2015 EPO No. 14

Examination Procedure Outline for

Belt-Conveyor Scale Systems

Introduction

It is recommended that this outline be followed as minimum criteria for examining belt-conveyor scale systems. This document has been prepared as a guide for determining if devices are correct and suitable for commercial service for owners, users, operators, service agencies and officials with statutory authority. Nonretroactive requirements are followed by the applicable date in parentheses.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the EPO Safety Annex (Safety Considerations and Glossary of Safety Key Phrases) should be duplicated and included with this outline.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Prior to beginning any inspection, the inspector should read and be familiar with the EPO Safety Annex - "Safety Considerations and Glossary of Safety Key Phrases." The terms and key phrases in each safety reminder of this outline are found in the glossary of the EPO Safety Annex. The inspector is reminded of the importance of evaluating potential safety hazards prior to an inspection and taking adequate precautions to avoid personal injury or damage to the device. As a minimum, the following safety precautions should be noted and followed during the inspection.

Clothing

Electrical Hazards

Emergency Procedures

Eye Protection

Fire Extinguisher

First Aid Kit

Lifting

Location

Material Safety Data Sheets (MSDS)

Nature of Product

Personal Protection Equipment

e.g.,

Safety Shoes, Safety Aprons, Respirators, Gloves, Barrier Cream, etc., if deemed necessary.

Hard Hat -- for protection from overhang in rear of vehicle tank truck

Safety Cones/Warning Signs

also: **Wet/Slick Conditions, Hazardous Materials, Traffic, Obstructions and Overhead Hazards**

SAFTEY REMINDER

- **Check the inspection site carefully for safety hazards and take appropriate precautions.**
- **Use caution while moving in wet, slippery areas.**
- **Use personal protection equipment appropriate for the inspection site.**
- **Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.**
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	H-44 General Code and BCS Systems Code References

Pre-Test Inspection – Installation:

1. General Considerations:

Selection	G-S.3., G-UR.1.1.
Installation	G-UR.2.
Protection from environment	G-UR.1.2. UR.2.1.
Foundation, supports, and clearance	G-UR.2.1., UR.2.2.(a)
Access to weighing elements	G-UR.2.3.
A belt-conveyor scale manufactured after January 1, 1981 shall be installed so that material tests can be conveniently conducted	U.R.1.3.
Retention of Maintenance, Test, and Analog or Digital Recorder Information	UR.2.6.
Notification of compliance.	UR.4.

2. Material handling ..... G-UR.2.1., G-UR.3.2., G-UR.4.1.

Inspect the entire material handling system, from load point to the discharge, inspecting all hoppers and transfer chutes, to ensure that there is no buildup of material or spillage that might create problems with normal measurements and material test results.

Material buildup in the hoppers or chutes must be removed prior to testing. Spillage must be removed and the cause of the spillage repaired prior to the test.

Verify that device meets all performance requirements when all associated or non-associated equipment is operated during testing (i.e., metal detectors/magnets, product additives, sampling equipment).

Magnets must not be located in close proximity to the scale area. Material additives not included as part of the product description must be introduced to the flow of product downstream from the belt-conveyor scale area. "Sweep-type" samplers are recommended to be located a minimum of 18 meters (60 feet) from the center of the belt-conveyor scale weigh area.

	H-44 General Code and BCS Systems Code References

Pre-Test Inspection – Installation (cont.):

3. Scale Conveyor

If practicable, the scale should be material tested to determine the as-found accuracy of the scale before conveyor inspections and corrections are made.....	UR.1.3. (1/1/1981), UR.3.1.
Inspect the entire conveyor. The inspection should include checking for damage, malfunctions, or wear in: chutes; belting; infeed skirting; tail pulley; impact idlers; troughing idlers; training idlers; return idlers; bend pulleys; snubbing pulley; head pulley; belt scrapers; take-up device; take up weight; support steel; feed points; clearances; guard devices; and the conveyor drive.	UR.1.
Inspect all idlers of the conveyor, both loaded and unloaded. If the belt will not conform to the requirements of NIST Handbook 44 installation requirements or faulty bearings are found then this must be corrected.....	UR.1.2. (m)
Inspect the skirt boards at the infeed point for proper alignment. If any spillage at this point exists, adjustments must be made to eliminate all spillage prior to the materials test.	UR.1.2., UR.1.2. (l)
The conveyor structure must be rigid in design to prevent vibration and significant deflection.	UR.1.2. (a)
Inspect the Take Up Unit, the bend pulley must travel freely when the belt is running and not bottom out at start up.....	UR.1.2. (d)
Inspect the Drive unit for slippage or spillage, which must be corrected before testing begins.	UR.1.2.

4. Scale

Inspect the weigh area idlers for worn bearings and belt alignment. The weigh area idlers should freely rotate and have no signs of material build-up, holes in the rollers, or corrosion. Excessive noise from the idlers indicates friction or worn bearings that may also affect scale performance. Inspect any load cell stay rods or flexure plates for distortion or binding.	UR.1.2.
Inspect the speed sensor; if the speed sensor is mounted on a non-driven bend pulley, it should be on the clean side of the return belt. Also check the bend pulley wrap to ensure positive contact. Check for material build-up on the speed sensing pulley, ensure sensor coupling is secure and has no worn bearings. The sensor should be corrected if a loose bearing exists on the shaft.	UR.1.4., G-UR.4.2.
Inspect the weighbridge support steel and bracing for the load cells and weighbridge.	UR.1.2. (i)

	H-44 General Code and BCS Systems Code References

Pre-test Inspection – Installation (cont.):

Inspect belt alignment. The belt must not extend beyond the edge of the idler roller in any area of the conveyor, either empty or loaded and must not touch any structure on the return side. Verify that belt is tracking properly on idlers and rollers. Belt (or sections of belt) should not deviate excessively in its tracking location on the idlers or rollers during revolutions.	UR.1.2. (m)
Inspect belt composition and maintenance. Belt should not exhibit excessive wear or extreme variation in uniform composition. The belt should make contact with all the rollers in the weigh area empty and loaded.	UR.1.2. (k)
Based on observations, corrections must be made to the scale or the area surrounding the scale if foreign material adheres to the scale structure at any time during normal operation and materials tests.	UR.3.1. (b)

Pre-Test Inspection – Scale:

1. Identification.	
1.1. Manufacturer's name or trademark, model number, and serial number on major components.	G-S.1.
2. Design of indicating and recording element	
2.l. Units installed after January 1, 1986 must be equipped with a recording element and a rate of flow indicator and recorder.	S.1.1.
3. Marking requirements.	S.4.
3.1. Rated capacity - units of weight per hour, both maximum and minimum.	S.4. (a)
3.2. The value of the scale division.	S.4. (b)
3.3. The belt speed in terms of feet or meters per minute at which the belt will deliver the rated capacity.	S.4. (c)
3.4. The belt load in terms of pounds per foot or kilograms per meter (determined by material tests).	S.4. (d)
3.5. On all new units installed after January 1, 1986, the operational temperature range if it is other than - 10 °C to 40 °C (14 °F to 104 °F).	S.4. (e)
3.6. For units installed after January 1, 1986 check that the rated belt speed and material loading of the Scale is within the parameters outlined in the manufacturer's certificate of conformance.	S.1.5. (1/1/1986), S.2.3., UR.2.4.

	H-44 General Code and BCS Systems Code References

Pre-Test Inspection – Scale (cont.):

3. Marking requirements (cont.). ..... S.4.

   3.7. Visibility of Identification and other required markings, including identification of scale area..... G-UR. 2.1.1. UR.1.2. (k)

4. Provisions for Sealing

   The MWT shall not be resettable without breaking a security means for devices manufactured after January 1, 1986..... S.1.7. (1/1/1986)

   Provisions shall be made to seal access to load cell and integrator calibration adjustments. Devices manufactured after January 1, 1999 are permitted to have an approved means for providing security such as a data change audit trail available to the inspector at the time of inspection..... S.5. (1/1/1999)

Pre-Test Determinations:

1. Determine if the conveyor scale is suitable for the amount of product weighed.

   1.1. The belt-conveyor scale system may be operated between 20 and 100 percent of its rated capacity. Record the maximum and minimum feed rate and run time it takes to deliver a test load. Determine the percentage of rated capacity..... UR.2.

   Example:

   The scale has a rated capacity of 500 tph.
   A test load of 80 tons was delivered in 15 minutes.

$$\frac{60 \text{ minutes (in one hour)}}{15 \text{ minutes}} \times \text{test load} = 4 \times 80 \text{ tons}$$

4 hours x 80 tons = 320 tons in one hour or tph (feed rate in tph)

$$\frac{320 \text{ tph}}{500 \text{ tph}} \times 100 = 64\ \% \quad \text{(feed rate as a percentage of scale capacity)}$$

The above example could also be stated as follows:

$$\frac{80 \text{ tons}}{15 \text{ minutes}} \times \frac{60 \text{ minutes}}{1 \text{ hour}} = \frac{320 \text{ tons}}{1 \text{ hour}}$$

$$\frac{320 \text{ tph}}{15 \text{ minutes}} \times \frac{}{100} = 64\ \%$$

	H-44 General Code and BCS Systems Code References

Pre-Test Determinations (cont.):

1.2. Delivered quantities of less than the minimum test load shall not be considered a valid weighment. ..... UR.2.2.

1.3. Material must not slip on the belt due to the angle of belt incline, belt speed or loading process. Material slipping backwards (in the opposite direction of belt travel) on an inclined belt-conveyor scale results in material being weighed more than once. ..... UR.1.2. (h), UR.1.2. (l)

2. Recording Elements and Recorded Representations

2.1. Recorded representations, General ..... G-S.5.6.

2.2. The value of the scale division of the recording element shall be the same as that of the indicating element. S.1.4. (1/1/1986)

All of the information in (a) and (b) must be recorded for each delivery for systems installed after January 1, 1994. ..... S.1.4. (1/1/1994)

The belt-conveyor scale system shall be capable of recording the results of automatic or semi-automatic zero load test installed after January 1, 2004. ..... S.1.4.1. (1/1/2004)

2.3. Rate of flow indicators and recorders. S.1.5. (1/1/1986)

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.

3. Value of the scale division. ..... S.1.3.

3.1. Scales installed ***after*** January 1, 1986 must have a scale division not greater than 1/800 of the minimum totalized load (0.125 percent) S.1.3.1. (1/1/1986)

3.2. Scales installed ***before*** January 1, 1986 must have a scale division not greater than 1/1200 of the minimum totalized load. ..... S.1.3.2.

Example:
Belt Scale Capacity = 1000 tons per hour (tph)
Max. Smallest Unit = 1000 tph × 1/1200 = 0.83 ton – rounded to 0.50 ton.

Note that 0.83 is <u>rounded down</u> to 0.50 to coincide with the MWT minimum increment requirement. Rounding to the <u>nearest</u> increment of 1.00 ton does not comply with the requirement.

	H-44 General Code and BCS Systems Code References

Pre-Test Determinations (cont.):

4. Determine the minimum amount of material to pass over the belt-conveyor scale for materials test..... N.2.3.

   Each test is to be run for not less than:

   (a) 800 scale divisions,
   (b) the load obtained at maximum flow rate in one revolution of the belt, or
   (c) at least 10 minutes of operation.

   For applications where a normal weighment is less than 10 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 (a) and (b).

   The official with statutory authority may determine that a smaller minimum totalized load down to 2 % of the load totalized in 1 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 (a) and (b), and

   2. consecutive official testing with the minimum totalized loads described in N.2.3. (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.

5. Reference scale and reference material

   5.1. The containers used in the material test should be inspected. They may be railroad cars, trucks, hoppers, or barges. They must not leak and should be large enough so that overloading or spillage does not occur. ..... N.3.2. (a)

   5.2. Determine accuracy of reference scale. It is preferable to verify the accuracy of the reference scale within 24 hours of the weight determination of the material used for the belt-conveyor materials test. (For vehicle scales refer to test procedure in NIST Examination Procedure Outline Numbers 13 and 13E.)

   The quantity of material used to conduct a material test shall be weighed on a reference scale to accuracy within 0.1 %..... N.3.2. (d), N.3.2.1.

   5.3. After the reference scale test and before commencing the belt scale materials test, attempt to establish the weight of a reference load. This reference load can be used to re-verify the reference scale after the reference scale test equipment has left the test site..... N.3.2. (e)

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Pre-Test Determinations (cont.):

6. Material test conditions..... N.3.2. (f)

Note (record) the following conditions before starting the test.

- Current weather and temperature.
- Check security system to determine if any metrological integrity items have been changed.
- The "as found" zero and span numbers.
- The "as found" auto zero track deviation from zero.
- The zero-load repeatability test, before and immediately after the official materials test.

7. Determine tolerance requirements

7.1. Zero Tests ..... N.3.1.2.

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 ± 0.06 % of the totalized load at full scale capacity for the duration of the test. No adjustments can be made during the three consecutive zero-load test readings.

Example: Belt-conveyor scale capacity: 700tph
Test duration: 3 minutes
Calculate permissible error zero test error:

$(0.06/100) \times 700\text{tph} \times (3\text{min}/60\text{min}) = 0.021$ tons

7.2 Zero stability following a materials test. ..... T.1.1.

The change in the accumulated or subtracted weight during the zero-load test shall not exceed 0.12 % of the totalized load at full scale capacity for the duration of that test. (See the example above but using 0.12% to replace 0.06 %.) 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, the official with statutory authority may establish an interval for zero-load testing during normal operation.

7.3. Check For Consistency of the Conveyor Belt Along Its Entire Length. ..... N.3.1.3.

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 ± 0.06 % requirement referenced in the "Test for Zero Stability."

Pre-Test Determinations (cont.):

7.4. Materials test. ..... T.1.

Maintenance and acceptance tolerances on the materials test, relative to the weight of the material, shall be 0.25 percent (1/400) of test load.

7.5. Repeatability test. ..... T.2.

Tolerance Values, Repeatability Tests. – The variation in the values obtained during the conduct of materials tests shall not be greater than 0.25 % (1/400).

Test:

SAFETY REMINDER

– **Wear appropriate personal protection equipment such as safety shoes to prevent possible injury from falling weights and slipping on slick surfaces and a hard hat to prevent injury from overhead hazards.**

1. Zero-load tests.

If the belt has been idle 2 hours or more, run empty for 30 minutes if temperature is 5 °C (41 °F) or above (longer if temperature is less than 5 °C (41 °F) before starting the zero-load test. ..... N.3.1.

(a) Determination of Zero: .....
For belt-conveyor scales with electronic integrators, the test must be performed over a period of at least 3 minutes and with a whole number of complete belt revolutions. For belt-conveyor scales with mechanical integrators, the test shall be performed with no less than three complete revolutions or 10 minutes of operation, whichever is greater. ..... N.3.1.1.

(b) Test of Zero Stability:
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 ± 0.06 % of the totalized load at full scale capacity for the duration of the test. No adjustments can be made during the three consecutive zero-load test readings. ..... N.3.1.2.

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

	H-44 General Code and BCS Systems Code References
shall not exceed 0.12 % of the minimum test load.....	N.3.1.3.

Test (cont.):

Note: The end value of the zero-load test must meet the ± 0.06 % requirement referenced in the "Test for Zero Stability."

Any changes in the zero reference will result in the action taken listed in UR.3.2.(c) for testing between official tests and during official tests.

2. Material test.

2.1. At the start of the test, write down the starting totalizer reading. Pass material over weigh belt using either pre-weighed material with controlled delivery or weigh material delivered from the belt..... .N.3.2.

Record the maximum and minimum feed rates during the delivery of the materials. Calculate the average feed rate.

2.2 Number of test runs and flow rates. ..... .N.2., N.2.1.

Initial Tests:

A belt-conveyor scale system shall be verified with a minimum of two test runs at each of the following flow rates:

(a) normal use flow rate,

(b) 20 % of the maximum rated capacity, and

(c) an intermediate flow rate between these two points.

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

Or:

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 single flow rate and that rate does not vary in either direction by an amount more than 10 % of the normal flow rate that can be developed at the installation for at least 80 % of the time.

Belt must be loaded so that the rate of flow indicator is maintained between 20% and 100% of rated capacity. ..... UR.2., UR.1.2.(l)

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. Different feeders or different feed rates may require additional materials tests. S.1.5. (1/1/1986)

Tests (cont.):

Subsequent tests:..... N.2.2.

Subsequent testing shall include testing at the normal use flow rate and other flow rates used at the installation. 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 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. 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).

2.3. Compare net weight of material passed over belt as shown by belt totalizer with net weight established by reference scale and determine error. Refer to the table in UR.3.2. to determine what action is necessary based on the error observed..... T.1.

Example: Calculate error and tolerance when 101.7 tons of pre-weighed material is passed over a 500 ton per hour belt scale and the final totalizer reading is 101.9 tons.

Belt totalizer reading: 101.9 tons (indicated net weight)
Pre-weighed material: 101.7 tons (weight determined on the reference scale)
Error = + 0.2 ton
% Error = (+ 0.2 tons/101.7 tons) × 100 = 0.197 percent
% Error = + 0.197% (complies or meets tolerance)

Tolerance: +/- 0.25 %

The above calculations may also be made using the following steps:

% Error = [(Indicated net weight – Reference weight)/Reference weight] × 100
% Error = [(101.9 – 101.7) / 101.7] × 100 = +0.197%

(Range of allowable totalizer readings 101.4 to 102.0 tons)

	H-44 General Code and BCS Systems Code References

Test (cont.):

3. Repeatability test. Any subsequent material testing should consist of at least 2 individual tests to determine repeatability of scale and must repeat within 0.25% on all tests. The results of all these tests shall be within tolerance limits and shall not be averaged.	T.2., N.3.2.
4. Simulated test. A simulated test, as recommended by the manufacturer, shall be performed within 12-hours after a material test has established scale accuracy. Record the established factor that relates the results of the simulated load tests to the results of the materials tests. Results of the simulated load test shall repeat within 0.1 percent.	N.3.3. N.3.3.(c) UR.3.1.(d) UR.3.1.(f)
5. Post-test inspection of the conveyor and the material handling system.	N.3.2. (a),(c),UR.2.5.

Walk through the complete system from load point to discharge, inspecting all hoppers, feeders, belts, and transfer chutes for spillage and build up of material.

Any spillage occurring during the material test should be noted and reported, however insignificant the spillage may seem.

Any material build up on the scale structure or belt should also be noted and reported.

If material build up or spillage that occurred during the material test is determined to be large enough to have biased the test and the actual weight cannot be determined from a traceable standard then the test is not valid.

This includes test material that may have been left in the containers during the unloading process.