2015 NIST EPO No. 7

Examination Procedure Outline for

Medium-Capacity Scales

It is recommended that this outline be followed as minimum criteria for examining 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 NIST EPO Safety Annex (Safety Considerations and Glossary of Safety Key Phrases) should be duplicated and included with this outline.

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

Prior to beginning any inspection, the inspector should read and be familiar with the NIST EPO Safety Annex - "Safety Considerations and Glossary of Safety Key Phrases." The terms and key phrases in each safety reminder of this outline are found in the glossary of the EPO Safety Annex. The inspector is reminded of the importance of evaluating potential safety hazards prior to an inspection and taking adequate precautions to avoid personal injury or damage to the device. As a minimum, the following safety precautions should be noted and followed during the inspection.

Clothing

Electrical Hazards

First Aid Kit

Lifting

Also: Wet/Slick Conditions
Chemicals and Hazardous Materials
Obstructions

Personal Protection Equipment
e.g., Safety Shoes

Support – for Scale and Test Weights

Transportation of Equipment

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	Comments[1]

Inspection:

1. Zero-load balance

Zero indication	S.1.1.	
Digital zero indication	S.1.1.1.(a), S.1.1.1.(b)..	E only
Digital display of zero	G-S.5.2.2.(d) (1/1/86)	M & E only
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 as found	UR.4.1.	

2. General considerations

Selection of equipment	G-UR.1.1., UR.1.1.	
Installation		
In accordance with manufacturer's 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)	

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.	
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
D = Dial Scales
E = Electronic digital scales
U = Unmarked scales
M = Scales marked with an accuracy designation

	H 44 General Code and Scales Code References	Comments[1]
Inspection (cont.):		
Use		
Facilitation of fraud	G-S.2.	
Method of operation	G-UR.3.1.	
Special designs or marked for special applications	G-UR.3.2.	
Environment	UR.3.5.	
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, initials, or trademark of manufacturer or distributor	Retroactive	
Model identifier	Retroactive	
Model identifier prefix	(1/1/03)	
Acceptable abbreviations for “model” and “number”	(1/1/03)	
Nonrepetitive serial number	(1/1/68)	
Serial number prefix	(1/1/86)	M only
Acceptable abbreviations for “serial” and “number”	(1/1/01)	
Current software version or revision identifier (for not built-for-purpose, software based devices)	(1/1/04)	
Version or revision identifier preface and acceptable abbreviations for “version,” “revision,” and “number”	(1/1/07)	
NTEP CC number or CC addendum number and prefix (for devices that have an NTEP CC)	(1/1/03)	
Devices or main elements remanufactured after January 1, 2002.	G-S.1.2. (1/1/02)	
Name, initials, or trademark - last remanufacturer or distributor	(1/1/02)	
Model designation if different from original model designation	(1/1/02)	
Location of marking information for not built-for-purpose, software-based devices	G-S.1.1. (1/1/04)	
	G-S.7.	
Lettering	G-S.6. (1/1/77)	
Operational controls, indications, and features	G-UR.2.1.1.	
Visibility of identification	G-S.4.	
Interchange or reversal of parts		
b. Marking requirements – weighing/load-receiving, and indicating element in same housing or covered on the same CC (in addition to marking for all devices).	S.6.3	
	(1/1/86)	M only
Accuracy class	Retroactive	
Nominal capacity	(1/1/83)	
Value of scale division with nominal capacity, if not apparent	(1/1/86)	
Value of "e" (if different from "d")		
Temperature limits if range on the NTEP CC is narrower than	(1/1/86)	M only
and within − 10 °C to 40 °C (14 °F to 104 °F)	(1/1/86)	M only

	H 44 General Code and Scales Code References	Comments[1]
Scales designed for special purposes		
Inspection (cont.):		
c. Marking requirements - indicating element not permanently attached to weighing and load-receiving element or covered by a separate 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 range on NTEP CC is narrower than and within - 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)	
d. Marking requirements – weighing and load-receiving element not permanently attached to indicating element or covered by a separate CC (in addition to marking for all devices)	S.6.3	
Accuracy class	(1/1/86)	
Nominal capacity	Retroactive	
Temperature limits if range on NTEP CC is narrower than and within − 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 the device complies with applicable requirements (e_{min})	(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 range on the NTEP CC is narrower than and within - 10 °C to 40 °C (14 °F to 104 °F)	(1/1/86)	
Maximum number of scale divisions (n_{max})	(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)	

	H 44 General Code and Scales Code References	Comments[1]

Inspection (cont.):

4. Design of weighing devices	S.5.	M only
Designation of accuracy class	S.5.1. (1/1/86)	
Parameters of accuracy class	S.5.2. (1/1/86)	
Multi-interval/multiple-range scale division value	S.5.3. Retroactive	M & E only
Relationship of load cell verification interval to the value of the scale division	S.5.4. (1/1/94)	M & E only
Relationship of the minimum verification scale division (e_{min}) of a weighing/load-receiving element to the value of the scale division	S.1.2.2.2.	M & E only
5. Indicating and recording elements		
Value of scale division	S.1.2. (1/1/86)	M only
Digital indicating scales	S.1.2.1. (1/1/89)	
Values of graduated intervals or increments	G-S.5.3.	
Recorded representations, General	G-S.5.6.	
Devices that indicate or record in more than one unit	G-S.5.3.1.	
Appropriate abbreviations		
Equipment manufactured on or after January 1, 2008	G-S.5.6.1.(a)	
Equipment manufactured prior to January 1, 2008	G-S.5.6.1.(b), Table 1	
Prepackaging scales only	S.1.9.1.	
Tare		
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		
Indicating and recording elements	G-S.5.	
Capacity indication, weight ranges, and unit weights	S.1.7.	
Maximum range of initial zero-setting mechanism		
Complete scales	S.2.1.5.(a)	
Scales with separable components	S.2.1.5.(b) (1/1/09)	E only
Recommended minimum load	UR.3.1	M & E 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.1.3.1, S.1.3.2.,	
Indicators	S.1.3.3.	B&D only
Clearance	S.1.4.1., S.1.4.2.,	
Parallax	S.1.4.3	B&D only
Damping	S.1.4.4.	
Damping means	S.1.4.5	
Electronic elements		
Adjustable components	S.2.5.	
Provision for sealing	S.2.5.1.(b)	
	S.1.10.	
Multiple weighing elements (common provision for sealing).	S.1.11.(a) (1/1/79)	E only
Security seal	S.1.11.(b) (1/1/90)	E only
	G-S.8.1. 1/1/10	E only
	G-UR.4.5.	E only

	H 44 General Code and Scales Code References	Comments[1]

Inspection (cont.):

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]

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

Tolerance application:

Unmarked scales	T.1.1.	
Unmarked scales with greater than 5000 divisions:	Table T.1.1.	

Apply the tolerances specified in Table T.1.1. Tolerances for Unmarked Scales and the corresponding T.N. paragraphs referenced in the Table.

Unmarked scales with 5000 or fewer divisions:	Table T.1.1.	

Apply Class III, T.N.3.1., Table 6 or T.N.3.2. in accordance with the instructions indicated in Table T.1.1. Tolerances for Unmarked Scales. Also apply "Other Applicable Requirements" (T.N. paragraphs referenced in Table 1.1.)

[2] On a multiple range or multi-interval scale the number of divisions for each weighing range or weighing segment independently shall not exceed the maximum specified for the accuracy class. The number of scale divisions, n, for each weighing range or segment is determined by dividing the scale capacity for each range or segment by the verification scale division, e, for each range or segment (i.e., do not add "n" for the ranges or segments 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 4 added 1997).

	H 44 General Code and Scales Code References	Comments[1]

Pretest Determinations (cont.):

Scales marked with an accuracy class designation.	T.N.2.1.	
Subsequent verification examinations	T.N.2.3.	
Multi-interval and multiple range scales	T.N.2.4.	
Ratio tests (scales equipped with commercial weights)	T.N.2.5.	B only
Maintenance tolerance values	T.N.3.1.[Table 6 (Class III)]	
Acceptance tolerance values	T.N.3.2.	
Tolerances for substitution test	T.N.3.11.	
Tolerances for strain-load test	T.N.3.12.	
Multiple indicating/recording elements	T.N.4.1.	
Single indicating/recording elements	T.N.4.2	
Single indicating element/multiple indications	T.N.4.3	
Shift or section test	T.N.4.4.	M only
Repeatability	T.N.5.	

2. Sensitivity.

Application	T.2.1.	U&B only
General	T.2.2.	U&B only
Sensitivity requirement, equilibrium change	T.3.	U&B only
Sensitivity	T.N.6.	M&B only

3. Discrimination.

Analog automatic indicating (includes balance indicators with graduations having specific values)	T.N.7.1.	M&D only
Digital automatic indicating	T.N.7.2.	E only

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

Test Notes:

1. Error Weights. For scales equipped with nonautomatic (beam) indication, 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. G-S.5.4., T.N.5.
   - Repeatability of indications ..... G-S.5.2.2.
   - Digital indication and representation .....

3. Recheck zero-load balance each time test load is removed.
   - Zero-load balance change ..... N.1.9.
   - Abnormal performance ..... G-UR.4.2.

	H 44 General Code and Scales Code References	Comments[1]

Test Notes (cont.):

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.	E only
Recorded representations Also verify that any options for obtaining a recorded representation are appropriate. The customer may be given the option of not receiving the recorded representation. If the system is equipped with the capability, the customer may also be given the option of receiving the recorded representation electronically in lieu of or in addition to a hard copy.	G-S.5.6.	
Money value, mathematical agreement	G-S.5.5.	
Motion detection	S.2.5.1.(b)	
Value of the indicated and recorded scale division	UR.1.3.(1/1/86)	

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

Digital indicating elements	S.1.1.1.(a), S.1.1.1.(b) (1/1/93)	E only
Discrimination test	N.1.5. (1/1/86)	M, D, & E only
Digital device	N.1.5.1.	E only

6. If the device is equipped with operational features such as programmable tare, multiple tare memory, weigh-in/weigh-out, or multiple weighing elements, verify 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) and (1/1/05), UR.3.9.

Test:

WEAR SAFETY SHOES!

USE PROPER LIFTING TECHNIQUES!

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)	M,D,&E only

	H 44 General Code and Scales Code References	Comments[1]

Test (cont.):

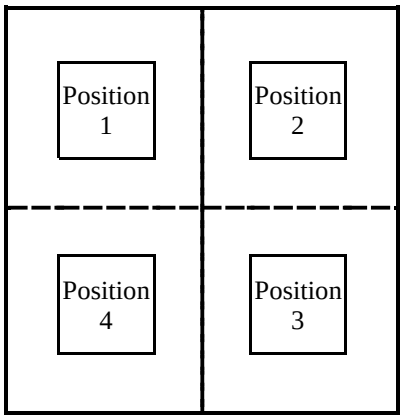
Digital Device	N.1.5.1.	E only
3. Increasing-load test (with the test load approximately centered)	N.1.1.	
Initial verification – to capacity	N.3.	
Subsequent verification		
a. Small scales - at minimum load (20d), 500d, 2000d, 4000d to capacity		
b. Larger scales – at minimum load (20d), 500d, 2000d, 4000d to capacity or, at tolerance intervals to Table 4 values.		
c. Beam scales - at a minimum, test at or near half and full capacity on each weighbeam bar. Scales not equipped with a full capacity beam should be ratio tested by applying field standard weights, specifically designed for this purpose, on the counterpoise hanger. At each test load, test scale counterpoise weights by substituting them for field standard weights. If there is a noticeable change in indication, remove the counterpoise weight from service until it can be determined that it meets the requirements in the Weights Code of NIST Handbook 44.	N.1.7.	B only
4. Shift test:		
Scales with a nominal capacity of 1000 lb or less:	N.1.3.7. (a)	
Use one-third capacity test load (defined as test weights in amounts of at least 30 % of scale capacity, but not to exceed 35 % of scale capacity) centered as nearly as possible in each quadrant of the load-receiving element using the prescribed test pattern as shown in Figure 1.		
Scales with a nominal capacity greater than 1000 lb	N.1.3.7. (b)	
Use one-third capacity test load (as defined above for Scales with a nominal capacity of 1000 lb or less) centered as nearly as possible in each quadrant of the load-receiving element as shown in figure 1 or one-quarter capacity test load centered as nearly as possible over each corner of the load-receiving element as shown in figure 2.		

	H 44 General Code and Scales Code References	Comments[1]

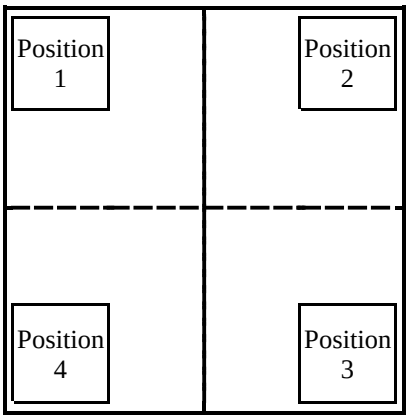
Test (cont.):

Shift-Test Positions
Medium-Capacity Platform Scales

Figure 1 ..... Figure 2



The above test pattern indicates the correct positions of a one-third capacity shift-test load and may be applied when performing the shift test on any medium capacity platform scale.



The above alternative test pattern indicates the correct positions of a one-quarter capacity shift-test load and may be applied alternatively to the positions shown and test loads indicated in Figure 1 when performing a shift test on medium capacity platform scales having a nominal capacity <u>greater</u> than 1000 lb.

Note: When multiple field standards are used as the prescribed shift-test load, do not concentrate those field standards in a test pattern that would be less than if that same load were comprised of only a single field standard.

5.	Sensitivity test at maximum test load	N.1.4.	B only
	Discrimination test at maximum test load (if applicable)	N.1.5.(1/1/86)	M, D, & E only
6.	RFI/EMI tests (if a problem is suspected) (operate each potential source one at a time).	N.1.6.	E only
	Radio Frequency Interference (RFI)		
	Electromagnetic Interference (EMI)		
	Testing with non associated equipment	G-N.2. G-UR.1.2.	
	Environment	G-UR.3.2	
	Associated and nonassociated equipment	G-UR.4.2	
	Abnormal performance	T.N.9.	E only
	Tolerance RFI/EMI tests		

	H 44 General Code and Scales Code References	Comments[1]

Test (cont.):

7. Test for over-capacity indication	S.1.7.	
8. Decreasing-load test	N.1.2.	D & E only
Scales marked with an accuracy designation	N.1.2.1.	M only
For scales having 1000 divisions or greater, 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 marked scales with fewer than 1000 divisions, 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 applies 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.	
Scales shall be tested using at least the minimum amount of test weights and to the minimum test loads specified in Table 4. In instances where the amount of test weight available for testing is equal to or greater than the minimum required by Table 4, but less than the amount of test load required, not more than three substitutions are to be performed to achieve a test load that equals at least the minimum required.		
Where practical, scales should be tested to capacity on an initial verification and to at least used capacity on subsequent tests. In accordance with Table 4, not more than three substitutions shall be used during substitution testing, after which the tolerances for strain load tests apply.		
11. Recheck zero load balance	N.1.9., G-UR.4.2.	
12. Conduct out-of-level test (portable scales without level-indicating means only).	S.2.4.	

	H 44 General Code and Scales Code References	Comments[1]

Test (cont.):

13. Test for proper design of automatic zero-tracking mechanism, if scale is so equipped:		
Scales manufactured between 1/1/81 and 1/1/07	S.2.1.3.1.(c)	E only
Scales manufactured on or after 1/1/07	S.2.1.3.2.(b)	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 0.6 scale division for scales manufactured between January 1, 1981, and January 1, 2007, and 0.5 scale division for scales manufactured on or after January 1, 2007.		
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 the effectiveness of motion detection.	S.2.1.2.	E only
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.	