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Section 2.21. Belt-Conveyor Scale Systems

A. Application

A.1. General. – This code applies to belt-conveyor scale systems and weigh-belt systems used for the weighing of bulk materials.

(Amended 2015)

A.2. Exceptions. – The code does not apply to the following:

(a) Devices used for discrete weighing while moving on conveyors.

(b) Devices that measure quantity on a time basis.

(c) Checkweighers.

(d) Controllers or other auxiliary devices except as they may affect the weighing performance of the belt-conveyor scale.

A.3. Additional Code Requirements. – In addition to the requirements of this code, Belt-Conveyor Scale Systems shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating and Recording Elements.

S.1.1. General. – A belt-conveyor scale shall be equipped with a primary indicating element in the form of a master weight totalizer *and shall also be equipped with a recording element, and a rate of flow indicator and recorder (which may be analog).** An auxiliary indicator shall not be considered part of the master weight totalizer.

*[*Nonretroactive as of January 1, 1986]*

(Amended 1986)

S.1.2. Units. – A belt-conveyor scale shall indicate and record weight units in terms of pounds, tons, long tons, metric tons, or kilograms. The value of a scale division (d) expressed in a unit of weight shall be equal to:

(a) 1, 2, or 5; or

(b) a decimal multiple or submultiples of 1, 2, or 5.

S.1.3. Value of the Scale Division.

S.1.3.1. For Scales Not Marked with an Accuracy Class and Installed After January 1, 1986. *– The value of the scale division shall not be greater than 0.125 % ($^1/_{800}$) of the minimum totalized load.*

[Nonretroactive as of January 1, 1986]

*(*Added 1985)(Amended 2009 and 2019)

S.1.3.2. For Scales Installed Before January 1, 1986. – The value of the scale division shall not be greater than $^1/_{1200}$ of the rated capacity of the device. However, provision shall be made so that compliance with the requirements of the zero-load test as prescribed in N.3.1. Zero Load Tests may be readily and accurately determined in 20 minutes of operation.

S.1.3.3. For Scales Marked with an Accuracy Class. - *The value of the scale division shall not be greater than:*

(a) 0.125 % (1/800) of the minimum totalized load for scales marked Class 0.25; and

(b) 0.05 % (1/2000) of the minimum totalized load for scales marked Class 0.1.

[Nonretroactive as of January 1, 2020]
(Added 2019)

S.1.4. Recording Elements and Recorded Representations. *– The value of the scale division of the recording element shall be the same as that of the indicating element.*

a) The belt-conveyor scale system shall record the unit of measurement (i.e., kilograms, tonnes, pounds, tons, etc.), the date, and the time.

*b) The belt-conveyor scale system shall record the initial indication and the final indication of the master weight totalizer and the quantity.**

*All of the information in (a) and (b) must be recorded for each delivery.**
[Nonretroactive as of January 1, 1986]
*[*Nonretroactive as of January 1, 1994]*
(Amended 1993)

S.1.4.1. *The belt-conveyor scale system shall be capable of recording the results of automatic or semi-automatic zero load tests.***
*[**Nonretroactive as of January 1, 2004]*
(Added 2002)

S.1.5. Rate of Flow Indicators and Recorders. *- A belt-conveyor scale shall be equipped with a rate of flow indicator and an analog or digital recorder. Permanent means shall be provided to produce an audio or visual signal when the rate of flow is equal to or less than 20 % and when the rate of flow is equal to or greater than 100 % of the rated capacity of the scale. The type of alarm (audio or visual) shall be determined by the individual installation.*
[Nonretroactive as of January 1, 1986]
(Amended 1989 and 2004)

S.1.6. Advancement of Primary Indicating or Recording Elements. – The master weight totalizer shall advance only when the belt conveyor is in operation and under load.
(Amended 1989)

S.1.7. Master Weight Totalizer. *– The master weight totalizer shall not be resettable without breaking a security means.*
[Nonretroactive as of January 1, 1986]

S.1.8. Power Loss. *– In the event of a power failure of up to 24 hours, the accumulated measured quantity on the master weight totalizer of an electronic digital indicator shall be retained in memory during the power loss.*
[Nonretroactive as of January 1, 1986]
(Amended 1989)

S.1.9. Zero-Ready Indicator. – *A belt-conveyor scale shall be equipped with a zero-ready indicator that produces an audio or visual signal during an unloaded belt condition when the zero balance is within:*

(a) ± 0.12 % of the rated capacity of the scale for scales not marked with an accuracy class;

(a) ± 0.12 % of the rated capacity of the scale for scales marked Class 0.25; and

(b) ± 0.05 % for scales marked Class 0.1.

The type of indication (audio or visual) shall be determined by the individual installation.
[Nonretroactive as of January 1, 2014]

(Added 2012) (Amended 2019)

S.2. Design of Weighing Elements. – A belt-conveyor scale system shall be designed to combine automatically belt travel with belt load to provide a determination of the weight of the material that has passed over the scale.

S.2.1. Speed Measurement. – A belt-conveyor scale shall be equipped with a belt speed or travel sensor that will accurately sense the belt speed or travel whether the belt is empty or loaded.

S.2.2. Adjustable Components. – An adjustable component that can affect the performance of the device (except as prescribed in S.3.1. Design of Zero-Setting Mechanism) shall be held securely in adjustment.

(Amended 1998)

S.2.3. Overload Protection. – The load-receiving elements shall be equipped with means for overload protection of not less than 150 % of rated capacity. The accuracy of the scale in its normal loading range shall not be affected by overloading.

S.3. Zero Setting.

S.3.1. Design of Zero-Setting Mechanism. – Automatic and semiautomatic zero-setting mechanisms shall be so constructed that the resetting operation is carried out only after a whole number of belt revolutions and the completion of the setting or the whole operation is indicated. *An audio or visual signal shall be given when the automatic and semiautomatic zero-setting mechanisms reach the limit of adjustment of the zero-setting mechanism.**

(Amended 1999 and 2002)

Except for systems that record the zero-load reference at the beginning and end of a delivery, the range of the zero-setting mechanism shall not be greater than ± 2 % of the rated capacity of the scale without breaking the security means. *For systems that record the zero-load reference at the beginning and end of a delivery, the range of zero-setting mechanism shall not be greater than ±5 % without breaking the security means.***
*[*Nonretroactive as of January 1, 1990]*
*[**Nonretroactive as of January 1, 2004]*

(Amended 1989 and 2002)

S.3.1.1. Automatic Zero-Setting Mechanism. – *The automatic zero-setting mechanism shall indicate or record any change in the zero reference.*
[Nonretroactive as of January 1, 2010]

(Added 2009)

S.3.2. Sensitivity at Zero Load (For Type Evaluation). *– When a system is operated for a time period equal to the time required to deliver the minimum test load and with a test load calculated to indicate two scale divisions*

applied directly to the weighing element, the totalizer shall advance not less than one or more than three scale divisions. An alternative test of equivalent sensitivity, as specified by the manufacturer, shall also be acceptable. [Nonretroactive as of January 1, 1986]

S.4. Accuracy Class. – Weighing devices shall be marked with an appropriate accuracy class as either Class 0.25 or as Class 0.1. This designation is determined by the manufacturer.
[Nonretroactive as of January 1, 2020]

(Added 2019)

S.5. Marking Requirements. – Belt-conveyor scale systems and weigh-belt systems shall be marked with the following: (Also see also G-S.1. Identification.)

(a) the rated capacity in units of weight per hour (minimum and maximum);

(b) the value of the scale division;

(c) the belt speed in terms of feet (or meters) per minute at which the belt will deliver the rated capacity, or the maximum and minimum belt speeds at which the conveyor system will be operated for variable speed belts;

(d) the load in terms of pounds per foot or kilograms per meter (determined by material tests);

(e) *the operational temperature range if other than − 10 °C to 40 °C (14 °F to 104 °F)*;* and

*(f) the accuracy classification as declared by the manufacturer.***
*[*Nonretroactive as of January 1, 1986][**Nonretroactive as of January 1, 2020]*

(Amended 2015 and 2019)

S.6. Provision for Sealing. – 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.

All other devices shall be designed using the format set forth in Table S.6. with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g. data change audit trail available at the time of inspection), before any change that affects the metrological integrity of the device can be made to any electronic mechanism.

[Nonretroactive as of January 1, 1999]

(Added 1998) (Amended 2019)

Table S.6. *Categories of Device and Methods of Sealing*	
Categories of Devices	***Methods* of Sealing**
Category 1: *No remote configuration capability.*	*Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.*
Category 3: *Remote configuration capability.*	*An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (**Note:** Does not require 1000 changes to be stored for each parameter.)*

[Nonretroactive as of January 1, 1999]

(Table Added 1998)

N. Notes

N.1. General. –The performance of belt-conveyor scales can be detrimentally affected by the conditions of the installation. (Also see User Requirements.) The performance of the equipment is not to be determined by averaging the results of the individual tests. The results of all tests shall be within the tolerance limits.

(Amended 2002 and 2019)

N.1.1. Official Test. – An official test of a belt-conveyor scale system shall include tests specified in N.3.1. Zero Load Tests, N.3.2. Material Tests, and, if applicable, N.3.3. Simulated Load Tests.

(Amended 2006)

N.1.2. Simulated Test. – Simulated loading conditions as recommended by the manufacturer and approved by the official with statutory authority may be used to properly monitor the system operational performance between official tests, but shall not be used for official certification.

(Amended 1991)

N.2. Conditions of Tests. – A belt-conveyor scale shall be tested after it is installed on the conveyor system with which it is to be used and under such environmental conditions as may normally be expected. Each test shall be conducted with test loads no less than the minimum test load. Before each test run, the inspector shall check the zero setting and adjust as necessary.

(Amended 1986, 2004, and 2009)

N.2.1. Initial Verification. – A belt-conveyor scale system or a weigh-belt system shall be tested using test runs as indicated in Table N.2.1. Initial Verification.

The minimum testing shall be two test runs performed consecutively and under the same (or practically identical) test conditions; the range of the results of those test runs shall not exceed the absolute value of the tolerance as specified in T.2.1. Tolerance Values, Repeatability Tests. The results of each individual test shall be within the tolerance as specified in T.1. Tolerance Values.

Test runs may also be conducted at any other rate of flow that may be used at the installation to establish linearity of the system.

A minimum of four test runs may be conducted at only one flow rate if evidence is provided that the system is used at a constant speed/constant loading setting and that rate does not vary by an amount more than plus or minus (+/-) 10 % of the normal flow rate that can be developed at the installation for at least 80 % of the time.

(Added 2004) (Amended 2009, 2015, and 2019)

Table N.2.1.
Initial Verification

Device Configuration	Minimum of Two Test Runs at Each of the Following Settings	Total Tests (Minimum)
Constant Belt Speed and Variable Loading	- Belt Loading: high (normal) - Belt Loading: medium (intermediate) - Belt Loading: low (35 %)	6
Variable Belt Speed and Constant Loading	- Belt Speed: maximum - Belt Speed: medium - Belt Speed: minimum	6
Variable Belt Speed and Variable Loading	- Belt Speed: maximum; Belt Loading: high (normal) - Belt Speed: maximum; Belt Loading: medium (intermediate) - Belt Speed: maximum; Belt Loading: low (35 %) - Belt Speed: minimum; Belt Loading: high (normal) - Belt Speed: minimum; Belt Loading: medium (intermediate) - Belt Speed: minimum; Belt Loading: low (35 %)	12
Constant Belt Speed and Constant Loading	- When the system is operated only at a single flow rate, minimum of four test runs at the flowrate used in normal operation	*4

1. Use the device configurations in the left-hand column to identify the scale being tested.
2. Perform two test runs (minimum) at each of the settings shown in the center column.
3. The following terminology applies to "Belt Loading":
   - Low: 35 % of the maximum rated capacity of the system.
   - Medium: an intermediate rate between the high and low settings.
   - High: maximum (normal use) operational rate.

*As provided in N.2.1. Initial Verification; for single flow rate systems, a minimum of four test runs at a single flow rate are required.

(Table Added 2015)

N.2.2. Subsequent Verification. – Subsequent testing shall include testing at the normal use flow rate and other flow rates used at the installation using a minimum of two consecutive test runs performed at each flow rate. The official with statutory authority may determine that testing only at the normal use flow rate is necessary for subsequent verifications if evidence is provided that the system is used to operate:

(a) at no less than 70 % of the maximum rated capacity for at least 80 % of the time (excluding time that the belt is unloaded); or

(b) with a normal use flow rate that does not vary by more than plus or minus (+/-) 10 % of the maximum rated capacity.

Example: If a belt-conveyor scale system has a maximum rated capacity of 200 tons per hour (tph), and the normal use flow rate is 150 tph (75 % of the maximum rated capacity), no testing at additional flow rates is required provided the flow rates remain above 140 tph for more than 80 % of the time. If the same device were operating with a normal use flow rate of 130 tph, it is operating at 65 % of the maximum rated capacity. In this case, testing at flow rates in addition to the normal use flow rate would be required if the normal use flow rate varies by more than 20 tph (10 % of the maximum rated capacity).
(Added 2004) (Amended 2019)

N.2.3. Minimum Test Load.

N.2.3.1. Minimum Test Load, Weigh-Belt Systems. – The minimum test load shall not be less than the largest of the following values:

(a) 800 scale divisions for systems not marked with an accuracy class, 800 scale divisions for systems marked Class 0.25, and 2000 scale divisions for systems marked Class 0.1;

(b) the load obtained at maximum flow rate in one revolution of the belt; or

(c) the load obtained during at least one minute of operation.

(Amended 2015 and 2019)

N.2.3.2. Minimum Test Load, All Other Belt-Conveyor Scale Systems. – Except for applications where a normal weighment is less than ten minutes, the minimum test load shall not be less than the largest of the following values:

(a) 800 scale divisions for systems not marked with an accuracy class, 800 scale divisions for systems marked Class 0.25, and 2000 scale divisions for systems marked Class 0.1; or

(b) the load obtained at maximum flow rate in one revolution of the belt; or

(c) the load obtained during at least ten minutes of operation.

For applications where a normal weighment is less than ten minutes (e.g., belt-conveyor scale systems used exclusively to issue net weights for material conveyed by individual vehicles and railway track cars) the minimum test load shall be the normal weighment that also complies with N.2.3.2.(a) and (b).

The official with statutory authority may determine that a smaller minimum totalized load down to 2 % of the load totalized in one hour at the maximum flow rate may be used for subsequent tests, provided that:

1. the smaller minimum totalized load is greater than the quantities specified in N.2.3.2.(a) and (b); and

2. consecutive official testing with the minimum totalized loads described in N.2.3.2.(a), (b), or (c) and the smaller minimum test load has been conducted that demonstrates the system complies with applicable tolerances for repeatability, acceptance, and maintenance.

(Added 2004) (Amended 2008, 2015, and 2019)

N.3. Test Procedures.

N.3.1. Zero-Load Tests. – A zero-load test shall be conducted to establish that the belt scale system (including the conveyor) is capable of holding a stable, in-service zero.

(Amended 1989 and 2002)

N.3.1.1. Determination of Zero. – A zero-load test is a determination of the error in zero, expressed as an internal reference, a percentage of the full-scale capacity, or a change in a totalized load over a whole number of complete belt revolutions. A zero-load test shall be performed as follows:

(a) For belt-conveyor scales with electronic integrators, the test must be performed over a period of at least three minutes and with a whole number of complete belt revolutions.

(b) For belt-conveyor scales with mechanical integrators, the test shall be performed with no less than three complete revolutions or ten minutes of operation, whichever is greater.

(c) For weigh belt systems, the test must be performed over a period of at least one minute and at least one complete revolution of the belt.

(Added 2002) (Amended 2015)

N.3.1.2. Test of Zero Stability. – The conveyor system shall be operated to warm up the belt and the belt scale shall be zero adjusted as required. A series of zero-load tests shall be carried out immediately before conducting the simulated load or materials test until the three consecutive zero-load tests each indicate an error which does not exceed:

(a) ± 0.06 % of the totalized load at full scale capacity for the duration of the test for scales not marked with an accuracy class;

(b) ± 0.06 % of the totalized load at full scale capacity for the duration of the test for scales marked Class 0.25; or

(c) ± 0.03 % of the totalized load of full scale capacity for the duration of the test for scales that are marked Class 0.1.

No adjustments can be made during the three consecutive zero-load test readings.

(Added 2002) (Amended 2004, 2009, and 2019)

N.3.1.3. Check for Consistency of the Conveyor Belt along Its Entire Length. – During a zero-load test with any operational low-flow lock-out disabled, the absolute value of the difference between the maximum and minimum totalizer readings indicated on the totalizer during any complete revolution of the belt shall not exceed 0.12 % of the minimum test load.

Note: The end value of the zero-load test must meet the values referenced in N.3.1.2. Test for Zero Stability of:

(1) ± 0.06 % for scales not marked with an accuracy class;
(2) ± 0.06 % for scales marked Class 0.25; or
(3) ± 0.03 % for scales marked Class 0.1.

(Added 2002) (Amended 2004, 2011 and 2019)

N.3.2. Material Tests. – Material tests should be conducted using actual belt loading conditions. These belt loading conditions shall include but are not limited to conducting materials tests using different belt loading points, all types and sizes of products weighed on the scale, at least one other belt speed, and in both directions of weighing.

On subsequent verifications, at least two individual tests shall be conducted as specified in N.2.2. Subsequent Verification. The results of all these tests shall be within the tolerance limits.

Either pass a quantity of pre-weighed material over the belt-conveyor scale in a manner as similar as feasible to actual loading conditions or weigh all material that has passed over the belt-conveyor scale. Means for weighing the material test load will depend on the capacity of the belt-conveyor scale and availability of a suitable scale for the test. To assure that the test load is accurately weighed and determined, the following precautions shall be observed:

(a) The containers, whether railroad cars, trucks, or boxes, must not leak, and shall not be overloaded to the point that material will be lost.

(b) The actual empty or tare weight of the containers shall be determined at the time of the test. Stenciled tare weight of railway cars or trucks shall not be used. Gross and tare weights shall be determined on the same scale.

(c) When a pre-weighed test load is passed over the scale, the belt-loading hopper shall be examined before and after the test to assure that the hopper is empty and that only the material of the test load has passed over the scale.

(d) Where practicable, a reference scale should be tested within 24 hours preceding the determination of the weight of the test load used for a belt-conveyor scale material test.

A reference scale which is not "as found" within maintenance tolerance should have its accuracy re-verified after the belt-conveyor test with a suitable known weight load if the "as found" error of the belt-conveyor scale material test exceeds maintenance tolerance values.*

(e) If any suitable known weight load other than a certified test weight load is used for re-verification of the reference scale accuracy, its weight shall be determined on the reference scale after the reference scale certification and before commencing the belt scale material test.*

(f) The test shall not be conducted if the weight of the test load has been affected by environmental conditions.

*Note: Even if the reference scale is within maintenance tolerance it may require adjusting to be able to meet paragraph N.3.2.1. Accuracy of Material.

(Amended 1986, 1989, 1998, 2000, 2002, 2009, and 2019)

N.3.2.1. Accuracy of Material.

(a) For scales not marked with an accuracy class and those marked Class 0.25, the quantity of material used to conduct a material test shall be weighed on a reference scale to within an accuracy of 0.1 %.

(b) For scales that are marked Class 0.1, the quantity of material used to conduct a material test shall be weighed on a reference scale to within an accuracy of 0.035 %.

Scales typically used for this purpose include Class III and III L scales or a scale without a class designation as described in Handbook 44, Section 2.20., Table T.1.1. Tolerances for Unmarked Scales.

(Added 1989) (Amended 1991, 1993, 1998, 2000, and 2019)

N.3.3. Simulated Load Tests.

(a) As required by the official with statutory authority, simulated load tests as recommended by the manufacturer are to be conducted between material tests to monitor the system's operational performance but shall not be used for official certification.
(Amended 1991)

(b) A simulated load test consisting of at least three consecutive test runs shall be conducted as soon as possible, but not more than 12 hours after the completion of the material test, to establish the factor to relate the results of the simulated load test to the results of the material tests.
(Added 1990)

(c) The results of the simulated load test shall repeat within 0.1 %.
(Added 1990)

(Amended 1989 and 1990

T. Tolerances

T.1. Tolerance Values.[1] – Maintenance and acceptance tolerances on material tests, relative to the weight of the material, shall be:

(a) ± 0.25 % of the test load for systems not marked with an accuracy class;

(b) ± 0.25 % of the test load for systems marked Class 0.25; and

(c) ± 0.1 % of the test load for systems marked Class 0.1.

(Amended 1993 and 2019)

T.1.1. Tolerance Values – Test of Zero Stability. – Immediately after material has been weighed over the belt-conveyor scale during the conduct of any material test run, the zero-load test shall be repeated. The change in the accumulated or subtracted weight during the zero-load test shall not exceed

(a) 0.12 % of the totalized load at full scale capacity for the duration of that test for scales that are not marked with an accuracy class;

(b) 0.12 % of the totalized load at full scale capacity for the duration of that test for scales marked Class 0.25; and

(c) 0.06 % of the totalized load at full scale capacity for the duration of the test for scales that are marked Class 0.1.

If the range of zero adjustments during a complete (official) verification test exceeds 0.18 % of the totalized load at full scale capacity for the duration of the zero-load test for unmarked scales and those marked Class 0.25 or 0.09 % of the totalized load at full scale capacity for the duration of the zero-load test for scales marked Class 0.1, the official with statutory authority may establish an interval for zero-load testing during normal operation.

(Added 2004) (Amended 2009 and 2019)

[1] The variables and uncertainties included in the relative tolerance represent only part of the variables that affect the accuracy of the material weighed on belt-conveyor scales. If this tolerance was based on an error analysis beginning with mass standards through all of the test processes and following the principle expressed in Section 3.2. of the Fundamental Considerations in Appendix A, the tolerance would be 0.5 %.

(Added 1993)

T.2. Tolerance Values, Repeatability and Linearity.

T.2.1 Tolerance Values, Repeatability Tests. – In any group of totalization operations performed consecutively and under the same (or practically identical) test conditions during the conduct of material tests, the variation in values shall not be greater than**:**

(a) 0.25 % (1/400) for systems not marked with an accuracy class;

(b) 0.25 % (1/400) for systems marked Class 0.25; and

(c) 0.1 % (1/1000) for systems marked Class 0.1.

(Amended 2019)

T.2.2. Linearity Tests, for Systems that Operate Using Multiple or Variable Flow Rates. – For totalization operations performed consecutively under different test conditions (e.g., different flow rates, different test loads, different test material) during the conduct of material tests, the results relative to the weight of the reference material shall not exceed:

(a) +/- 0.25 % (1/400) for systems not marked with an accuracy class;

(b) +/- 0.25 % (1/400) for systems marked Class 0.25; and

(c) +/- 0.1 % (1/1000) for systems marked Class 0.1.

(Added 2019)

T.3. 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;

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

(c) all devices manufactured after January 1, 1988, shall comply with the requirements of this section.

T.3.1. Temperature. – Devices shall satisfy the tolerance requirements at temperatures from − 10 °C to 40 °C (14 °F to 104 °F).

T.3.1.1. Effect on Zero-Load Balance. – The zero-load indication shall not change by more than 0.035 % of the rated capacity of the scale (without the belt) for a change in temperature of 10 °C (18 °F) at a rate not to exceed 5 °C (9 °F) per hour.

(Amended 2004)

T.3.1.2. Temperature Limits. *– If a temperature range other than − 10 °C to 40 °C (14 °F to 104 °F) is specified for the device, the range shall be at least 30 °C (54 °F).*
[Nonretroactive as of January 1, 1990]

(Added 1989)

T.3.2. Power Supply, Voltage, and Frequency. – A belt-conveyor scale system shall satisfy the tolerance requirements over a range of 100 V to 130 V or 200 V to 250 V as appropriate and over a frequency range of 59.5 Hz to 60.5 Hz.

UR. User Requirements

UR.1. Installation Requirements.

UR.1.1. Protection from Environmental Factors. – The indicating elements, the lever system or load cells, and the load-receiving element of a belt-conveyor scale shall be adequately protected from environmental factors such as wind, moisture, dust, weather, and radio frequency interference (RFI) and electromagnetic interference (EMI) that may adversely affect the operation or performance of the device.

UR.1.2. Conveyor Installation. – The design and installation of the conveyor leading to and from the belt-conveyor scale is critical with respect to scale performance. Installation shall be in accordance with the scale manufacturer's instructions and the following:

(a) Installation - General. – A belt-conveyor scale shall be so installed that neither its performance nor operation will be adversely affected by any characteristic of the installation, including but not limited to, the foundation, supports, covers, or any other equipment.

(Amended 2002)

(b) Live Portions of Scale. – All live portions of the scale shall be protected with appropriate guard devices and clearances, as recommended by the scale manufacturer, to prevent accidental interference with the weighing operation. (Also see UR.3.1. Scale and Conveyor Maintenance.)

(Amended 2004)

(c) Storage of Simulated Load Equipment. – Suitable protection shall be provided for storage of any simulated load equipment.

(d) Take-up Device. – Any take-up device shall provide constant and consistent tension for the belt under all operating conditions.

(Amended 2014)

(e) Scale Location and Training Idlers. – The scale shall be so installed that the first weigh idler of the scale is at least 6 m (20 ft) or five idler spaces, whichever is greater, from loading point, skirting, head or tail pulley, or convex curve in the conveyor. Any training idler shall be located at least 18 m (60 ft) from the centerline of the weigh span of the scale. Training idlers shall not be restrained at any time in order to force belt alignment.

(Amended 1998)

(f) Concave Curve. – If there is a concave curve in the conveyor, before or after the scale, the scale shall be installed so that the belt is in contact with all the idler rollers at all times for at least 6 m (20 ft) or five idler spaces, whichever is greater, before and after the scale.[2] A concave curve shall start no closer than 12 m (40 ft) from the scale to the tangent point of the concave curve.

(Amended 1998)

(g) Tripper and Movable Pulleys. – There shall be no tripper or movable head pulleys in the conveyor.

[2] Installing the belt scale five-idler spaces from the tail pulley or the infeed skirting will be in the area of least belt tension on the conveyor and should produce the best accuracy. The performance of a belt-conveyor scale may be adversely affected by a concave curve in the conveyor that is located between the loading point and the scale. Therefore, whenever possible, a belt-conveyor scale should not be installed with a concave curve in the conveyor between the loading point and the scale.

(Amended 1995 and 1998)

(h) Conveyor Orientation. – The conveyor may be horizontal or inclined, but, if inclined, the angle shall be such that slippage of material along the belt does not occur.

(i) Conveyor Stringers. – Conveyor stringers at the scale and for not less than 6 m (20 ft) before and beyond the scale shall be continuous or securely joined and of sufficient size and so supported as to eliminate relative deflection between the scale and adjacent idlers when under load. The conveyor stringers should be so designed that the deflection between any two adjacent idlers within the weigh area does not exceed 0.6 mm (0.025 in) under load.

(j) Identification of Scale Area. – The scale area and five idlers on both ends of the scale shall be of a contrasting color, or other suitable means shall be used to distinguish the scale from the remainder of the conveyor installation, and the scale shall be readily accessible.

(Amended 1998)

(k) Belt Composition and Maintenance. – In a loaded or unloaded condition, the belt shall make constant contact with horizontal and wing rollers of the idlers in the scale area. Splices shall not cause any undue disturbance in scale operation. (Also see N.3. Test Procedures.)

(Amended 1998, 2000, 2001, and 2015)

(l) Uniformity of Belt Loading and Flow. – The conveyor loading mechanism shall be designed to provide uniform belt loading. The distance from the loading point to the scale shall allow for adequate settling time of the material on the belt before it is weighed. Feeding mechanisms shall have a positive closing or stopping action so that material leakage does not occur. Feeders shall provide an even flow over the scale through the full range of scale operation. Sufficient impact idlers shall be provided in the conveyor under each loading point to prevent deflection of the belt during the time material is being loaded.

(m) Belt Alignment. – The belt shall not extend beyond the edge of the outermost roller of any carry side (top) roller in any area of the conveyor nor touch the conveyor structure on the return (bottom) side of the conveyor.

(Amended 1998 and 2008)

(Amended 2002, 2012, 2013, 2014, and 2015)

UR.1.3. Material Test. *– A belt-conveyor scale shall be installed so that a material test can be conveniently conducted.*

[Nonretroactive as of January 1, 1981]

UR.1.4. Belt Travel (Speed or Velocity). – The belt travel sensor shall be so positioned that it accurately represents the travel of the belt over the scale for all flow rates between the maximum and minimum values. The belt travel sensor shall be so designed and installed that there is no slip.

(Amended 2012)

UR.2. Use Requirements.

UR.2.1. Rate of Operation. – A belt-conveyor scale system shall be operated between 20 % and 100 % of its rated capacity.

(Amended 2004)

UR.2.2. Minimum Totalized Load. – Delivered quantities of less than the minimum test load shall not be considered a valid weighment.

UR.2.3. Security Means. – When a security means has been broken, it shall be reported to the official with statutory authority.

(Amended 1991)

UR.2.4. Loading. – The feed of material to the scale shall be controlled to assure that, during normal operation, the material flow is in accordance with the manufacturer's recommendation for rated capacity.

UR.2.5. Diversion or Loss of Measured Product. – There shall be no operation(s) or condition(s) of use that result in loss or diversion that adversely affects the quantity of measured product.

(Added 2005)

UR.2.6. Retention of Maintenance, Test, and Analog or Digital Recorder Information. – Records of calibration and maintenance, including conveyor alignment, analog or digital recorder, zero-load test, and material test data shall be maintained on site for at least the three concurrent years as a history of scale performance. Copies of any report as a result of a test or repair shall be mailed to the official with statutory authority as required. The current date and correction factor(s) for simulated load equipment shall be recorded and maintained in the scale cabinet.

(Added 2002)

(Amended 2012)

UR.3. Maintenance Requirements – Scale and Conveyor Maintenance. – Weighing systems and idlers shall be maintained and serviced in accordance with manufacturer's instructions and the following:

(a) Zero Balance. – The zero-balance condition of a belt-conveyor scale shall be maintained such that, prior to beginning any commercial transaction, with no load on the belt, the zero-balance condition is within:

i. ± 0.12 % of the scale's rated capacity for systems marked Class 0.25; and
ii. ± 0.05 % of the scale's rated capacity for systems marked Class 0.1.

(Added 2012) (Amended 2019)

(b) Scale Clearance. – The scale and area surrounding the scale shall be kept clean of debris or other foreign material that can detrimentally affect the performance of the system.

(c) Weighed Material. – There shall be provisions to ensure that weighed material does not adhere to the belt and return to the scale system area.

(Added 2004)

(d) Simulated and Zero-Load Test Intervals. – Zero-load tests and simulated load or material tests shall be conducted at periodic intervals between official tests and after a repair or mechanical adjustment to the conveyor system in order to provide reasonable assurance that the device is performing correctly. The minimum interval for periodic zero-load tests and simulated load tests shall be established by the official with statutory authority or according to manufacturer recommendations.

(i) The actions to be taken as a result of the zero-load test are shown in the following table.

Table UR.3. (d) (i)
Zero-Load Test Intervals and Actions

Change in Zero (Δ 0)	Actions to be Taken
If the change in zero is less than ± 0.25 % (Δ 0 < 0.25 %)	Perform zero adjustment and proceed to simulated load test.
If the change in zero is ± 0.25 % to ± 0.5 % (0.25 % ≤ Δ 0 ≤ 0.5 %)	Inspect the conveyor and weighing area for compliance with UR.1. Installation Requirements and repeat the zero-load test.
If the change in zero is greater than ± 0.5 % (Δ 0 > 0.5 %)	Inspect the conveyor and weighing area for compliance with UR.1. Installation Requirements, repeat the zero-load test, and reduce the interval between zero-load tests.

(ii) The action to be taken as a result of the simulated load or material tests is shown in the following table.

Table UR.3. (d) (ii)
Simulated Load or Material Test Intervals and Actions

Change in Factor (Reference) Established in N.3.3.(b) [Δ N.3.3.(b)]	Action to be Taken
For scales not marked with an accuracy class and those marked Class 0.25, if the error is less than 0.25 %: (Δ N.3.3.(b) < 0.25 %)	No Action
For scales marked Class 0.1, if the error is less than 0.1%: (Δ N.3.3.(b) < 0.1%)	
For scales not marked with an accuracy class and those marked Class 0.25, if the error is at least 0.25 % but not more than 0.6 %: (0.25 % ≤ Δ N.3.3.(b) ≤ 0.6 %)	Inspect the conveyor and weighing area for compliance with UR.1. Installation Requirements and, after compliance is verified, repeat the test.
For scales marked Class 0.1, if the error is at least 0.1% but not more than 0.25%: (0.1 % ≤ Δ N.3.3.(b) ≤ 0.25 %)	If the result of that test remains greater than ± 0.25 %, for scales not marked with an accuracy class and those marked Class 0.25, or greater than ± 0.1% for scales marked Class 0.1, a span correction shall be made and the official with statutory authority notified. (Amended 1991 and 2019)

Table UR.3. (d) (ii)
Simulated Load or Material Test Intervals and Actions

Change in Factor (Reference) Established in N.3.3.(b) **[**Δ N.3.3.(b)]	**Action to be Taken**
For scales not marked with an accuracy class and those marked Class 0.25, if the error is greater than 0.6 % but does not exceed 0.75 %: (0.6 % < Δ N.3.3.(b) ≤ 0.75 %)	Inspect the conveyor and weighing area for compliance with UR.1. Installation Requirements and, after compliance is verified, repeat the test. If the result of that test remains greater than ± 0.6 %, for scales not marked with an accuracy class and those marked Class 0.25, or greater than ± 0.25% for scales marked Class 0.1, a span correction shall be made, the official with statutory authority shall be notified, and an official test shall be conducted. (Amended 1991 and 2019)
For scales marked Class 0.1, if the error is greater than 0.25% but does not exceed 0.3%: (0.25 % < Δ N.3.3.(b) ≤ 0.3 %)	
For scales not marked with an accuracy class and those marked Class 0.25, if the error is greater than 0.75 %: (Δ N.3.3.(b) > 0.75 %)	An official test is required. (Amended 1987)
For scales marked Class 0.1, if the error is greater than 0.3%: (Δ N.3.3.(b) > 0.3 %)	

(Amended 2002, 2009, and 2019)

(e) Scale Alignment. – Alignment checks shall be conducted in accordance with the manufacturer's recommendation. A material test is required after any realignment.
(Amended 1986, 2000, and 2015)

(f) Simulated Load Equipment. – Simulated load equipment shall be clean and properly maintained.

(g) Zero Load Reference Information. – When zero load reference information is recorded for a delivery, the information must be based upon zero load tests performed as a minimum both immediately before and immediately after the totalized load.
(Added 2002)

(Amended 1986, 2000, 2002, 2004, 2009, 2012, and 2015)

UR.4. Compliance. – Prior to initial verification, the scale manufacturer or installer shall certify to the owner that the scale meets code requirements. Prior to initial verification and each subsequent verification, the scale owner or his agent shall notify the official with statutory authority in writing that the belt-conveyor scale system is in compliance with this specification and ready for material testing.
(Amended 1991)