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Examination of Automatic Weighing Systems (AWS)

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If you have read the related article in this newsletter on the status of the AWS Code, you are aware that the status of NIST Handbook 44 Section 2.24. Automatic Weighing Systems Code was changed from "tentative" to "permanent" effective January 1, 2005. This article is intended to provide weights and measures officials some guidelines that can be used for the inspection and testing of these devices. The order of the guidelines follow format of the NIST Handbook 112 Examination Procedure Outline (EPO) for Retail Computing Scales. These guidelines do not eliminate the need to check the net contents of packaged items weighed on these devices since the user has a significant impact on the accuracy of the net content representations and a repeatable and accurate AWS is part of a packager's "good quantity control practices" as referenced in NIST Handbook 130, Interpretations and Guidelines Section 2.6.11.

The terms "weigh-labelers," "automatic checkweighers," and "test pucks" are frequently used in these guidelines. WMD recommends reviewing the definitions for these terms which are found in Handbook 44 Appendix D–Definitions before attempting to test and evaluate these devices for the first time. Additionally, be aware that weigh-labelers and automatic checkweighers are different types of AWS with different applications, specifications, tolerances, and test requirements.

Inspection:

1. Checking the zero-balance condition. For an AWS equipped with a zero-load display, check that the user is maintaining the AWS so the device indicates or records a zero-balance condition. Be aware the AWS Code paragraph S.1.1. (c) states that automatic checkweighers are not required to have indicating and recording elements.

2. General considerations. For jurisdictions requiring an NTEP Certificate of Conformance (CC), review the CC for the AWS and determine that the manufacturer has designated the AWS for the service intended by the user. Alternatively, check the owner's manual for the type of service the AWS is intended. You will also need to check the conditions of the installation such as supports, clearance, level condition (a level indicator is not required on an AWS), environmental factors, obstructions, and modifications to the AWS. As with other weighing and measuring devices, Handbook 44 General Code paragraph G-UR.4.4. requires the owner of the AWS provide assistance to the weights and measures official if the design or installation of the AWS requires special equipment or accessories or additional labor to conduct the test.

3. Marking. Verify that the required markings are provided for the AWS and separable AWS components. These include General Code identification requirements, operational controls, identification of indications, accuracy class, capacity, value of the scale division, designed for special purpose statements, and maximum number of divisions for

separable indicating and load-receiving elements. The NTEP CC for the AWS provides information on the content and location of the required markings.

4. Indicating and recording elements. All requirements in General Code paragraph G-S.5. Indicating and Recording Elements are applicable to an AWS except that automatic checkweighers are not required to have indicating and recording elements. Following are particular paragraphs to consider carefully:

- Paragraphs S.1.3. through 1.5. and Table S.1.3. address sealing requirements for AWS.
- Paragraph S.1.3. (b) provides an exception to sealing requirements for automatic checkweighers where it would prohibit an authorized user from having access to the calibration functions.
- Paragraph S.2.2. Tare states that the value of the tare division shall be the same as the value of the scale division.
- Paragraph S.3. Verification Scale Interval discusses the requirements for the value of the scale division and suitability of load cells with CCs.
- Paragraph S.4. includes requirements for additional digits for performance evaluation, motion detection, over-capacity indications, and label printing information.
- Paragraph UR.1.2. states that the value of the indicated and recorded scale division shall be the same.

5. Weighing/load-receiving elements. The installation requirements in paragraph UR.2.2. mandate that the foundations and supports for an AWS installed at a fixed location provide strength, rigidity and permanence of the components. Clearance shall also be provided around the live parts to the extent that no contacts may result when the load-receiving element is empty or throughout the weighing range. This includes package guides and transport mechanisms that are not part of the load-receiving element. Paragraph UR.2.3. requires the user to maintain the belts or other conveyance system per the manufacturer's recommendations.

Pretest Determinations

1. Acceptance/maintenance tolerances. Determine if acceptance or maintenance tolerances will be applied to the AWS.

2. Tolerance application. General Code tolerance paragraph G-T.3. and Appendix D-Definitions state that tolerances are applied to errors in the direction of overregistration or underregistration depending if the indications are greater or less than they should be.

3. Tolerance values. The tolerances for an AWS depend on the marked accuracy class, the application (whether weigh-labeler or checkweigher), and the mode of operation. The different types of AWS and modes of operation were discussed in detail in a related AWS article in this newsletter. The specific tolerances for an AWS are found in the AWS Code Table T.3., and tolerance paragraphs T.3.1. for Class III Weigh-labelers, T.3.2. for Class III S Weigh-labelers, T.3.3.2. Field Tests for Automatic Checkweighers,

T.4. Agreement of Indications, T.5. Repeatability, and T.6. Discrimination. You will also need a copy of NIST Handbook 133 Maximum Allowable Variations (MAV) Table 2-5 . . . Packages Labeled by Weight, Table 2-6 . . . Packages Labeled by Liquid and Dry Volume, or Table 2-9 . . .USDA Groups and Lower Limits . . . to verify that the standard deviation of the test results on automatic checkweighers does not exceed one-ninth of the MAV for specific package weights.

Test Notes

1. Increasing-load, decreasing-load, shift, discrimination and zero-load balance change tests. Paragraph N.2.1. lists the tests that shall be conducted if the AWS is designed for use in a non-automatic weighing mode. These tests are equivalent to the tests in Section 2.20. Scales Code.

2. Accuracy of test pucks or packages and field standards. **The error in any test puck or test package used to conduct a field test shall be determined on a reference scale with an inaccuracy that does not exceed one-fifth of the smallest tolerance that can be applied to the AWS under test. Field standard weights shall comply with the requirements of NIST Handbook 105-1 (Class F) or with Handbook 44 Fundamental Considerations paragraph 3.2. Requirements for test puck or package (for testing in the automatic mode) and field standards are found in AWS Code paragraphs N.1.1. and N.1.2., and paragraph N.1.3.**

3. Repeatability. Check repeatability of indications throughout the test. Check for the agreements of indications between indicating and recording elements. Do not compare results of indications in the automatic mode with the results obtained in the non-automatic mode.

4. Recorded representations. If the AWS is equipped with a printer, check the effectiveness of the damping means, and check the labels for mathematical agreement. General Code indicating and recording element paragraphs G-S.5.2.2, G-S.5.5., and G-S.5.6. address the indication and recording element design and mathematical agreement requirements. These are the same requirements that would be applied to retail computing scales. AWS paragraph S.4.2. Damping requires that weight values can only be recorded if the indication is stable within ± one scale division with all values within applicable tolerances.

5. Maintenance of equipment and abnormal performance. If the AWS is equipped with operational features such as programmable tare and/or unit prices and manual weight entries, check for proper operation and appropriateness. General Code paragraph G-UR.4.1. Maintenance of Equipment requires that the operator properly maintain the AWS and the attached components. Point out to the operator any worn or improperly maintained components of the AWS and any attached component that may have an effect on the accurate performance of the AWS. General Code paragraph G-UR.4.2. Abnormal Performance states that any unstable indications or other abnormal AWS performance observed during operation shall be corrected.

Non-Automatic Tests. The following tests are designed for an AWS that can determine the weight of an object in a non-automatic mode of operation. The tests are not applicable for an AWS that is designed for only automatic weighing.

1. Discrimination test near zero. Conduct a discrimination test if environmental conditions permit. This is the same test that would be performed on a retail price computing or other scale. Handbook 112 EPO 1 Retail Computing Scales has an example of a discrimination test. Test notes and tolerances are found in AWS Code paragraphs N.2.1.4. and T.6.

2. Increasing-load test for non-automatic testing. The increasing-load test should be conducted as you would on a retail price computing or other scale. Test notes and tolerances are found in AWS Code paragraphs N.2.1.1. and either Table T.3. for Class III AWS or Table T.3.1.2. for Class III S Weigh-Labelers.

3. Shift test for non-automatic weighing. The shift test should be conducted as you would on a retail price computing or other scale. Test notes and tolerances are found in AWS Code paragraphs N.2.1.3. and either Table T.3. or Table T.3.1.2.

4. Discrimination at capacity. Test for discrimination if environmental conditions permit. This is the same test that would be performed on a retail price computing or other scale. Handbook 112 EPO 1 has an example of the discrimination test. Test notes and tolerances are found in AWS Code paragraphs N.2.1.4. and T.6.

5. Test for over-capacity indication. The test for over-capacity indications should be conducted as you would on a retail price computing scale. AWS Code paragraph S.4.2. states that the indicating or recording element of an AWS shall not display nor record any values when the capacity is exceeded by nine scale divisions.

6. Decreasing-load test for non-automatic testing. The decreasing-load test should be conducted as you would on a retail price computing or other scale. Test notes and tolerances are found in AWS Code paragraphs N.2.1.2. and either Table T.3. for Class III AWS or Table T.3.1.2. for Class III S Weigh-Labelers.

7. RFI/EMI tests. This test is conducted to determine that electrical or electronic equipment normally located and used under conditions that are usual and customary does not adversely affect the performance of the AWS. Examples of electronic equipment include fans, fluorescent lighting fixtures, conveyor or hydraulic pump motors, and wireless communication devices. To conduct the test, place a load on the AWS and record the indication or print a label. Activate the electronic equipment (disturbance) and record the deviation of the indication or recorded representation. The test notes are found in General Code paragraph G-N.2. Testing with Nonassociated Equipment, and tolerances are found in AWS Code paragraph T.8. Radio Frequency Interference . . . Susceptibility.

Automatic Tests. The following tests are designed for the AWS that automatically determines the weight, either statically or dynamically, of objects in the automatic mode of operation. They are not applicable for the non-automatic mode of the AWS.

1. Automatic tests for weigh-labelers. Tests will be conducted at normal operating speeds using test pucks or packages with at least two different test loads distributed over its normal weighing range. Each test load should be run across the AWS at least 10 times. Test notes and tolerances are found in AWS Code paragraphs N.2.2.2., T.3.1.2. (Class III), T.3.2.2. (Class III S), and Table T.3. or Table 3.2.2.

2. Automatic tests for checkweighers. Tests will be conducted at the highest operating speed using test pucks or packages with at least two different test loads distributed over ***each weighing range and*** with the ***number of consecutive weighments*** specified in Table N.3.2. For example, an automatic checkweigher with a capacity of 15 kg would be tested as follows:

- The first test load would include 30 standardized test pucks or packages with test loads near the lower weight range and 30 standardized test pucks or packages near 10 kg.
- The second test load would include 16 standardized test pucks or packages with test loads just above 10 kg and 16 standardized test pucks or packages near 15 kg.

Test notes and tolerances are found in AWS Code paragraphs N.3.2., T.3.3.2.2., and Handbook 133 MAV Tables 2-5, 2-6, or 2-9.

The above examination guidelines will form the basis for a complete EPO, which will be further developed and included in NIST Handbook 112. Please contact Steve Cook at stevenc@nist.gov with comments and suggestions for the final EPO. Electronic copies of these guidelines are available on the WMD Internet homepage (www.nist.gov/owm) by selecting the link to the DRAFT AWS Examination Procedures in the column titled "W&M Resources."