



The National Conference on Weights and Measures National Training Program Curriculum Segment 3.1.1. STATIC ELECTRONIC WEIGHING SYSTEMS, GENERAL

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Overview

This segment sets standards for knowledge, understanding, and performance required for INSPECTION and testing of static electronic scales. This segment will cover a wide range of information that is generic and applicable to many different static scale applications.

Prerequisites

- 3.0. Introduction to Device Control
- 3.0.a Safety Considerations
- 3.1. Weighing Technologies and Terminology, General

Objectives and Competencies

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:

- Restate that scales measure the weight of mater resulting primarily from the force exerted by gravity on the material on the scale
- 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.
- Describe the basic components of a weighing system: load receiver, load sensor, indicator, and peripherals like printers and computers.
- 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.
- Explain that the digital division for a typical system is defined by the two zones of uncertainty (break points) at approximately $+\frac{1}{2}d$ and $-\frac{1}{2}d$.
- Restate that digital scale components can be packaged in multiple ways involving separate discrete elements (OIML: modules).
- Define common terms used with regard to electronic weighing systems.

2. Classes, 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:

- 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.
- Describe how the concepts of accuracy, repeatability, linearity and hysteresis relate to scale performance.
- Describe the organization of accuracy classes for marked scales as specified in Tables 3.

- Explain how scale class is related to typical application in Table 7a in the Scales Code.
- Appraise whether a scale conforms to the class declared by the manufacturer.
- Compute tolerances for any class marked scale as per Table 6 of the Scales Code.
- Illustrate how to find either the acceptance or maintenance tolerance for any load on a scale given the scale class, capacity and division size.
- Illustrate how repeatability requirements apply to static scales.

3. 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:

- Recognize and interpret required identification markings on a scale as per Table S.6.3..
- Recognize and interpret required markings on the controls, indications and features of a scale.
- Demonstrate how to operate the following functions/operations on a typical scale.
 - Power on/off
 - Zero
 - Tare (both platter and keyboard tare) and Tare Clear – if scale has a tare function
 - Units selector – if scale indicates in more than one unit
- Recognize and interpret the information displayed on a scale, including:
 - Gross, Net, and Tare weight indications
 - Center of Zero, Motion, pricing displays, and others
 - Underload/Overload error conditions

4. 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:

- Apply the technical specifications relating to the following scale features/indications and cite the HB44 Code paragraph.
 - Zero load indications, zero setting operations, and automatic zero setting (zero tracking)
 - Digital scale divisions and limit of indication
 - Level indication for portable scales
 - Motion detection requirements – zero, tare, printing, etc
 - Design requirements for weighing elements
- Interpret the rules for matching weighing elements to indicating elements (modules).

5. 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:

- Assess suitability of a class marked scale for a given application, considering design, class, application and typical load in Tables 7a. and 8.
- Evaluate compliance of a scale with scale installation requirements in UR.2.
- Evaluate compliance of a scale with general use requirements in UR.3. (Subsections 3.1., 3.2., 3.3., and 3.5.)
- Evaluate compliance of a scale with maintenance requirements in UR.4.

6. 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:

- Demonstrate how to properly use test weights and care for them when not in use.
- Determine minimum amounts of standards required for testing a given scale.
- 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.

- 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.
- 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.
- Discuss appropriate times to perform a Discrimination Test or a Repeatability Test.
- Select appropriate test loads for a Discrimination Test for a given scale, perform the test, and evaluate the test results for compliance with the applicable standards.
- 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