Module: 4.3.1
Static Electronic Weighing Systems, General

Overview and Scope

This module sets standards for basic inspection and testing of static electronic weighing systems. The module is geared toward general and basic concepts that can be applied to a wide range static scale applications. These concepts range from device technology, classification, and operations, to general technical requirements and common test procedures.

Prerequisites

4.2 NIST Handbook 44 - Introduction to Device Control

Learning Objectives

1 Technology of Weighing Systems

A weights and measures inspector should understand the method of operation and the primary technologies used in typical electronic weighing systems. To demonstrate this, the inspector can:

1.1 Restate that scales measure the weight of matter resulting primarily from the force exerted by gravity on the material on the scale.

1.2 Restate that weight on a scale is a close approximation of the mass of the material on the scale in reference to reference standards used when the device is calibrated, hence scale units are in units of mass, e.g. lb or kg.

1.3 Describe the basic components of a weighing system: load receiver, load sensor, indicator, and peripherals like printers and computers.

1.4 Describe the principle of operation of strain gage load cell scale technologies from the load sensors, to A to D converters, to computer based processors, to indicators/printers.

1.5 Explain that the digital division for a typical system is defined by the two zones of uncertainty (break points) at approximately +½ d and -½ d.

1.6 Restate that digital scale components can be packaged in multiple ways involving separate discrete elements (OIML: modules).

1.7 Recognize that scale performance will vary with the size of the load (linearity), position of load, influences such as temperature, supply voltage, etc, and disturbances such as drafts, vibration, EMI/RFI, etc.

2 Applications, Tolerances and Performance requirements for Scales with a Class Mark

A weights and measures inspector should understand the classification system for static scales and be able to apply the performance standards under each class. To demonstrate this, the inspector can:

2.1 Explain how the basic tolerances, repeatability tolerances, agreement requirements, and General Code abnormal performance requirements all work together to specify limits to deviations in scale performance.

2.2 Review how the concepts of accuracy, repeatability, linearity and hysteresis relate to scale performance.

2.3 Describe the organization of accuracy classes for marked scales as specified in Table 3.

2.4 Explain how scale class is related to typical application in Table 7a in the Scales Code.

2.5 Appraise whether a scale conforms to the class declared by the manufacturer.

2.6 Appraise whether a given scale is suitable for weighing certain commodities based on Table 7.a.

2.7 Compute tolerances for any class marked scale as per Table 6 of the Scales Code.

2.8 Illustrate how to find either the acceptance or maintenance tolerance for any load on a scale given the scale class, capacity and division size.

2.9 Illustrate how repeatability requirements apply to static scales.

3 Applications, Tolerances and Performance requirements for Scales with no Class Mark

A weights and measures inspector should understand the differences in code applications for unmarked scales and be able to apply the performance standards for unmarked scales. To demonstrate this, the inspector can:

3.1 Explain how unmarked devices are defined from their application rather than class design as described in Table 7.b. and Table T.1.1.

3.2 Appraise whether an unmarked scale is suitable for use in an application as per Table 7.b.

3.3 Compute the tolerances for unmarked scales for a given test load and test procedures as per Table T.1.1.

4 Scale Markings and Operations

A weights and measures inspector should understand the various marking requirements applicable to a static scale and demonstrate ability to operate a static scale. To demonstrate this, the inspector can:

4.1 Recognize and interpret required identification markings on a scale as per Table S.6.3..

4.2 Recognize and interpret required markings on the controls, indications and features of a scale.

4.3 Demonstrate how to operate the following functions/operations on a typical scale.

4.3.1 Power on/off.

4.3.2 Zero.

4.3.3 Tare (both platter and keyboard tare) and Tare Clear - if scale has a tare function.

4.3.4 Units selector - if scale indicates in more than one unit.

4.4 Recognize and interpret the information displayed on a scale, including:

4.4.1 Gross, Net, and Tare weight indications.

4.4.2 Center of Zero, Motion, pricing displays, and others.

4.4.3 Underload/Overload error conditions.

4.5 Apply appropriate security measures to a scale, i.e. seals or audit trails.

5 Technical Requirements

A weights and measures inspector should be able to apply the various technical requirements to a static scale and cite the applicable code reference for a deficiency. To demonstrate this, the inspector can:

5.1 Apply the technical specifications relating to the following scale features/indications and cite the HB44 Code paragraph.

5.1.1 Zero load indications, zero setting operations, and automatic zero setting (zero tracking).

5.1.2 Digital scale divisions and limit of indication.

5.1.3 Level indication for portable scales.

5.1.4 Motion detection requirements - zero, tare, printing, etc.

5.1.5 Design requirements for weighing elements.

5.2 Interpret the rules for matching weighing elements to indicating elements (modules).

6 User Requirements

A weights and measures inspector should be able to apply the various user requirements applicable to a static scale and cite the applicable code reference for a deficiency. To demonstrate this, the inspector can:

6.1 Assess suitability of a class marked scale for a given application, considering design, class, application and typical load in Tables 7a. and 8.

6.2 Evaluate compliance of a scale with scale installation requirements in UR.2.

6.3 Evaluate compliance of a scale with general use requirements in UR.3. (Subsections 3.1., 3.2., 3.3., and 3.5.).

6.4 Evaluate compliance of a scale with maintenance requirements in UR.4.

7 Basic Test Procedures

A weights and measures inspector should be able to apply the appropriate performance tests to a static scale and evaluate compliance the applicable tolerances and performance standards. To demonstrate this, the inspector can:

7.1 Demonstrate how to properly use test weights and care for them when not in use.

7.2 Determine minimum amounts of standards required for testing a given scale.

7.3 Select appropriate test loads for an Increasing Load Test for a given scale, perform the test, and evaluate the test results for compliance with applicable tolerances.

7.4 Select appropriate test loads for a Decreasing Load Test for a given scale, perform the test, and evaluate the test results for compliance with applicable tolerances.

7.5 Select appropriate test loads for a Shift Test (eccentric loading) for a given scale, perform the test, and evaluate the test results for compliance with applicable tolerances and agreement requirements.

7.6 Discuss whether a Sensitivity test or a Discrimination test is appropriate to the scale type and discuss appropriate times to perform a Sensitivity Test, a Discrimination Test or a Repeatability Test.

7.7 Select appropriate test loads for a Sensitivity or Discrimination test, perform the test, and evaluate the test results for compliance with the applicable standards.

7.8 Select appropriate test loads for a Repeatability Test for a given scale, perform the test, and evaluate the test results for compliance with applicable tolerances and agreement requirements.

7.9 Select appropriate situations to perform a RFI/EMI Susceptability Test for a given scale, perform the test, and evaluate the test results for compliance with applicable tolerances and agreement requirements.

7.10 Describe when it is either necessary or appropriate to use error weights in performing tests, apply the errror weights in tests, and correctly compute scale errors based on the observations.

Contributors:

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