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INTRODUCTION

There should exist a similarity in attitude, procedure and performance by all Measurement Canada personnel and recognized technicians of accredited or registered organizations performing the same general inspections. Uniform application and consistent interpretation of legislation, policies and procedures is key to the effective administration and enforcement of the Weights and Measure Act, Regulations and Ministerial Specifications.

The purpose of this Field Inspection Manual is to provide inspectors and other interested parties with a guide to the inspection of Automatic Weighing Devices and systems (AWDS). Each test procedure includes the actual Standard Test Procedures (STP) which provides detailed criteria for testing the device or system. If required, reference is made to other test procedures, specifications and legislation.

The use of these test procedures to evaluate the compliance of an automatic weighing device or system should be considered the norm rather than the exception. In some circumstances, additional tests may be warranted. In cases such as these, the Regional Specialists should be consulted, and care must be taken to ensure that these tests adhere to the intent of the Act, Regulations and other Specifications.

Enforcement action shall be initiated when an infraction sufficient enough to warrant non compliance with the legislation is identified. The enforcement strategy shall be in accordance with the Weights and Measures Enforcement Policy for Weighing and Measuring Devices.

Measurement Canada encourages the reference and use of test procedures and test equipment as identified in this manual, but acknowledges that there are alternative test procedures or test equipment that can be used to inspect a weighing or measuring device. Subject to the review and approval of the proposed test procedure or test equipment by Measurement Canada, the alternative methodology will be accepted and documented in the respective Standards Test Procedure (STP) on a case-by-case basis.

REVISION
Original document.
AUTOMATIC WEIGHING DEVICES
- a weighing device that weighs without the intervention of an operator and follows a predetermined program of automatic processes characteristic of the device.

Catch Weighing Device [ACWD] - an automatic device that weighs pre-assembled discrete loads or single loads of loose material. Includes ‘Automatic Overhead Rail Scales’ and ‘Automatic Belt Scales’. Does not include those devices commonly known as ‘Conveyor Belt Scales’.

Discontinuous Totalizing Weighing System [DTWS] - an automatic device that weighs bulk product by dividing it into discrete loads, determining the mass of each discrete load in sequence, summing the weighing results and delivering the discrete loads to bulk. Often referred to as a ‘Bulk Weigher’.

Continuous Totalizing Weighing System [CTWS] - an automatic device for continuously weighing a bulk product on a conveyor belt, without systematic subdivision of the mass and without interrupting the movement of the conveyor belt. Often referred to as a ‘Conveyor Belt Scale’.

Rail Weighing Device [IMRW] - an automatic device having a load receptor, inclusive of rails for conveying railway cars and that determines the total mass of a train or, of an individual car, by weighing while in-motion.

In-Motion Vehicle Weighing Device [IMVW] - an automatic device having a load receptor(s) that determine the total mass of a vehicle by weighing the vehicle while in-motion.
INTRODUCTION - SYMBOLS, ACRONYMS AND DEFINITIONS

**Gravimetric Filling Device** - an automatic device which fills containers with predetermined and virtually constant mass of product from bulk by automatic weighing, and which comprises essentially an automatic feeding device or devices associated with one or more weighing units and the appropriate control and discharge devices. This will be considered an automatic packaging machine.

**NON-AUTOMATIC WEIGHING DEVICE** - a weighing device that weighs discrete loads and that requires an operator's intervention during the weighing process, such as to deposit the load to be measured on the weighing and load-receiving element and to remove it therefrom or to obtain weighing results. If there is doubt whether a device should be included as an Automatic, or Non-Automatic Weighing Device, the Non-Automatic designation shall prevail.

**DIMENSIONAL MEASURING DEVICE**

- **Linear Measuring Device** (static & dynamic)
- **Area Measuring Device**
- **Multi Dimensional Measuring Device (MDMD)**
- **Time Measuring Device**

**REVISION**

Original document.
INTRODUCTION - REVISIONS TABLE

This document will continue to be periodically reviewed by Measurement Canada to ensure its effectiveness with respect to its objectives.

<table>
<thead>
<tr>
<th>Date of Revision or Addition</th>
<th>Language</th>
<th>Section</th>
<th>Nature of the Revision or Addition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb01/09</td>
<td>English/French</td>
<td>Part - 2-ASTP / Section - 2-CTWS</td>
<td>- minor revision to correct applicable tolerance table for Regular Commodity, Freight Charge. Change from section 174/175 to section 193.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- remove reference to SGM-3 which is not applicable to CTWS.</td>
</tr>
</tbody>
</table>

REVISION
1
Type 2-X1, 3-X1, 3-21, 7-11 Automatic Catch Weighing Device [ACWD]

**REFERENCE**

*Weights and Measures Regulations.* Tolerances from Regulation 176, 177 and 185 as appropriate.

**PURPOSE**

Weighing of discrete loads on an overhead rail scale or belt scale (not including Automatic Continuous Totalizing Weighing Systems [CTWS] - commonly referred to as Conveyor Belt Scales). Typical applications include carcass weighing on overhead rail scales in meat processing plants and individual package weighing across in-motion belt scales in shipping and courier establishments.

**REQUIREMENTS**

The Device Under Test (DUT) must be tested for performance in the static mode (excluding motion detection), using the STP/IPO from the Specifications for Non-Automatic Weighing Devices (NAWDS), applying limits of error applicable to automatic scales (if static testing is not possible, consult your gravimetric specialist as additional tests may be required). The following requirements are in addition to static testing:

**Creating Test Loads**

1. Selecting appropriate test loads.
   a) Suitable test loads should be selected (typically 10 for belt scales / 5 for overhead rail scales). Test loads must be stable and should be representative of the actual loads to be weighed.
   b) If the DUT is used over a range of weighments, then the test loads must be selected so that they span the intended usage range of the device (light - medium - heavy).

2. Selecting the scale used to create the test loads.
   a) The use of a Reference Scale (REF) is the preferred method of creating test loads. The actual scale interval \(d\) of the Reference Scale must be less than, or equal to, the actual scale interval of the DUT. \(d_{REF} \leq d_{DUT}\).
   b) The DUT may be used in static mode if a suitable Reference Scale is not available.

3. Testing the scale used to create the test loads.
   a) If the DUT is used to create the test loads, at this point, it has already passed static testing. If a Reference Scale is used to create the test loads, then it must also pass static testing using the appropriate NAWDS STP/IPOs for the device.
b) Determine the Measurement Error of the scale used to create the test loads.

   i) If the DUT will be used for weighing articles within a narrow band of weight values (± 5% Max), then the measurement error of the scale must be determined at this point.

   ii) If the DUT will be used for weighing articles with varying weight values, then the measurement error of the scale must be determined at the upper test load weight.

   iii) To minimize repeatability errors while creating test loads, standards and test loads should be placed on approximately the same area of the load receiving element.

c) Procedure:

   i) Place standards, approximately equal to the test load weight, on the scale.

   ii) Record the indicated weight of the standards.

      Note: The weight indication may be taken directly. The weight indication should be recorded to an accuracy not greater than 0.1d (of the DUT), using small error weights if necessary.

   iii) Repeat the above steps until 8 weighings for the standard have been recorded. (n = 8)

      Note: If the DUT is used to create the test loads, then these weights must agree within the repeatability limits allowed by R185 (do not include the ½ d allowance from R184), and also be within the R176, 177 limits of error for the DUT (plus ½ d allowance from R184).

      If a Reference Scale is used to create the test loads, then these weights must agree within the repeatability limits allowed by NAWDS section 12.

d) Calculate the average (\( \bar{x} \)) of the above 8 weights.

   \[
   \bar{x} = \frac{\sum(X_1..X_n)}{n}
   \]

   The actual weight of the standards divided by the calculated average of the weight indications is the Measurement Error in the scale.

   Measurement Error = Actual Weight of Standards / \( \bar{x} \)

4. Weighing a test load, and correcting it for the Measurement Error.

   Note: Each test load must be adjusted to compensate for any error in calibration that may exist in the Reference Scale (or DUT, if it is used for determining test loads).

   a) Weigh each of the test loads to 0.1d (of the DUT) using small error weights if necessary.
b) Record the indicated Test Load Weight (TL).

c) Adjust indicated Test Load Weight to include any Measurement Error determined above.

Adjusted Test Load Weight = Test Load Weight (TL) × Measurement Error

6. Determine the Uncertainty of a test load.

a) If 27 times the increment of registration of the scale used to create the test loads (d REF) is less than the DUT Limit of Error (LOE) (at 50% Max), then the uncertainty due to the reference scale may be considered insignificant. 

\[ (27 \times d_{\text{REF}}) < (\text{DUT LOE @ 50\% Max}) \]

Uncertainty (U_i) = 0

b) If d REF is larger than that stated above, but 9 times d REF is less than the DUT Limit of Error (LOE) (at 50% Max), then the uncertainty due to the reference scale graduation must be considered.

\[ (9 \times d_{\text{REF}}) < (\text{DUT LOE @ 50\% Max}) < (27 \times d_{\text{REF}}) \]

Uncertainty (U_i) = d_{\text{REF}}

c) If d REF is larger than that stated in a) or b) above, then the following method must be used:

\[ (9 \times d_{\text{REF}}) > (\text{DUT LOE @ 50\% Max}) \]

i) Determine the difference between the maximum [Max] and the minimum [Min] value of the 8 weight indications above. This is the uncertainty in the measurement.

\[ \text{Uncertainty} (U_i) = F \times \text{[Max - Min]} \]

ii) For a Confidence Level of 90%, multiply this value by the Confidence Factor (F = 2).

7. Determine the range of acceptable dynamic weights for each test load.

a) The acceptable upper value indicated by the DUT (dynamically) for a test load:

Acceptable DUT Upper Limit = Adjusted Test load weight + [Uncertainty (U_i) + LOE (R176/177) + ½ dDUT]

b) The acceptable lower value indicated by the DUT (dynamically) for a test load:

Acceptable DUT Lower Limit = Adjusted Test load weight – [Uncertainty (U_i) + LOE (R176/177) + ½ dDUT]

PROCEDURE - CONDUCT DYNAMIC TESTS

1. Determine the belt or track speed. Ensure that it is within the limits stipulated in the Notice of Approval (NOA). Refer to the procedure for determining belt speed below.

2. Conduct Dynamic tests using the previously established test loads. Refer to the table below for minimum number of weighments required.
3. For overhead track scales, known loads should be interspersed amongst the unknown loads (Start - Middle - End). Known test loads may also be used in place of the unknown loads.

4. For each test load the indicated weight must be within the appropriate range or tolerance as established above.

**Note:** If the belt or track speed is operator adjustable, the weighments shall be conducted at the lowest and highest speeds (half at lowest speed, half at highest speed). Otherwise test at as found speed.

### Minimum Number of Weighments Required

<table>
<thead>
<tr>
<th>Belt Scale</th>
<th>Weighments</th>
<th>Consisting of:</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \leq 60 \text{ m/min} \ (\leq 200 \text{ ft/min}) )</td>
<td>60 weighments</td>
<td>10 test loads ( \times 6 ) runs</td>
</tr>
<tr>
<td>( &gt; 60 ) to 75 m/min \ (&gt; 200 to 250 ft/min)</td>
<td>70 weighments</td>
<td>10 test loads ( \times 7 ) runs</td>
</tr>
<tr>
<td>( &gt; 75 ) to 90 m/min \ (&gt;250 to 300 ft/min)</td>
<td>80 weighments</td>
<td>10 test loads ( \times 8 ) runs</td>
</tr>
<tr>
<td>( &gt; 90 ) to 106 m/min \ (&gt;300 to 350 ft/min)</td>
<td>90 weighments</td>
<td>10 test loads ( \times 9 ) runs</td>
</tr>
<tr>
<td>( &gt; 106 ) m/min \ (&gt; 350 ft/min)</td>
<td>100 weighments</td>
<td>10 test loads ( \times 10 ) runs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Overhead Track Scale</th>
<th>Weighments</th>
<th>Consisting of:</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Devices</td>
<td>15 weighments at each speed. (5 known test loads ( \times 3 ) runs = 15 weighments)</td>
<td>minimum of: 5 known test loads &amp; 5 unknown loads(^1) = 10 loads / run</td>
</tr>
</tbody>
</table>

### Interpretation of Results

The DUT is deemed to comply if all results are within the acceptable LOE or range as previously determined.

**Note:** If one test load consistently causes problems, the inspector should determine if the problem is with the load and not the scale. If the load is defective, its test results should be discarded.

### Repeatability (Conduct at As Found Speed)

- Run a test load (near minimum) up to ten (10) times.
- Run a second test load (near maximum) up to ten (10) times.
- These two test loads may be run and used as part of the dynamic test.

\(^1\) Note: All loads may be ‘known’ if desired. The ‘unknown loads’ are used simply to evaluate the interactions between individual loads prevalent while the system is in operation.
OVER LENGTH PACKAGE TEST (CONDUCT AT AS FOUND SPEED)

Do not conduct this test if it will damage the system: Pass a package that exceeds the length of the scale platter. The device should not display or transmit an incorrect weight, or should go into an error mode of some kind. This test may not apply to some device types (e.g. overhead rail).

OFF CENTER LOAD TEST (BELT SCALE ONLY)

With the belt in motion, run a test load (0.5 Max) down each side of the scale and in the centre.

POWER FAILURE TEST (INITIAL INSPECTION ONLY)

Systems which store cumulative totals for subsequent trade transactions must have power failure safeguards in place. Prior to proceeding with the power failure test, the inspector must ensure that a loss of power will not adversely affect any other ancillary equipment associated with the DUT.

While the system is in operational mode, interrupt the power to the DUT or if so equipped, to the Uninterruptible Power Supply (UPS). If a UPS is used, do NOT disconnect the DUT from the UPS to conduct the Power Failure Test.

After a sufficient length of time (1-2 min) has elapsed, return power to the system and complete the transaction. All Items which have passed over the load receiving element must be accounted for in the systems memory or on a printed ticket.

INTERPRETATION OF RESULTS

The DUT is deemed to comply if all results are within the acceptable LOE.

PROCEDURE - DETERMINING BELT SPEED

If the DUT does not have a built in tachometer, belt speed must be determined during the test.

Portable Tachometer

Using a suitable contact or non-contact tachometer, follow the manufacturers instructions for determining the speed of one of the belt pulleys. If the tachometer is used to measure the speed of a pulley directly driving the belt, the belt speed may be calculated using one of the following formulas:

\[
\text{Belt Speed (m/min)} = \frac{[\text{Diameter (cm)} \times 3.1416 (\pi) \times \text{rpm}]}{100}
\]

or

\[
\text{Belt Speed (ft/min)} = \frac{[\text{Diameter (in)} \times 3.1416 (\pi) \times \text{rpm}]}{12}
\]

Stop Watch & Tape Measure

Using a stop watch and tape measure, belt speed may be calculated by measuring the total length of the belt and the time required for X revolutions of the belt. If the belt revolutions cannot be obtained to the nearest full revolution, add/subtract the appropriate fraction of over/under run to the number of revolutions.

Use a piece of tape on the belt and a fixed reference on the belt frame to count number of revolutions.
The final belt speed is then calculated using the following formula.

\[
\text{Belt Speed (m/min)} = \frac{\text{Belt Length (m) } \times \text{ Number of revolutions of belt (X)} }{\text{Time (min)}}
\]

**Example:**

- Belt Length = 12 metres
- Revolutions = 10
- Over Run = 3 metres
- Time = 1 minute

\[
\begin{align*}
\text{Revolutions} & = 10 + (\frac{3}{12}) \\
& = 10.25 \\
\text{Belt Speed (m/min)} & = \frac{12 \times 10.25}{1} \\
& = 123 \text{ m/min}
\end{align*}
\]

Revision 1 (May 2008)
- simplified procedure
- added uncertainty formulas
Type 6-11 Automatic Continuous Totalizing Weighing Systems (Conveyor Belt Scale [CTWS])

REFERENCE

Weights and Measures Regulations - tolerances from Regulation 172(3), 174, 175, 193 as appropriate.

For more information on the inspection of ‘conveyor belt scales’ consult the Weights and Measures National Technical Training Program Automatic Continuous Totalizing Weighing System training module.

PURPOSES

Continuous totalizing of bulk commodities across a continuously integrating device commonly known as a conveyor belt scale. Only mechanical, electro-mechanical and full electronic strain gauge load cell scales are covered by this procedure. Linear Variable Displacement Transducers (LVDT) and Nuclear belt weighing systems are not covered.

GENERAL

The inspection of an Automatic Continuous Totalizing Weighing System (CTWS) is of a complex nature. Not only because of the inspection procedure itself, but also because it involves a great deal of planning, organization and communication with the parties involved.

This type of inspection requires a large number of pieces of testing equipment, and requires the involvement of many people. An CTWS inspection is also time consuming. On occasion, the test may restrict or stop the operations of the plant where the inspection is performed. Therefore, the cost of an CTWS inspection may be relatively high.

The inspection must be very well planned and organized. Before going to the site to perform the tests, the inspector must ensure the following:

- A sufficient and suitable quantity and type of test product to complete a material test is readily available.
- A suitable and inspected reference scale is accessible to either pre-weigh the test product before passing it over the DUT, or to weigh the captured product after it has been passed over the DUT.
- All testing equipment, appropriate amount and type of local standards (see Bulletin M-05), suitable test product and equipment to move test product between the DUT and the reference scale must be readily available.
- The scale operator as well as officials from the company owning and/or using the scale must be present. In many cases, the primary customer will also demand a presence at the inspection.
- A technician should be on site in case minor adjustments to the scale have to be made. It would be unjustifiable to cancel the inspection with all the equipment and personnel in place because of a simple minor adjustment.
- The DUT is accessible so that all testing equipment can be brought in and used for the scale
Type 6-11 Automatic Continuous Totalizing Weighing Systems (Conveyor Belt Scale [CTWS])

The inspector must, in advance, become familiar with the instrumentation used. The characteristics of the scale, its operation and installation as well as the intended use are some of the elements that must be known by the inspector prior to testing the scale. It is recommended that the inspector follow the product delivery path from loading to discharge to identify any possible areas of concern (product diversion, spillage or other loss).

This information is needed to effectively implement the inspection procedure and to know which limits of error will be applied.

Classification of Automatic Continuous Totalizing Devices

Automatic Continuous Totalizing Devices may be used to weigh product for assessing transportation charges or for buying or selling the product. The intended use of the in-motion scale determines which limits of error apply. Limits of error for a CTWS are found in the Weights and Measures Regulations:

<table>
<thead>
<tr>
<th>Intended Use</th>
<th>Regular Commodity</th>
<th>Inexpensive Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freight Charge</td>
<td>section 193</td>
<td>section 193</td>
</tr>
<tr>
<td>Buy or Sell</td>
<td>section 174/175</td>
<td>section 193</td>
</tr>
</tbody>
</table>

Testing philosophy

The system shall be tested in a manner which will simulate its intended use. This means that although the device is the primary concern, the interaction between the device and the rest of the system must be taken into account in assessing the overall performance of the system. The other system components that may cause issues include the load hopper, feed conveyor, transport conveyor, gates and loading arms.

Typically, a belt scale is used for continuous duty with consistent belt loading and the testing should reflect this. However, in some cases the owner of the device may intend to stop and start the belt during use, or have intermittent loading on the belt. In these cases, the testing procedures should take into account this potential usage.

In developing the test procedure for a particular site, the inspector must give consideration to the type of load, the weather and it’s impact upon the material to be weighed, the loading characteristics of the belt as well as the speed of operation of the device.

Test Load

Although a scale can be tested using calibrated weights (block or chain), a test load is required to certify a CTWS. Only by using a test load can the inspector be satisfied that the entire system is working properly.
Type 6-11 Automatic Continuous Totalizing Weighing Systems (Conveyor Belt Scale [CTWS])

The test load can either be pre-determined or can be unknown material which has passed through the system, been caught and then weighed. In either case, the amount of material to conduct a suitable test can be very large and appropriate arrangements must be made to move this material around the site.

In the case of a pre-weighed test load, it is important that the load is stored in such a manner so as to ensure all of the material, and no extra material, is ultimately passed over the system. In both cases, utmost care must be exercised to ensure that no material is lost during the test as this will jeopardize the results.

Reference Scale

The weight of the test load will be obtained statically on a scale that has been demonstrated to perform accurately to within the required limits of error. The scale must be tested using NAWDS and suitable standards.

The test load may be weighed on any suitable scale. Typically a bulk hopper scale or truck or rail scale is used. The location and installation of the device and reference scale will be the determining factors in making this decision.

Any inherent error in the reference scale must be identified and documented. Uncertainty in the Test Load due to the Reference Scale must be determined and accounted for.

Refer to the Procedures for information on how to develop suitable test loads.

Visual Examination

Notice of Approval

The inspector will ensure that the scale and instrumentation are approved models. The inspector will ensure that the scale complies with all conditions, restrictions or parameters that may be stated in the Notice of Approval(s) or on the certificate from the last inspection. Restrictions may include: belt speed, belt inclination, minimum loads, material types, location, etc.

Marking

Ensure that the scale is marked as required by section 18 of the Regulations (model number, SWA number, serial number, etc.). The instrumentation must also be appropriately marked.

Sealing

Ensure that the device complies with section 10 of SGM-3 if applicable. Ensure that the junction box(es) can also be sealed if they contain means of adjustment.
Type 6-11 Automatic Continuous Totalizing Weighing Systems (Conveyor Belt Scale [CTWS])

Weighbridge

Belt scales generally contain one or more live rollers. The number of rollers which are live is dependant upon the design of the device. Ensure that the number, size and location of the rollers is as per the approval.

Inclination of the belt scale is extremely important and is directly related to the calibration of the scale. As the angle of inclination is increased, the apparent load sensed by the scale decreases. The relationship is related to the cosine of the angle of inclination.

\[
\text{Apparent Load} = \cos(\theta) \times \text{Actual Load}
\]

The result of this is that the angle of the scale must not be changed after calibration unless an angle compensator is used and has been tested.

In addition, extreme angles will result in product slippage on the belt resulting in measurement errors.

Load cells & Levers

Ensure that the load cell(s) are installed in accordance with the approved design. If the scale uses levers, ensure that they are properly aligned and fully supported. Belt scales with mechanical integration and indication will have a lever system mounted beneath the belt and integration is performed with a mechanical disk assembly.

Check System

Ensure that the check system is in place, and adjusted properly.

Cables and ground

Ensure that the grounding system is in place and that the cables are suitably protected and shielded.

Instrumentation

Ensure that the systems instrumentation is suitable for the intended use.

Electronic instrumentation must be approved for Automatic Continuous Weighing and contain suitable integration circuitry. Instruments approved only as Non-Automatic Weighing devices shall not be used for this purpose.

Manual instrumentation, although rare, does exist. Refer to the Notice of Approval for details of the configuration.

Regulation 172(3) stipulates that the value of the minimum increment of registration may not exceed 100 kg (200 lb).
Type 6-11  Automatic Continuous Totalizing Weighing Systems (Conveyor Belt Scale [CTWS])

PROCEDURE - DEVELOP TEST LOAD

The amount of product (test load) required for each individual test run across the device shall be equal to at least 10 minutes flow at rated belt capacity.

The reference scale must be tested to full capacity (NAWDS requirements for sensitivity, accuracy, repeatability, etc.) or at least to the used capacity, before the test load is weighed. It is highly important that the scale used to determine the test load is sensitive and repeats (0.05% or better). A sufficient amount of local standards must be available to test the reference scale. Any inherent error in the scale should be noted.

The test load must be weighed as accurately as possible. For the determination of the weight of the test load, the error of the scale should be taken into consideration. Immediately following the determination of the test load, the reference scale should be re-tested to ensure it retained its accuracy.

If determining a test load using a hopper scale, the hopper must be completely emptied before and after each weighment. If the product tends to cling to the inside of the hopper, the actual net weight of the product can be determined by subtracting the empty weight from the full weight.

If determining a test load using a vehicle or rail scale, it is important to ensure that the weighments (gross and net) are taken at approximately the same locations on the scale deck. This can be accomplished by marking the deck to indicate where the axles of the vehicle are located for the first weighment and ensuring that the vehicle is again located at the same spot for the subsequent weighments. It should also be remembered that if a truck is used for transporting the product to and from the DUT, the tare weight of the truck is subject to change while in use and appropriate considerations must be made.

Test Performance of the Reference Scale

a. Determine the nominal size of load which will be weighed on the reference scale. Test the Reference Scale at approximately this test load using known standards. Using small error weights and break points determine the actual weight to 0.1 $d$. Record this weight, zero the scale and repeat until you have recorded 5 weights for the standards.

   \[ (n = 5 \quad \text{for other possible values, consult your Gravimetric Specialist}) \]

b. Take the average of the 5 weights previously determined. The difference between the actual weight and the calculated average is the error in the Reference Scale.

   \[ \bar{X} = \frac{\sum(X_1...X_5)}{n} \]

c. Determine the difference between the maximum [Max] value obtained and the minimum [Min] value obtained. This is the uncertainty of the measurement. To ensure appropriate Confidence Level (90%) in the test loads this value must be multiplied by the Confidence Factor (F).

   \[ F = 3.15 \quad \text{for other possible values, consult your Gravimetric Specialist} \]

   Uncertainty (Ui) = F x [Max-Min]

Develop Test Load

d. If several Partial Loads (N) are required to develop a suitable Test Load (10 minutes flow at
Type 6-11 Automatic Continuous Totalizing Weighing Systems (Conveyor Belt Scale [CTWS]) capacity), then the Uncertainty of the total Test Load (Ustd) must be established.

Uncertainty (Ustd) = Square Root (N) x Ui
Type 6-11 Automatic Continuous Totalizing Weighing Systems (Conveyor Belt Scale [CTWS])

e. Determine DUT tolerance. Verify that $U_{std} < \frac{1}{9}$ of the DUT Tolerance.

Example:

Belt Scale rated Capacity: 600 tonnes per hour (10 minutes flow = 100,000 kg)
Reference Scale = 10 000 kg * 1 kg
Number of Partial Test Loads (N) = 10
Total Known Test Load = 100 000 kg (10 * 10 000 kg)
Max - Min = 0.75 kg

$n = 5$ (consult Gravimetric Specialist for other possible values)

$F @ 90\% \text{ c.l.} = 3.15 \quad [r = 1, p = 1]$

$U_i = F \times [\text{Max} - \text{Min}]$
$= 3.15 \times [0.75 \text{ kg}]$
$= 2.36 \text{ kg (uncertainty in the measurement)}$

$U_{std} = \sqrt{N \times U_i}$
$= \sqrt{10 \times 2.36} = 3.16 \times 2.36$
$= 7.45 \text{ kg (total uncertainty in Test Load)}$

Verify:

$U_{std} < \frac{1}{9} \text{ DUT tolerance (choose appropriate tolerance for test)}$

DUT Tolerance = (100 000 kg * 0.1%) = 100 kg

$\frac{1}{9} \times (100 \text{ kg}) = 11.1 \text{ kg}$

$7.45 \text{ kg} < 11.1 \text{ kg}$

Test Load Established Before passing over DUT

Once a Test Load has been established, it must be protected. Product which forms the test load must be fully accounted for to ensure that it all passes over the DUT. In addition, it is imperative that no additional product be introduced during the test.

Test Load Established After passing over DUT

In those cases where the weight of the Test Load is established after it passes over the DUT, it is important to ensure that all product is caught and accounted for. This can sometimes be difficult as the amount of test product may exceed the capacity of a single truck or rail car. If product is lost, the test run must be rejected.

**NOTE:** Ensure that a sufficient quantity of test product is available to conduct all of the required tests. Belt loading throughout the test should remain reasonably constant.
Type 6-11 Automatic Continuous Totalizing Weighing Systems (Conveyor Belt Scale [CTWS])

PROCEDURE - BELT SCALE TEST

Definitions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Indication of belt weigher</td>
</tr>
<tr>
<td>s</td>
<td>Weigh span length (m)</td>
</tr>
<tr>
<td>T</td>
<td>Actual Totalized Load</td>
</tr>
<tr>
<td>n</td>
<td>Number of belt revolutions</td>
</tr>
<tr>
<td>S</td>
<td>Static Load</td>
</tr>
<tr>
<td>w</td>
<td>Weight per length (kg/m)</td>
</tr>
<tr>
<td>E</td>
<td>Error = (I - T)</td>
</tr>
<tr>
<td>t</td>
<td>Belt run time (minutes)</td>
</tr>
<tr>
<td>E%</td>
<td>Error % = [(I - T) * 100] / T</td>
</tr>
<tr>
<td>L</td>
<td>Weigh Belt Length (m)</td>
</tr>
<tr>
<td>d</td>
<td>Totalizer Scale Interval</td>
</tr>
</tbody>
</table>

Material Test

This test is designed to assess the system's ability to measure a known quantity of material it is designed for. It is analogous to a test of a volumetric device, where the product is passed through (in this case, over) the measuring element and the registered quantity is then compared to a standard.

Procedure for a Material Test

1. Prepare the materials necessary for the test
   "appropriate quantity of product to run the test. See Development of Test Product for more information.
   "suitable means to transport the material to and from a reference scale (recently verified hopper, vehicle, rail or other suitable scale).
   "sufficient supplementary material for pre-run conditioning of the belt prior to the actual test.
2. Run material over the scale for about ten minutes at the rate of flow which will be used for the test.
3. Zero the scale.
4. Run the first test quantity over the scale. Ensure that no product is lost (or gained) during the transfer of product between the reference scale, the transportation means and the belt scale.
5. Note the totalizer reading. Allow for 0.5d for digital indication (R184).
6. Compare this with the known quantity of material. Determine the error.

\[
E\% = \left(\frac{I - T}{T}\right) \times 100
\]

Error % = \left(\frac{\text{Indicated} - \text{Actual Load}}{\text{Actual Load}}\right) \times 100

7. Continue to run test loads until accuracy and repeatability requirements have been suitably demonstrated.

NOTE: The weight of the known quantity may be determined before or after it is run over the belt scale. This decision will be dependant upon the installation of the belt scale and ease of product access. In either case, it is imperative that no product is lost (or gained) between the time of weighing on the reference scale and the time of passing over the belt scale. Keep in mind that the required test load size at rated capacity could be a great deal of product.
Type 6-11  Automatic Continuous Totalizing Weighing Systems (Conveyor Belt Scale [CTWS])

To certify or reject an Automatic Continuous Totalizing Weighing System, a material test must be completed. Performance of the DUT must be verified using Test Loads at the limits of desired operational speed, both the fastest and slowest operating speeds must be tested.

Belt Conveyor Scales (Automatic Continuous Totalizing Devices) are seldom used as stand-alone devices. More commonly, they are installed as part of a loading facility. In these installations, there may be many opportunities for product loss or diversion, both before and after the belt scale. The inspector must make themselves familiar with the installation as well as details regarding product ownership and transfer points. Once this information is obtained, the system should be examined to ensure that any potential product loss or diversion points have been addressed.

Scale Zero

Initial Zero Setting

The nature of a conveyor belt scale means that any error in the zero setting will translate into an error in the final weight totalization. Therefore, it is important that the device is capable of maintaining a steady zero while running in an unloaded state. When first started, the system must be allowed to warm-up and exercise the belt. During this time, the zero setting may be adjusted as required. Zero testing should be completed with a whole number of belt revolutions. This allows errors within the belt length to self correct.

Zero Stability

Once warmed up, the device shall be tested for Zero Stability. The belt shall be run unloaded for no less than 3 complete revolutions or 10 minutes operation, whichever is greater. The indicated totalization (zero error) shall not exceed ± 0.05% of the totalized load at full scale capacity for the duration of the test. This test shall be repeated until 3 consecutive tests meet this requirement without adjustments being made to the zero settings.

Minimum Load

The value of the minimum increment of registration shall not exceed 0.1% (1/1000) of the minimum totalized load and in no case shall the value of the minimum increment of registration exceed 100 kilograms.

Installation

Installation of the scale must be as per the manufacturers recommendations.

Standards or Simulated Load Test (optional)

A belt scale may be tested using certified standards. This test however may not be used to certify or reject the device. The test is useful for assessing the proper operation of the scale.
Automatic Weighing Devices

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Loads are simulated by using calibrated test chains of the roller, wheel or link type, or by using known test weights that are either suspended from or set upon the weighbridge. Use of known standards is less desirable as the belt will run unloaded and therefore the results will be less representative of actual device operation.

To conduct a Simulated Load test, the following must be determined.

1. **Length of the Belt (L)**
   - Measure accurately the entire belt length by successive measurements of flat sections of the belt.
   - This measurement must be taken to the nearest centimeter.

2. **Weight/Unit Length of the test standards (w)**
   - Test Chain - the weight per unit length will be stamped upon or otherwise marked on the chain. The certified weight per unit will also be available on the certificate of calibration which should accompany the chain.
   - Test Weights - to obtain the appropriate weight per unit of length when using test standards, the inspector must first determine the length of the span (s). This is done by measuring the length of the weighbridge (from first to last live rollers) and adding to that one half of the distance from the leading idler to the weighbridge and one half the distance from the trailing idler to the weighbridge. If there is only one live roller, then the length of the span is equal to one half of the length from the leading idler to the trailing idler. All measurements should be taken from the center or the roller/idler. The weight per unit length is then equal to the total known weight (S) divided by the length of the span (s).
   \[
   w = \frac{S}{s}
   \]

3. **Speed of the Belt (v)**
   - Using a stop watch and a reference point marked upon the belt, time the belt for ten complete revolutions of a long belt or 30 revolutions of a short belt (n). Record the time (t) in seconds.
   - Calculate the belt speed in metres per second as follows:
   \[
   v = \frac{n \times L}{t}
   \]

**NOTE:** If a test chain is used to simulate a load, the belt speed should be determined with the chain in position on the belt. This will ensure that the calculated speed is representative of the belt speed under loaded testing conditions.

There are two acceptable methods that may be used to test the belt scale with a simulated load.
Type 6-11 Automatic Continuous Totalizing Weighing Systems (Conveyor Belt Scale [CTWS])

1. Flying Start and Stop

- obtain zero balance
- stop the belt and place the standards on the scale.
  
  Test Chain - affix the bridles (cable or rope) to the ends of the chain to securely hold it in place. Run the belt through several revolutions to centre the chain on the belt. Adjust the bridles as necessary to ensure the chain is tracking properly in the center of the belt.

  Test Weights - test weights are either hung below the belt or loaded above the belt depending upon the design of the system. The belt runs empty. Ensure that the weights and the hanging hardware do not interfere with the scale components. Ensure that the hanging hardware has been zeroed off and does not form part of the test load.

- Start the belt
- using a stop watch, run the belt for a minimum of 10 minutes, reading the totalizer at the beginning and end of that time.
- calculate the known test load \( T \) over the timed interval \( t \) as follows:

\[
T = w \times v \times t
\]

- As many integrators will display results in tonnes (tons) you must divide your results in kg by 1 000 to arrive at tonnes (lb / 2 000 = tons).
- calculate the difference between the stop and start totalizer readings. Compare this with the results calculated above.

**NOTE:** As the totalizer readings are taken with the belt running, care must be taken to ensure that the totalizer readings are taken as accurately as possible.

2. Stationary Start and Stop

- With the belt running and the scale unloaded, obtain a zero balance condition and then stop the belt.
- Load the scale with the chain or test weights as described above.
- If using a test chain, run the belt for at least three revolutions to ensure that the chain is properly centered and stretched. Stop the belt.
- Select one scale roller and mark it as the reference point.
- Make a corresponding mark on the side of the belt.
- Record the totalizer reading. Run the belt for an appropriate length of time. (e.g. 5 revolutions for a long belt or 20 revolutions for a short belt).
- Stop the belt approximately at the point where the two reference points meet.
- Read the totalizer. Measure the amount of over-run or under-run between the reference idler and the mark on the belt.
- Calculate the known test load \( T \) over the total number of revolutions \( n \) made by the belt during the test:

\[
T = w \times L \times n
\]

- As many integrators will display results in tonnes (tons) you must divide your results in kg by 1 000 to arrive at tonnes (lb / 2 000 = tons).
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NOTE: “n” will generally not be a whole number. If the belt is 100m long and stops 5m past the reference mark for 5 complete revolutions, then:

\[ n = 5 + \left(\frac{5}{100}\right) = 5.05 \]

Alternatively, if the belt is stopped 5m short of the fifth complete revolution then:

\[ n = 5 - \left(\frac{5}{100}\right) = 4.95 \]

Determine System Correction Factor (K) (optional)

The simulated load test provides not only an indication of linearity and repeatability, but with a correction factor (K) can be used as a preliminary indication of the scale’s accuracy during subsequent product tests. The value for K is determined at the time of initial inspection and, if necessary, at subsequent inspections. K is equal to the ratio of scale error on actual load to error on simulated load. For example, the error found on the simulated load test is 0.18% and on the actual load test, 0.06%. The value of K is calculated as:

\[ K = \frac{0.06}{0.18} = 0.333 \]

Following a simulated load test, applying the K factor to the error will reasonably indicate the actual performance under load. This is an approximation only, and may change over time, if modifications are made to the system, or if a different simulated load is used.

Certification

The Inspection Certificate must describe the system. The Certificate also indicates the manner(s) the scale may be used (restrictions); for instance, the speed of the belt (min & max), the angle of the belt, etc. Section 70 of the Weights and Measures Regulations requires that the restriction(s) be posted.

Sealing and Stamping

The in-motion weighing scale (equipment) must be sealed and stamped as required by sections 29, 31 and 32 of the Weights and Measures Regulations.

INTERPRETATION OF RESULTS

The DUT is deemed to comply if all results are within the acceptable LOE.

REVISION

a) (Feb 2008)
- minor revision to correct applicable tolerance table for Regular Commodity, Freight Charge.
  Change from section 174/175 to section 193.
- remove reference to SGM-3 which is not applicable to CTWS.
Type 4.11 - Automatic Discontinuous Totalizing Weighing Systems (ADTWS) [Bulk-weighers]

REFERENCE

*Weights and Mesures Regulations*, NAWDS & the National Technical Training Bulk Weigher Training Module.

PURPOSE

The following procedure is applicable to hopper scale installations commonly known as bulk-weighers with a capacity of 15 tonnes or less, used to weigh granular product such as those typically found in grain elevators, feed mills or grain cleaning facilities.

The procedure is also valid for bulk-weighers with a capacity exceeding 15 tonnes. As product testing of larger bulk-weighers, typically installed at grain terminal and transfer elevators, is not always feasible, the inspector should consult with the Regional Gravimetric Specialist, who in discussion with the Canadian Grain Commission (if applicable), will decide if a product test must be performed or not.

REQUIREMENTS

Standard Test Procedures - Static Testing

If possible, the Device Under Test (DUT) must be tested in the static mode using the STP/IPO’s from the *Specifications for Non-Automatic Weighing Devices* (NAWDS). The following requirements are in addition to those tests.
Type 4.11 - Automatic Discontinuous Totalizing Weighing Systems (ADTWS) [Bulk-weighers]

Typical Grain Elevator Installation

Figure 1
Type 4.11 - Automatic Discontinuous Totalizing Weighing Systems (ADTWS) [Bulk-weighers]

Inspection Philosophy for Bulk-weighing Systems

The hopper scale is a relatively simple device which by itself would be very easy to inspect, except for its location. In most bulk-weighing systems, product travels a protracted path from the front receiving pit to the hopper scale or from the hopper scale to the loading spout encountering many possible diversions along the way. The inspection of a bulk-weighing system requires a knowledge of the entire system and includes tests for verifying the accuracy of the scale itself as well as the testing of all the required interlocks to verify the integrity of the overall shipping or receiving transaction. Furthermore, it should be noted that virtually all bulk-weighing systems are different as are the facilities in which they are installed.

How the System Operates

Refer to Figure 1.

In its simplest form, a bulk-weighing system designed for receiving granular product consists of a receiving pit, elevating system, distributor, upper and lower garner, scale and control system. In a typical trade transaction, grain or other granular product is received through a front pit, transferred either via drag conveyor or direct input to an elevating leg. The elevating leg then deposits the product in either a distributor or directly into the upper garner where it flows to the scale for weighment in successive drafts without operator intervention. Interlocks, normally position sensing devices, are placed at strategic points where possible product loss may occur.

In most bulk-weighing applications, the scale and indicator are approved as non-automatic devices. However, since most bulk-weigher applications are unique to their location and specific use, each controller must be equipped with software that is specifically designed for that installation. Therefore it stands to reason that the dynamic functioning of every bulk-weighing system must be approved and tested on site.

This test procedure combines both static procedures as well as dynamic test procedures. The static tests have been extracted from the Field Inspection Manual for Non-Automatic Weighing Devices and are conducted using local standards. Dynamic testing is done with a net known test load or product test which allows an inspector to evaluate a bulk-weighing systems’ dynamic capability. The product test has been designed to simulate an actual trade transaction from the point of delivery to the point of weighment or vice-versa. The product test is extremely useful for evaluating a bulk-weighing systems’ totalizing capability as well as for identifying product loss due to leaks or diversions or scales that have been calibrated with a bind. By using a combination of both tests, an inspector can confidently determine if a bulk-weighing system is capable of weighing all product that is either shipped or received.

Visual Inspection of the System

Prior to testing, determine if the system is used for receiving, shipping or both. You must also ascertain the product flow path as well as all pertinent interlocks. This information is critical when determining the manner of product testing as all interlocks must be tested.

One must also determine if the system can be operated manually without using the bulk-weighing control system. If it can be operated manually, all the interlocks must still be operational or it should not be possible to initiate a receiving transaction. Determine if the system can be switched from automatic to manual during a transaction. If this can occur, product can be lost, this feature must be locked out when you are in the automatic receiving mode.
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**Tare** and **automatic zero maintenance** features **must be disabled**. It should be noted that some systems cannot handle negative weight indications and have been allowed to have a slight positive zero offset to prevent the occurrence of a negative weight indication (i.e. with the scale empty, the primary indicator is set to a positive weight value).

Further visual examinations include; checking for adequate clearance around the hopper scale and proper operation of the weight lifting mechanism. Check for binding problems on the weights and lifting mechanism when the weights are raised. The following are potential problems that could possibly occur with the use of the test weight lifting mechanism:

- the hydraulic cylinders should be double ended to ensure that no hydraulic fluid is displaced during the lifting process.
- the hydraulic cylinders could be resting on the test standards giving a false zero indication.
- the test standards when raised will twist and bind on a support structure.
- the hydraulic cylinder will not raise the test standards sufficiently to clear the base they are located on.
- hydraulic hoses cause a binding error when weights are raised (use a product test to check).

Where portions of the system are visible, **check for leaks**. The feed gate (upper garner gate) and the scale discharge gates must also be checked to determine that they are indeed fully closed when closed by the control system. It may be necessary to conduct a product test to verify that these gates close completely.

**Dynamic Test Procedures**

Once the static testing has been completed, a bulk-weighers’ dynamic capability can be tested. The dynamic portion of the testing analyses a bulk-weigher’s totalizing capability when subjected to a known test load. It also verifies that a positive product path has been maintained throughout the transaction. In essence this testing is designed to simulate an actual trade transaction.

The product test is the primary method of dynamic testing. By introducing a known test load into a bulkweighing system we are able to identify operational problems with the system where no other means of testing can achieve the same result. A product test is especially useful for locating leaky gates or product diverters thus ensuring that all product that should be weighed has actually been weighed. If a system fails to meet the limit of error established for this test, further investigation is necessary to determine the cause of the discrepancy and at no time should the results of a product test be used to calibrate the weighing system.
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1. Check Pertinent Interlocks

Most interlocks can and will be tested during the product test outlined in section 3.1. It is important however that all interlocks be identified prior to initiating the product test. Interlock testing is normally done through the manipulation of the operator control panel or software, therefore it is recommended that on-site staff, familiar with the bulk-weigher operation, be present for this testing.

The following are the most common interlocks to be tested, refer to Figure 1:

1) High level sensor in the scale (8)
2) High level sensor in the upper garner (8)
3) Spill pipe paths
4) Automatic pit gates (1)
5) Manual pit gates
6) Back pit gate (11)
7) Leg off or feed path blocked (4)
8) Boot auger
9) Grain samplers (6)
10) Distributor position (7)
11) Empty pits sensors (2)

• Upper Garner and Scale Discharge Gate

The feed gate and the scale discharge gate cannot be operated (open) at the same time allowing product to bypass the scale. You should be able to follow the path of the product throughout the elevator from the front receiving pit, to the scale, to a bin (receiving transaction). This test is conducted after a product test has been initiated. Request the controller to open the scale while the upper garner feed gate is open. The request must be rejected.

• High Level Sensor in the Scale

Most bulk weighers limit the filling of the hopper on the basis of draft weights and a high level sensor. The high level sensor is placed in the hopper scale at a point where it will activate when the scale is almost full. The control system continuously monitors this sensor and when the sensor is activated, the control system closes the feed gate to keep the scale from overfilling and spilling product which would bypass the scale.

The following should happen when product in the hopper scale activates the high level sensor:

i) the upper garner gate should close;
ii) the product would then be weighed once motion has ceased;
iii) the gross, tare, and net weights for that draft would then be printed;
iv) the scale gate would then open and the product discharged;
v) the scale gate is then closed so that the next draft can begin.
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How to test high level sensors:

i) change the draft size to equal the scale capacity (changing the draft size may require that a change be made in the Configuration or Initialization Mode);
ii) run product through the system;
iii) the high level sensor should be activated and the weighing, printing and discharge sequence should occur before the preset draft size is attained.

Note that the action of closing the upper garner gates is not instantaneous. As a result, the weigh hopper's high level sensor must be located so as to leave enough room to catch all the grain that may escape past the gates after the order to close the gate has been issued by the control system. The quantity of grain escaping past the gates will not be great if the gates are closed at the end of a normal cyclic draft.

There is a second method of testing this function. This can be tested by filling the weigh hopper to about 75% of the draft size and by hitting the pause button. On systems with automatic front pit gates or drag conveyor, these will respectively either automatically close or stop. On systems with manual pit gates, these will have to be manually closed. The amount of grain left in transit in the leg will empty into the upper garner (surge bin). Once this has happened, hit the resume button and the feed gate will open and flood the scale with grain at a high rate. If the high level sensor is set correctly, the weigh hopper will not overfill and spill grain overboard.

If the high level sensor is placed too high in the scale it may allow product to contact the feed gate. Usually when this occurs, motion is detected in the scale and the system cannot continue. However, if the scale does weigh, print and discharge the product, the weight registration will probably be erroneous and some of the grain may have spilled over the side of the weigh hopper. This situation will be detected by the use of a product test.

• High Level Sensor in the Upper Garner

This is a level sensor which is placed in the upper garner to signal to the control system that the upper garner is full and the flow of product must be stopped.

When the high level sensor signals to the control system that the upper garner is full, the control system should automatically close the front pit gate (in the case of a receiving operation) or the bin gate, or stop the drag conveyor in systems incorporating a drag conveyor.

Other ways of preventing the upper garner from continuing to fill are:

• the leg could be stopped to prevent more product from going into the upper garner. The leg should be running empty before trying to stop it;
• if there is a manual pit gate, there must be a warning to the operator that the pit gate must be closed and the product that will not go into the upper garner will have to backleg;
• if there is a spill pipe off the leg or the upper garner, the excess product must flow back down the spill pipe to the front receiving pit;
• in all of cases, the sensor must be placed low enough in the upper garner to allow sufficient room to accommodate the product remaining in the leg.
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When the feed gate is reopened, the product will drop into the scale very quickly. If there is too much product in the upper garner, the scale may go over capacity or fill up to the feed gate before the system senses the scale is full and can close the feed gate. Therefore, the sensor should not be placed too high in the upper garner.

• **Spill Pipe Paths**

If the system incorporates a spill pipe then spilled product must return to the front pit when the bulkweigher is in the receive mode. There may be a “Y” connection where the product can take one of two paths. One path will lead to the front pit and the other to the back pit.

If there is a “Y”, an interlock must be included and function as follows:

• the flapper valve must be set to return product to the front pit and locked in that position before the system can begin a receiving transaction;

• the flapper may not change once a transaction has begun. This may be achieved by disarming the control or including a solenoid and pin to mechanically lock it.

• **Automatic Pit Gates**

Put the system into the receive mode and use the controls to attempt to open the back pit gate. You should not be able to open it in the receive mode. Opening the back pit gate should not allow product into the front pit.

• **Manual Pit Gates**

A check of the interlocks on a manual pit gate can be performed by opening the back pit gate and attempting to put the system into the receiving mode. This should not be possible. Opening the back pit gate should not allow product into the front pit.

With the back pit gate closed, put the system into the receiving mode and then open the back pit gate. The system should shut itself down.

The system should not be able to complete the transaction with the front pit gate closed or if there is product in the pit. The system must first determine that there is no more product in the product path and then the front pit gate must be open before the transaction can be completed.

• **Leg Off or Feed Path Blocked**

With the system in the receiving mode, have the leg shut off (with no product in it so that it can be restarted) and attempt to finalize the transaction. You should not be able to complete the transaction with the leg shut off. Next, start the leg and then close the gates and/or stop drags in as many combinations as you can so there is not a continuous feed path of product from the front pit to the scale and attempt to complete the transaction. Again you should not be able to complete the transaction.
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- **Boot Auger**

Some elevators will have a boot auger which is used to clean out the boot if the leg plugs up with grain and will not start. Traditionally, the boot auger moves the grain to the back pit; however, when a bulkweighing system is installed and it is in the receive mode, it must move the grain to the front pit only. If the boot auger only moves grain to the back pit, then it must be disabled in the receive mode.

- **Grain Samplers**

The grain sampler takes a portion of the grain being received to determine the grade of the grain and the amount of dockage. It can be of either a manual or automatic type.

The manual sampler catches product off the leg. Usually it will take an insignificant percentage of the product. However, a product test is the only way of confirming this.

If the sampler is adjustable it should be tested at highest sampling rate or interlock so no product can be taken without being weighed.

- **Check Overall Operation**

In order to check the bulk-weighing system operation in the receiving mode, close the front pit gate, open the back pit gate, put the four-way to a position other than to the scale, set overflow spill pipe to the back pit, etc. and attempt to start a receiving transaction. The computer software and controller should effectively detect the incorrect positions and prevent any transaction until everything is reset correctly.

Each system may do this in a different order but the end result must be the same in all cases.

The following must be confirmed by the controller before allowing the agent to enter the receiving transaction:

- that there is no product in the system;
- that the feed patch is complete (i.e., upper garner gate open, distributor and valves in the correct conveyors and elevating leg are operating;
- the scale gate is closed;
- any gates or drags which can divert product from the system are closed or shut off.

- **No Product in the System**

The computer software must perform a verification in order to ensure that there is no product anywhere in the system. There could be product remaining in the leg if it was stopped prematurely when it was last used. There could also be product left in the upper garner from the last transaction, in the case of a shipping or transfer, at the end of which the system was not cleaned.
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The following checks are required in order to establish that the system is empty prior to starting the receiving transaction:

- **the front pit must be empty** - this can be checked by means of a sensor in the front pit or a switch that indicates that the pit gate is open, or by query by the control system, visual inspection and confirmation by the operator.
- **the leg must be empty** - this can be checked by means of a sensor in the leg or by query by the control system, visual inspection and confirmation by the operator.

**NOTE:** These steps may be combined by establishing that the pit gate is open and the leg is running empty.

- **the drag is running empty** - this can be checked by means of a product sensor at the discharge of the drag.
- **the upper garner must be empty** -- a sensor indicating that the feed gate is open and monitored to ensure that it remains open for a period of time after the leg is empty and/or by monitoring the absence of motion of the weigh hopper.
- **the weigh hopper must be empty** - the control system must verify that the upper garner gate is in the open position and that weight registration is either at zero or at the pre-established "zero offset" reading (this maybe as high as 10 kg).

**Product Tests**

Normally three product test are conducted, each of which must be within the LOE. Any equipment or accessories used in conjunction with the bulk-weigher such as a dust collection system must be activated for the duration of product testing.

**Reasons for Doing Product Tests**

Product tests are carried out for the following reasons:

- the scale gate could be leaking, allowing product to bypass the scale;
- the feed gate could be leaking allowing product into the scale as it is being discharged, again allowing product to bypass the scale;
- to check if product is being diverted;
- the grain sampler could be taking too large a sample;
- to check if the flow controls in the software are correct;
- there could be a faulty load cell;
- as you are unable to conduct a corner test, the product test will evaluate if off center loading results in errors, this will check the balance of the cells.
- to ensure test standard lifting mechanism is not causing binding errors

The first step in performing a product test consists of obtaining a known load. The bulk-weigher is then put into the receiving mode to begin the product test. The bulk-weigher may prompt the operator to enter the customer's name, the type of product and other supplementary information. The product test is used to verify the following safeguards:

- **Gates, Diverters, Grain Samplers and Flappers Set Correctly**
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Automatic Weighing Devices

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The computer software should then check that all gates, diverters and valves are set correctly so that no grain can be diverted away from that being weighed.

The following checks are required in order to establish that there is a complete uninterrupted flow of product to the scale:

i) all gates must be in the correct position; this can be checked by verifying that the signal from the sensors located on the gates are working correctly.
ii) all distributors and/or valves must be in the correct position; this can be checked by verifying that the signal from the sensors located on the distributors are working correctly.
iii) all valves on spill pipes must be in the correct position; this can be checked by verifying that the signal from the sensors located on the valves are working correctly.

Once all the verifications have been performed, one may start a receiving operation on a known load of grain. The inspector may use the control panel and attempt to move the diverters and open any gates which could divert product away from the scale. All these functions should be interlocked so that the control panel is not active. Furthermore, the diverters, distributors and gates which can divert product away from the scale should be locked in position to prevent inadvertent or fraudulent manual operation. If they are not locked into position, attempting to move any of them should shut the system down automatically without the loss of product.

• Completing the Receiving Transaction

The inspector should attempt to complete the transaction after having blocked the feed path (i.e. by turning off the leg when empty, by closing the front pit gate, by turning off the drag conveyor, etc.). While the feed path is blocked, it must be impossible to complete the receiving transaction. Attempting to complete the transaction may cause the feed path to open automatically and check for an empty system or it may just wait for the path to be cleared. Before the system can complete the transaction, it must establish that the system is empty of product (See 2.1: No Product in the System).

Normally, during the last draft of the transaction, the remaining product that accumulates in the weigh hopper is not enough to reach the preset draft cutoff weight. Some control systems will sense this and prompt the operator to complete the transaction. A transaction cannot be completed automatically and must be initiated by an operator.

• Normal Receiving Transaction

The following test determines whether the bulk-weigher is accurate within the prescribed commodity Limits of Error (LOE) for a known quantity on a normal receiving transaction. A known test load must first be obtained. The known test load should be determined using a suitable master scale with a graduation approximately 4 times smaller than that of the bulk-weigher (if this is not available, then the method outlined in Appendix A "Product Test Load Determination" may be used). The system is then put into the Receive Mode and the transaction is allowed to proceed normally until the entire load is weighed. The total weight of the product as recorded by the bulk-weigher must agree with the known test load within ± 0.15% of the known test load. If it does not agree within the limit of error and the reason for the discrepancy cannot be found and corrected, the system cannot be verified for receiving.

• High Level Sensor in Scale and Garner
Type 4.11 - Automatic Discontinuous Totalizing Weighing Systems (ADTWS) [Bulk-weighers]

During a receiving transaction force the system to activate the high level sensors. (See 1.2 & 1.3)

- **Gates, Diverters, Grain Samplers**

During the product test the manipulation of gates, diverters and grain samples should not causes excessive product losses.

- **Printed Ticket**

**For receiving purposes:** a printed ticket shall contain information for the total transaction (gross, tare, net). The system must be able to produce, upon request, information from each draft (gross, tare, net) for inspection purposes. If each individual draft is printed, drafts may be printed at the end of the transaction, so long as no data is lost in the event of a power failure or malfunction.

**For shipping purposes:** a printed ticket shall contain the net weight loaded into the vessel. Information pertaining to individual drafts need not be printed, however it must be accessible for inspection purposes and must not be lost in the event of a power failure or malfunction.

- **Power Failure Test (Initial Inspection Only)**

In the event that there should be a power failure while the system is in operation, there must be safeguards in the system to ensure that no product is lost. Prior to proceeding with the power failure test, the inspector must ensure that a loss of power will not adversely effect any other computer systems or equipment in the elevator. While the system is in the receiving mode, interrupt the power to the controller’s UPS. If there is no controller UPS then interrupt the power to the controller. The power failure should occur when both the front pit and scale have product in them and the leg is empty. This can be accomplished by closing the front pit gate during the transaction. The printed ticket should contain the transaction information up to the point of the power failure. After you believe anything that would normally happen has taken place (including computer time out), turn on the power, recover all the product and complete the transaction. Some systems run manually while others hold memory. All product should be accounted for.

For systems not capable of storing printed information, an additional power failure test consisting of interrupting the power only to the printer should be conducted. This should be done at this so-called "critical moment". The control system should be capable of verifying whether or not the information sent to the printer has effectively been printed.

**NOTE:** This test is only done at the time of initial inspection.
Type 4.11 - Automatic Discontinuous Totalizing Weighing Systems (ADTWS) [Bulk-weighers]

- **Shipping Systems Testing**

The inspection of a bulk-weigher used for shipping purposes consists of the following tests:

1) Visual inspection of the system

2) Static testing the hopper scale for accuracy using test weights

Follow the procedures stated above for the visual, build-up tests and product testing. A product test may not be necessary depending on the complexity of the system. Consult your regional gravimetric specialist to determine the need for a product test on a shipping system. Shipping systems used exclusively for rail weight determination are to be marked “Not For Use In Trade” and do not require certification.
Type 4.11 - Automatic Discontinuous Totalizing Weighing Systems (ADTWS) [Bulk-weighers]

Appendix A
Product Test Load Determination

When creating a product test load, we recommend the use of a master scale or portable hopper scale with a graduation at least four times smaller than that of the device under test. In the event that such a scale is not available, the following procedure using a vehicle scale or hopper scale may be used.

1. **Equipment and Preparations**
   - Test truck and approximately 10 000 kg test standards.
   - Truck equipped with a dump box capable of holding at least 10 tonne of product.
   - Inspectors weight kit.
   - Reference vehicle scale or hopper scale located close by so fuel and accumulated debris do not effect load values.

2. **Use of Error Weights to Establish a Finer Degree of Accuracy**

Determining a weight value to a finer degree of accuracy than the division of the scale used for the development of the product test, requires the use of error weights. Error weights must be in denominations equivalent to $0.1d$ of the scale on which the product test is being developed.

To use this method, note the weight indicated on the scale. Add error weights in $0.1d$ increments until the indicator flashes to the next division (i.e. reaches the zone of uncertainty). Note the number of error weights required to make the indicator flash.

**Actual weight = (Indicated Weight + ½ division) - error weights added**

Example:

A vehicle scale with a 10 kg divisions indicates 23 460 kg with a loaded truck on it. Using error weights, add 4 kg to make the indicator flash to 23 470 kg. The actual weight of the loaded truck would be:

Actual Weight= (23 460 kg + 5 kg) - 4 kg
Actual Weight= 23 461 kg
3. Repeatability Test (TRL)

Repeatability testing on the vehicle scale should be conducted using the loaded truck, or a weight truck approximating the weight of the loaded truck. Only the end of the scale being used to determine the weight of the product needs to be tested however a complete scale inspection is recommended prior to beginning any further testing.

Establish a zero, move the truck on to the portion of the scale that will be used exclusively to establish the known test load, mark the trucks location on the scale deck and record the indication. Move the truck forward 3 metres, mark this new location and record the new indication. Remove the truck from the scale and zero the device. Repeat this test four more times, ensuring that the truck is located at the previously marked locations on the scale deck. Calculate the repeatability range for the loaded truck (TRL) by subtracting the lowest reading from the highest reading. (Note - Error weights must be used to determine the precise indication; or $1d$ must be added to the repeatability range (TRL) value.)

Example:

\[
\begin{align*}
&[24\ 010 / 24\ 011] [24\ 007 / 24\ 010] 24\ 004 / 24\ 010] [24\ 009 / 24\ 011] [24\ 009 / 24\ 011] \\
The\ above\ readings\ would\ yield\ a\ repeatability\ equal\ to\ the\ highest\ value\ minus\ the\ lowest:
\end{align*}
\]

\[
TRL = 24\ 001 - 24\ 004 = 7\ kg
\]

4. Sensitivity Factor (Sf)

When the loaded truck is on the scale and an exact indication has been determined (usually after the last repeatability test), add an amount of standards approximately equal to the In-Service LOE for the load on the scale.

\[
Sf = 1 + \frac{\text{Difference between Actual and Indicated values}}{\text{Actual value of the added mass}}
\]

Example:

- 20 kg of standards are added to the scale, the corresponding indication using error weights is 21 kg;

therefore $Sf = 1 + (1kg / 20kg) = 1.05$

- 20 kg of standards are added to the scale, the corresponding indication using error weights is 18 kg;

therefore $Sf = 1 + (2kg / 20kg) = 1.1$
Type 4.11 - Automatic Discontinuous Totalizing Weighing Systems (ADTWS) [Bulk-weighers]

* Note that Sf cannot be less than 1.

5. **Test Sample Size**

   1) If (TRL x Sf) is less than or equal to 7 kg then 9 500 kg of test product or 3 hopper drafts are required which ever is greater.

   2) If (TRL x Sf) is greater than 7 kg and less then or equal to 10 kg, then 19 000 kg of test product or 3 hopper drafts are required which ever is greater.

   3) If (TRL x Sf) is greater than 10 kg and less then or equal to 13 kg then 30 000 kg of test product or 3 hopper drafts are required which ever is greater.

   4) If (TRL x Sf) is greater than 13 kg and less then or equal to 15 kg then 40 000 kg of test product or 3 hopper drafts are required which ever is greater.

   5) If (TRL x Sf) is greater than 15 kg and less then or equal to 17 kg then 50 700 kg of test product or 3 hopper drafts are required which ever is greater.

6. **Establishing Target Weights**

a) Note the exact value of an empty truck using error weights. Add approximately one half the total available test standards (5 000 kg) immediately behind the truck. Using error weights determine the exact value that the scale is indicating and record this value. Add the remainder of the test standards (10 000 kg) to the scale and once again determine the exact value indicated for the amount of standards on the scale. Determine the correction factors (Cf) at both test points.

\[
Cf = \text{local standard's weight/ indicated weight}
\]

(round to 4 digits)

**Example:**

<table>
<thead>
<tr>
<th>Exact empty truck weight (tare)</th>
<th>8 750 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>½ the available standards (5 000 kg)</td>
<td>Full complement of standards (10 000 kg)</td>
</tr>
<tr>
<td>exact indicated wt - 13 753 kg</td>
<td>exact indicated wt - 18 755 kg</td>
</tr>
<tr>
<td>(Cf_1 = \frac{5 000}{(13 753 - 8 750)})</td>
<td>(Cf_2 = \frac{10 000}{(18 755 - 8 750)})</td>
</tr>
<tr>
<td>(Cf_1 = 5 000/5 003 = 0.9994)</td>
<td>(Cf_2 = 10 000/10 005 = 0.9995)</td>
</tr>
</tbody>
</table>
b) Load the truck with approximately 10 000 kg of product and repeat step “a”. Determine the correction factors for ½ and full complement of test standards.

Example:

Exact weight of truck loaded with approximately 10 000 kg of products is 18 775 kg

½ the available standards (5 000 kg) Full complement of standards (10 000 kg)

exact indicated wt - 23 777 kg exact indicated wt - 28 778 kg

\[
\begin{align*}
Cf_3 &= \frac{5 \, 000}{(23 \, 777 - 18 \, 775)} \\
Cf_4 &= \frac{10 \, 000}{(28 \, 778 - 18 \, 775)} \\
Cf_3 &= 5 \, 000/5 \, 002 = 0.9996 \\
Cf_4 &= 10 \, 000/10 \, 003 = 0.9997
\end{align*}
\]

If the difference between the highest and lowest correction factors obtained in steps a & b, multiplied by 20 000 kg , does not exceed 9 kg (approx 1/5 of the tolerance for a 20 000 kg product test - [(20 000 C 0.225%) / 5]), then the scale is linear and the product test load may be determined anywhere from 0 to 20 000 kg. The average correction factor shall be used when calculating the products true weight. If the difference between correction factors exceeds 9 kg, then the product test load must be determined exactly at 10 000 kg and the Cf for 10 000 kg shall be used.

Example:

Using the correction factors obtained in steps a&b above, the difference between the highest and lowest correction factor is:

\[
(0.9997 - 0.9994) = 0.0003
\]

\[
(0.0003) \times (20 \, 000 \text{ kg}) = 6 \text{ kg} \text{ which is within 9 kg, therefore the scale may be used between 0 kg and 20 000 kg. The correction factor used for determining the true product weight will be the average of the four values which in this case is 0.9995, rounded to 0.9996.}
\]
7. **Products True Weight**

Note the exact value of the empty truck using error weights. Load the truck with stable product to the target weight as determined in step 6 a or b. Using error weights determine the actual indicated weight. The true weight is determined as follows:

\[
\text{True wt} = Cf \times \text{indication}
\]

**Example:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full truck weight</td>
<td>28 564 kg</td>
</tr>
<tr>
<td>Empty truck weight</td>
<td>8 750 kg</td>
</tr>
<tr>
<td>Net product weight</td>
<td>19 814 kg</td>
</tr>
<tr>
<td>Cf (from step 6)</td>
<td>0.9996</td>
</tr>
<tr>
<td>True Weight</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.9996) x (19 814)</td>
</tr>
<tr>
<td>True Weight</td>
<td>19 806.07 kg</td>
</tr>
</tbody>
</table>

8. **Allowable Error for Product Test Developed on a Vehicle Scale**

Allowable Error (Product test) = Product weight uncertainty (0.15%) + LOE for automatic weighing device (0.075% Acceptance or 0.1% In-Service) + ½ division (bulk-weigher)

**Acceptance** = 0.225% (test sample size) + ½d

**In-service** = 0.250% (test sample size) + ½d

9. **Product Test Developed on a Hopper Scale**

When using a hopper scale equipped with test standards to develop a product test load, the following procedure shall be used:

i) Determine the Repeatability (TRL) by placing a load in the hopper equivalent to Max minus the weight of the standards. Place the standards on the scale five (5) times and record the exact indication each time. To determine the repeatability, subtract the lowest reading from the highest.

ii) On the last reading, determine the Sensitivity Factor (Sf) by adding a weight approximating the In-Service LOE for the load in the scale as outlined in step 4 above.

iii) Refer to step 5 to determine the amount of test product required.
Type 4.11 - Automatic Discontinuous Totalizing Weighing Systems (ADTWS) [Bulk-weighers]

iv) Establish the Correction Factor (Cf) for the scale by using the substitution method to build the load up to Max. Correction Factors must be determined at each substitution point.

v) If the difference between the highest and lowest correction factors obtained in steps iv, multiplied by Max, does not exceed \( \frac{(Max \times 0.225\%) \times 5}{5} \), then the scale is linear and the product test load may be determined anywhere from zero to Max. The average correction factor shall be used when calculating the products true weight. If the difference between correction factors exceeds allowable, then the product test load must be determined at the weight equivalent to the amount of local standards used. The correction factor for that weight shall also be used.

vi) Allowable Error (Product test) = Product weight uncertainty (0.15%) + LOE for automatic weighing device (0.075% Acceptance or 0.1% In-Service) + \( \frac{1}{2} \) division (bulk-weigher)

\[
\text{Acceptance} = 0.225\% \text{ (test sample size)} + \frac{1}{2}d
\]

\[
\text{In-service} = 0.250\% \text{ (test sample size)} + \frac{1}{2}d
\]
Type 10-11, 10-21 Automatic In-Motion Rail Weighing [IMRW]

REFERENCE

Weights and Measures Regulations - tolerances from Regulation 189, 190, 191 and 192 as appropriate. SGM-3 and SGM-4.

For more information on the inspection of in-motion railway scales consult the Weights and Measures National Technical Training Program In-Motion Weighing of Railway Cars training module.

PURPOSE

In Motion weighing of rail cars, either Coupled or Uncoupled on a rail scale. Typical installations are on a rail spur, often in a rail yard or at an industrial site.

GENERAL

The inspection of an in-motion railway track scale is of a complex nature. Not only because of the inspection procedure itself, but also because it involves a great deal of planning, organization and communication with the parties involved.

This type of inspection requires an unusually large number of pieces of testing equipment, and requires the involvement of many people. A weighing in-motion track scale inspection is also time consuming. On occasion, the test may restrict or stop the operations of the plant where the inspection is performed. The cost of an in-motion weighing track scale inspection is relatively high.

The inspection must be very well planned and organized. Before going to the site to perform the tests, the inspector must ensure the following:

- A sufficient number of reference cars identical, in terms of type and weight range, to the cars normally weighed must have their weights determined on a suitable reference scale which must be previously inspected. Test car(s) and local standards must be available to perform this task.

- All testing equipment such as test car(s), appropriate amount and type of local standards (see Bulletin M-05), suitable reference cars, a locomotive and additional cars to form a train if required, must be readily available on site to perform the inspection of the in-motion weighing scale.

- A locomotive engineer, the scale operator, officials from both the railway company and the company owning the scale must be present.

- A technician should be on site in case minor adjustments to the scale have to be made. It would be unjustifiable to cancel the inspection with all the equipment and personnel in place because of a simple minor adjustment.

- The in-motion scale is accessible so that all testing equipment can be brought in and used for the scale inspection.
Type 10-11, 10-21 Automatic In-Motion Rail Weighing [IMRW]

The inspector must, in advance, become familiar with the instrumentation of the in-motion scale. The characteristics of the scale operation and installation as well as the intended use are some of the elements that must be known by the inspector prior to testing the scale. This information is needed to effectively implement the inspection procedure and to know which limits of error will be applied.

Classification of In-motion Weighing Systems

In-motion rail systems may be used to weigh complete trains as a summation of all rail cars or to obtain individual weights of the rail cars in a train. For trade purposes, the rail car weights may be used to either assess transportation charges or to assess commodity values. In general, in-motion weighing can be classified under the following headings:

- uncoupled in-motion weighing single draft
- uncoupled in-motion weighing double draft
- coupled in-motion total summation
- coupled in-motion individual rail car weighing

The intended use of the in-motion scale determines which limits of error apply. Limits of error for in-motion weighing are found in sections 189 to 191 of the Weights and Measures Regulations

<table>
<thead>
<tr>
<th>Intended Use</th>
<th>Uncoupled Single/Double Draft</th>
<th>Coupled Individual</th>
<th>Coupled Summation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freight Charge</td>
<td>section 189 (2)</td>
<td>section 191 (1)</td>
<td>section 190 (2)</td>
</tr>
<tr>
<td>Commodities</td>
<td>section 189 (2)</td>
<td>section 191 (2)</td>
<td>section 190 (2)</td>
</tr>
</tbody>
</table>

Testing Philosophy

The scale shall be tested in a manner which will simulate its intended use. The reference cars and the length of the test train shall be representative of the types and weight range of railway cars and length of the trains intended to be weighed. In developing the test procedure for a particular site, the inspector must give consideration to the direction of motion, the manner of movement and the velocity requirements.

Reference Cars

Reference cars are required to perform tests on an in-motion rail scale. As mentioned above, the design and configuration of reference cars must be representative of the cars normally weighed. However, the content of the reference cars shall be of a dry stable nature to ensure that the load will not move in the car during the tests. However, if the scale is intended to be used to weigh tank cars (liquids), the scale shall demonstrate its ability to weigh accordingly. If the reference cars are exposed to the rain, snow etc., the inspector must be conscious that their weight is susceptible to change drastically. The inspector shall not use reference cars which are suspected to have changed weight.
Type 10-11, 10-21 Automatic In-Motion Rail Weighing [IMRW]

Reference Scale

The weight of the reference cars will be obtained statically on a scale that has been demonstrated to perform accurately to within the required limits of error. The scale must be tested using NAWDS and suitable standards.

Three acceptable methods for obtaining the reference weights are given in order of preference:

1. The scale under test, if it is capable of fully supporting the reference cars.
2. A previously inspected scale capable of fully supporting the rail cars.
3. The scale under test using a double draft method.

Refer to the Procedures for information on how to develop suitable reference cars.

IN-MOTION WEIGHING SCALE

Visual examination

Notice of Approval

The inspector will ensure that the scale is an approved model. The inspector will ensure that the scale complies with all conditions, restrictions or parameters that may be stated in the Notice of Approval or on the certificate from the last inspection. Restrictions may include: speed limits, directional restrictions, method of use, train configurations, location, etc.

Electronic instrumentation must be approved for Automatic In-Motion weighing. Instruments approved only as Non-Automatic Weighing devices shall not be used for this purpose. (Note: In-Motion Rail Weighing systems installed before NAWDS shall be grandfathered as required.)

Marking

Ensure that the track scale is marked as required by section 18 of the Regulations (model number, SWA number, serial number, etc.) and section 33 of the specifications (operating velocity). The instrumentation must also be appropriately marked.

Sealing

Ensure that the device complies with section 10 of SGM-3 and section 7 of SGM-4, In-Motion Weighing Specifications. Ensure that the coarse zero and the span adjustment in the static mode as well as the dynamic setting in the in-motion mode, can be sealed. Ensure that the junction box(es) can also be sealed if they contain means of adjustment.

Wheel Detectors

Ensure that the wheel detectors are properly and securely installed.
Type 10-11, 10-21  Automatic In-Motion Rail Weighing [IMRW]

Weighbridge

Determine if the scale is of a live weighbridge or live rail variety. Ensure that the rails on the load receiving element are installed and secured according to section 15 of the Specifications. Ensure that there is no undue displacement of the rails or weighbridge as a locomotive passes over the weighing element.

Approach and Departure Rails

Ensure compliance with sections 22, 23 and 24 of the Specifications (SGM-4). Examine the approach and departure rails. The rails shall be:

- parallel, aligned and levelled;
- anchored properly. The rails must be solidly fastened to the foundation at the scale end so that the expansion/contraction due to temperature fluctuations will occur in the direction opposed to the scale;
- straight, uninterrupted and without joints for a minimum length as specified.

The gap between the weighbridge rails and the approach and departure rails must be minimized by means of transverse bevelling of the rails.

The rails must be installed on solid foundations to prevent any displacement due to frost or the weight of the train.

Scale Pit

The pit must conform to the Regulations in terms of access, cleanliness, etc.

**NOTE:** Never enter a scale pit without permission from the scale owner. Any persons entering a scale pit shall be familiar with Confined Space Entry procedures.

Load Cells

Ensure that the load cells and check system are installed in accordance with the approved design. Load cell bases or levelling plates must be properly secured and grouted as appropriate.

Check System

Ensure that the check system is in place, and adjusted properly.

Cables and Ground

Ensure that the grounding system is in place and that the cables are enclosed in conduits for their protection and shielding.

Ensure that the load cell and power cables are in separate conduits.
Type 10-11, 10-21 Automatic In-Motion Rail Weighing [IMRW]

Instrumentation

Static Mode

Ensure that both the static and dynamic mode are operational. Identify any other operating modes such as "overload" or "internal" modes.

Ensure that the mode selected is properly indicated.

Ensure that the minimum graduation complies with section 15.3 of SGM-3. The maximum allowed is 10 kg. The minimum graduation is displayed only in the static mode.

Dynamic Mode

Ensure that the mode selected is properly indicated.

PROCEDURE - DEVELOP REFERENCE CARS

The weight of the reference cars will be obtained statically on a scale that has been demonstrated to perform accurately to within the required limits of error. Three acceptable methods for obtaining the reference weights are given in order of preference:

**Single Draft Weighing Method**

1. The scale under test, if it is capable of fully supporting the reference cars.
2. A previously inspected scale capable of fully supporting the rail cars.

**Double Draft Weighing Methods**

3. The scale under test using a double draft method.

Single Draft Weighing Methods

Methods one and two listed above allow the reference cars to be fully supported by the scale. This is the preferred method for developing reference cars.

The scale must be tested to full capacity (NAWDS requirements for sensitivity, accuracy, repeatability, etc.) or at least to the used capacity, before the reference cars are weighed. It is highly important that the scale used to determine the weight of the reference cars is sensitive and repeats (0.05% or better). The test car(s) and a sufficient amount of local standards must be available to test the reference scale.

The reference cars must be weighed as accurately as possible. For the determination of the weights of the reference cars, the error of the scale should be taken into consideration. Immediately following the assessment of reference car weights, the test car must be placed back on the reference scale to ensure that it has maintained its accuracy.
Type 10-11, 10-21 Automatic In-Motion Rail Weighing [IMRW]

In determining if method 2 is a viable alternative, consideration must be given to the retrieval time rather than simply the distance between the reference scale and the in-motion weighing scale. Any long delay increases the chance that the weight of the reference cars may change.

Double Draft Weighing Method

Method 3 listed above may be used to determine the weight of the reference cars if neither of the other two methods is viable. It must be emphasized that the scale must demonstrate the required static accuracy and have the capability of weighing double draft accurately. The double draft weighing method must take into account the effects of the approach and departure areas of the scale. Usually, the weighing of the reference cars takes place in the inspection procedure of the in-motion track scale right after the static tests.

The equipment needed to determine if the scale has the capability of weighing double draft accurately, is a flat bed railcar and a minimum of 10 000 kg (20 000 kg preferable) of local standards. The following procedure will determine if the double draft method can be used to determine the weight of the reference cars:

Each buggy of the empty flat bed rail car will be weighed at two predetermined positions located near the ends of the weigh deck. These predetermined positions will be used for all the weighing under this part of the procedure and should be marked on the scale deck. Each buggy is weighed in turn at each of the predetermined positions. The weight of the flat bed rail car is obtained by summing all the weights and dividing by two. The result is the weight of the empty flat car.

The local standards are then distributed across the flat car in a manner which will prevent the weight from shifting due to the car movement.

The loaded flat bed rail car is weighed as previously respecting the same positions. The result is the total weight of the flat car and the standard weights.

The difference between the two weighing must equal (subject to the tolerance) the standard weights placed on the flat bed car. Any error shall be within the limits of error specified in sections 174 and 175 of the Regulations. If unsuccessful, this method can not be used to determine the weight of the reference cars.

If the performance and accuracy of the scale is acceptable, then the in-motion weighing scale may be used in determining the weights of the reference cars. The reference cars will be weighed using the same procedure as for the flat bed rail car. The reference cars will be placed at the same predetermined positions.

Number of Reference Cars

To inspect an uncoupled in-motion weighing track scale, at least 5 reference cars are needed. Each reference car will be run over the scale a minimum of 3 times and may be run over the scale up to 10 times (see section 189.(2) of the Regulations).
Type 10-11, 10-21 Automatic In-Motion Rail Weighing [IMRW]

To inspect a coupled in-motion weighing track scale intended to be used exclusively to establish transportation charges, 15 loaded reference cars or 10% of the number of cars that compose trains normally weighed, whichever is greater, are needed. If the trains normally weighed are composed of less than 15 cars, the test train will be composed of the same number of reference cars. A minimum of 3 tests in each manner of using the scale (i.e. pushing/pulling, directions) will be performed. The scale may be tested in each manner of use up to 10 times according to section 191.(3) of the Regulations.

To inspect a coupled in-motion weighing track scale intended to be used for custody transfer of commodities, two test trains are needed. The first one will be composed of empty cars, the second will be composed of loaded cars. Each train will contain 15 reference cars or 10% of the number of cars that compose trains normally weighed, whichever is greater. However, if the trains normally weighed are composed of less than 15 cars, the test trains will be composed entirely of reference cars. They will be run over the scale at least 3 times in each manner of use. The scale may be tested in each manner of use up to 10 times according to sections 190(3) and 191(3) of the Regulations.

Note: It is prudent to assemble 1 or 2 extra reference cars, especially when conducting coupled in-motion testing. Having an extra reference car allows the inspector the flexibility to ‘discard’ the results from a problematic car during the dynamic testing.

PROCEDURE - UNCOUPLED IN-MOTION

Static Test

The static test of an in-motion scale is similar to the tests performed on railway track scales for static weighing and should be conducted using the applicable STP’s from NAWDS. The scale should be tested to capacity or at least to the capacity at which the scale is to be used. The instrument must include a static operating mode. In this mode, wheel detectors and circuitry are deactivated and the in-motion scale operates like a static weighing scale.

The inspector should record the errors of the scale even if errors are within the allowable limits. This information will be useful in assessing the performance of the device during dynamic/automatic operation.

Dynamic Test

To test an uncoupled in-motion track scale, five reference cars will be passed over the scale a minimum of 3 times. The reference cars may be passed over the scale up to ten times (see section R189.2(2)) for a maximum of 50 weighings. The reference cars shall be representative of the types and weight range of the railway cars normally weighed.

The reference cars are pulled up to the start point. The cars are uncoupled and launched. Due to the effect of gravity or momentum, they pass over the scale.
Type 10-11, 10-21 Automatic In-Motion Rail Weighing [IMRW]

During the test, ensure that:

- all weights are automatically erased from the scale memory after printing.
- the weight indications are identified with the words "gross weight", "tare" and "net weight" (or the French equivalent).

Ticket - General

The time and date of the weighing and the identification number of the cars must appear on the ticket. The weight of the locomotive shall not be printed.

The tare weight shall be identified as "stenciled" or "actual".

When a scale is used in a mode (overload, internal) other than a mode for which it is approved or certified, or when a scale is used in a manner (direction, pulling/pushing) other than a manner for which it is approved or certified, tickets shall bear the legend "The weights recorded shall not be used in trade" or words having the same meaning.

PROCEDURE - COUPLED IN-MOTION

Static Test

The static test of an in-motion scale is similar to the tests performed on railway track scales for static weighing and should be conducted using the applicable STP’s from NAWDS. The tests should be carried to capacity or at least to the capacity at which the scale is to be used. The instrument must include a static operating mode. In this mode, wheel detectors and circuitry are deactivated and the in-motion scale operates like a static weighing scale.

The inspector should record the errors of the scale even if errors are within the allowable limits. This information will be useful in assessing the performance of the device during dynamic/automatic operation.

Dynamic Test

As mentioned earlier, the scale shall be tested in a manner which simulates its intended use. The test procedure takes into consideration the length of trains normally weighed, the type of cars and the range of their weight. Also taken into consideration are the direction of motion, the manner of movement (pushing or pulling the cars), and the velocity. The intended use of the scale determines which limits of error will apply: determination of transportation charges, weighing commodities for custody transfer, individual cars or summation. This information is provided by the owner or the operator of the scale at the earliest stage.

Forming the Test Train

In forming the train for test purposes, the rail cars and the number of rail cars in the train shall be representative of the type of cars which will normally be weighed on the scale. There should be no mix of empty and loaded cars in the same train unless the scale is intended to be used in this specific manner. Experience has demonstrated that weighing accurately a mix of empty and loaded cars is difficult.
Type 10-11, 10-21 Automatic In-Motion Rail Weighing [IMRW]

Number of Reference Cars in Test Train

Test train containing 15 cars or less will be composed entirely of weighed reference cars. Longer test trains will be composed of a minimum of 15 reference cars or 10% of the total number of cars forming the train, whichever is greater.

Positioning the reference cars within the train.

The reference cars are placed in groups of five cars each. The groups, within the test train, are positioned in the following manner:

- Coupled at the locomotive
- into 1/3 of the train
- into 2/3 of the train

Test trains which are comprised of rail cars of different masses must be tested accordingly. The reference cars must reflect these variations in mass. Each group of reference cars will be composed of varying masses and the cars will be distributed within the group as follows:

< light - heavy - light - heavy - heavy >

Another acceptable alternative is to use a test train composed of 50% (approx.) of reference cars. For the first three runs, the reference cars are located in the first half of the train. For the next three runs the reference cars are located in the second half of the train. This method is sometime advantageous because it requires less railway car repositioning or movement. However, the number of reference cars required may prove to be excessive.

Transportation Charges

For scales intended for assessing freight charges, the net weight may be obtained by using the "stencilled" tare of the rail cars. Stencilled tare may be entered by any means. Normally, trains will be composed of loaded cars only.

Commodity Assessment

Scales intended to weigh commodities require the determination and the testing for gross and tare weight. The use of stencilled tare is prohibited. Calculated net may be obtained manually from simple arithmetic or may be calculated internally by the device. This procedure will determine the ability of the in-motion weighing scale to weigh commodities accurately. Empty reference cars and loaded reference cars must be made available for this test. The limit of error applies to the net known test load which is the difference between the static weight of a loaded reference car and the static weight of an empty reference car.
Type 10-11, 10-21   Automatic In-Motion Rail Weighing [IMRW]

Two-Train Method

Since the limits of error are based on the net known test load, results are obtained by weighing statically each car in each train and comparing the results to the same cars weighed dynamically. If each loaded car in one train is a known test load and each empty car in the other train is a known test load, the difference between the gross and the tare will be the net known test load providing that each car in one train is matched with its counterpart in the other train. To achieve this, weigh statically each car of the empty train using one of the three methods described earlier to obtain a known test load of each car. Proceed with the dynamic test for a minimum of three runs. Weigh the other train statically on the same device used for the first static test to obtain the known test load of each loaded car in that second train. Proceed with the dynamic test for a minimum of three runs. Subtract the dynamic weight of the first empty car from the dynamic weight of the first loaded car. Find the difference between the same cars weighed statically. Do the same calculation for each train for each run remembering to match each of them. The difference between static and the dynamic weights must be within the prescribed limits of error.

One-Train Method

Weigh statically each empty reference car. Place them in a train composed of empty cars. Proceed with the dynamic test for a minimum of three times. Record the results. Load the cars in the train with dry material. Weigh statically each loaded reference car. The difference between the static loaded and the static empty weight of a reference car is the net known test load. Then the train is weighed dynamically at least three times. The difference between the dynamic loaded and the dynamic empty weight of a reference car is the dynamic net weight. The dynamic net weight of each reference car is compared to its net know test load. The difference shall be within the prescribed limits of error.

Another acceptable method is to couple empty cars to form a train. Then the cars will be dynamically weighed on the in-motion scale. Each car will then be loaded with material the weight of which has been previously determined. The load (material) in each car is the net known test load. Then the train composed of these loaded cars is weighed dynamically. The difference between the dynamic loaded and the dynamic empty weigh of each reference car is the dynamic net weight. The dynamic net weight of each reference car is compared to its net known test load. For instance, a hopper scale having the necessary accuracy and that has been previously inspected could serve to determine the weight of the material in each reference car.

Velocity

A coupled in-motion scale will be tested at two different speeds within the approved range. It is not recommended to change the speed during a run because unusual dynamic forces may jeopardize the test.

Limits of Error

Coupled in-motion - Transportation

• At least 70 % of the individual weights shall be within 0.2 % of the known individual static weights.
• Not more than 5 % of the individual weights shall differ by more than 0.5 % from the known individual static weights.
• None shall differ by more than 1 %.
Type 10-11, 10-21  Automatic In-Motion Rail Weighing [IMRW]

Coupled In-Motion - Commodities

Unit train - The limit of error is 0.15 % of the sum of the net known test load.

Individual - The limit of error is 0.15 % of the net known test load for each dynamic weighing.

Note: When conducting commodity tests, the scale will calculate the net weights from previously stored tare weights and currently weighed gross weights. Because the tare weights may be recalled by entering the car number (manually or automatically), or recalled by sequence of car in the train, it is important that testing for the "full" cars follow the same order of cars and sequence of weighing that was used for the "empty" cars.

Safeguard Features

The following tests are to ensure that the safeguard features of the device are in operation. Just a few cars and the locomotive are needed for these tests.

Set the device to the dynamic weighing mode. Run the train over the scale at a velocity within the approved limits.

There should be no weighing since the activation of the controls have not been done properly. Examples of controls and sequences are:

- setting the scale to zero before weighing;
- entering the identification number of the cars to be weighed;
- entering the stencilled tare if the device is used for freight determination only;
- setting the device to the right mode;
- entering a code to allow for the use of the scale;
- activating a button to authorize the weighing.

Reposition the train. Reset the device to zero. Enter the data following the sequence. Ensure that the following safeguard features operate correctly:

The scale must stop weighing if the approved speed limits are exceeded. It shall not be possible to print the weight of the cars.

Stop the train after half has crossed the scale, reverse its direction for several car lengths and then complete the test. Each car must be weighed once. If the scale is not designed to weigh accurately when rollback occurs, it shall stop registering the weights.
Type 10-11, 10-21  Automatic In-Motion Rail Weighing [IMRW]

During this test:

Attempt to change the gross weight through the keyboard. It shall not be possible.

Ensure that keyboard entries such as "tare" are identified as such. For this purpose a "*" beside the weight indications may be used if on each ticket a footnote explains the meaning.

Ensure that actual tares are stored in association with the proper identification numbers of the cars and once recalled that they are linked to the correct car and the correct gross weight.

Coupled In-Motion Performance Tests

Position the train at a starting point located at least 30 metres from the scale. The inspector should ensure that all weights are obtained with the train moving at a constant velocity. To obtain a constant velocity, the train must begin its acceleration well before the scale approach and decelerate only after the last weighing has been obtained. The smoother the train runs across the scale, the better the chance the results will be within tolerance.

Initiate the weighing sequence (i.e. enter car data; reset the scale to zero; authorize the weighing).

Perform at least three tests in each desired manner of use (both directions, pulling and pushing, cars empty and loaded).

Perform tests at two different speeds within the approved limits. Do not attempt to change the speed during a run.

During the tests, ensure that:

• all weights are automatically erased from the scale memory after printing.

• the weight indications are identified with the words "gross weight", "tare" and "net weight" (or the French equivalent).

Ticket - General

The time and date of the weighing and the identification number of the cars must appear on the ticket. The weight of the locomotive shall not be printed.

The tare weight shall be identified as "stencilled" or "actual".

When a scale is used in a mode (overload, internal) other than a mode for which it is approved or certified, or when a scale is used in a manner (direction, pulling/pushing) other than a manner for which it is approved or certified, tickets shall bear the legend "The weights recorded shall not be used in trade" or words having the same meaning.
Automatic Weighing Devices

Type 10-11, 10-21  Automatic In-Motion Rail Weighing [IMRW]

Ticket - Unit Train

Computation or registration of individual car net weights is prohibited.

The gross weight of individual cars may be printed as long as they are identified by "UT" or "TB". This information is for overload control only.

If the summation of the net weights is printed, the total gross weight must also be printed. This is particular to "unit train" weighing.

Performance

The in-motion weighing track scale will be certified if it meets or exceeds the performance requirements prescribed by the Regulations. The limits of error for in-motion weighing scales are related to the manner the scale is intended to be used. The limits of error that apply to a track scale used exclusively to assess transportation charges are larger than for a track scale used to assess the weight of the commodities. The results of the dynamic tests will be analyzed taking into account the intended use of the device and the applicable limits of error.

Dynamic Adjustment

A dynamic adjustment may be necessary to bring the device within tolerances. The maximum range (design) for the dynamic adjustment is limited to 0.25%; this is an approval criteria. One way of ensuring that the factor entered (dynamic adjustment) does not exceed 0.25%, is to weigh the test car in the static mode, and re-weigh it statically in the dynamic mode by activating the wheel detectors to simulate the passage of a car.

Certification

The Inspection Certificate must describe the in-motion weighing track scale. The Certificate also indicates the manner(s) the scale may be used (restrictions); for instance, the scale may be restricted for weighing in one direction when the locomotive is pulling; it may only be used to determine transportation charges, etc. Section 70 of the Weights and Measures Regulations requires that the restriction(s) be posted.

Sealing and Stamping

The in-motion weighing scale (equipment) must be sealed and stamped as required by sections 29, 31 and 32 of the Weights and Measures Regulations.

INTERPRETATION OF RESULTS

The DUT is deemed to comply if all results are within the acceptable LOE.

REVISION

Original Document
Type 9-X1 Automatic In-Motion Vehicle Weighing [IMVW]

REFERENCE

Weights and Measures Regulations.

PURPOSE

In Motion Weighing of Road Vehicles.

GENERAL

This device class is not in trade service in Canada and suitable test procedures have not yet been developed.

This document is issued as a place holder only.

REVISION

Original Document.
Appendix A

The following table lists acceptable defining words and symbols for the marking of devices. This list does not standardize the abbreviation or symbols that must be used, rather it identifies abbreviations or symbols routinely used. Other abbreviations or symbols, such as those internationally recognized (OIML), are also acceptable.

<table>
<thead>
<tr>
<th>Units</th>
<th>Definition</th>
<th>Acceptable Symbol</th>
<th>Not Acceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>kilogram</td>
<td>basic unit</td>
<td>kg</td>
<td>KG, kilo</td>
</tr>
<tr>
<td>gram</td>
<td>(1/1000) kg</td>
<td>g</td>
<td>gr, gm, G, GM</td>
</tr>
<tr>
<td>pound</td>
<td>0.453 592 37 kg</td>
<td>lb</td>
<td>LB, lbs, #</td>
</tr>
<tr>
<td>ounce</td>
<td>(1/16) pound (or 437 ½ grains)</td>
<td>oz</td>
<td>OZ</td>
</tr>
<tr>
<td>dram</td>
<td>(1/16) ounce</td>
<td>dr</td>
<td>DR</td>
</tr>
<tr>
<td>grain</td>
<td>(1/7000) pound</td>
<td>gr</td>
<td>GRN, gm, GN, g</td>
</tr>
<tr>
<td>tonne (or metric ton)</td>
<td>1 000 kg</td>
<td>t</td>
<td>T, TN, tn</td>
</tr>
<tr>
<td>ton</td>
<td>2 000 pounds</td>
<td>tn</td>
<td>t, TN, T</td>
</tr>
<tr>
<td>cental (or hundredweight)</td>
<td>100 pounds</td>
<td>ctl or cwt</td>
<td></td>
</tr>
<tr>
<td>troy ounce</td>
<td>480 grains</td>
<td>tr oz</td>
<td></td>
</tr>
<tr>
<td>carat</td>
<td>200 milligrams</td>
<td>ct</td>
<td>c</td>
</tr>
</tbody>
</table>

Zero key or center of zero indicator: \[→0←\]

Tare entered: \[\rightarrow\rightarrow\]
## Appendix A

### Abbreviations and Symbols Accepted in Canada

<table>
<thead>
<tr>
<th>Units</th>
<th>Definition</th>
<th>Acceptable Symbol</th>
<th>Not Acceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy class</td>
<td>Class I, II, III, III HD, IIII, or symbols enclosed in an ellipse such as:</td>
<td><img src="image" alt="I" /></td>
<td>I, II, III, III HD, IV or 1, 2, 3, 3 HD, 4</td>
</tr>
<tr>
<td>Maximum number of scale intervals</td>
<td>$n_{max}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum verification scale interval</td>
<td>$e_{min}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of the actual scale interval</td>
<td>$d$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of the verification scale interval</td>
<td>$e$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of scale intervals</td>
<td>$n$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross weight</td>
<td>gross, G, GR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tare</td>
<td>tare, T, TA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net weight</td>
<td>net, N, NT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual weight entry</td>
<td>manual weight MAN WT, MANUAL WT, MAN WEIGHT</td>
<td></td>
<td>M, MW, MAN</td>
</tr>
</tbody>
</table>
## Appendix A

### Additional Authorized Symbols

<table>
<thead>
<tr>
<th>Units</th>
<th>Symbols</th>
<th>Units</th>
<th>Symbols</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acre</td>
<td>no symbol allowed</td>
<td>Inch (pouce)</td>
<td>in (po)</td>
</tr>
<tr>
<td>Bushel (boisseau)</td>
<td>bu</td>
<td>Link (chaînon)</td>
<td>li (chon)</td>
</tr>
<tr>
<td>Chain (chaîne)</td>
<td>ch</td>
<td>Mile (mille)</td>
<td>mi</td>
</tr>
<tr>
<td>Dram (drachme)</td>
<td>dr</td>
<td>Peck (quart de boisseau)</td>
<td>pk</td>
</tr>
<tr>
<td>Fluid dram (drachme fluide)</td>
<td>fl dr</td>
<td>Pint (chopine)</td>
<td>pt (chop)</td>
</tr>
<tr>
<td>Fluid ounce (once fluide)</td>
<td>fl oz</td>
<td>Quart (pinte)</td>
<td>qt (pte)</td>
</tr>
<tr>
<td>Foot (Pied)</td>
<td>ft (pi)</td>
<td>Rod, perch, pole (perche)</td>
<td>no symbol allowed</td>
</tr>
<tr>
<td>Furlong</td>
<td>no symbol allowed</td>
<td>Ton (tonne)</td>
<td>tn</td>
</tr>
<tr>
<td>Imperial gallon</td>
<td>gal</td>
<td>Yard (verge)</td>
<td>yd (vg)</td>
</tr>
<tr>
<td>Gill (roquille)</td>
<td>gi</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Original Document.
Appendix C - Standards Accuracy Class - Automatic Weighing Device

The following tables list the required accuracy standard for an inspection of a given device Automatic Device class. Individual tables are provided for *Acceptance* and *In-Service* as well as for *Metric* and *Avoirdupuis* units of measure.

<table>
<thead>
<tr>
<th>Metric Device type</th>
<th>Required accuracy class of the standard - Acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E₁</td>
</tr>
<tr>
<td>Automatic scale (0.075%) - R174</td>
<td>E₁ ≥ 20 mg</td>
</tr>
<tr>
<td>Automatic hopper / tank scale (0.05%) - R188</td>
<td>All</td>
</tr>
<tr>
<td>In-motion railway scale Static Test (0.075%) - R189, 174</td>
<td>All</td>
</tr>
<tr>
<td>In-motion railway scale (approx. 0.15%) - R189.2, 190, 191</td>
<td>All</td>
</tr>
<tr>
<td>Automatic crane scale Freight (0.5%) - R192</td>
<td>All</td>
</tr>
<tr>
<td>Conveyor belt scale - cheap commodities (0.5%) - R193</td>
<td>Material tests (Bulletin M-02)</td>
</tr>
</tbody>
</table>

**NOTES:**

- Class **F₂** is equal to Measurement Canada’s *Precious Metal Weight Kits*.
- Class **M₁** is equal to Measurement Canada’s *Inspector’s Weight Kits*.
- **n** is the maximum number of scale intervals which can be verified on the indicated device type, with the indicated accuracy class standard.
### Appendix C - Standards Accuracy Class - Automatic Weighing Device

<table>
<thead>
<tr>
<th>Metric Device type</th>
<th>Required accuracy class of the standard - In Service</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E₁</td>
</tr>
<tr>
<td>Automatic scale (0.1%) R175</td>
<td>E₁ ≥ 10 mg</td>
</tr>
<tr>
<td>Automatic hopper / tank scale (0.1%) - R188</td>
<td>All</td>
</tr>
<tr>
<td>In-motion railway scale Static test (0.1%) R189, 175</td>
<td>All</td>
</tr>
<tr>
<td>In-motion railway scale (approx. 0.15%) R189.2, 190, 191</td>
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</tr>
<tr>
<td>Automatic crane scale Freight (0.5%) - R192</td>
<td>All</td>
</tr>
<tr>
<td>Conveyor belt scale - cheap commodities (0.5%) R193</td>
<td>All</td>
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**NOTES:**

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Appendix C - Standards Accuracy Class - Automatic Weighing Device

<table>
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<tr>
<th>Avoirdupois Device type</th>
<th>Required accuracy class of the standard - Acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E₁</td>
</tr>
<tr>
<td>Automatic scale (0.075%) R174</td>
<td>E₁ 1 gr ≥ 0.0002 oz tr</td>
</tr>
<tr>
<td>Automatic hopper / tank scale (0.05%) R188</td>
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</tr>
<tr>
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</tr>
<tr>
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<td>All</td>
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<tr>
<td>Automatic crane scale Freight (0.5%) R192</td>
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NOTES:

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- Class M₁ is equal to Measurement Canada’s Inspector’s Weight Kits.
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</thead>
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<td></td>
<td>E₁</td>
</tr>
<tr>
<td>Automatic scale (0.1%) R175</td>
<td></td>
</tr>
<tr>
<td>Automatic hopper / tank scale (0.1%) - R188</td>
<td>NA</td>
</tr>
<tr>
<td>In-motion railway scale Static test (0.1%) R189, 175</td>
<td>All</td>
</tr>
<tr>
<td>In-motion railway scale (approx. 0.15%) R189.2, 190, 191</td>
<td>All</td>
</tr>
<tr>
<td>Automatic crane scale Freight (0.5%) - R192</td>
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<tr>
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Material tests (Bulletin M-02)

**NOTES:**
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- Class M₁ is equal to Measurement Canada’s *Inspector’s Weight Kits*.
- n is the maximum number of scale intervals which can be verified on the indicated device type, with the indicated accuracy class standard.

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