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## Section 5.56.(b) Grain Moisture Meters

**Section 5.56. was reorganized into two sections beginning with the 1997 Edition of NIST Handbook 44. This Section, 5.56.(b), applies to all non-NTEP grain moisture meters manufactured or placed into service before January 1, 1998.**

(Code reorganized and renumbered 1996.)

### A. Application

**A.1.** This code applies to grain moisture meters; that is, devices used to indicate directly or through conversion and/or correction tables the moisture content of cereal grain and oil seeds. The code consists of general requirements applicable to all moisture meters and specific requirements applicable only to certain types of moisture meters.

**A.2.** This code does not apply to devices used for in-motion measurement of grain moisture content or seed moisture content.

**A.3.** See also Section 1.10. General Code requirements.

### S. Specifications

#### S.1. Design of Indicating and Recording Elements and of Recorded Representations.

**S.1.1. Primary Elements, General.** – A meter shall be equipped with a primary indicating element and may also be equipped with a primary recording element. If the meter indicates directly and/or is equipped to record, the meter shall indicate and/or record its measurements in terms of percent moisture content, wet basis. Subdivisions of this unit shall be in terms of decimal subdivisions (not fractions). If the meter indicates in the conventional scale and requires conversion or correction tables, the resulting values after use of such tables shall be in terms of percent moisture content, wet basis. Subdivisions of this unit shall be in terms of decimal subdivisions (not fractions).

#### S.1.2. Digital Indications.

**S.1.2.1. Measurement Completion.** – A digital indicating element shall not display any values (either moisture content or conventional scale) before the end of the measurement cycle.

#### S.1.3. Graduations.

**S.1.3.1. Length.** – Graduations shall be so varied in length that they may be conveniently read.

**S.1.3.2. Width.** – In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations, and the width of the main graduations shall be not more than 50 % greater than the width of subordinate graduations. Graduations shall in no case be less than 0.2 mm (0.008 in) in width.

**S.1.3.3. Clear Interval Between Graduations.** – The clear interval shall be not less than 0.75 mm (0.03 in) between graduations. If the graduations are not parallel, the measurement shall be made:

- (a) along the line of relative movement between the graduations at the end of the indicator, or
- (b) if the indicator is continuous, at the point of widest separation of the graduations.

**S.1.4. Indicators.**

**S.1.4.1. Symmetry.** – The index of an indicator shall be symmetrical with respect to the graduations, at least throughout that portion of its length associated with the graduations.

**S.1.4.2. Length.** – The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).

**S.1.4.3. Width.** – The width of the index of an indicator in relation to the series of graduations with which it is used shall be not greater than:

- (a) the width of the widest graduation, nor
- (b) the width of the minimum clear interval between graduations.

When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width as the graduation throughout the length of the index that coincides with the graduation.

**S.1.4.4. Clearance.** – The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).

**S.1.4.5. Parallax.** – Parallax effects shall be reduced to the practicable minimum.

**S.1.5. Recording Elements.**

**S.1.5.1. General.** – If a meter is equipped with a recording element, it shall record in terms of percent moisture content, wet basis only, and not in terms of conventional scale.

**S.1.5.2. Measurement Completion.** – A recording element shall not record any values before the end of the measurement cycle.

**S.1.5.3. Range of Moisture Content.** – A recording element shall not record any values when the moisture content of the grain sample is beyond the operating range of the device.

**S.1.6. Design of Direct Reading Grain Moisture Meters.**

**S.1.6.1. Grain or Seed Kind and Class Selection and Recording.** – Provision shall be made for selecting and recording, if equipped to record, the kind and class (as appropriate) of grain or seed to be measured. The means to select the kind and class of grain or seed shall be readily visible and the kind and class of grain or seed selected shall be clearly and definitely identified in letters (such as Wheat or WHT, HRWW, etc.).

**S.1.6.2. Operating Range.** – *A meter shall automatically and clearly indicate when the operating range of the meter has been exceeded or the manufacturer shall:*

- (a) *clearly and conspicuously mark the operating ranges on the meter; or*
- (b) *furnish the operating ranges of the meter and the means to clearly and conspicuously display this information on or immediately adjacent to the device.*

*The operating range shall specify the following:*

- (a) *the temperature range over which the meter may be used and still comply with the applicable requirements;*
- (b) *the moisture range for each grain or seed for which the meter is to be used;*
- (c) *the temperature range for each grain or seed for which the meter is to be used; and*
- (d) *the maximum allowable difference in temperature between the meter and the sample for which an accurate moisture determination can be made.*

*Examples of clearly indicating these conditions include an error indication, flashing the displayed moisture value, or blanking the display.*

*[Nonretroactive as of January 1, 1989]*

*(Amended 1986 and 1988)*

**S.1.6.3. Value of Smallest Unit.** – The value of the minimum indicated or recorded moisture indication shall not be greater than 0.1 %.

**S.1.7. Electric Power Supply.**

**S.1.7.1. Power Supply, Voltage and Frequency.**

- (a) *A meter that operates using alternating current must perform within the tolerances defined in Section T.2. Tolerance Values over the line voltage range 100 V to 130 V, or 200 V to 250 V rms as designed, and over the frequency range of 59.5 Hz to 60.5 Hz.*
- (b) *Battery-operated instruments shall not indicate or record values outside the applicable tolerance limits when battery power output is excessive or deficient.*

*[Nonretroactive as of January 1, 1989]*

**S.1.7.2. Power Interruption.** – A power interruption shall not cause an indicating or recording element to display or record any values outside the applicable tolerance limits.

*[Nonretroactive as of January 1, 1989]*

*(Added 1988)*

**S.1.8. Level Indicating Means.** – A meter shall be equipped with a level indicator and leveling adjustments if its performance is changed by an amount greater than the applicable tolerance when the meter is moved from a level position to a position that is out of level in any upright direction by up to 5 % (approximately 3 degrees).

*The level-indicating means shall be readable without removing any meter parts requiring a tool.*

*[Nonretroactive as of January 1, 1989]*

*(Added 1988) (Amended 1994)*

**S.1.9. Operating Temperature.**

- (a) *A meter shall not display or record any usable values until the operating temperature necessary for accurate determination has been attained, or the meter shall bear a conspicuous statement adjacent to the indication stating that the meter shall be turned on for a time period specified by the manufacturer prior to use.*
- (b) *A meter shall meet the requirements of T.2. Tolerance Values when operated in the temperature range of 2 °C to 40 °C (35 °F to 104 °F) or within the range specified by the meter manufacturer.*

(c) *If the manufacturer specifies a temperature range, the range shall be at least 10 °C (20 °F) and shall be marked on the device.*

*[Nonretroactive as of January 1, 1989]*

(Added 1988)

## **S.2. Design of Measuring Elements.**

**S.2.1. Design of Zero-Setting and Test Point Mechanisms.** – If a grain moisture meter is equipped with a zero setting and/or test point mechanism(s), this (these) mechanism(s) shall be adjustable only with a tool outside and entirely separate from this mechanism or enclosed in a cabinet. This requirement shall not apply to manual operations that the operator must make (following operating instructions) in order to obtain a meter reading on a grain sample.

**S.2.2. Provision for Sealing.** – Provision shall be made for applying a security seal in a manner that requires the security seal to be broken before an adjustment can be made to any component of the grain moisture meter that is set by the manufacturer or authorized service representative and not intended to be adjusted by the user.

**S.3. Accessory Equipment.** – When the operating instructions for a moisture meter require accessory equipment separate from and external to the moisture meter, such equipment shall be appropriate and complete for the measurement.

**S.3.1. Grain-Test Scale.** – If the moisture meter requires the weighing of the grain sample, the weighing device shall meet the requirements of the General Code and those applicable portions of the Scales Code.

### **S.3.2. Thermometers or Other Temperature Sensing Equipment.**

(a) The temperature sensing equipment or thermometer shall be designed to be in direct contact with a grain sample in a closed container. It is acceptable to insert thermometer through a small hole in the lid of the container used to hold the grain sample.

(b) A separate thermometer or other temperature sensing equipment shall have temperature divisions not greater than the temperature increments used by the manufacturer in the correction table.

(Amended 1988)

**S.3.3. Conversion and Correction Tables.** – Conversion and correction tables, charts, graphs, slide rules, or other apparatus to convert the conventional scale values read from a moisture meter to moisture content values, if such apparatus is required, shall be appropriate and correct for the moisture meter being used and shall be marked with the following information:

(a) name and address or trademark of the manufacturer;

(b) the type or design of the device with which it is intended to be used;

(c) date of issue;

(d) the kinds or classes of grain or seed for which the device is designed to measure moisture content;

(e) the limitations of use, including but not confined to the moisture measurement range, grain or seed temperature, kind or class of grain or seed, moisture meter temperature, voltage and frequency ranges, electromagnetic interferences, and necessary accessory equipment; but

(f) values exceeding any measurement range shall not be included.

(Added 1984)

**S.3.4. Operating Instructions and Use Limitations.** – Operating instructions shall be furnished by the manufacturer with each device with all of the information required by paragraph S.3.3. Conversion and Correction Tables. Complete information concerning the accuracy, sensitivity, and use of accessory equipment (e.g., test weight per bushel equipment, thermometer, etc.) necessary in obtaining a moisture content shall be included.

## N. Notes

### N.1. Testing Procedures.

**N.1.1. Transfer Standards.** – Official grain samples shall be used as the official transfer standards with moisture content values assigned by the reference methods. The reference methods shall be the oven drying methods as specified by the USDA GIPSA. Tolerances shall be applied to the average of at least three measurements on each official grain sample. Official grain samples shall be clean and naturally moist, but not tempered (i.e., water not added).

(Amended 1992)

**N.1.2. Minimum Test.** – A minimum test of a grain moisture meter shall consist of tests:

- (a) with samples (need not exceed three) of each grain or seed for which the device is used, and
- (b) with samples having at least two different moisture content values within the operating range of the device.

(Amended 1986 and 1989)

**N.1.3. Temperature Measuring Equipment.** – The accuracy of accessory temperature measuring equipment shall be determined by comparison with a calibrated temperature sensor, such as a total immersion thermometer with 0.1 °C (0.2 °F) subdivisions, indicating over a range of from 0 °C to 40 °C (32 °F to 104 °F) with a maximum error of ± 0.1 °C (0.2 °F). Tests shall be conducted at two temperatures using liquid baths (e.g., ice water and room temperature water). The two temperatures selected shall not exceed the range of temperatures identified in the moisture meter operating instructions.

(Amended 1988)

## T. Tolerances<sup>1</sup>

**T.1. To Underregistration and to Overregistration.** – The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration.

**T.2. Tolerance Values.** – Maintenance and acceptance tolerances shall be as shown in Table T.2. Acceptance and Maintenance Tolerances for Grain Moisture Meters. Tolerances are expressed as a fraction of the percent moisture content of the official grain sample, together with a minimum tolerance.

Table T.2. Acceptance and Maintenance Tolerances for Grain Moisture Meters		
Type of Grain or Seed	Tolerance	Minimum Tolerance
Corn, oats, rice, sorghum, sunflower	0.05 of the percent moisture content	0.8 % in moisture content
All other cereal grains and oil seeds	0.04 of the percent moisture content	0.7 % in moisture content

<sup>1</sup> These tolerances do not apply to tests in which grain moisture meters are the transfer standards.

**T.3. For Test Weight Per Bushel Devices.** – The maintenance and acceptance tolerances on separate test weight per bushel devices used to determine the test weight per bushel of grain samples for the purposes of making density corrections in moisture determination shall be 0.193 kg/hL or 0.15 lb/bu. The test methods used shall be those specified by the USDA GIPSA using a dockage-free sample of dry hard red winter wheat.

(Amended 1992 and 2003)

**T.4. Thermometers or Other Temperature Sensing Equipment.** – The tolerance for a separate thermometer or temperature sensing equipment used to determine the temperature of grain samples for the purpose of making temperature corrections in moisture determinations shall be  $\pm 0.5$  °C (1 °F).

(Added 1988)

## **UR. User Requirements**

### **UR.1. Selection Requirements.**

**UR.1.1. Value of the Smallest Unit on Primary Indicating and Recording Elements.** – The value of the smallest unit on a moisture meter, whether the moisture meter reads directly in terms of moisture content, or when the conventional scale unit is converted or corrected to moisture content, shall be equal to or less than 0.1 %.

**UR.1.2. Environment.** – Equipment shall be suitable for the environment in which it is used including, but not limited to, the effects of wind, weather, and RFI.

**UR.2. Installation Requirements.** – The grain moisture meter shall be installed in an environment within the range of temperature and/or other environmental factors specified (a) in the operating manual, and (b) on the conversion or correction tables if such tables are necessary for the operation of the device.

### **UR.3. Use Requirements.**

**UR.3.1. Operating Instructions.** – The operating instructions for the use of the grain moisture meter shall be readily available to the user, service technician, and weights and measures official at the place of installation. It shall include a list of accessory equipment, conversion and correction charts if any are required to obtain moisture content values, and the kinds of grain or seed to be measured with the moisture meter.

(Amended 1988)

**UR.3.2. Other Devices not used for Commercial Measurement.** – If there are other moisture meters on the premises not used for trade or determining other charges for services, these devices shall be clearly and conspicuously marked “Not for Use in Trade or Commerce.”

**UR.3.3. Maintaining Integrity of Grain Samples.** – Whenever there is a time lapse (temperature change) between taking the sample and testing the sample, means to prevent condensation of moisture or loss of moisture from grain samples shall be used. For example, a cold grain sample may be kept in a closed container in order to permit the cold grain to come to the operating temperature range of the meter before the grain moisture measurements are made.

**UR.3.4. Printed Tickets.** – Printed tickets shall be free from any previous indication of moisture content or type of grain or seed selected.

**UR.3.5. Accessory Devices.** – Accessory devices, if necessary in the determination of a moisture content value, shall be in close proximity to the moisture meter and allow immediate use.

**UR.3.6. Sampling.** – A grain sample shall be obtained by following appropriate sampling methods and equipment. These include, but are not limited to, grain probes of appropriate length used at random locations in the bulk, the use of a pelican sampler, or other techniques and equipment giving equivalent results. The grain sample shall be taken such that it is representative of the lot.



**UR.3.7. Location.** – See G-UR.3.3. Position of Equipment.

**UR.3.8. Level Condition.** – If equipped with a level indicator, a meter shall be maintained in a level condition.

(Added 1988)

**UR.3.9. Operating Limitation.** – Unless otherwise specified by the meter manufacturer, moisture determinations shall not be made when the difference in temperatures between the grain sample and the meter exceeds 10 °C (20 °F).

(Added 1988)

**UR.3.10. Current Calibration Chart or Data.** – Grain moisture determinations shall be made using only the most recently published calibration charts or calibration data.

(Added 1988)

**UR.3.11. Posting of Meter Operating Range.** – The operating range of the grain moisture meter shall be clearly and conspicuously posted in the place of business such that the information is readily visible from a reasonable customer position. The posted information shall include the following:

- (a) The temperature range over which the meter may be used and still comply with the applicable requirements. If the temperature range varies for different grains or seed, the range shall be specified for each.
- (b) The moisture range for each grain or seed for which the meter is to be used.
- (c) The temperature range for each grain or seed for which the meter is to be used.
- (d) The maximum allowable difference in temperature that may exist between the meter and the sample for which an accurate moisture determination can be made.

(Added 1988)

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