equipment.
2. Determine the tare weight of the test tank and record.
Repeat this process prior to each delivery.
3. To determine proper operation of totalizer, observe and record the totalizer indications before and after all test drafts S.7.
4. After each test draft:
 - a. Print ticket if device is so equipped G-S.5.6., UR.3.4.
All recorded values shall be digital.
Total-price, quantity, and unit price must be on the receipt.
 - b. Check price computations on all indicators (including consoles) and on recorded representations..... G-S.5.5.
Mathematical agreement of associated quantity or indication to the nearest one cent
 - c. Check all indicated and recorded values for proper comparability G-S.5.2.2., S.2.5.4.(a), S.2.5.4.(b)

Check design of digital indication to determine that:
Like values agree.
Values coincide with analog value to nearest minimum graduation.

EPO No. 28

Test Notes (cont.):

Value rounds off to nearest minimum unit.
Digital zero display all places to the right, and at least one place to the left of the decimal point.

Tests:

<p>Ground test tank and scale properly during return of product.</p> <p>Use proper lifting techniques when lifting test tank!</p> <p>Be aware of and attempt to eliminate potential ignition sources in or near the inspection site.</p> <p>Be aware of vehicular and pedestrian traffic when moving between dispenser and product return area.</p>

- 1. Normal test S.3.7.,N.4., N.6.1, T.2., T.3.

Computer jump:

Remove nozzle from dispenser and connect to test cylinder. (Test cylinder pressure should not be greater than 200 psi to simulate an actual delivery.)
 Turn nozzle valve from “OFF” position to “FILL” position.
 Empty discharge hose.
 Turn nozzle valve to “OFF” position.
 Activate dispenser.
 Observe dispenser indications, if computer jump occurs take appropriate action.

NOTE: A test cylinder is not necessary for the computer jump test on dispensers equipped with an autovent system. To test, turn dispenser on and observe the indication display for computer jump when the dispenser shuts off.

Minimum test drafts are as follows:

Place empty test cylinder on the scale.
 Access mass display of the dispenser.
 Tare weight of the test cylinder, chocks, and stand.
 Connect the nozzle to the test cylinder.
 Fill the test cylinder to 1/3 capacity full at maximum flow rate.

<p>Stop delivery manually if delivery hose pressure exceeds allowable safety limits.</p>

Disconnect the nozzle from the test cylinder.
 Compare mass display to scale indication.
 Determine dispenser error T.2.
 Leave product in test cylinder.

Tests (cont.):

Tare the weight of the test cylinder, chocks and stand.

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Connect the nozzle to the test cylinder.
Begin the fill operation with product in the cylinder; fill cylinder to 2/3 capacity at maximum flow rate.

Stop delivery manually if delivery hose pressure exceeds allowable safety limits.

Disconnect the nozzle from the test cylinder.
Compare mass display to scale indication.
Determine dispenser error T.2.
Tare the weight of the test cylinder, chocks, and stand.
Connect the nozzle to the test cylinder.
Begin the fill operation with product in the cylinder; fill cylinder to capacity at maximum flow rate.

Stop delivery manually if delivery hose pressure exceeds allowable safety limits.

Disconnect the nozzle from the test cylinder.
Compare mass display to scale indication.
Determine dispenser error T.2.
Return product to owner/operator of dispenser UR.3.8.
Place empty test cylinder on scale (scale may be supported by chocks and stand.)
Tare the weight of the test cylinder, chocks, and stand.
Connect the nozzle to the test cylinder.
Fill test cylinder to capacity at maximum flow rate.

Stop delivery manually if delivery hose pressure exceeds allowable safety limits.

Disconnect the nozzle from the test cylinder.
Compare mass display to scale indication.
Determine dispenser error T.2.
Return product to owner/operator of dispenser.
Repeating previous tests T.3.(a)
 Applicable tolerance for multiple tests at the same flow rate
Return product to owner/operator of dispenser.
If the meter minimum measured quantity (MMQ) is less than the smallest test draft, conduct a test at the MMQ value..... N.4.

NOTE: If 300 divisions (d) or 2.27 kilograms (5 pounds) is greater than 1/3 of the test cylinder capacity, then the test cylinder should be emptied to accommodate a delivery of at least 300 d or 2.27 kilograms (5 pounds) otherwise a larger tank is necessary.

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Tests (cont.):

- 2. Check effectiveness of zero-setback interlock S.3.8., UR3.6., UR.3.7.

No subsequent delivery until indicating and recording element returned to zero.
 After delivery is complete the dispenser starting lever (mechanism) is shutoff, interlock engaged, and discharge nozzle is in the designed hanging position. (Note: This does not apply to nozzle control.)

Remove nozzle from hanging position.

Reset computer to zero and turn on dispenser.

Attempt to return the nozzle to its designed hanging position, carefully remove nozzle and connect it to the test tank and open valve. Move the dispenser starting lever (mechanism) to “ON” position and attempt to dispense product. (Note: This does not apply to nozzle control.)

Product should not flow without resetting the indications to zero.

- 3. Check operation of low-flow cut-off valve UR.2.3.

Valve shall not be set lower than the minimum flow rate.
 Valve stops registration when flow is below the low-flow cut-off value.

Connect nozzle to empty test tank and dispense product. Slowly throttle down on the valve on the test tank to the minimum attainable flow rate. Product delivery should not occur below the mass flow meter minimum flow rate.

- 4. Power loss test..... S.2.4.1., S.2.4.2.

Transaction in progress at power loss, information shall be retainable for 15 minutes.
 Device memory shall retain quantity of product and sales price during power loss.

- 5. Security seal--apply wire security seal to secure adjusting mechanism (if applicable) G-UR.4.5., S.3.5.

Note on the official report the number of gasoline gallon equivalents of product dispensed during the test.

After all equipment at a location has been tested, review results to determine compliance with equipment maintenance and use of adjustments..... G-UR.4.1., G-UR.4.3.

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Appendix to EPO No. 28

**Compressed Natural Gas (CNG)
Retail Motor-Fuel Dispensers**

Scale Selection Criteria³:

The size of the division relative to the net load has a significant effect on the accuracy to which a meter can be tested. It will also affect the size of the test draft required to evaluate the meter. To keep the “rounding error” (caused by reading a scale to the nearest scale division) to an acceptably small level for a single weighing, the value of the scale division should not exceed one-tenth of the tolerance applied to the CNG dispenser. (For example, if applying the acceptance tolerance of ± 1.5 percent to a 50 kg or 100 lb test draft, the scale division should be no greater than 70 g or 0.15 lb; applying the maintenance tolerance of ± 2.0 percent the scale division should be no greater than 90 g or 0.20 lb.) The rounding error occurs in both the gross and tare weights, so it could represent as much as two-tenths of the tolerance. **Either a high-resolution scale is needed, error weights should be used, or a larger test draft selected. A combination of these approaches may be used. If the size of the test draft must be small due to the available test cylinder(s) then a scale must be selected with an appropriate division size. If the scale available for testing has a relatively large division size then the size of the test draft must be increased accordingly.**

For example, if a CNG dispenser is to be tested using a scale with a 5 g or 0.01 lb division, error weights should be used to increase readability to the nearest 0.5 g or 0.001 lb for the gross and tare weights. Each weight value is, thus, ± 0.5 g or ± 0.001 lb or to the nearest 0.5 g or 0.001 lb, but since there are two weighings, gross and tare, the potential for total rounding error is 1 g or 0.002 lb. The acceptance tolerance for a CNG mass flow meter is ± 1.5 percent. To limit the error for each weighing to one-tenth of the tolerance, the minimum test draft must be equal to:

$$\frac{(1.0 \text{ g} \times 10)}{(0.015)} = 666.67 \text{ g} = 0.67 \text{ kg} \quad \text{or} \quad \frac{(0.002 \text{ lb} \times 10)}{(0.015)} = 1.333 \text{ lb}$$

Thus, if a scale with 0.5 g or 0.001 lb divisions is used, or a scale with 5 g or 0.01 lb divisions and error weights to 0.5 g or 0.001 lb is used and a tolerance of ± 1.5 percent is applied, the minimum test draft is recommended to be at least 0.67 kg or 1.34 lb. Other considerations may apply when determining minimum test draft size such as average customer delivery and meter size. (See also EPO discussion concerning determination of minimum test draft size.)

Verifying Scale Accuracy:

The Fundamental Considerations of Handbook 44, state it is necessary to limit the total error in a standard used without corrections to less than one-third of the tolerance of the device under test. For example, if applying the acceptance tolerance of ± 1.5 percent to a CNG meter, this means the scale must be accurate to at least 0.5 percent. Consequently, it is necessary to thoroughly test the scale, verify that its results repeat very well, correct for any errors determined during the scale test, and use the scale properly. This takes considerable time and care under field conditions. For devices with larger applicable tolerances (large test drafts), the requirements for the test may not be as stringent.

³The scale selection criteria and minimum test draft size for mass flow meter technology are discussed in the 1987 Report on the Specifications and Tolerances Committee Agenda Item 330-2.

Glossary of Safety Key Phrases

NOTE: When excerpting an Examination Procedure Outline for duplication, the "Safety Considerations" section at the beginning of this publication and this "Glossary" should also be duplicated and included with the outline.

Prior to using the safety information contained in the EPO's and in this glossary, the reader should review the "Safety Considerations" section at the beginning of this publication.

Before proceeding with the inspection and testing of a weighing or measuring device, the inspector or serviceperson should be completely familiar with all safety regulations and policies in effect at the inspection location. Such regulations and policies include federal, state, or local Occupational Safety and Health Administration (OSHA) regulations, safety policies established by the firm in which the inspection is taking place, and safety policies established by the inspector's or serviceperson's employer.

The safety reminders included in this publication are not intended to include all possible safety precautions which should be taken before proceeding with the inspection of a weighing or measuring device, nor are the listings of safety information and contacts a comprehensive source of safety information and guidance. Additional information is available on various safety topics from sources such as OSHA.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

The following key phrases are used throughout this publication to serve as reminders to the inspector or serviceperson to practice safety as a routine part of their work.

Chemicals, Petroleum Products, and Hazardous Materials:

Be familiar with the nature of the products at an inspection site that is located in a plant or other facility which handles, uses, or packages chemicals, petroleum products, or hazardous materials; it is essential that the inspector or serviceperson be familiar with the nature of the product and any protective measures which should be taken prior to working around the product. For example, some products may cause injury through exposure to the skin or through inhalation of the fumes or airborne particulates. Similarly, caustic products may also damage field standard weights or measures or equipment used in the test process.

Determine whether or not protective clothing or equipment is needed prior to working with the product.

Material Safety Data Sheets (MSDS's) can provide much of the basic information about the hazards involved with a product. The manufacturer of the product should be able to provide further information about the product. Several sources of information concerning chemicals, petroleum products, and hazardous materials are listed below.

American Chemical Society
1155 16th Street, N.W.
Washington, DC 20036
800-227-5558 (U.S. only)
(202) 872-4600 (outside the U.S.)
FAX# (202) 872-4615

American Chemistry Council
1300 Wilson Blvd.
Arlington, VA 22209
(703) 741-5000

American Petroleum Institute
1220 L. Street, NW
Washington, DC 20005-4070
(202) 682-8000
FAX#: (202) 682-8232

Look for leakage or spillage of chemicals, petroleum products, or hazardous materials at or near the inspections site. Leakage or spillage of these products can be potentially hazardous if the inspector/serviceperson or facility employee is exposed to the product and is not wearing personal protection equipment. Additionally, any product collecting on the ground surface can result in slippery, unsafe conditions for an individual moving about the inspection area. If leaking or spilled product results in unsafe conditions at the inspection site, it is recommended that the testing procedure be discontinued until the unsafe conditions are corrected.

Clothing:

Synthetic clothing should not be worn when working around flammable products. Synthetic clothing melts at high temperatures; if the person wearing the synthetic clothing is exposed to flames, the clothing may melt and stick to the persons skin to result in severe burns.

Combustion can result when an ignition source is present and fuel and oxygen are also available. Many types of synthetic clothing also tend to build up a static charge; this can be dangerous as a potential ignition source around flammable products.

Use caution when wearing **loose** clothing (or hanging jewelry) around machinery such as conveyor belts, weight movers, meat hooks, gears, etc. The clothing (or jewelry) may become entangled in the machinery and result in personal injury.

Electrical Hazards:

Be particularly aware of potential electrical hazards in or near the inspection site when testing electronic devices or working in the vicinity of electrical equipment. Loose or exposed wiring and a frayed or worn electrical cord should be brought to the attention of management at the inspection site. Avoid standing on wet surfaces unless the electrical equipment is properly insulated and grounded.

Combustion can result when an ignition source is present and fuel and oxygen are also available. Electrical hazards may also be potential ignition sources when testing devices which dispense flammable products or working near flammable products. Be sure that provers and other test equipment are equipped with explosion-proof motors. Always check the electrical supply lines for testing equipment carefully for signs of wear or

damage, and correct any potentially hazardous conditions. Take steps to protect these supply lines from damage during use.

Emergency Procedures:

Always be familiar with emergency procedures **BEFORE** beginning an inspection. After an emergency has developed, crucial time can be lost if emergency procedures are not known. Be familiar with the procedures to follow in the event of an equipment malfunction or the development of a dangerous situation with the equipment or in the vicinity of the inspection site when operating specialized testing equipment.

Be familiar with the nature of any product being dispensed by a device or being used in or near the inspection area. Know the emergency procedures to be followed when a spill has occurred or a person has been exposed to the product. Knowledge of emergency procedures and related information should include the correct selection and use of fire extinguishers, the location of emergency shut-offs, and evacuation procedures.

Keep a list of emergency phone numbers handy at all times in a notebook or on a card. Examples of numbers to keep are the local fire department, emergency medical facility, and other appropriate public safety agencies.

Eye Protection:

Appropriate eye protection is recommended when working around hazardous products which may inadvertently splash into the eyes, and eye-wash facilities should be considered. Contact lens wearers should be particularly careful to follow the instructions of their eye-care practitioner and local OSHA representative when working around hazardous products.

Appropriate eye protection should also be worn when working in an area with overhead projections such as meat hooks or other sharp objects or where there is a potential of flying projectiles (e.g., when working near tools that grind, chip, etc.).

Fire Extinguisher:

Know the proper use and selection of fire extinguishers for a given application. Contact your local fire department for current information and training.

First Aid Kit:

An appropriate first aid kit or kits should be provided for every vehicle and in every laboratory. Consideration should be given to the type of work that the inspector, metrologist, or serviceperson typically performs and the types of hazards typically encountered in these types of activities. Items in addition to those contained in a basic first aid kit may need to be added to address the potential hazards which may be encountered by the person who will be most likely to use the first aid kit. Check with your local OSHA office or with your departmental safety officer for input on the items to be included in each kit.

Grounding:

It is essential to properly ground the prover being used when inspecting meters which dispense flammable products. Be sure to connect the grounding wire or jumper cable to bare metal surfaces, not to painted or plastic surfaces.

Retail Motor Fuel Dispensers:

When testing retail motor fuel dispensers, be sure to:

- Ground the nozzle against the prover neck when dispensing product.
- Ground the neck of the prover against the metal funnel when returning product to the storage tank.
- If a test measure is left on a cart when dispensing product or returning product to the storage tank, be sure the card is properly grounded.

Vehicle Mounted Tank, Loading Rack, or Wholesale Meters:

- Use a grounding wire, jumper cable, or terminal ground to ground the prover to the vehicle from which the product is obtained.
- Use a grounding wire, jumper cable, or terminal ground to ground the prover to the vehicle or tank when returning product to storage.
- These guidelines also apply when testing liquefied petroleum gas liquid-measuring devices. Although these devices are tested as a "closed system", the possibility of leaks is always present and can present a potential hazard.
- Always ground yourself to an above ground storage tank before climbing onto the tank by touching the tank or the hand rails.

Ignition Sources:

Combustion can result when an ignition source is present and fuel and oxygen are also available. It is necessary to avoid possible sources of ignition when testing meters which dispense petroleum products or other flammable materials. Possible sources of ignition include, but are not limited to: open flames or smoking, metal to metal contact which causes sparking (e.g., metal wrench or hammer on a pipe fitting), a running motor, static discharge, worn or faulty electrical wiring, improper grounding, and the wearing of synthetic clothing. Also be sure that provers and other test equipment are equipped with explosion-proof motors. If ignition sources cannot be eliminated at the time of the inspection, it is recommended that the testing procedure be discontinued until the hazardous conditions are corrected.

Because disposable lighters can spark upon impact, the inspector should avoid carrying a lighter in his or her front shirt pocket.

ALWAYS USE A METAL FUNNEL TO RETURN PRODUCT TO PRODUCT STORAGE TANKS. NEVER USE A PLASTIC SAFETY CONE AS A FUNNEL!! Pouring product into the return fill can build up static electricity; a proper ground must be made by placing the metal neck of the prover against the metal lip of the funnel.

Lifting:

Be familiar with and use proper lifting techniques when lifting test weights or heavy equipment to prevent personal injury. To reduce the possibility of back injury, use equipment which would decrease the amount of lifting required whenever possible (For example: an extended height funnel, carts for transporting weights, platforms suspended from monorail scales instead of overhead meat hooks, etc.).

Periodic training in proper lifting techniques is encouraged.

Location:

Carefully examine the inspection site prior to beginning an inspection and testing procedure. Look for potentially dangerous situations such as wet areas which may be slippery (see also **Wet/Slick Conditions**), the use or presence of hazardous and/or flammable materials and any spillage or leakage of these products (see also **Chemicals, Petroleum Products, and Hazardous Materials**), adjacent activities which may contribute a potential hazard to the inspection (e.g., welding near the inspection area would provide a potential ignition source when testing devices which dispense flammable liquids), obstructions in the area which may prove to be safety hazards (e.g., objects on the ground which the inspector might trip over, objects in the path of the inspector to and from the device being tested, exits blocked by test equipment or vehicles, etc. -- see also **Obstructions**), pedestrian or vehicle traffic (see also **Traffic**), steep or narrow stairways, overhead hazards (e.g., feed bins, loading rack equipment, low-hanging beams in feed mills and warehouses, overhead activities, low doorways, etc. -- see also **Overhead Hazards**), lack of or defective handrails, and loose or exposed wiring (see also **Electrical Hazards**). Use great care when moving around and working in areas in which these potential hazards are present. When using flammable products (e.g., testing metering devices), note the location of the fire extinguisher, emergency shut-offs, etc. prior to beginning the inspection.

Material Safety Data Sheets (MSDS):

MSDS's are provided by the manufacturer of a product to identify the product's basic characteristics and hazardous information. MSDS's typically provide information pertaining to the characteristics of a product such as hazardous ingredients, physical data, fire and explosion hazard information, health hazard information, reactivity data, spill or leak procedures, special protection information, special precautions, toxicological information, and other relevant information. MSDS's can be obtained from the manufacturer of the product. As new information is discovered concerning the properties of a product and the effects of various levels of exposure to it, MSDS's can change. It is recommended that updated versions of the MSDS's be obtained on at least an annual basis. For further information on MSDS's, contact your local OSHA office.

Nature of Product:

Be knowledgeable about the nature of the product being dispensed by a device prior to beginning a test on the device. For all hazardous materials it is recommended that a copy of the Material Safety Data Sheet (MSDS) be obtained for that product and reviewed prior to testing the device. Carefully read and follow the instructions on any warning labels posted on the device or affixed to a packaged product for precautions which should be taken when working around the product.

Obstructions:

Care should be taken to avoid injury from obstructions in the work area during the course of an inspection. Obstructions which might prove to be safety hazards include objects on the ground which the inspector might trip over, objects in the path of the inspector to and from the device being tested, steep or narrow stairways, exits blocked by test equipment or vehicles, etc.

Overhead Hazards:

Note any overhead hazards such as feed bins, loading rack equipment, low-hanging beams in feed mills and warehouses, activities overhead, and low doorways prior to the inspection. Take precautions (such as wearing

a hardhat) to avoid potential injuries as the situation dictates.

Personal Protection Equipment:

Included among the many types of personal protection equipment which is available are items such as non-synthetic clothing, coveralls, gloves, barrier cream, non-permeable safety aprons, safety sleeves, safety shoes, respirators, goggles or safety glasses, hearing protection, and hardhats. OSHA and safety-clothing and safety-equipment manufacturers can provide additional information concerning the selection of personal protection equipment for a given type of inspection activity.

Before providing personal protection equipment (PPE), management should determine whether or not PPE is actually required for a particular inspection activity. If it is determined that an employee is exposed to a hazard, the management should first try to minimize the hazard by examining and modifying work methods and conditions. If it is determined that the employee is still exposed to the hazard after modifying work methods and conditions, consideration should be given to purchasing PPE. It should be realized that certain types of PPE such as respirators can require employee physicals and extensive ongoing training and maintenance; failure to follow these requirements may render the PPE ineffective or even dangerous.

Safety Shoes:

Safety shoes are recommended to be worn when performing certain weights and measures activities to prevent personal injury. Safety shoes are available to prevent possible injury to the foot from falling weights or equipment and also to provide protection from slippage and static discharge. Many styles and types of safety shoes are available. The American National Standards Institute and safety-shoe manufacturers can provide additional information concerning the selection of safety shoes for different types of inspection activities.

Safety Cones/Warning Signs:

Safety warning signs or safety cones should be positioned to block off the work area when the inspection site is exposed to vehicular or pedestrian traffic. These precautions should also be taken when working around flammable liquids to warn people of a potential hazard; in this instance, it is also recommended that "No Smoking" and "No Open Flame" signs be posted.

Static Discharge:

Combustion can result when an ignition source is present and fuel and oxygen are also available. Sources of static discharge introduce the potential of an ignition source into the testing area. Avoid all sources of static discharge when testing flammable products.

Support:

Scales: Be certain that the installation is adequate to support the scale, test weights equal to the capacity of the scale, and any weight carts, test platforms, platters, chains, hooks, or other accessories used to suspend or support the test weights prior to proceeding with a testing procedure. Any test platforms, platters, chains, hooks, or other accessories must be capable of supporting the test weights necessary for the inspection.

Meters: Be sure the inspection site surface is rigid enough to support the weight of a large volume prover

when the prover is filled with the test liquid. **Chocks** should be used to secure the wheels of the prover during the testing procedure.

Switch Loading:

Do not use a test measure that has been used for drafts of gasoline to measure diesel fuel until you are certain that all gasoline vapors have dissipated. This practice, called "switch-loading" is extremely hazardous because diesel fuel is likely to produce a static charge while being dispensed. Sparks from this charge could easily ignite gasoline vapors inside the measure.

Traffic:

Be aware of vehicular and pedestrian traffic patterns in and around the inspection site. Mark the test spot appropriately by using safety cones, flags, etc.

Transportation of Equipment:

Consideration must be given to isolating the inspector/serviceperson from weighing and measuring equipment during the transportation of the equipment to and from the work site. The inspector/serviceperson must be isolated from hazardous fumes; means of such isolation include, but are not limited to, vehicles outfitted with protective barriers; equipment carriers located outside of the vehicle; vehicles with separate driver/equipment compartments, etc.

All equipment must be properly secured to avoid exposing the inspector/serviceperson to the potential of flying projectiles.

Wet/Slick Conditions:

Caution should be exercised when working in wet, slippery, or icy conditions to avoid slipping or possible injury from electrical sources. Shoes with non-skid soles should be worn to provide adequate traction to prevent slipping.

Absorbent material should be used on any product spills to prevent possible injury due to slipping on a slick surface.