

**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**

**Electrical Hazards**

**First Aid Kit**

**Lifting**

**Location**

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

**Personal Protection Equipment**

e.g., **Safety Shoes**

**Hard Hat – for protection from overhead  
hazard**

**Safety Cones/Warning Signs**

**Support – for scale, test weights, and test  
equipment**

**Transportation of Equipment**

**EPO No. 13**

**Inspection:**

**Safety First**

<p><b>Check the inspection site carefully for safety hazards and take appropriate precautions.</b></p> <p><b>Learn the nature of hazardous products used at or near the inspection site.</b></p> <p><b>Use caution in moving in wet, slippery areas.</b></p> <p><b>Use personal protection equipment appropriate for the inspection site.</b></p> <p><b>Position safety cones and warning signs if necessary.</b></p> <p><b>Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.</b></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. .... 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 indicators<sup>1</sup> ..... 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.

<sup>1</sup>A 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.

**EPO No. 13**

**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.):**

**EPO No. 13**

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

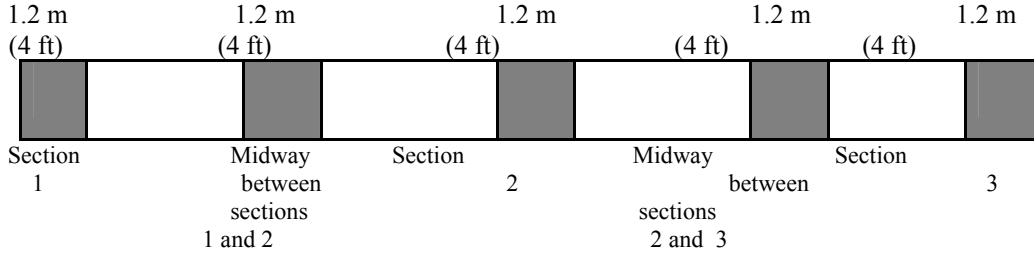
Multiple pattern loading: To test to the nominal capacity, multiple patterns may be simultaneously loaded in a manner consistent with the method of use.

**Test (cont.):**

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

**EPO No. 13**

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.

**EPO No. 13**

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



**EPO No. 13**

**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.