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Section 2.22. Automatic Bulk Weighing Systems¹

A. Application

A.1. General. – This code applies to automatic bulk weighing systems, that is, weighing systems adapted to the automatic weighing of a commodity in successive drafts of predetermined amounts, automatically recording the no-load and loaded weight values and accumulating the net weight of each draft.

(Amended 1987)

A.2. Exceptions. – This code does not apply to batching systems.

(Added 2018)

A.3. Additional Code Requirements. – In addition to the requirements of this code, Automatic Bulk Weighing Systems shall meet the requirements of Section 1.10. General Code.

S. Specifications

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

S.1.1. Zero Indication. – Provisions shall be made to indicate and record a no-load reference value and, if the no-load reference value is a zero-value indication, to indicate and record an out-of-balance condition on both sides of zero.

S.1.1.1. Digital Zero Indication. – A digital zero indication shall represent a balance condition that is within $\pm \frac{1}{2}$ the value of the scale division.

S.1.2. Value of Scale Division (*d*). – *The value of the scale division (*d*), expressed in a unit of weight, shall be equal to:*

(a) *1, 2, or 5; or*

(b) *a decimal multiple or submultiple of 1, 2, or 5; or*

(c) *a binary submultiple of a unit of weight.*

Examples: Scale divisions may be 0.01, 0.02, or 0.05; 0.1, 0.2, or 0.5; 1, 2, or 5; 10, 20, or 50; or $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, etc.

[Nonretroactive as of January 1, 1986]

(Amended 1987)

S.1.3. Capacity Indication and Recorded Representation. – An indicating or recording element shall not indicate or record any values when the gross load is in excess of 105 % of the capacity of the system.

S.1.4. Weighing Sequence. – For systems used to receive (weigh in), the no-load reference value shall be determined and recorded only at the beginning of each weighing cycle. For systems used to deliver (weigh out), the no-load reference value shall be determined and recorded only after the gross load reference value for each weighing cycle has been indicated and recorded.

¹ (Title amended 1986)

S.1.5. Recording Sequence. – Provision shall be made so that all weight values are indicated until the completion of the recording of the indicated value.

S.1.6. Provision for Sealing Adjustable Components on Electronic Devices. – For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, 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 affecting the performance of the device.

(Amended 2019)

S.2. Design of Balance and Damping Mechanism.

S.2.1. Zero-Load Adjustment. – The weighing system shall be equipped with manual or semiautomatic means by which the zero-load balance or no-load reference value indication may be adjusted. Automatic zero-tracking and automatic zero-setting mechanisms are prohibited.

(Amended 2010)

S.2.1.1. Manual. – A manual zero-load or no-load reference value setting mechanism shall be operable or accessible only by a tool outside of or entirely separate from this mechanism or enclosed in a cabinet.

S.2.1.2. Semiautomatic. – A semiautomatic zero-load or no-load reference value setting mechanism shall meet the provisions of S.2.1.1. Manual or shall be operable only when:

- (a) the indication is stable within ± 3 scale divisions; and
- (b) cannot be operated during a weighing operation.

S.2.2. Damping Means. – A system shall be equipped with effective means necessary to bring the indications quickly to a readable, stable equilibrium. Effective means shall also be provided to permit the recording of weight values only when the indication is stable within plus or minus three scale divisions for devices with 10 000 scale divisions, or plus or minus one division for devices with less than 10 000 scale divisions.

S.3. Interlocks and Gate Control.

S.3.1. Gate Position. – Provision shall be made to clearly indicate to the operator the position of the gates leading directly to and from the weigh hopper.

S.3.2. Interlocks. – Each automatic bulk weighing system shall have operating interlocks to provide for the following:

- (a) Product cannot be cycled and weighed if the weight recording element is disconnected or subjected to a power loss.
- (b) The recording element cannot print a weight if either of the gates leading directly to or from the weigh hopper is open.
- (c) A “low paper” sensor, when provided, is activated.
- (d) The system will operate only in the proper sequence in all modes of operation.
- (e) When an overfill alarm is activated, the system shall indicate and record an overfill condition.

(Amended 1993)

S.3.3. Overfill Sensor.

- (a) The weigh hopper shall be equipped with an overfill sensor which will cause the feed gate to close, activate an alarm, and inhibit weighing until the overfill condition has been corrected.

(Added 1993)

- (b) *If the system is equipped with a lower garner or surge bin, that garner shall also be equipped with an overfill sensor which will cause the gate of the weigh hopper to remain open, activate an alarm, and inhibit weighing until the overfill condition has been corrected.*

[Nonretroactive as of January 1, 1998]

(Amended 1997)

S.4. Design of Weighing Elements.

S.4.1. Antifriction Means. – At all points at which a live part of the mechanism may come into contact with another part in the course of normal usage, frictional effects shall be reduced to a minimum by means of suitable antifriction means, opposing surfaces and points being properly shaped, finished, and hardened.

S.4.2. Adjustable Components. – An adjustable component, such as a potentiometer, shall be held securely in adjustment and, except for a component for adjusting level or a no-load reference value, shall not be adjustable from the outside of the device.

S.4.3. Multiple Load-Receiving Elements. – A system with a single indicating or recording element, or a combination indicating recording element, that is coupled to two or more load-receiving elements with independent weighing systems, shall be provided with means to prohibit the activation of any load-receiving element (or elements) not in use, and shall be provided with automatic means to indicate clearly and definitely which load-receiving element (or elements) is in use.

S.4.4. Venting. – All weighing systems shall be vented so that any internal or external pressure will not affect the accuracy or operation of the system.

S.5. Marking Requirements. (Also see Section 1.10. General Code paragraph G-S.1. Identification.)

S.5.1. Capacity and Value of the Scale Division. – The capacity of the weighing system and the value of the scale division shall be clearly and conspicuously marked on the indicating element near the weight value indications.

S.5.2. Weighing Elements. – On a weighing element not permanently attached to an indicating element, there shall be clearly and permanently marked for the purposes of identification, the name, initials, or trademark of the manufacturer, the manufacturer's designation that positively identifies the pattern or design, and the nominal capacity.

S.5.3. Temperature Limits. – *Unless the temperature range is -10°C to $+40^{\circ}\text{C}$ (14°F to 104°F), the temperature range shall be marked on the device.*

[Nonretroactive as of January 1, 1986]

(Added 1985)

S.5.4. Accuracy Class.

- (a) *All systems used to weigh grain shall be marked Class III.**

- (b) *All other systems shall be marked either Class III or III L.**

*(*Also see Section 2.20. Scales Code for the parameters for these accuracy classes for scales. The specific requirements for automatic bulk weighing systems apply to these devices when there is a conflict between the Scales Code and the Automatic Bulk Weighing Systems Code.)*

[Nonretroactive as of January 1, 1986]

(Added 1985) (Amended 1992)

N. Notes

N.1. Testing Procedures.

N.1.1. Test Weights. – The increasing load test shall be conducted using test weights equal to at least 10 % of the capacity of the system:

(a) on automatic grain bulk-weighing systems installed after January 1, 1984; and

(b) on other automatic bulk-weighing systems installed after January 1, 1986.

(Amended 1987)

N.1.2. Increasing-Load Test. – An increasing-load test consisting of substitution and strain-load tests shall be conducted up to the used capacity of the weighing system.

(Amended 1987)

N.1.3. Decreasing-Load Test. – A decreasing-load test shall be conducted on devices used to weigh out.

(Added 1986)

N.1.4. Zero-Balance or No-Load Reference Value Change Test. – A test for change of zero-balance or no-load reference value shall be conducted on all scales after the removal of any test load. The change shall not be more than the minimum tolerance applicable.

N.1.5. Discrimination Test. – *A discrimination test shall be conducted on all automatic indicating scales with the weighing device in equilibrium at zero-load and at maximum test load, and under controlled conditions in which environmental factors are reduced to the extent that they will not affect the results obtained.*

[Nonretroactive as of January 1, 1986]

N.1.5.1. Digital Device. – On a digital device, this test is conducted from just below the lower edge of the zone of uncertainty for increasing-load tests, or from just above the upper edge of the zone of uncertainty for decreasing-load tests.

(Added 1987)

N.2. Verification (Testing) Standards. – Standard weights and masses used in verifying weighing devices shall comply with requirements of NIST Handbook 105-1 (Class F) or the tolerances expressed in Appendix A, Fundamental Considerations, paragraph 3.2. (i.e., one-third of the smallest tolerance applied).

T. Tolerances

T.1. Tolerance Application. – Tolerance values shall be applied to all indications and recorded representations of a weighing system.

T.1.1. To Errors of Underregistration and Overregistration. – The tolerances hereinafter prescribed shall be applied equally to errors of underregistration and errors of overregistration.

T.1.2. To Increasing-Load Tests. – Basic tolerances shall be applied.

T.1.3. To Decreasing-Load Tests. – Basic tolerances shall be applied to systems used to weigh out.
(Added 1986)

T.1.4. To Tests Involving Digital Indications or Representations. – To the tolerances that would otherwise be applied, there shall be added an amount equal to one-half the value of the scale division. This does not apply to digital indications or recorded representations that have been corrected for rounding using error weights.
(Added 1986)

T.2. Minimum Tolerance Values. – The minimum tolerance value shall not be less than half the value of the scale division.

T.2.1. For Systems Used to Weigh Construction Materials. – The minimum maintenance and acceptance tolerance shall be 0.1 % of the weighing capacity of the system, or the value of the scale division, whichever is less.
(Added 1986)

T.3. Basic Tolerance Values.

T.3.1. Acceptance Tolerance. – The basic acceptance tolerance shall be one-half the basic maintenance tolerance.

T.3.2. For Systems Used to Weigh Grain. – The basic maintenance tolerance shall be 0.1 % of test load.

T.3.3. For All Other Systems. – The basic maintenance tolerance shall be 0.2 % of test load.
(Amended 1986)

T.4. Time Dependence. – *At constant test conditions, the indication 20 seconds after the application of a load and the indication after one hour shall not differ by more than the absolute value of the applicable tolerance for the applied load.*
[Nonretroactive as of January 1, 1987]
(Added 1986)

T.5. Repeatability. – The results obtained by several weighings of the same load under reasonably static test conditions shall agree within the absolute value of the maintenance tolerance for that load, and shall be within applicable tolerances.
(Added 1986)

T.6. Discrimination, Digital Automatic Indicating Scales. – A test load equivalent to 1.4 d shall cause a change in the indicated or recorded value of at least 2.0 d. This requires the zone of uncertainty to be not greater than 0.3 times the value of the scale division.
(Added 1985)

T.7. Influence Factors. – *The following factors are applicable to tests conducted under controlled conditions only, provided that:*

(a) *types of devices approved prior to January 1, 1986, and manufactured prior to January 1, 1988, need not meet the requirements of this section; and*

(b) *new types of devices submitted for approval after January 1, 1986, shall comply with the requirements of this section; and*

(c) *all devices manufactured after January 1, 1988, shall comply with the requirements of this section.*
[Nonretroactive as of January 1, 1986]

T.7.1. Temperature. – Devices shall satisfy the tolerance requirements under the following temperature conditions:

T.7.1.1. If not marked on the device, the temperature limits shall be: $-10\text{ }^{\circ}\text{C}$ to $40\text{ }^{\circ}\text{C}$ ($14\text{ }^{\circ}\text{F}$ to $104\text{ }^{\circ}\text{F}$).

T.7.1.2. If temperature limits are specified for the device, the range shall be at least $30\text{ }^{\circ}\text{C}$ ($54\text{ }^{\circ}\text{F}$).

T.7.1.3. Temperature Effect on Zero-Load Balance. – The zero-load indicator shall not vary by more than one division per $5\text{ }^{\circ}\text{C}$ ($9\text{ }^{\circ}\text{F}$) change in temperature.

T.7.1.4. Operating Temperature. – An indicating or recording element shall not display or record any usable values until the operating temperature necessary for accurate weighing and a stable zero-balance condition has been attained.

[Nonretroactive as of January 1, 1986]

T.7.2. Barometric Pressure. – The zero indication shall not vary by more than one scale division for a change in barometric pressure of 1 kPa over the total barometric range of 95 kPa to 105 kPa (28 in to 31 in of mercury).

[Nonretroactive as of January 1, 1986]

T.7.3. Electric Power Supply.

T.7.3.1. Power Supply, Voltage, and Frequency.

- (a) Weighing devices that operate using alternating current must perform within the conditions defined in paragraphs T.2. through T.7., inclusive over the line voltage range of 100 V to 130 V or 200 V to 250 V rms as appropriate and over the frequency range of 59.5 Hz to 60.5 Hz.
- (b) Battery-operated instruments shall not indicate nor record values outside the applicable tolerance limits when battery power output is excessive or deficient.

T.7.3.2. 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, 1986]

(Added 1985)

UR. User Requirements

UR.1. Selection Requirements.

UR.1.1. For Systems used to Weigh Grain. – The number of scale divisions of a weighing system shall not be less than 2 000 nor greater than 10 000 divisions.

[Nonretroactive as of January 1, 1984]

(Amended 1986 and 1992)

UR.1.2. For Systems used to Weigh Commodities other than Grain. – The number of scale divisions shall not be less than 500 nor greater than 10 000.

[Nonretroactive as of January 1, 1987]

(Added 1986)

UR.2. Installation Requirements.

UR.2.1. Protection from Environmental Factors. – The indicating elements, the lever system or load cells, the load-receiving element, and any permanently installed test weights shall be adequately protected from environmental factors such as wind, weather, and RFI that may adversely affect the operation or performance of the system.

UR.2.2. Foundation, Supports, and Clearance. – The foundation and supports of any system shall be such as to provide strength, rigidity, and permanence of all components, and clearance shall be provided around all live parts so that no contact can result before or during operation of the system.

UR.3. Loading Requirements.

UR.3.1. For Systems Used to Weigh Grain. – A system shall not be used to weigh drafts less than 40 % of the weighing capacity of the system except for a final partial draft. Loads shall not normally be retained on the weighing element for a period longer than a normal weighing cycle.

(Amended 1986)

UR.3.2. For Systems Used to Weigh Commodities Other than Grain. – *A system shall not be used to weigh drafts less than 20 % of the weighing capacity of the system except for a final partial draft. Loads shall not normally be retained on the weighing element for a period longer than a normal weighing cycle.*

[Nonretroactive as of January 1, 1987]

(Added 1986)

UR.4. System Modification. – The weighing system shall not be modified except when the modification has been approved by a competent engineering authority, preferably that of the engineering department of the manufacturer of the scale, and the official with statutory authority having jurisdiction over the scale.

(Amended 1991)

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