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Recommended Practice

Application and Installation of Continuous-Belt Weighbridge Scales

ISA-RP74.01 — Application and Installation of Continuous-Belt Weighbridge Scales

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Preface

This preface is included for information purposes and is not a part of ISA-RP74.01.

This recommended practice has been prepared as a part of the service of ISA toward a goal of uniformity in the field of instrumentation. To be of real value, this document should not be static, but should be subject to periodic review. Toward this end, the Society welcomes all comments and criticisms, and asks that they be addressed to the Secretary, Standards and Practices Board, ISA, 67 Alexander Drive, P.O. Box 12277, Research Triangle Park, NC 27709, Telephone (919) 549-8411, e-mail: standards@isa.org.

The ISA Standards and Practices Department is aware of the growing need for attention to the metric system of units in general, and the International System of Units (SI) in particular, in the preparation of instrumentation standards. The Department is further aware of the benefits to U.S.A. users of ISA standards of incorporating suitable references to the SI (and the metric system) in their business and professional dealings with other countries. Toward this end, this Department will endeavor to introduce SI-acceptable metric units in all new and revised standards to the greatest extent possible. *The Metric Practice Guide,* which has been published by the Institute of Electrical and Electronic Engineers as ANSI/IEEE Std. 268-1982, and future revisions will be the reference guide for definitions, symbols, abbreviations, and conversion factors.

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The information contained in the preface, footnotes, and appendices is included for information only and is not a part of the recommended practice.

Prior to issuance of this recommended practice, NBS Handbook 44 (Specification Tolerances and Other Technical Requirements for Commercial Weighing and Measuring Devices) and OIML IR50 (Laws of the Member States' Journal of European Communities Relating to Continuous Totalizing Weighing Machines) were available to guide specifiers and buyers of weighbridge-type, continuous-belt weigh scales. These two documents are intended for use on the regulation of weighing and apply to sales approved by weights and measures personnel.

The purpose of this recommended practice is to furnish design criteria to simplify the specification of weighbridge-type, continuous-belt weigh scales and to provide recommendations for their installation, calibration, and maintenance. It is recognized that nuclear-radiation-type belt weigh scales and "bolt-on" sensors perform a valuable service in the industry and can provide Class III accuracy (1-percent error). This recommended practice, however, addresses only the weighbridge-type scale, leaving the application and installation of nuclear scales and other weighing devices to subsequent consideration.

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Contents

1 Purpose and scope

The purpose of this recommended practice is to furnish design criteria inducive to simplified specifications and to provide recommendations for installation, calibration, and maintenance of continuous-belt, weighbridge-type scales. The recommended practice will provide an effective base of comparison of scale suppliers, will establish minimum values, and will ensure that a scale specification and purchase incorporates the essentials to satisfy a particular weighing job. It will permit full knowledge of the weigh scale configuration (regardless of the manufacturer) early in the design stages of the belt conveyor.

2 Definitions

The following definitions apply to this recommended practice. (See also Figure 1.)

Approach idler: The last *idler* passed before the material on a belt reaches the weighbridge.

Belt conveyor: An endless fabric, rubber, plastic, leather, or metal belt operating over suitable drive, tail-end, and bend terminals; belt idlers; or slider beds for handling bulk materials, packages, or objects placed directly upon the belt.

Bell-conveyor scale: A device installed on a belt-conveyor structure that continuously weighs the material being conveyed.

Belt-speed sensor: A device that generates a signal as a function of belt speed.

Belt-speed transmitter: A device that transmits a belt speed signal to a receiver.

Bend pulley: Any pulley used to change the direction of travel of a belt.

Calibration test: A test using known weights and forces to load the scale in order to determine the performance of a *belt-conveyor scale*.

Concave curve: A change in the angle of inclination of a *belt conveyor* where the center of the curve is above the conveyor.

Convex curve: A change in the angle of inclination of a *belt conveyor* where the center of the curve is below the conveyor.

Conveyor stringers: Support members for the conveyor on which the *idlers* are mounted.

Design capacity: The maximum weight load that the scale is designed to weigh in one hour within the designated class accuracy. It is customarily 125 percent of normal capacity and is also known as "scale capacity."

Head pulley: The pulley at the discharge end of the *belt conveyor*. The power drive for the belt is generally applied to the end pulley.

Idler spacing: The center-to-center distance between consecutive *idler rollers*, measured parallel to the belt.

Idlers (idler rollers): Freely-turning cylinders mounted on a frame to support the conveyor belt. For a flat belt, the *idlers* may consist of one or more horizontal cylinders transverse to the direction of belt travel. For a troughed belt, the *idlers* may consist of one or more horizontal cylinders with one or more additional cylinders at an angle that lifts the sides of the belt to form a trough.

Impact idler: A belt *idler* incorporating resilient roll coverings to absorb large amounts of shock at the *loading point*.

Load reactor: A device that generates a signal proportional to the force imposed upon it by the *load sensor*.

Load sensor: See "weigh carriage." Also called "load receiving element."

Loading point: The location at which material to be conveyed is applied to the conveyor.

Normal capacity: Normal capacity is 80 percent of design capacity.

Retreat idler: The first *idler* reached after the material on the belt leaves the weigh carriage. Also called "departure idler."

Service idlers: Those *idlers* in the weighing area, including scale-borne *idlers* and several *idlers* on either side of the scale-borne *idlers*. They must be of the same type and grade and receive maintenance as *weigh idlers*.

Simulation tests: Tests on the weighing unit in which either the movement of the belt, the effect of the material thereon, or both are simulated by using known weights and forces.

Skirting: Stationary sideboards or sections of the *belt conveyor* attached to the conveyor support frame or other stationary support to prevent the bulk material from falling off the side of the belt.

Snub pulley: Any pulley used to increase the arc of contact between the belt and the drive pulley.

String lines: Wires, piano wire, or monofilament line of suitable tensile strength and visibility, strung over each of the three rolls of the *weigh idlers* to confirm idler alignment and elevation (three-wire line alignment).

Tail pulley: The pulley at the opposite end of the conveyor from the *head pulley*.

Takeup (gravity): A device plus a calculated quantity of dead weight to provide sufficient tension in a conveyor belt to ensure that the belt will be positively driven by the drive pulley. A counter-weighted *takeup* consists of a horizontal pulley free to move in either the vertical or horizontal direction, with dead weights applied to the pulley shaft to provide the tension required.

Test chain: A calibrating device consisting of a series of rollers or wheels linked together to ensure that their weight is uniform and they move freely (so that chain weight loss due to wear is minimized).

Totalizer: A device used with a *belt-conveyor scale* to indicate the total weight of the material that has been conveyed over the scale. The master weight *totalizer* is the primary indicating element of the *belt-conveyor scale*. An auxiliary vernier counter used for scale calibration should not be part of the master weight *totalizer*. *Totalizers* can be remote auxiliary *totalizers* as well as local masters. The *totalizer* shows the accumulated weight; a *totalizer* may be nonresettable or resettable to zero to measure a definite amount of conveyed material.

Training idlers: *Idlers* of special design or mounting that are intended to counteract any tendency of the belt to shift sideways.

Tripper: A device for unloading a *belt conveyor* at a point between the loading point and the head pulley.

Weigh carriage: A structure supporting the *weigh idlers*, which in turn transmits weight to the load reactor.

Weigh idlers: *Idlers* positioned in the *weigh carriage* assembly so that they sense the weight of the material on the conveyor belt and transmit the weight through the carriage to the *load reactor*.

Weighbridge-type belt scale: A scale mounted above or below a *belt conveyor* that supports a section of the conveyor belt via a structural suspension system (*weigh carriage*) and *weigh idlers*.

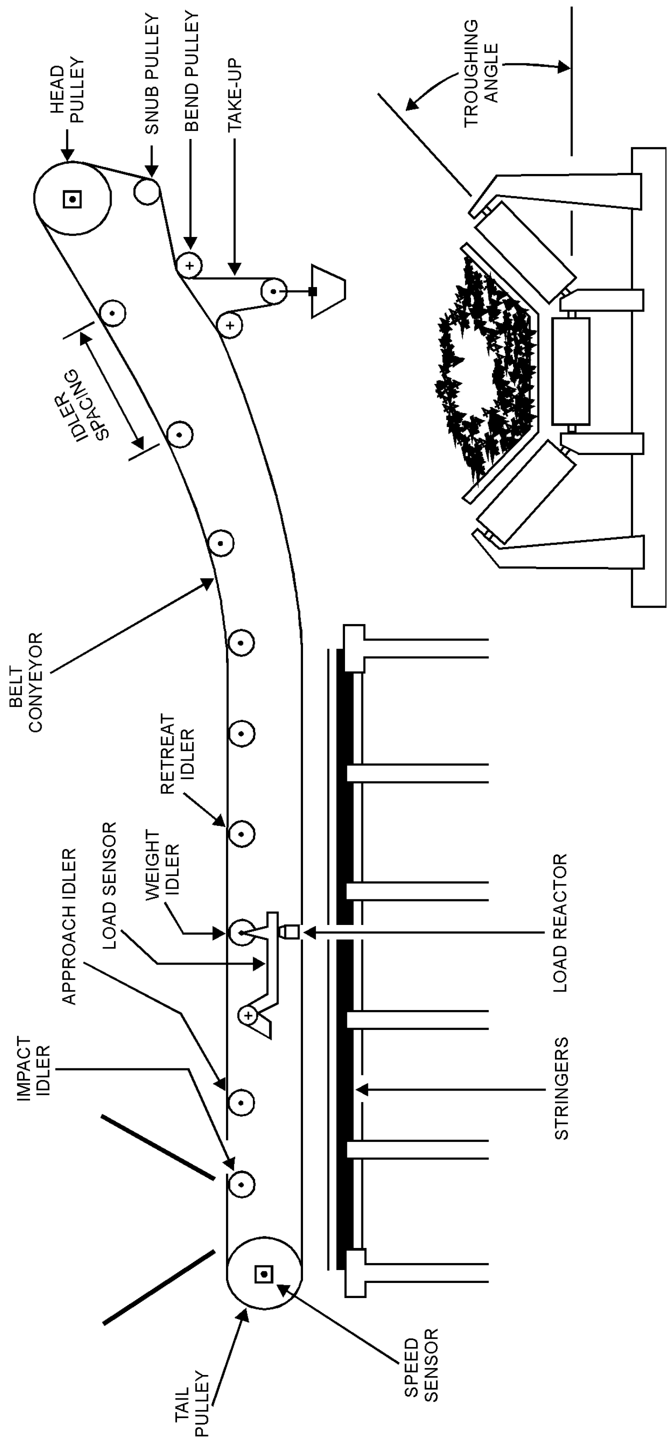

Figure 1: Belt conveyor and weighbridge assembly

3 Conveyor design recommendations

The design and installation of the conveyor leading to and from the weigh scale are crucial to enable the scale to perform within accuracy specifications.

3.1 Conveyor length

The maximum conveyor length may be dictated by the desire to make one belt revolution within a given time period or a given tonnage. The minimum conveyor length is 40 ft (12 m), unless the conveyor is specifically designed as a weighing conveyor and certified by the scale manufacturer.

3.2 Maximum angle of inclination

The maximum angle of inclination is a function of material properties and belt speed. The primary objective is that the material must not slide back on the belt.

3.3 Belt speed

Belt speed is a function of conveyor length and application. In general, accuracy can be maintained in the range of 100 to 1,000 ft/min (30 to 305 m/min).

3.4 Troughing angle carrying idlers

The maximum troughing angle for carrying idlers is 35°.

3.5 Idler spacing

Idler spacing is a function of conveyor load, troughing, and belt construction, e.g., stiffness, and belt width. The scale can function as long as the conveyor does not spill the load between idlers.

3.6 Takeup

Where space permits, the takeup is vertical gravity type, preferably near the drive or head pulley.

3.7 Concave/convex curves

No vertical curve in the belt should be located between the loading point and the scale. The scale should be located not less than 40 ft (12 m) from the convex curve and not less than 70 ft (21.3 m) from the concave curve. The belt should be in contact with at least eight idlers on either side of the scale.

3.8 Conveyor stringers

Conveyor stringers should be continuous to accommodate scale weigh idlers, with at least four idlers on either side of the scale, to minimize deflection under load. If the stringers are not continuous, welding them together can be helpful. (See Section 3.9.)

3.9 Conveyor vertical supports

Conveyor vertical supports are located at weigh-section, load-bearing points, with additional supports spaced at 10 ft (3.1 m) to span an area equal to at least four idlers on each side of the weigh idlers. Relative deflection between the idlers (eight idlers plus weigh idlers) should not exceed ±0.010 in. (0.0254 cm) under load.

3.10 Support footing

Preferably, support footings are located on concrete foundations, but they may be located on a suitably reinforced concrete floor.

3.11 Training idlers

Training idlers shall not be allowed within 40 ft (12 m) on either side of the scale or within 10 idler spacings, whichever is greater.

3.12 Weigh idlers

Weigh idlers shall be evenly spaced and normal (square) to the conveyor. At least four idlers on either side of the weighbridge shall be similarly aligned.

3.13 Conveyor load point

Conveyor loading shall be preferred at one point only. If multiple load points are required, they should be grouped in close proximity to one another. Where a load point is within eight approach idlers of the weighbridge, multiple impact idlers are recommended. The conveyor loading mechanism should be designed to provide uniform belt loading.

3.14 Wind loading

The conveyor in the scale area should be provided with wind shields on the sides, ends, and top and bottom of each end of the scale for a distance of 30 ft (9 m) measured along the belt, where exposed to outdoor environment. The wind screen should protect against wind, at least 6 in (15 cm) below the return belt.

3.15 Material transition

The distance from the loading point to the scale shall allow a minimum settling time of 2 s for the material on the belt before it is weighed. Appropriate apron feeders, profilers, etc., should be used to produce as uniform a loading as possible.

3.16 Idler alignment

The manufacturer's installation instructions should be followed for the stringline alignment of weighing, approach, and retreat idlers.

3.17 Belt tracking

The belt should have sufficient flexibility to ensure contact with all weighing idler rolls and be centered when it is running empty. The belt should track within ±1/2 in (1.25 cm) from empty to fully loaded. This can be aided by loading material onto the belt in the direction of travel rather than transverse to it. Lagging on the head pulley is advisable; it will grip the belt and carry it into a well-centered position. It will also permit belt tension to be reduced to a minimum, which will allow better weighing accuracy.

3.18 Calibration chain storage

A suitable protective support should be provided to allow storage of the test chain, where used, to facilitate handling of the chain onto the conveyor belt.

4 Calibration

4.1 Methods

Operate the conveyor under load for a sufficient time, depending upon weather conditions, to ensure normal operating conditions and instrument warmup. In temperatures below freezing, it is advisable to operate with a load at least 1 hour prior to starting calibration.

Assure that the belt is clear, that all idlers are free, and that the belt is in alignment. To account for variations in belt thickness, zero-balance the weigh signal transmitter with an integrated average belt weight. To determine the average belt weight, run the belt for at least five integral revolutions or 3 min, whichever is greater (to reduce the error caused by inaccurate observations). Begin and end zero balance while the conveyor is running. On long belts (e.g., 1,000 ft (305 m)), three revolutions should be sufficient for Class II accuracy. (See Section 5.)

4.1.1 Material run — preferred method

Material is passed over the scale at or near the normal load rate (80 percent of the design capacity) for at least five revolutions of the belt (three revolutions for Class II accuracy). It is collected in a collecting bin with an integral (reference) scale. A second method is to collect material that has passed over the scale into a truck or railcar and weighed on a certified scale. (See Section 5.) The reference scale shall have an error no greater than 25 percent of the smallest tolerance to be applied when the standard is used.

4.1.2 Simulated test calibration with a test chain

The chain should permit calibration from 65 to 75 percent of the design capacity. The pounds-per-foot rating of the chain should be equal to the desired conveyor loading and be certified to 0.5 percent accuracy of the total weight. All links of the chain should weigh within 0.5 percent of the mean link weight. The chain shall have sufficient length to span the second fixed idler on both sides of the scale. It should have free rollers or wheels and a pitch that divides the idler spacing evenly —no longer than 6 in. Suitable support above the belt shall be provided to house and protect the chain from dust and moisture.

4.1.3 Simulated test calibration with a static weight

A static weight suspended from the center of the carriage may be used for an interim check on calibration. Failure of the check to fall within the predetermined limits would indicate a need for recalibration by the test chain or the material run.

4.1.4 Simulated test with electronic calibration

The effect of the built-in electronic weight simulator, if available, should permit calibration of the scale system between 60 and 80 percent of its design capacity.

The scale manufacturer should be consulted if the capacity or the type of load reactor is changed after the initial commissioning of the scale system.

After calibration, report accuracy as "as found" and "as left."

4.2 Frequency of alignment, calibration, and zero balancing

4.2.1 Zero balancing interval

The interval is determined by sensitivity to ambient conditions, stability of structure, rate of dust buildup, or spill on scale suspension. Zero should be checked every other day for several weeks after the installation and the results observed. The period can be lengthened thereafter.

4.2.2 Span calibration interval

Calibration with a built-in weigh signal, if available, should be done weekly for the Class I conveyor and monthly for the Class II conveyor. Tests with material and/or test chains should be done at regular intervals, not to exceed 90 days.

Accuracy classification and operating experience should guide the user when determining the allowable intervals between calibrations and the frequency of zero balancing.

Realignment with three-wire lines should be done once each year.

Test chains should be certified once every 2 yr at a minimum. As an alternative, a correction factor can be determined for the chain when material tests are run. (See Section 4.1.1.)

5 Accuracy

Class I accuracy is defined as permitting no more than ±1/4 percent error of totalized weight when operated over a design capacity of 33-1/3 percent to 100 percent.

Class II accuracy is defined as permitting no more than ±1/2 percent maximum error of totalized weight when operated over a design capacity of 33-1/3 percent to 100 percent.

The accuracy classification should take into consideration the following:

1) Custody transfer scales require high accuracy, as they are used for billing and accounting purposes.

2) Control system scales, such as those used in ratio blending and general bulk transfers, require less accuracy, but repeatability must be assured.

Accuracy should be established based on an appropriate test condition (e.g., a material run, Section 4.1.1). Requirements for the determination of accuracy, as found in Chapter II of OIML* Recommendation No. 50 (June 1980) may be applicable to a specific installation. (See Appendix A.)

For the best accuracy, belt scales should operate at a minimum load of 7 lb/ft (10.4 kg/m) of the belt width. A counterbalance device that offsets the tare weight of the belt can be used to reduce the minimum load to 3 lb/ft (4.46 kg/m).

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6 Belt weigh scale components

6.1 Load sensor and reactor

Each scale should include a load sensor (weighbridge) and a load reactor.

The weighbridge should utilize as many suspended idlers as required to meet the accuracy requirements of the installation.

The load reactor should measure the forces generated by the load sensor.

Strain gage load cells, LVDTs (linear variable differential transformers), and mechanical reactors are typical load reactors.

The load reactor and the sensor should incorporate not less than 150 percent of the design capacity overload protection. It should include temperature compensation over the temperature range specified and suitable environmental protection.

6.2 Speed measurement system

A belt speed sensor should be employed in all scale systems. It should be designed such that there is no possibility that a slip will affect the results, regardless of whether the belt is loaded or unloaded.

The belt speed sensor transmitter should provide a continuous speed signal to the multiplier. It may be analog or digital. For troubleshooting purposes, it is desirable to have the speed signal available at the scale readout.

6.3 Multiplier

The totalized weight may be obtained either by multiplying the speed and weight information and integrating it with respect to time, or by integrating the weight information directly with respect to distance traveled.

6.4 Information display

At a minimum, all information to be displayed or transmitted should be available at one location.

Span and zero adjustments of the display should be non-interacting.

A weigh scale integrator/totalizer should be supplied to record the weight crossing the scale. The weight should be displayed in engineering units. The totalizer should contain a minimum of six digits and should display the total in accordance with the accuracy designation. Weight may be expressed in kilograms, pounds, tons, or multiples or subdivisions thereof. The value of the smallest unit should not be greater than 1/800 of the total number of counts produced on the master totalizer during the calibration test interval.

If the totalizer depends on electrical power, a backup power supply (e.g., a battery) should be considered in order to preclude rerunning the material upon loss of power.

The instantaneous weight flow rate should be displayed on all scales. The display should be indicated in engineering units or as design capacity (0 to 100 percent). It should be displayed in such a manner that the error of the indicator shall not be greater than twice that permitted in the designated accuracy class.

6.5 Transmission

When the instantaneous weight information is transmitted in pulse form, the signal may be produced by a dry contact or a solid-state circuit closure, or by an internally generated signal at a pulse rate proportional to the flow rate of the material, electrically isolated from the input signal and the ground. A local indication of contact closure should be supplied to facilitate troubleshooting.

When transmitted in analog form, a 4 to 20 mA dc signal may be used to a 0 to 600 Ω receiver to represent 0 to 100 percent of the scale's design capacity. The signal should be electrically isolated from the input signals and the ground. Alternatively, the signal may be transmitted via a solid-state device remotely powered from a 24 or 48 V dc source and be capable of driving loads of 100 Ω to 1,000 Ω. The accuracy of the flow signal should not exceed twice the class accuracy.

All transmission signals shall be available and clearly marked at a central termination junction.

6.6 Power supply

The measuring system should maintain accuracy upon a ±10 percent deviation of the rated voltage.

6.7 Enclosure

The manufacturer may supply an enclosure suitable for the environment to house the above components. A key lock is advisable to secure calibration. The following information should be supplied on a permanent tag on the outside of the enclosure:

1) Manufacturer
2) Serial number
3) Design capacity in units of weight per hour
4) Design speed at which the belt will deliver design capacity, in feet per minute (meters per second)
5) Units of registration, in tons, kilograms, etc.
6) Number of weight units totalized for the load simulator for a specific number of feet of belt travel
7) Power requirements
8) Output signal, e.g., 4-20 mA, pulses/ton, etc.
9) Hazardous area classification
10) Identification of laboratory test approval, e.g., UL (Underwriters Laboratories) or FM (Factory Mutual).

The enclosure should allow the scale to operate within specification over the ambient temperature range expected, augmented if necessary by heaters.

In hazardous locations, the instrument housing should be located outside the hazardous area to allow meter reading and calibration adjustment under a "power on" condition.

All electronic equipment mounted in the enclosure and not interconnected with printed circuit boards should have crimped, soldered, or screw terminal interconnections. Suitable test points should be provided on all printed circuit boards to enable connection of the test equipment.

7 Scale maintenance

7.1 Cleanliness

If it is impractical to keep the weight scale continuously clean of dust, dust can be allowed to build up on the weighbridge until it will no longer accumulate. The effect can then be zeroed out. Scales weighing large solid particles should be cleaned as necessary to prevent weighbridge binding.

A history of scale maintenance and process stability should be used to determine frequency of cleaning.

7.2 Alignment

Alignment should be made by using measurements of scale carriage in relation to the conveyor frame. The need for "wire line" alignment checks should be considered any time conveyor work is performed in the scale area.

7.3 Tension adjustment

Too much tension will cause excessive wear of both the belt and the scale components. It may also make the scale read light since the belt will not conform to weigh idlers properly.

Too little tension will cause the belt to sag and/or slip. If the scale is not speed-compensated, weighing errors will occur.

Proper tension should prevent slippage, but should not impede contact of the belt with idlers in the weigh area. As a guide, the tension should be tight enough to limit the sag at maximum load to less than 2 percent of the weigh idler pitch.

The calibration of the scale should be checked after mechanical maintenance, such as tension adjustment.

7.4 Monitoring accuracy

Test chains should be clean, in good repair, and certified at a minimum of once every 2 yr. As an alternative, a correction factor can be determined for the chain when material tests (Section 4.1.1) are run.

Records of calibration and maintenance, including conveyor alignment and belt tension adjustment, should be maintained to develop a history of scale performance. The use of forms is recommended to provide a comprehensive, repeatable history log. (See Appendix B for sample form.)

8 Bibliography

The following references are applicable to certifying a scale for billing applications:

1) *Association of American Railroads Scale Handbook*, 1983, Association of American Railroads, American Railroads Building, 1920 L Street, NW, Washington, DC 20036.

2) "Requirements for the Approval of Belt Conveyor Scales," Circular 9585-5, Southern Weighing and Inspection Bureau, Suite 306, Transportation Building, 151 Ellis Street, NE, Atlanta, GA 30303.

3) "An Explanation of Rules for the Inspection, Testing, and Calibration of Belt Conveyor Scales," Circular 9585-5, Southern Weighing and Inspection Bureau, Suite 306, Transportation Building, 151 Ellis Street, NE, Atlanta, GA 30303.

4) "Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices," *Conveyor Belt Scale Handbook, Handbook 44,* 1980, National Bureau of Standards, U.S. Department of Commerce, Washington, DC 20234.

Additional references applicable to belt conveyors and belt-conveyor scales include the following:

1) *Belt Conveyors for Bulk Materials*, Conveyor Equipment Manufacturers Association, 1979, Van Nostrand Reinhold Publishing Company, 135 West 50th Street, New York, NY 10020.

2) *Continuous Totalizing Weighing Machines*, OIML IR50, June 1980, International Organization of Legal Metrology (Organisation Internationale de Métrologie Légale), 11 rue Turgot, 75009 Paris, France.

3) "Weighing Scales," PTC 19.5:1-1964, Supplement of ASME Power Test Codes, American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017.

4) "Safety Standards for Conveyors and Related Equipment," ANSI B20.1-1976, American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017.

Appendix A — OIML* recommendation no. 50, chapter II metrological requirements

4 Accuracy classes

Belt weighers are divided into two accuracy classes: class 1 and class 2.

4.1 Characteristics of belt weighers in class 1

4.1.1 Totalisation scale interval (d_t)

The totalisation scale interval of the belt weigher must be:

- less than or equal to 0.05% of the load totalised in one hour at maximum flowrate (C_{max})
- more than or equal to 0.002% of this load (C_{max})

4.1.2 Scale interval of the zero indicator (d_0)

The scale interval of the zero indicator must not exceed the following value of the load totalised in one hour at the maximum flowrate:

0.005% for continuous (analogue) indication

0.0025% for discontinuous (digital) indication

and must not be greater than the totalisation scale interval (d_t)

4.1.3 Scale interval of the test indicator

The scale interval of the test indicator must not exceed the following value of the minimum totalised load:

0.2% for continuous (analogue) indication

0.1% for discontinuous (digital) indication

and must not be greater than the totalisation scale interval (d_t)

4.2 Characteristics of belt weighers in class 2

4.2.1 Totalisation scale interval (d_t)

The totalisation scale interval of the belt weigher must be:

- less than or equal to 0.1% of the load totalised in one hour at the maximum flowrate (C_{max})
- more than or equal to 0.004% of this load (C_{max})

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4.2.2 Scale interval of the zero indicator (d_0)

The scale interval of the zero indicator must not exceed the following value of the load totalised in one hour at the maximum flowrate:

0.01% for continuous (analogue) indication

0.005% for discontinuous (digital) indication

and must not be greater than the totalisation scale interval (d_t)

4.2.3 Scale interval of the test indicator

The scale interval of the test indicator must not exceed the following value of the minimum totalised load:

0.4% for continuous (analogue) indication

0.2% for discontinuous (digital) indication

and must not be greater than the totalisation scale interval (d_t)

4.3 Form of scale interval

The scale interval must be equal to a number of units of mass expressed by one of the following formulae:

$1 \text{ X } 10^n$, $2 \text{ x } 10^n$, or $5 \text{ x } 10^n$, where n represents a positive or negative whole number or zero.

However, the scale intervals of the zero indicator and those of the test indicator need not comply with this requirement.

4.4 Minimum flowrate

The minimum flowrate must be equal to 20% of the maximum flowrate.

5 Maximum permissible errors

After the belt weigher has been set correctly to zero with no load, the maximum permissible errors, positive or negative, must be equal to the values specified below, for any totalised load equal to or greater than the minimum totalised load.

5.1 Maximum permissible errors on initial verification

5.1.1 Belt weighers in class 1

0.5% of the totalised load for any flowrate between 20 and 100% of the maximum flowrate.

5.1.2 Belt weighers in class 2

1% of the totalised load for any flowrate between 20 and 100% of the maximum flowrate.

5.2 Maximum permissible errors in service

5.2.1 Belt weighers in class 1

1% of the totalised load for any flowrate between 20 and 100% of the maximum flowrate.

5.2.2 Belt weighers in class 2

2% of the totalised load for any flowrate between 20 and 100% of the maximum flowrate.

6 Variation of maximum permissible errors

The maximum permissible errors specified above are applicable only to results of totalisation under the following conditions:

6.1 Discontinuous (digital) test indicating device

When the indicating device used for testing is discontinuous (digital), the maximum permissible errors must be increased by one scale interval of this device.

6.2 Belt weighers fitted with several totalisation indicating or printing devices

The errors on the indications or printed results provided for the same totalised load by different totalisation indicating or printing devices on the same belt weigher must not exceed the maximum permissible errors.

The difference between these indications or printed results, taken two by two, must not be greater than:

- one discontinuous (digital) scale interval when the results are supplied by two discontinuous (digital) indicating devices having the same scale interval,
- the absolute value of the maximum permissible error, when the results are provided by two continuous (analogue) indicating devices,
- the greater of the two values: absolute value of the maximum permissible error and one discontinuous (digital) scale interval, when the results are provided by a continuous (analogue) indicating device and a discontinuous (digital) indicating device.

6.3 Simulation tests

6.3.1 Maximum permissible errors during simulation tests

The maximum permissible errors, positive or negative, must be equal to the values specified below:

6.3.1.1 Belt weighers in class 1

For any flowrate between 5 and 20% of the maximum flowrate: 0.07% of the load totalised at the maximum flowrate during the duration of the test.

For any flowrate between 20 and 100% of the maximum flowrate: 0.35% of the totalised load.

6.3.1.2 Belt weighers in class 2

For any flowrate between 5 and 20% of the maximum flowrate: 0.14% of the load totalised at the maximum flowrate during the duration of the test.

For any flowrate between 20 and 100% of the maximum flowrate: 0.7% of the totalised load.

6.3.2 Displacement simulation error

The relative error due to the simulated displacement of the belt must be less than 20% of the maximum permissible error for the totalised load. This error is included in the maximum permissible error.

6.3.3 Difference between two results obtained due to a variation in the simulated speed

For any variation in the speed of the displacement simulation device corresponding to a variation of ±10% of the speeds of the conveyor belt, the variation in the relative error of the results of the simulation tests shall not exceed 20% of the maximum permissible error in point 6.3.1.

6.3.4 Difference between two results obtained by varying the point of application of a load

When the point of application of the same load is varied, in a manner compatible with the design of the load receptor, the difference between the two results must not be greater than the absolute value of the maximum permissible error.

6.3.5 Zero-setting

For any load within the range of the zero-setting device, the results, after setting the machine to zero, shall comply with the maximum permissible errors for the totalised load.

6.3.6 Influence factors

6.3.6.1 Temperature

Belt weighers must comply with the requirements relating to the maximum permissible errors at all practically constant temperatures between –10°C and +40°C after adjustment of zero. However, for special applications the belt weighers may have different temperature ranges. In that case, the interval must be at least 30°C and must be indicated on the data plate.

For a temperature variation of 10°C at a rate not exceeding 5°C per hour, the zero indication or, in the case of belt weighers fitted with a zero checking device with additional mass, the control value, must not vary by more than:

0.07% for class 1

0.14% for class 2

of the load totalised at the maximum flowrate for the duration of the test.

6.3.6.2 Power supply

Belt weighers must comply with the requirements relating to the maximum permissible errors, without adjustment of zero, for the following variations of the power supply:

15% to + 10% of the nominal voltage and

2% to + 2% of the nominal frequency

6.3.6.3 Other influence factors

Belt weighers must under normal conditions of use comply with the requirements relating to the maximum permissible errors when they are submitted to the effects of influence factors other than those referred to in points 6.3.6.1 and 6.3.6.2, and resulting from the conditions of their installation.

6.3.7 Metrological characteristics

6.3.7.1 Repeatability

The difference between two results obtained for the same load placed under the same conditions on the load receptor must not be greater than the absolute value of the maximum permissible error.

6.3.7.2 Discrimination of the totalisation indicating device

At any flowrate, between the minimum and maximum flowrate, the difference between the indications obtained for two totalised loads, differing from each other by a value equal to the maximum permissible error, must be at least equal to one half of the calculated value corresponding to the difference between these totalised loads.

6.3.7.3 Discrimination of the indicator used for zero-setting

For tests of a duration of three minutes there must be a clearly visible difference between the indications of the zero indicator obtained at no load and for a load, deposited or removed equal to the following percentages of the maximum capacity:

0.1% for class 1

0.2% for class 2

6.3.7.4 Stability of zero

6.3.7.4.1 Short-term stability

The difference between the smallest and largest indications of the zero indicator obtained in five tests of three minutes duration must not exceed the following percentages of the load totalised in one hour at the maximum flowrate:

0.0025% for class 1

0.005% for class 2

6.3.7.4.2 Long-term stability

When the short-term stability tests are repeated after 3 hours of operation and without zero adjustment:

- the results must satisfy the requirements laid down in point 6.3.7.4.1 and
- the difference between the smallest and largest of all indications at the zero indicator must not exceed the following percentages of the load totalised in one hour at the maximum flowrate:

  0.0035% for class 1

  0.007% for class 2

6.3.7.5 Supplementary totalisation indicating devices

Supplementary totalisation indicating devices must not affect the operation of the belt weigher.

6.3.7.6 Zero checking device with additional mass

The requirements in points 6.3.7.3 and 6.3.7.4 apply also to testing of belt weighers fitted with zero checking devices with additional mass.

Appendix B — Test report

TEST DATE	REPORTED BY
1-Length Conveyor Belt- 2-Weight Test Chain P/Ft- 3-Lbs. For 1 Circuit of Conv- 4-Wgt. for 1 Circuit- (Same as Counter)	5-Registration In Unit Of- 6-One Rev. of Dial- 7-Wgt. for 1 Ft. Travel- (Same as Counter) 8-Wgt. For 1 In Travel-

	Zero	Adjustments	1	2	3
No. of Circuits Over-Under Travel Reading After Reading Before					
Registered Wgt. Correction + –					
Corrected Wgt. True Wgt.					
Diff Error in % Adjusted					

Chain Factor	Parts Used
Does Overloading Occur- Conveyor Speed- Peak Cap. Rating Minimum Load Tonnage- Normal Operating Load- (Tonnage)	Weight Registration to Be Net. After Completion of Test
	Scale Reading As Left- Reading as Start- Deduct ________
COMMENTS:	Control Room counter Reading After- Reading Before- ________

Figure 2: — Sample form of a test report

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