PART 1

PART 2 - Standard Test Procedures

PART 3 - APPENDIX

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.

INTRODUCTION - SYMBOLS, ACRONYMS AND DEFINITIONS

AZSM	Automatic Zero-Setting Mechanism
d	Actual Scale Interval
DUT	Device Under Test
e	Verification Scale Interval
e_{min}	Minimum Verification Scale Interval
EMI	Electromagnetic Interference
IPO	Inspection Procedure Outlines
IZSM	Initial Zero-Setting Mechanism
Laboratory	Measurement Canada Laboratory
MC	Measurement Canada
Max	Maximum Capacity
MZSM	Manual Zero-Setting Mechanism
NOA	Notice of Approval
n_{max}	Maximum Number of Scale Intervals
OIML	Organisation internationale de métrologie légale
PLU Code	Price Look Up Code
POS	Point-of-Sale Weighing System
RFI	Radio Frequency Interference
SAZSM	Semi Automatic Zero-Setting Mechanism
STP	Standard Test Procedures
ZU	Zone of Uncertainty

AUTOMATIC WEIGHING DEVICE - 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.

Date of revision or addition	Language	Section	Nature of the revision or addition
October 2016	English/French	Part 2, section 1	-Renamed the title: "Part 2, section 1a: Type 2-11, 3-11, 7-11: Automatic Catch Weighing Device—Dynamic Weighing'' -In Part 2, added section 1b, titled "Type 3-12: Automatic Catch Weighing Device—Static Weighing'' -Updated the document to specify that the procedure in section 1a is to be used for testing of ACWDs that perform dynamic weighing -Specified the device types which can be tested using section 1a procedure -Editorial corrections to ensure consistency of terminology used
October 2016	English/French	Part 3, section D	- Editorial changes and extensive modifications to the Product Test Load Development procedure for individual commodities.
September 2013	English/French	Part 2, ASTP – 3 DTWS	- Simplified procedure and grouped relevant sections. - Provided references for procedures addressed elsewhere (e.g. break point).

Introduction - Revisions Table

May 2013	English/French	Part 3, Appendix C	- Removed all references to bulletin M-02, which has been revoked.
March 2013	English/French	Part 2, ASTP – 8	- Removed Product Test Load Development procedure as they will be included elsewhere. - Removed Test Chain procedure as they are now considered obsolete. - Added notification regarding LOE from sections 174 and 175. - Reduced Minimum Totalized Load to 800e for R193 devices to harmonize with OIML. - Added weighbelt and roller information. - Expanded sealing requirements to include speed sensors. - Miscellaneous clarifications and corrections.
March 2013	English/French	Product Test Load Development	- New procedure
October 2011	English/French	Part 2, ASTP – 3 DTWS	- Simplified test procedure.

Type 2-31, 3-11, 7-11 Automatic catch weighing device—Dynamic weighing

Reference

Weights and Measures Regulations – limits of error from sections 176,177 and 185, as appropriate. Product Test Load Development procedure.

Purpose

Weighing of discrete loads on an overhead rail scale or belt scale (not including automatic continuous totalizing weighing systems, which are 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 meat and cheese processing plants as well as shipping and courier establishments.

Requirements

The device under test (DUT) must be tested for performance in the static mode (excluding motion detection) using the standard test procedures / inspection procedure outlines from the *Specifications Relating to Non-automatic Weighing Devices*. The limits of error applicable to automatic scales must be applied. 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.

General

Automatic catch weighing devices (ACWDs) that weigh dynamically must be tested dynamically using product test loads which are representative of the types of products intended to be weighed by the system. In order to use test loads, the weight and uncertainty of the test loads must be determined. The separate Product Test Load Development procedure will assist the inspector in assuring that the intended test loads are suitable for use.

Type 2-31, 3-11, 7-11 Automatic catch weighing device—Dynamic weighing

Procedures

Creating test loads

1. Selecting appropriate test loads.

    a. Select suitable test loads representative of the product typically weighed on the device. The number of test loads and test runs required may be determined from the table below (typically ten for belt scales and five for overhead rail scales). The total number of individual test loads may be increased in order to facilitate testing, but the minimum number of runs must be respected at all times. Test loads must be stable and should be representative of the actual product to be weighed.

    b. If the DUT is used over a range of weights, then the test loads must be selected so that they span the intended usage range of the device (light - medium - heavy).

2. Refer to the Product Test Load Development procedure to determine the acceptable upper and lower indicated values for each of the product test loads.

Dynamic test procedure

1. Determine the belt or overhead rail speed and ensure that it is within the limits stipulated in the Notice of Approval. 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 rail scales, known loads should be interspersed amongst the unknown loads (start - middle - end). To facilitate testing, 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 previously established using the Product Test Load Development procedure.

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

Type 2-31, 3-11, 7-11 Automatic catch weighing device—Dynamic weighing

Minimum number of weighments required – Dynamic weighing		
Automatic catch weighing device—Belt scale	Weighments	Description
≤ 60 m/min (≤200 ft/min)	60 weighments	10 test loads × 6 runs
> 60 to 75 m/min (> 200 to 250 ft/min)	70 weighments	10 test loads × 7 runs
> 75 to 90 m/min (>250 to 300 ft/min)	80 weighments	10 test loads × 8 runs
> 90 to 106 m/min (>300 to 350 ft/min)	90 weighments	10 test loads × 9 runs
> 106 m/min (> 350 ft/min)	100 weighments	10 test loads × 10 runs
Automatic catch weighing device—Overhead rail scale	Weighments	Description
All devices	15 weighments at each speed. (5 known test loads × 3 runs = 15 weighments)	Minimum of: 5 known test loads and 5 unknown loads[1] = 10 loads/runs

Interpretation of results

The DUT is deemed to comply if all results are within the appropriate limits of error.

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, the test results for that load should be discarded. This is sometimes the case when a defective trolley is used to suspend a load, but it may also be due to a poorly selected test object.

Repeatability test (conduct at as found speed)

- Run a test load (near minimum capacity) up to ten (10) times.
- Run a second test load (near maximum capacity) up to ten (10) times.

These two test loads may be run and used as part of the dynamic test.

[1] All loads may be known test loads if desired. The unknown loads are used simply to evaluate the interactions between individual loads usually used while the system is in operation.

Type 2-31, 3-11, 7-11 Automatic catch weighing device—Dynamic weighing

Over length package test (conduct at as found speed)

Do not conduct this test if it will damage the system. Run 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). If a problem is found, the device should be rejected or the usage of the device restricted.

Off centre load test (scales with a belt only)

With the belt in motion, run a test load (0.5 Max) down each side of the scale and in the centre. The device must remain accurate within prescribed limits of error regardless of the location of the package on the belt.

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 the 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. If an uninterruptible power supply is used, do **not** disconnect the DUT from the UPS to conduct the power failure test.

After a sufficient length of time has elapsed (i.e. 1-2 min), 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 system memory or on a printed ticket.

Interpretation of results

The DUT is deemed to comply if all results of repeatability test, over length package test, off centre load test and power failure test are within the acceptable limits of error.

Determining belt speed

Belt speed may be determined directly from the DUT if so equipped with this feature. The accuracy of the DUT belt speed indication must be checked. If the DUT does not have a built in belt speed indication, belt speed must be determined as part of the test procedure. If belt speed is adjustable, the as tested speed must be entered on the inspection form and the speed control sealed. If the speed control is intended to be operator controlled or it cannot be sealed, the DUT must be tested at both the lowest and highest possible speeds.

Type 2-31, 3-11, 7-11 Automatic catch weighing device—Dynamic weighing

Portable tachometer

Using a suitable contact or non-contact tachometer, follow the manufacturer's instructions for determining the speed of one of the belt pulleys in rotations per minute (rpm). If the tachometer is used to measure the speed of a pulley directly driving the belt, the inspector must ensure that there is no slippage between the belt and the drive wheel. A better option is to measure the speed of an idler or a non-driven pulley. The belt speed may be calculated using one of the following formulas:

$$\text{belt speed(m/min)} = [\text{diameter(cm)} \times \pi \times \text{rpm}]/100$$

or

$$\text{belt speed(ft/min)} = [\text{diameter(in)} \times \pi \times \text{rpm}]/12$$

Where:
diameter = diameter of the pulley
rpm = rotations per minute of the pulley

If using a belt sensing tachometer capable of direct readings in feet or metres per minute, follow the manufacturer's instructions to determine the belt speed. In most cases, it can be measured directly from the belt with no further calculations.

Stop watch and 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 or subtract the appropriate fraction of the over or 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:

$$\text{belt speed(m/min)} = [\text{belt length(m)} \times \text{number of belt revolutions}(x)]/\text{time(min)}$$

Type 2-31, 3-11, 7-11 Automatic catch weighing device—Dynamic weighing

Example

You are measuring the belt speed of a 12 metre long belt by timing ten revolutions of the belt. It takes an additional 3 metres of overrun before the belt comes to a complete stop. The extra 3 metres must be added into your calculations if the time is taken until the belt stops. Acceleration and deceleration of the belt may be ignored for the purposes of determining the average belt speed.

Belt length = 12 metres
Revolutions = 10
Over run = 3 metres
Time = 1.5 minute

Actual revolutions $= 10 + (3/12) = 10.25$
Belt speed (m/min) $= (12\text{ m} \times 10.25)/1.5\text{ min} = 82\text{ m/min}$

Revisions

Rev. 3 (Oct 2016)

- updated to specify that the procedure is to be used to test automatic catch weighing devices that perform dynamic weighing
- specified the device types which can be tested using this procedure
- editorial corrections to ensure consistency of terminology used

Rev. 2 (June 2013)

- eliminated product test load criteria and reference product test load procedure instead
- reformatted for accessibility requirements

Rev. 1 (May 2008)

- simplified the procedure
- added uncertainty formulas

Type 3-12 Automatic catch weighing device—Static weighing

Reference

Weights and Measures Regulations—limits of error from section 176, 177 or 185, as appropriate.

Purpose

Static weighing of discrete loads on a scale incorporated into a fully automated production system. Typical applications include scales equipped with motorized belts or roller systems used in manufacturing facilities and other industrial establishments where the products being weighed must come to a complete stop before their weight can be recorded or printed.

Requirements

The device under test (DUT) must be tested for performance in the static mode (including motion detection), using the standard test procedures (STPs) / inspection procedure outlines (IPOs) from the *Specifications Relating to Non-automatic Weighing Devices*, applying limits of error applicable to automatic scales. The following requirements are in addition to static testing.

General

Automatic catch weighing devices (ACWDs) that weigh statically must also be tested to ensure that the automated production system in which they are installed does not adversely affect their ability to record or print accurate weights. Additional testing must be conducted using test loads representative of the types of products intended to be weighed by the system.

Procedures

Determining the speed of the weighing system in automatic mode

Although the number of loads weighed by an automatic catch weighing device that weighs statically is typically not very high, the speed of the operation of the weighing system must be recorded in the comments section of the device examination certificate. If the speed of the weighing system is intended to be operator controlled or the speed control cannot be sealed, the range of possible operating speeds must be determined and recorded on the device examination certificate and the DUT must be tested in automatic mode at both the lowest and highest possible speeds.

The operating speed of the weighing system can be determined by counting the number of loads weighed in a one-minute period.

Type 3-12 **Automatic catch weighing device – Dynamic weighing**

Selecting test loads and testing in automatic mode

Once the device has been tested and it has been determined that the motion detection feature operates correctly in static mode, the device must then be tested to ensure that the motion detection feature also operates correctly when used in automatic mode.

Selecting appropriate test loads

1. Select suitable test loads representative of the product typically weighed on the device. The minimum number of test loads and test runs required must be representative of the range of weights intended to be weighed by the system. The total number of individual test loads may be increased in order to facilitate testing, but the minimum number of runs must be respected at all times. Test loads must be stable and should be representative of the actual product to be weighed.

2. The weight of each test load must first be determined and recorded using the DUT in static mode.

3. A minimum of three test runs must be conducted to confirm the correct operation of the motion detection feature when the DUT is used in automatic mode.

4. If the DUT is used to weigh loads which are similar in size and do not vary in weight by more than 10%, one test load may be used provided that it can be run across the device several times, otherwise separate test loads can be used to obtain the minimum of three test runs required. If the DUT is used to weigh loads that vary in size or have a range of weights which vary by more than 10%, then a minimum of three test loads must be selected so that they span the intended usage range of the device (small to large, light to heavy).

Interpretation of results

For each test run, the weight of the test load(s) obtained in automatic mode must be recorded or printed by the DUT in accordance with the requirements for motion detection when compared to the weight of the test load(s) obtained in static mode.

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.

Type 3-12 **Automatic catch weighing device – Dynamic weighing**

While the system is in operational mode, interrupt the power to the DUT or, if so equipped, to the uninterruptible power supply. If an uninterruptible power supply is used, do **not** disconnect the DUT from the UPS to conduct the power failure test.

After a sufficient length of time (i.e. 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 system memory or on a printed ticket.

Interpretation of results

The DUT is deemed to comply if items previously weighed are accounted for in the system memory or on a printed ticket.

Type 6-11 Automatic Continuous Totalizing Weighing Systems [CTWS] (commonly referred to as a "*Conveyor Belt Scale*")

Reference

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

Product Test Load Development Procedure – Field Inspection Manual.

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.

Purpose

This device is designed for the 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. Devices which use other sensing technologies (nuclear, LVDT, etc.) may have specific requirements not addressed in these procedures.

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. A CTWS inspection is also time consuming. On occasion, the test may restrict or stop the operations of the facility where the inspection is performed. Therefore, the cost of a 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.

Type 6-11 Automatic Continuous Totalizing Weighing Systems [CTWS] (commonly referred to as a "*Conveyor Belt Scale*")

- 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 undesirable to have 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 inspection. If product is to be loaded onto, or received from, the DUT in a non typical fashion, modifications to the feed belts or other structures may be required to facilitate inspection. Modifications to the in-feed belt shall be assessed to ensure that the do not significantly alter the operational characteristics of the DUT. Modifications between the DUT and the custody transfer point shall not normally be permitted.

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 and how to best perform the inspection of the DUT.

Classification of Automatic Continuous Totalizing Devices

Automatic Continuous Totalizing Devices (CTWS) 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 (LOE) for a CTWS are found in the Weights and Measures Regulations:

Table 1

Intended Use	Regular Commodity	Inexpensive Commodity[1]
Assess Freight Charges	regulation 193	regulation 193
Custody Transfer Buy or Sell	regulation 174/175 as appropriate	regulation 193

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

[1] Inexpensive Commodity is deemed to mean any item for which a NAWDS Class IIII device would be suitable as per NAWDS Table 62.

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 its 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 setup and configured using calibrated weights (blocks or chain), a product test load is required to certify a CTWS. Only by using a product test load can the inspector be satisfied that the entire system is working properly.

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.

Development of the Product Test Load shall be done as per the appropriate procedure. Please refer to the procedure for Product Test Load Development for more information.

Type 6-11 Automatic Continuous Totalizing Weighing Systems [CTWS] (commonly referred to as a "*Conveyor Belt Scale*")

Visual Examination

Notice of Approval (NoA)

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 or on the certificate from the last inspection. Restrictions may include: belt speed, belt inclination, minimum loads, material types, location, etc.

Manufacturer's Installation Instructions

All components of the system must be installed as per the manufacturer's instructions and recommendations.

Marking

Ensure that the weighbridge is marked as required by section 18 of the Weights and Measures Regulations (model number, approval number, serial number, etc.). The integrating instrumentation must also be appropriately marked.

Sealing

The speed transducer, junction boxes and integrator are typically sealed to ensure that modifications which may affect the accuracy of the device are not made without breaking a seal.

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.

Installation of the weighbridge shall follow the manufacturer's recommendations and installation requirements as appropriate.

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.

$$Apparent\ Load = \cos(\theta) \times Actual\ Load$$

The result of this is that the angle of the scale must not be changed after calibration unless an approved angle compensator is used and has been tested. Scales which are designed to operate at several different angles shall be equipped with an angle sensor and shall be inspected at the high and low limits. The angle(s) of the belt shall be noted on the inspection certificate.

In addition, extreme angles will result in product slippage on the belt resulting in measurement errors. The angle at which this occurs is dependent upon the product being weighed.

Type 6-11 Automatic Continuous Totalizing Weighing Systems [CTWS] (commonly referred to as a "*Conveyor Belt Scale*")

Once the device has been inspected, the angle of the belt scale shall not be changed without verification that the device continues to operate within acceptable limits.

Weigh Belt

Changing the weigh belt will affect the calibration of the device. New weigh belts will stretch over time and should be conditioned by running for several hours, or as per the manufacturer's recommendations, before the initial inspection of the device.

Bad belt splices will result in zero stability issues. The effect of the splice on the integrators indication should be noted. Excessive effect will results in zero stability issues.

Material build up on the weigh belt will result in repeatability issues during testing. The belt should be checked both on the loaded surface and the unloaded surface. Scrapers may need to be provided to reduce product build up.

The trough angle of the weigh belt will affect the calibration of the device and shall not be changed without ensuring that the device remains within limits of error.

Weigh and belt rollers

Weigh rollers must run straight and true. The alignment of the rollers on the scale should be verified with a straightedge. Individual rollers should be examined to ensure that they are true and move freely inline with the weighbelt. All rollers must be free running - a seized roller will cause performance issues and must be replaced.

Lead in and out rollers must be inline with the weigh rollers. Training rollers should not be located immediately adjacent to the weighing element.

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 and Tension System

Ensure that the check system is in place, and adjusted properly. Any tension take up devices shall be free moving and functioning correctly. Build up of material beneath a take up roller or weight will cause tension problems and must be removed.

Cables and ground

Ensure that the grounding system is in place and that the cables are suitably protected and shielded as per the manufacturer's instructions. Cables should not be rubbing on moving components.

Type 6-11 Automatic Continuous Totalizing Weighing Systems [CTWS] (commonly referred to as a "*Conveyor Belt Scale*")

Speed Sensors

Speed sensors or transducers shall not be mounted on a drive pulley. These sensors must be suitably located to ensure that they measure actual belt speed accounting for slippage if any occurs. Speed sensors must be securely mounted and sealed to the device.

Instrumentation

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

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

Manual integration instrumentation, although rare, does exist. Refer to the Notice of Approval (NoA) 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).

Test Procedure

1. Develop Test Load

Product Test loads shall be developed according to the procedure for Product Test Load Development.

Product Test Load size

Each test run must be of sufficient quantity to ensure a proper evaluation of the device. The minimum totalized test load shall equal or exceed 800 intervals for a device subject to LOE from regulation 193 and 1000 intervals for a device subject to LOE from regulation 174/175 or at least one full revolution of the belt, whichever is greater.

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 captured 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 [CTWS] (commonly referred to as a "*Conveyor Belt Scale*")

2. Conduct Product Test

This test is designed to assess the systems ability to measure a known quantity of product that 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

a. Prepare the materials necessary for the test
   i. appropriate quantity of known product to run the tests.
   ii. suitable means to transport the product to and from the reference scale.
   iii. sufficient supplementary product for pre-run conditioning of the belt prior to the actual test.
b. Run supplementary product over the scale for at least three complete belt revolutions or ten minutes at the rate of flow which will be used for the test, whichever is greater.
c. Zero the scale. Ensure that the zero indication is stable - see procedure for zero below.
d. Run the first test quantity over the scale at maximum expected flow rate. Ensure that no product is lost (or gained) during the transfer of product between the reference scale, the transportation means and the belt scale.
e. Note the integrator totalizer reading. Allow for 0.5d for digital indication (R184).
f. Compare this with the know quantity of material. Determine the error.

$$Error\ \% = \frac{(Indicated\ Load\ -\ Actual\ Load)}{Actual\ Load} \times 100$$

g. Continue to run test loads until accuracy and repeatability requirements have been suitably demonstrated. At least three runs shall be completed at the maximum flow rate to demonstrate repeatability.
h. Conduct at least one run at approximately 35% maximum flow rate.

Note: The weight of the known quantity of product 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.

To certify or reject a CTWS, a product test must be completed. Performance of the DUT must be verified using known test loads at the limits of desired operational speed; both the fastest and slowest operating speeds must be tested.

CTWS 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.

Type 6-11 Automatic Continuous Totalizing Weighing Systems [CTWS] (commonly referred to as a "*Conveyor Belt Scale*")

3. Supplementary Requirements

a. Initial Zero Setting

The integrator or totalizer must only advance when the belt is running and loaded. The nature of operation of a CTWS 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.

New devices or existing devices with new weigh belts should be run for several hours or as per the manufacturer's recommendations for belt break in. New belts will stretch significantly and the result could be changes to the calibration of the device.

b. 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.

c. Minimum Load

The minimum totalized load shall equal or exceed 800 intervals for a device subject to LOE from regulation 193 and 1000 intervals for a device subject to LOE from regulation 174/175. In no case shall the value of the minimum increment of registration exceed 100 kilograms R172(3). Minimum totalized load shall be calculated and included on the Inspection Certificate as a usage restriction.

d. Installation

Installation of the scale must be as per the manufacturers recommendations, design and installation drawings and any requirements contained within the NoA. Location of belt direction changes, loading points, weighing element and non standard rollers shall comply with all manufacturers' recommendations. Distance from the loading point to the scale can affect the accuracy of the measurements.

e. Certification

The Inspection Certificate must describe the system and identify the product to be measured. The Certificate must also indicate 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.

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f. Sealing and Stamping

The DUT and all applicable ancillary equipment must be sealed and stamped as required by sections 29, 31 and 32 of the Weights and Measures Regulations. Any additional requirements from the NoA must also be addressed as appropriate (e.g. sealing of speed sensors).

Interpretation of Results

The DUT is deemed to comply if all results are within the acceptable LOE (R174/175) for the quantity of product test load passed over the device.

Revision

Rev. 2

- remove product test load development procedures as they will be included elsewhere.
- remove Test Chain procedures as they are now considered obsolete.
- add notification regarding LOE from R174/175.
- reduced Minimum Totalized load to 800e for R193 devices to harmonize with OIML.
- added weighbelt and roller information.
- expanded sealing requirements to include speed sensors.
- miscellaneous clarifications and corrections.

Rev. 1

- 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 (DTWS) [Bulk-Weigher]

Reference

Weights and Measures 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 (15 000 kilograms) 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 (15 000 kilograms). 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, CGC, (if applicable), will decide if a product test must be performed or not.

Type 4.11 – Automatic Discontinuous Totalizing Weighing Systems (DTWS) [Bulk-Weigher]

System Overview

Typical Grain Elevator Installation

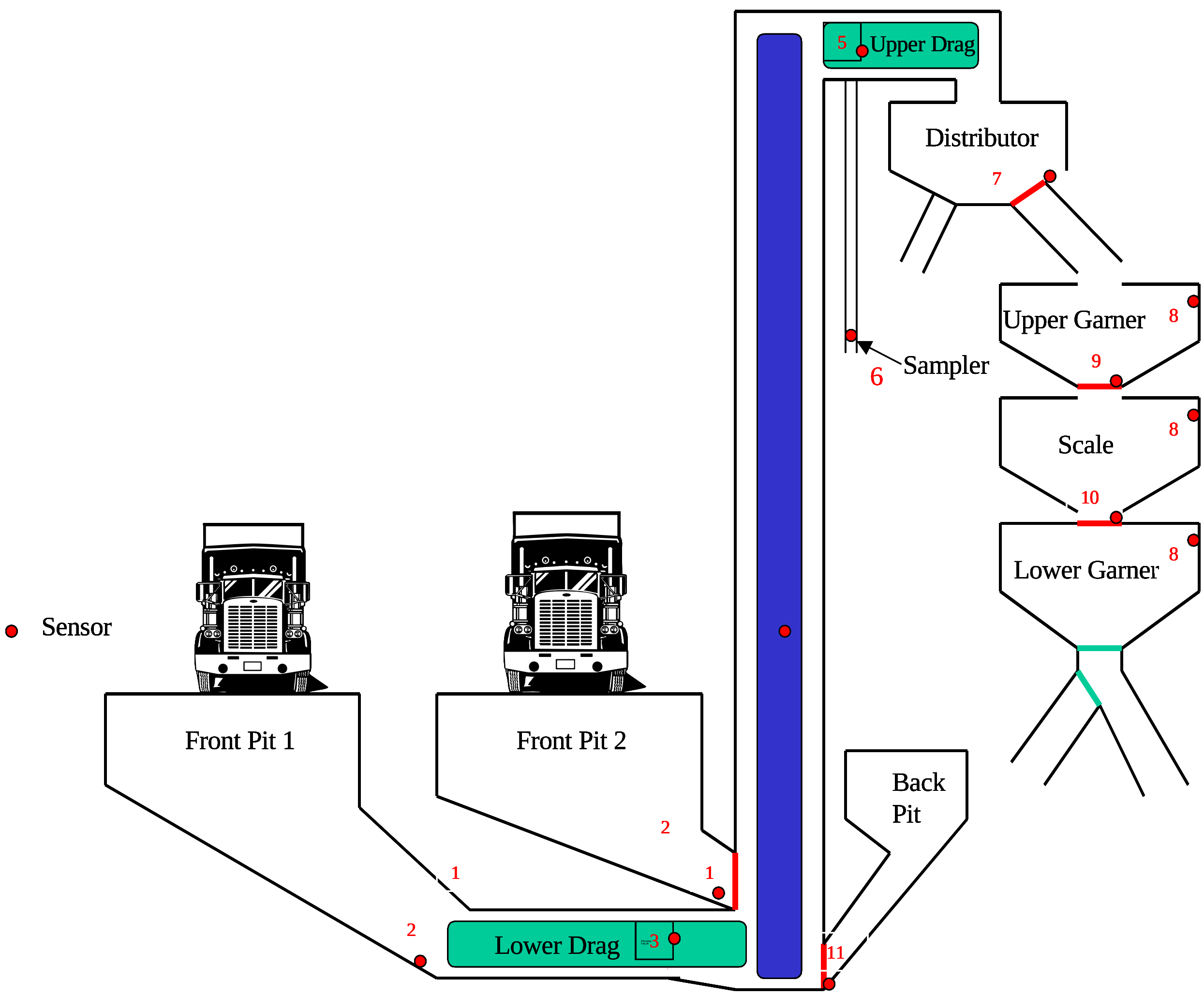

Figure 1 – See page 5 for description of interlocks and sensors

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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 (receiving system) or from the hopper scale to the loading spout (shipping system) encountering many possible product diversions along the way. The inspection of a bulk-weighing system requires a thorough 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 receiving and/or shipping transaction. Furthermore, it should be noted that virtually all bulk-weighing systems are different as are the facilities in which they are installed. For this reason, the following tests may have to be adapted for your particular installation.

How the System Operates

Refer to Figure 1.

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

In most bulk-weighing applications, the hopper scale and indicator are approved as non-automatic devices. Since most bulk-weighing installations 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 document combines both static 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 product test load (product test) which allows an inspector to evaluate a bulk-weighing system's' dynamic capability. The product test simulates 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 system's totalizing capability as well as for identifying product loss due to leaks or diversions. This test also identifies potential problems with the scale while in automatic operation that may not have been obvious during static testing. By using a combination of both static and dynamic testing, an inspector can confidently determine if a bulk-weighing system is capable of accurately weighing all product that is being received or shipped.

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Visual Inspection of the System

Prior to testing, determine if the system is to be used for receiving, shipping or both. The inspector must thoroughly understand the product flow path and where the pertinent interlocks are located. This information is critical in customizing the tests for each specific installation.

Some systems allow for manual operation without using the bulk-weighing control system. If the system 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.

Tare and automatic zero maintenance features are not appropriate for these installations and 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). In these cases, net weight is calculated as gross weight minus the zero offset.

Further visual examinations include; checking for adequate clearance around the hopper scale and proper operation of the test 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:

- If part of the live load, the hydraulic cylinders should be double ended to ensure that no hydraulic fluid is displaced during the lifting process.
- The hydraulic cylinders must be free floating and not be resting on or otherwise touching the test standards when the weights are in the normal unloaded position. Ensure that you start with a true zero indication.
- The test standards, when raised, must remain free of and not bind on a support structure.
- The hydraulic cylinders must raise the test standards sufficiently to clear the base they are located on.
- Hydraulic hoses may cause a binding error when weights are raised and may contribute to a false zero when they are lowered.

The inspector shall walk the entire product path and where portions of the system are visible, check for product leaks – pay particular attention near gates and diverters. The feed gate (upper garner gate) and the scale discharge gates must also be checked to determine that they are indeed fully closed and not allowing product to leak when closed by the control system. Ensure that the gates are in the correct position as indicated by the controller. It may be necessary to conduct a product test to verify that these gates close completely.

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Standard Test Procedure

Although a bulk weighing system (DTWS) is considered as an automatic weighing system, the hopper scale is tested using the static test procedures common to all non-automatic hopper scales. See static testing below for more information. The bulk weighing system is then assessed for proper operation using the dynamic test procedures outlined below.

Static Testing

The Device Under Test (DUT) must be tested with local standards in the static mode using the STP/IPO's from the *Specifications Relating to Non-Automatic Weighing Devices (SRNAWD)*. Tolerances for static testing are those outlined in *the Weights and Measures Regulations* applicable to automatic weighing devices. The following requirements are in addition to those tests.

The hopper scale shall be tested as for any static hopper scale using the NAWDS STPs. However, remember that the applicable tolerances are for automatic devices from the regulations and not the same as those applicable to true non-automatic devices.

Dynamic Testing

Once it is determined that a bulk-weigher meets static requirements, its dynamic capability can be assessed. The dynamic portion of the testing analyses the bulk-weigher's totalizing capability as well as verifying the systems integrity when subjected to a known product test load. In essence this testing is designed to simulate an actual trade transaction ensuring product received or delivered is within the applicable commodity limits of error.

The product test is the primary method of dynamic testing. By introducing a known product test load into a bulk-weighing 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. At no time should the results of a product test be used to calibrate the weighing system.

Interlocks and Sensors

Most interlocks and sensors will be tested during the product test. It is important that the inspector identify and locate all sensors and interlocks prior to initiating the product test.

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The inspector must understand what position each sensor, gate or interlock needs to be in for proper operation of the system and will attempt to change these settings during testing to ensure the system responds appropriately.

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 and sensors to be tested, depending on the complexity of the installation some or all of the following may be present, refer to Figure 1:

1. Automatic or Manual pit gate sensors
2. Empty pit sensors
3. Lower drag sensor
4. Elevating leg sensor
5. Upper drag sensor
6. Grain sampler
7. Distributor position sensor
8. High level sensors in the upper & lower garners and scale
9. Upper garner gate sensor
10. Scale gate sensor
11. Back pit gate sensor

In addition to these sensors, there are specific requirements for some of the common equipment that is present in a typical bulk weighing system.

Upper Garner and Scale Discharge Gate

The upper garner feed gate and the scale discharge gate must not be open at the same time as this would allow product to bypass the scale.

Testing Gate Interlocks

Using the controller, initiate a transaction and then attempt to open the scale discharge gate while the upper garner feed gate is still open. The request must be rejected.

Attempt to open both the upper garner gate and the scale discharge gate at anytime during the transaction. Since this would allow product to flow past the scale without being weighed, the request must be rejected.

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High Level Sensors in the Scale

Most bulk-weighers limit the filling of the hopper scale based on programmed draft size (weight) and/or high level sensors. The draft size is configured in the controller and may be specific to the product type being weighed. The high level sensor is placed in the hopper scale at a point where it will activate when the scale is almost full, but before product can spill or touch the upper garner feed gate. The control system continuously monitors this sensor and when the sensor is activated, closes the upper garner feed gate to stop additional product from flowing into the scale which could result in an overflow and product loss.

Activating the high level sensor must stop product flow to the scale. Typically, the following will happen:

- the upper garner feed gate will close;
- once the scale has stabilized, the product in the scale will be weighed;
- the scale discharge gate will then open allowing the product to exit the scale;
- the net weight for that draft will be taken (calculated if required) and printed;
- the scale discharge gate will close and a new zero or start condition will be established;
- the upper garner feed gate will open and the next draft will begin.

Other potential sequences may be allowed providing they safeguard the accurate and complete measurement of the product.

Testing High Level Sensors

High Level Sensor in Weigh Hopper

Change the draft size to exceed the scale capacity to allow an overfill condition to happen (changing the draft size may require that a change be made in the Configuration or Initialization Mode of the controller); initiate a transaction and begin running product through the system; the high level sensor should be activated and stop product flow before any is lost due to overfilling the scale.

Note: The action of closing the upper garner feed gate is not instantaneous and some product will continue to flow after the sensor has been activated but before the gate can be closed completely. As a result, the hopper will continue to fill for some period after the sensor has been activated. Therefore 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 if the preset draft size has been set correctly for the product being weighed.

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 then pausing the system (if so equipped). On systems with automatic front pit gates or drag conveyors, 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 completed, resume operation. The upper garner feed gate will open and flood the scale with grain at a high rate. If the high level sensor is set correctly, the upper garner feed gate will again close and 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. Often when this occurs, motion will detected in the scale and the system will not 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 may be detected through a product test.

High Level Sensor in Upper Garner

There may be a high level sensor which 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 must automatically stop product flow to this hopper. This may be done in several ways including:

- Closing the front pit gate (receiving operation).
- Closing the supply bin gate (shipping operation).
- Stopping the upper and/or lower drag conveyor in systems incorporating a drag conveyor.
- Stopping the elevating leg (warning: The leg must be running empty before trying to stop it).
- Warning the operator that a manual pit gate must be closed.
- Spilling excess product through a spill pipe back to the front receiving pit.
- Closing access to the upper garner and allowing product to “back-leg”. This product must return to the front pit to be reweighed and must not be diverted to another location where it will be lost from the accumulated net weight for the transaction.

In all cases, the upper garner high level sensor must be positioned appropriately to ensure that any remaining product in the system can be captured before spilling and being lost. This includes allowance for product remaining in the leg when the front drag or gate is the control method. Legs should not normally be stopped while they still contain product as it may be impossible to restart them without manually removing the product. Therefore, the leg will generally continue to run until it is empty even after a high level signal from the upper garner high level sensor has been received.

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Distributor

If the system includes a distributor capable of diverting product away from the upper garner and scale being used for the transaction, the distributor must be interlocked to prevent product diversion during operation.

Attempt to divert product during a transaction by moving the distributor. It should not be possible.

Spill Pipe Paths

If the system incorporates a spill pipe from the upper garner then spilled product must return to the front pit when the bulk-weigher is in the receive mode. This pipe may include a "Y" connection where the product can take one of two paths, one to the front pit and the other to the back pit, however if there is a "Y", an interlock must be included and function as follows:

- the directional 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 position once a transaction has begun. This may be achieved by disarming the flapper control solenoid or motor or including a solenoid and pin to mechanically lock the valve during a transaction.

Attempt to move the flapper during a transaction. It should not be possible.

Automatic Pit Gates

DTWS receiving installations typically receive product from the customer through the front pit. It is important that all received product is accounted for (weighed) and is not diverted elsewhere. The pits will have gates to control product flow. These gates may be automatic or manually operated.

The system should not be able to complete a transaction until all received product has been accounted for. Therefore, a transaction may not be completed with the front pit gate closed or if there is product remaining in the pit. The system must first determine that there is no more product in the product path and the front pit gate must be open before the transaction can be completed.

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Testing 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 to flow into the front pit.

Testing 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. It must not be possible to initiate a receiving transaction with the back pit gate open. Opening the back pit gate should not allow product to flow 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.

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 bulk-weighing system is installed and it is in the receive mode, the boot auger 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. Usually a sampler will take an insignificant amount of product. However, a product test is the only way of confirming this.

If an adjustable automatic sampler is used it should be tested at highest sampling rate or interlocked so no product can be taken without being weighed.

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System Clear of Product

The control system software must ensure that there is no product left anywhere in the system, between the receiving pit and the scale, before finalizing the current transaction and again before initiating a new transaction. 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 operation, at the end of which the system was not cleaned.

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 a query from the control system followed by a visual inspection and confirmation by the operator that the pit is empty.
- The leg must be empty – this can be checked by means of a sensor in the leg or by query from the control system followed by a visual inspection and confirmation by the operator that the leg is 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 may be as high as 10 kg).

Note: An empty product path may also be verified by establishing that the pit and upper garner gates are open, the scale is empty or in a zero or start condition and the leg and drags are running empty for a period of time long enough to clear any remaining product from the system.

Completion of the Transaction

To complete a transaction, there must be no product remaining in the system and the product path must be open throughout the system. Any product sensors in the system must not indicate that there is still product present. These requirements can be tested in a variety of ways:

Leg

Stop the leg and attempt to finalize the transaction. You should not be able to complete the transaction with the leg shut off. (Do not stop the leg if it still contains product as it may not be possible to restart it while loaded).

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Gates and Drags

With the leg running close the pit or hopper gates and/or stop drags in any combination so there is not a continuous feed path of product from the front pit to the scale and attempt to complete the transaction. You should not be able to complete the transaction while the product path is blocked by any means.

Product Sensor

If feasible, trip a product sensor to indicate that the system still contains product. You should not be able to complete transaction with a sensor indicating product remaining in the system.

Printed Ticket

A printed ticket shall contain the net weight received or shipped. 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 affect any other computer systems or equipment in the elevator. While the system is in the receiving mode, interrupt the line power to the controller's UPS. If there is no controller UPS then interrupt the power to the controller directly. If a UPS can keep the controller in operation during a power failure, it is sufficient to meet the requirements of this test.

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 remaining product and complete the transaction. Some systems run manually while others hold memory. All product must be accounted for.

Note: Do not cut power to the system if the leg contains product.

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.

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Note: The power failure test is only done at the time of initial inspection.

Product Testing

The first step in performing a product test consists of developing a suitable known test load. See Appendix A for details.

At least three (3) successful product tests must be done each of which must be within the applicable limit of error (LOE) in order to certify a bulk-weighing system. 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 controller's software are correct.
- There could be a faulty load cell; as you are often unable to conduct a comer test of a hopper scale, the product test will evaluate if any off center loading results in measurement errors.
- To ensure test standards lifting mechanism is not causing binding errors

Product Test – Receiving Operation

Once a suitable load has been developed, the bulk-weigher is put into the receiving mode to begin the product test. The system's controller may prompt the operator to enter the customer's name, the type of product and other supplementary information. Once this has been entered, product may be delivered into the front receiving pit.

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At anytime during delivery, the inspector may use the control panel and attempt to move the distributor, reposition any diverters, open and close any gates or otherwise attempt to manipulate the system in a manner 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.

During the delivery, 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 not be possible 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.

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 be an operator. As long as the system is truly empty, the operator should now be able to finalize the transaction.

Product Test – Shipping Operation

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.

If a product test is deemed necessary, it will be necessary to adapt the test procedure for receiving operation.

Shipping systems used exclusively for rail freight weight determination are to be marked “Not For Use In Trade” and do not require certification.

Product Test Load Limit of Error

Once the transaction has been completed and the total net weight of product has been determined and printed by the system, the weight should be compared to the expected net weight of the product used. The total weight of the product as recorded by the bulk-weigher must agree with the known test load within the applicable commodity limit of error of ± 0.15% of the known product test load weight. 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.

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Appendix A – Product Test Load Determination

When creating a product test load, we recommend the use of a scale with a graduation at least four times smaller than that of the device under test. In this case, the readings from the reference scale may be used directly accounting only for any inherent error in the scale.

In the event that such a scale is not available, the following procedure using a certified vehicle scale (d≤10 kg) may be used. Under no circumstances should a product test load be developed on a scale that does not meet legislative requirements.

1. Equipment and Preparations

- Test truck and 10 000 kg test standards.
- Suitable vehicle equipped with a dump box capable of holding at least 10 tonne of product. Product used for testing should be the same as or similar to the product intended to be weighed on the system.
- Inspectors weight kit.
- Certifiable vehicle scale located close to the bulk weigher so that fuel and accumulated debris do not affect established product test load values.
- If using break points to read the reference scale to finer that 1d, please consult the Break Point Determination test procedure in the NAWDS FIM Preparation, Appendix III.

2. Span Test

The reference scale should be tested using known test standards and any inherent measurement error at the intended weighing range must be eliminated or noted and considered during further testing.

3. Repeatability Test

Repeatability testing on the vehicle scale should be conducted using a loaded truck or weight truck approximating the weight of the loaded truck. Zero the scale and place the truck on the portion of the scale that will be used to develop the product test load; preferably under a loading spout or at the receiving pit opening. At this point it is desirable to leave enough room behind the truck for adding 10 000 kg test standards in the next step. Mark the axle locations to facilitate returning the truck to the same position on the reference scale. Determine the exact weight of the truck (using error weights as appropriate). Remove the truck from the reference scale, zero and repeat this test two more times, ensuring the truck is placed in the previously marked location each time. In order to use this scale for development of a product test load, the difference between results must not exceed 5 kg.

Example:

Reading 1 – 23 015 kg
Reading 2 – 23 018 kg
Reading 3 – 23 014 kg

Difference between highest and lowest reading is $23\ 018\ \text{kg} - 23\ 014\ \text{kg} = 4\ \text{kg}$, therefore the scale meets repeatability requirement.

4. Establishing Reference Scale Correction Factor (Cf)

Place an empty truck on the reference scale at or just ahead of the previously marked location determined from the repeatability testing allowing room for the application of standards. Note and record the exact weight of the vehicle using break point weights as appropriate. Add 10 000 kg of standards immediately behind the truck. Again using 0.1d break point weights determine the exact value that the scale is indicating and record this value. Determine the correction factor Cf as follows:

Cf = local standard's weight/ indicated weight (round to 4 digits)

Example:

Exact empty truck weight (tare) = 8 750 kg
Add 10 000 kg of certified standards
Exact indicated weight = 18 755 kg
Therefore:

$$\text{Cf} = 10\ 000\ \text{kg}/(18\ 755\ \text{kg} - 8\ 750\ \text{kg})$$
$$\text{Cf} = 10\ 000\ \text{kg}/10\ 005\ \text{kg}$$
$$\text{Cf} = 0.9995$$

5. Develop Product Test Load

The product test load should be at least 10 000 kg or the equivalent of 3 hopper drafts, which ever is greater.

Place the empty truck back on the reference scale at the marked location. Note the exact value of the empty truck (tare weight) using error weights as appropriate. Load the truck with approximately 10 000 kg of stable product. Using error weights determine the actual indicated weight (gross weight). The true weight is then determined as follows:

Net weight = Gross weight – tare weight
True wt = Net weight × Correction Factor (Cf)

Example:

Full truck weight (Gross) – 18 712 kg
Empty truck weight (Tare) – 8 750 kg
Product Weight (Net) – 9 962 kg

Cf (from step 4) – 0.9995

True Weight
$$= \text{Cf} \times \text{Net Weight}$$
$$= 0.9995 \times 9962 \text{ kg}$$
$$= 9957.02 \text{ kg}$$

6. Allowable Error for Product Test

The bulk-weighing system must be capable of meeting the commodity limit of error of 0.15% for each test and for a minimum of 3 consecutive tests.

Example:

True Weight (from step 5) $= 9957.02 \text{ kg}$

allowable LOE
$$= 9957.02 \text{ kg} \times 0.15\%$$
$$= \pm 14.94 \text{ kg}$$
$$9942.08 \text{ kg} \le \text{DUT} \le 9971.96 \text{ kg}$$

Therefore, the DUT must indicate a net weight of product somewhere between 9942.08 kg and 9971.96 kg. Round off all values to no less than d_{DUT}.

Type 4.11 – Automatic Discontinuous Totalizing Weighing Systems (DTWS) [Bulk-Weigher]

Revisions

Revision 3

- Simplify procedure and group relevant sections.
- Provide references for procedures addressed elsewhere (e.g. break point).

Revision 2

- Base product test on commodity LOE.
- Identify product test as system compliance test.
- Ensure calibration is not based on product test.

Revision 1

- Minor editorial changes.

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

Reference

Weights and Measures Regulations - tolerances from Regulation 189, 190, 191 and 192 as appropriate. 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 railway freight cars, either coupled or uncoupled on a rail scale. Weights may be used for determining freight charges or for custody transfer of a commodity. 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 test equipment, and requires the involvement of many people. A weighing in-motion railway track scale (IMRW) may take considerable time, often more than a single day. On occasion, the test may restrict or stop the operations of the plant where the inspection is performed. Because of these factors, the cost of an in-motion weighing track scale inspection may be significant.

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 certified scale test car(s), appropriate amount and type of local standards (see Bulletin M-05), suitable reference cars, a locomotive or track mobile 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 and the scale operator must be present for the inspection. Officials from both the railway company and the company owning the scale, if different, must be made aware of the inspection.
- A scale 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 due to a simple adjustment being required.

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- The in-motion scale is accessible so that all testing equipment can be brought in, stored and used for the scale inspection. The inspector should note that it may be very difficult to move rail cars across track under different jurisdictions. A car in close proximity to the scale is no guarantee that it can easily be moved onto the scale without involvement and permission of other authorities. This is especially important if the rail scale is on private property but must move onto the main line to switch tracks.
- 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 weighing systems may be broadly classified into coupled in-motion weigh scales and uncoupled in-motion weigh scales. Coupled in-motion weigh scales may be further categorized into scales intended to weigh complete trains as a summation of all rail cars or scales used to obtain individual weights of the rail cars in a train. For trade purposes, the individual rail car weights may be used to either assess transportation charges or for custody transfer of a commodity. Weights of complete trains are only appropriate for freight charges or for custody transfer when the entire shipment is destined for a single consignee. 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 IMRW 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.*

In-Motion Rail Scale LOE			
Intended Use	**Uncoupled Single/Double Draft**	**Coupled Individual Car Weighing**	**Coupled Summation Weighing**
Freight Charge	section 189 (2)	section 191 (1)	section 190 (2)
Custody Transfer	section 189 (2)	section 191 (2)	section 190 (2)

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.

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Reference Cars

Reference cars of a predetermined weight are required to perform tests of an in-motion rail scale. The design and configuration of reference cars must be representative of the cars normally weighed. 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 intended to transport liquids, the scale shall be tested using reference cars filled with liquid in order to demonstrate its ability to weigh accurately. Reference cars should be carefully selected in order to eliminate any problematic cars. Cars with bad bearings, brakes or couplers (in the case of coupled in-motion scales) may lead to issues during testing.

Reference car weights are usually determined at a location remote from the IMRW scale. Cars must be protected in order to ensure that their weights do not change between the reference scale and the DUT. If the reference cars are exposed to inclement weather, the inspector must be conscious that their weight is susceptible to change drastically. Rain, snow and even ice can significantly change the weight of a rail car. The inspector shall not use reference cars which are suspected to have changed weight.

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. Before use, the reference scale must be tested to the required capacity using the requirements from the *Specifications relating to Non-automatic Weighing Devices (1998)* (SRNAWD) and suitable standards as prescribed in mass *Bulletin M-05*. Any error in the reference scale or uncertainty in the process must be addressed. Refer to the *Product Test Load Development* procedure for more information.

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

Visual examination

Before beginning the testing phase of the inspection, the inspector must conduct a visual examination of the scale, the system and the environment that the system is intended to be used in. The following items must be assessed.

Notice of Approval

The inspector shall ensure that the scale and indicator are of an approved type or model. The inspector shall ensure that the device complies with all conditions, restrictions or parameters that may be stated in the Notice of Approval and/or on the certificate from the last inspection. Restrictions may include: speed limits, directional restrictions, method of use, train configurations, number of cars, commodity type, device location, etc.

Marking

Ensure that the scale and indicator are marked as required by section 18 of the Regulations (model number, approval number, serial number, etc.) and section 33 of SGM-4 (operating velocity). The instrumentation must also be appropriately marked.

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Sealing

Ensure that the device complies with section 7 of SGM-4. 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.

Weighbridge

Determine if the scale is of a live weighbridge or live rail variety. If of a live weighbridge variety, ensure that the weighbridge is clear and not binding. Ensure that the rails on the load receiving element are installed and secured according to section 15 of SGM-4. Ensure that there is no undue displacement of the rails or weighbridge as a rail car passes over the weighing element. If the scale is intended to allow the passage of a locomotive, pay particular attention to the scale while the much heavier locomotive passes over the scale.

Approach and Departure Rails

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

- parallel, aligned and levelled;
- securely anchored. 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 a direction away from the scale;
- straight, uninterrupted and without joints for a minimum length as specified in SGM-4 or by the manufacturer whichever is greater.

The gap between the weighbridge rails and the approach and departure rails must be minimized in order to reduce vibrations and oscillations during weighing. This is typically achieved by means of transverse bevelling of the approach rails where they meet the scale rails.

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

Scale Pit

If the scale is of a pit type, 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 and follow all 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 as per the manufacturer's recommendations.

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Wheel Detectors

Many IMRW require wheel detectors on or adjacent to the tracks to function correctly. These wheel detectors are subject to extreme conditions. In the case of mechanical wheel detectors the operation may be impeded if they are not kept clean and free of debris. Ensure that all wheel detectors are properly and securely installed and that they function correctly.

Instrumentation

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 SRNAWD shall be grandfathered as required.)

The inspector must be familiar with the operation of the instrumentation. During testing of a coupled in-motion weighing system a lot of data will be generated and it must be clear which weights are associated with which reference cars.

Static Mode

Ensure that the static mode is operational. Identify any other operating modes such as overload or internal modes.

Ensure that the appropriate mode is selected and is properly indicated.

Ensure that the graduation is appropriate. The minimum graduation is displayed only in the static mode.

Dynamic Mode

Ensure that the dynamic mode is operational. Identify any other operating modes such as overload or internal modes.

Ensure that the appropriate mode is selected and is properly indicated.

Ensure that system captures and records dynamic weigh results.

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, if used, are in separate conduits.

Test Procedure

IMRW are tested in the manner the device is intended to be used. This information must be obtained before hand from the device owner in order to ensure that all necessary test equipment and personnel are available for testing purposes. A suitable number and type of reference cars must be prepared prior to inspecting the IMRW. These reference cars are usually developed the day before the IMRW inspection in order to maximum the time available on inspection day.

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

Procedure - Develop Reference Cars

In order to evaluate the performance of the IMRW a series of reference cars are needed. These cars could be calibrated railway scale test cars but more commonly will be reference cars created for testing purposes. Cars selected to become reference cars should be representative of the type and configuration of the cars normally weighed on the device.

The weight of the reference cars will be obtained statically on a reference 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 Methods (preferred)

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

Double Draft Method (optional)

3. The scale under test using a double draft method. If choosing this method, the inspector must discuss the details of the inspection and obtain approval from the Regional Gravimetric Specialist prior to the inspection.

Single Draft Weighing Methods

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

The reference scale must be tested to full capacity (SRNAWD requirements for sensitivity, accuracy, repeatability, etc.) or at least to the used capacity, before the reference cars are weighed. It is critical that the reference scale is sensitive and repeatable (0.05% or better). Valid scale inspection 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, any inherent error in the reference scale shall be taken into consideration. Immediately following the determination of each reference car weight, the scale test car must be placed back on the reference scale to ensure that it has maintained its accuracy.

In determining if the use of a remote reference scale 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. Long delays or distances may increase the chance that the weight of the reference cars will change. Weather at either location or in between locations may also affect the validity of the reference scale weights.

Double Draft Weighing Method

Method three 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.

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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 bogie of the empty flat bed rail car will be weighed at two predetermined positions located near the ends of the load receiving element (LRE). These predetermined positions will be used for all the weighing under this part of the procedure and the exact location of the bogie should be marked on the rail. Each bogie is weighed in turn at each of the two predetermined positions. The weight of the flat bed rail car is obtained by summing the weights from the four weighings and dividing the result by two. The result is the weight of the empty flat car.

The local standards are then distributed across the flat bed rail 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).

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 comprise trains normally weighed, whichever is greater, are required. If the trains normally weighed are comprised of less than 15 cars, the test train shall be comprised of the same number of reference cars. A minimum of 3 tests in each manner of use (i.e. pushing/pulling, directions, etc.) shall 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 required. The first one shall be comprised of empty cars, the second shall be comprised of loaded cars. Each train shall contain 15 reference cars or 10% of the number of cars that comprise trains normally weighed, whichever is greater. However, if the trains normally weighed are comprised of less than 15 cars, the test trains shall be comprised entirely of reference cars. The test trains shall be run over the scale at least 3 times in each manner of use (i.e. pushing/pulling, directions, etc.). 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.

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Note: It is recommended that an additional 1 or 2 reference cars are developed, 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

Uncoupled in-motion IMRW are used to determine individual car weights. The cars are separated from the rest of the train and shunted across the IMRW. The power locomotive will not accompany the car across the scale during the test. These scales may be installed in a flat yard or may be part of a scale hump installation where cars are rolled across the scale. In all cases, provisions must be made for the safe passage of the car after it has crossed the scale as there will be no locomotive attached to the car to provide braking power.

Static Test

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 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 Non-automatic weighing device STPs. The scale should be tested to capacity or at least to the capacity at which the scale is to be used.

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 for a minimum of 15 weighings. 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. Cars will continue to run after the scale unless captured in some manner. The scale operator will advise of the appropriate procedures.

Note: The weighing of uncoupled rail cars results in rail cars moving through the yard in an almost silent manner. Extreme caution must be exercised at all times to ensure that no person or equipment enters the rail line being used for test purposes.

During the test, ensure that:

- all weights are automatically erased from the scale memory after printing or storage so that they cannot be reused for subsequent weighings.
- the weight indications are identified with the words "gross weight", "tare" and "net weight" (or the French equivalent) as appropriate.

Printed Ticket

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

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The tare weight shall be identified as stencilled or actual as appropriate. The use of stencilled tare is only appropriate for determining freight charges. Actual tare weights must be obtained for custody transfer purposes.

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.

Interpretation of Results

The DUT is deemed to comply if all results are within the acceptable LOE for each certified mode of operation.

Procedure - Coupled In-Motion

Coupled in-motion IMRW are used to determine individual car, or complete train weights. The cars are coupled together, usually with a locomotive. The locomotive is used to push or pull the train across the scale for weighing purposes. Since the locomotive usually has an influence on the weighing accuracy of the first coupled car, it is common practice to place a buffer car between the locomotive and the train to be weighed during testing. In addition, the system must identify and cease weighing when the locomotive passes over the device. In all cases, ensure that the scale is capable of supporting the weight of the locomotive being used for testing.

Static Test

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 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 Non-automatic weighing device STPs. The scale should be tested to capacity or at least to the capacity at which the scale is to be used.

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

The scale shall be tested in a manner which simulates its intended use. The test procedures used must take into consideration the length of trains normally weighed, the type of cars and the range of their weights. The direction of motion, the manner of movement (pushing or pulling the cars), and the velocity must also be taken into consideration when testing the device. 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 must be obtained from the owner or the operator of the scale at the pre-inspection stage.

Position the train at a starting point located far enough from the scale to ensure it has reached a constant speed before weighing begins (e.g. 30 metres). The inspector shall ensure that all weights are obtained with the train moving at a constant velocity. To ensure a constant velocity, the train must begin its acceleration well before the scale approach and decelerate only after the last car has been weighed. The smoother the train runs across the scale, the better the chance the results will be within tolerance. The inspector must be in constant communication with the locomotive engineer to ensure that the test runs smoothly.

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Initiate the weighing sequence (i.e. enter car data; reset the scale to zero; authorize the weighing). A properly trained operator should be available to handle this aspect of testing.

Perform at least three tests in each desired manner of use (i.e. direction of travel, location of power unit - pulling or pushing, formation of train – empty or loaded and number of cars, etc.).

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

During the tests, ensure that:

- all weights are automatically erased from the scale memory after printing or storing.
- the weight indications are identified with the words "gross", "tare" and "net" (or the French equivalent) as appropriate.
- over and under speeds are identified and flagged on the printed weight ticket. Alternately, the system may refuse to print over or under speed results.

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 never be a 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 a mix of empty and loaded cars accurately is difficult.

Number of Reference Cars in Test Train

Test train containing 15 cars or less shall be comprised entirely of weighed reference cars. Longer test trains shall be comprised 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 Test Train

The reference cars shall be placed in groups of five cars each. These groups shall be positioned in the following locations:

- 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 weights must be tested accordingly. The reference cars must reflect these variations in weight. Each group of reference cars will be comprised of varying weights and the cars will be randomly distributed within the group as follows:

[light - heavy - light - heavy - heavy]

Another acceptable alternative is to use a test train comprised of 50% (approx.) reference cars. For the first three runs, the reference cars shall be located in the first half of the train. For the next three runs the reference cars shall be 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.

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

Interpretation of Results

The DUT is deemed to comply if all results are within the acceptable LOE for each certified mode of operation.

Device Usage

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 and only a Gross weight need be obtained on the DUT.

Commodity Custody Transfer

If a scale is intended to weigh commodities for custody transfer then the actual gross and tare weights must be obtained. The use of stencilled tare is prohibited in this case. Net weight may be calculated manually from the gross and tare weights or may be determined 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.

Two-Train Method

Since the limits of error are based on the net known test load, results are obtained by weighing each car in each train statically on the reference scale and comparing the results to the same cars weighed dynamically on the DUT. If each loaded car in one train is a known test load and each empty car in the other train is also 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, the inspector must prepare two reference trains, one consisting of empty (tare weight) reference cars and the other consisting of full (gross weigh) reference cars.

Conduct the dynamic test of the train comprised of empty (tare) reference cars for a minimum of three runs. Conduct the dynamic test of the train comprised of full (gross) reference cars for a minimum of three runs. For each reference car in the trains, subtract the dynamic weight of the empty car from the dynamic weight of the loaded car. Find the difference between the same cars weighed statically. For each car, the difference between static and the dynamic weights must be within the prescribed limits of error.

One-Train Method

Weigh each empty reference car statically. Place them in a train comprised solely of empty cars. Weigh this train on the DUT a minimum of three times. Record the results. Load the cars in the train with appropriate material representative of the material intended to be weighed by the device when in service. Again, weigh each loaded reference car statically. Reassemble the train using the loaded reference cars. Weigh this train on the DUT 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 difference between the static loaded and the static empty weight of a reference car is the net known test load. 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.

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

Another acceptable method is to use a known test load determined on a suitable reference scale, typically a large hopper scale. To test in this manner assemble a train of the required number of empty rail cars. Weigh the train dynamically on the DUT and record the weights of each rail car. Each rail car is then loaded with a known amount of test product. The weight of the test product in each car is the net known test load for that car. The now loaded train is again weighed dynamically on the DUT and the results recorded. 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 the net known test load

Velocity

A coupled in-motion scale shall be tested at two different speeds within the approved range. The speed for any single test run shall not be changed because dynamic forces due to acceleration may jeopardize the test results.

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 weighing cycle has not been initiated. Examples of controls and sequences required to initiate the weighing cycle 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. Initiate the weighing cycle following the appropriate 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.

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 an asterisk "*" 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.

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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.

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" (unit train) or "TB" (train bloc). 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 the scale may be used and includes any 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 all restrictions be posted on site.

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.

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

Limits of Error

Limits of error are listed in the Weights and Measures regulations and are the same for Acceptance and In-Service. The LOE is dependant upon the usage of the device. It is imperative that this information is obtained beforehand to ensure that the appropriate LOE is selected for the installation. In the case of multiple uses (custody transfer and transportation charges), the most stringent LOE (custody transfer) shall be selected.

Coupled in-motion – Transportation Charges

- 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%.

Coupled In-Motion – Commodity Custody Transfer

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

Uncoupled In-Motion – Transportation or Custody Transfer

- LOE is equal to 0.15% of the known weight of each reference car for freight determination.
- LOE is equal to 0.15% of the net known test load for custody transfer applications
- All weights must be within 0.15% of the known weight of the reference car.

Revision

Rev. 1

- Reformat for Accessibility
- Update references to SGM-3 & 4

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 tables list the acceptable symbols and definitions of units of measurement used for displays and printed receipts as well as the marking of devices. The symbols or abbreviations shown are the preferred ones, although in some cases, others may be acceptable. Internationally recognized (OIML, ISO, IEC, DIN) symbols or abbreviations are generally acceptable if they do not cause confusion. The symbols listed in the “Unacceptable Symbols” column are not appropriate and should not be used. Any marking which may be confused with other commonly used symbols or markings should also be avoided.

Common Mass Symbols

Units	Definition	Symbol	Unacceptable Symbol
kilogram	See *W&M Act*, Sch. I	kg	KG, kilo
gram	0.001 kilogram	g	gr, gm, G, GM
tonne (metric ton)[1]	1000 kilograms	t	T, TN, tn
ton[2]	2000 pounds	tn	t, TN, T
pound	0.453 592 37 kilogram	lb	LB, lbs, #
ounce	$1/16$ pound	oz	OZ
dram (*drachme*)	$1/16$ ounce (mass)	dr	ʒ
grain	$1/7000$ pound	gr	GRN, grn, GN, g
troy ounce	480 grains	tr oz	
carat	200 milligrams	ct	C, k, kt

[1] In order to prevent confusion, reference to tonne should be avoided if possible and the kilogram used instead.

[2] In order to prevent confusion, reference to ton should be avoided if possible and the pound used instead. The symbol for ton (tn) should also be avoided. Spelling out the unit is preferable.

Appendix A

Additional Authorized Symbols

Units	Definition	Symbol	Unacceptable Symbol
acre	4840 square yards	no symbol allowed	
bushel (*boisseau*)	8 gallons	bu	
chain (*chaîne*)	22 yards	ch	
fluid dram (*drachme fluide*)	⅛ fluid ounce	fl dr	fʒ
fluid ounce (*once fluide*)	$1/160$ gallon	fl oz	US fluid ounce ($1/128$ US gallon)
foot (*pied*)	⅓ yard	ft (*pi*)	
gallon (imperial)	$454\,609/100\,000\,000\ m^3$	gal	US gallon ($378541/100000000\ m^3$)
inch (*pouce*)	$1/36$ yard	in (*po*)	
litre	$1/1000$ cubic metre	L, l, ℓ	
metre	See *W&M Act*, Sch.I	m	M
mile (*mille*)	1760 yards	mi	
pint (*chopine*)	⅛ gallon	pt (*chop*)	
quart (*pinte*)	¼ gallon	qt (*pte*)	
yard (*verge*)	$9144/10\,000$ metres	yd (*vg*)	

Obsolete Authorized Symbols[3]

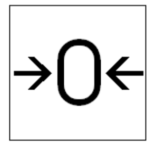
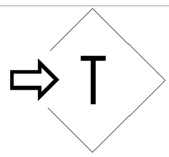
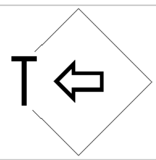
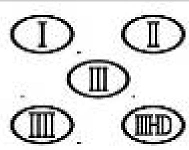
Units	Definition	Symbol	Unacceptable Symbol
cental/hundredweight (*quintal court*)	100 pounds	ctl or cwt	
chain (*chaîne*)	22 yards	ch	
cord[4]	128 cubic feet (ft^3) stacked roundwood	no symbol allowed	
fluid dram (*drachme fluide*)	⅛ fluid ounce	fl dr	fʒ
furlong	220 yards	no symbol allowed	
gill (*roquille*)	$1/32$ gallon	gi	
link (*chaînon*)	$1/100$ chain	li (*chon*)	l, lnk
peck (*quart de boisseau*)	2 gallons	pk	
rod, pole or perch (*perche*)	5½ yards	no symbol allowed	

3 Obsolete units that are still authorized but should be avoided if possible.

4 Cord is a valid and authorized unit, but cubic metre (m^3) is preferred.

Appendix A

Gravimetric Device Markings and Symbols

Definition	Markings & Symbols	Unacceptable Markings & Symbols
zero set		
centre of zero		
tare set		
tare clear		
tare in use		
NAWD accuracy classes		I, II, III, III HD, IV 1, 2, 3, 3 HD, 4
Maximum number of verification scale intervals	n_{max}	
Minimum verification scale interval	e_{min}	
Actual scale interval	d	
Verification scale interval	e	
Number of scale intervals	n	
Device capacity	Max	
Gross	gross, G, GR	
Tare	tare, T, TR, TA	
Net	net, N, NT	
Manual weight entry	manual weight MAN WT, MANUAL WT, MAN WEIGHT	M, MW, MAN

Revisions

Rev. 1

- Reformatted tables
- Moved obsolete authorized units to separate table
- Added IEC, ISO and DIN 30 600 symbols
- Added references to the *W&M Act* and *Regulations* in the “Definition” column.
- Reformatted the definition of the gram
- Removed unit *Ton (tonne)* from Additional Authorized Symbols

Appendix B

RESERVED

REVISION
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.

Required accuracy class of the standard – Acceptance

Metric Device type – Automatic	E_1	E_2	F_1	F_2	M_1	M_{1-2}	M_2	M_{2-3}	M_3
Automatic scale (0.075%) R174	$E_1 \geq 20\,mg$	$E_2 \geq 50\,mg$	$F_1 \geq 500\,mg$	$F_2 \geq 2\,mg$	$M_1 \geq 10\,g$	All	$M_2 \geq 50\,g$	---	—
Automatic hopper / tank scale (0.05%) – R188	All	All	All	All	All	All	All	—	—
In-motion railway scale Static Test (0.075%) R189, 174	All	All	All	All	All	All	All	—	—
In-motion railway scale (approx. 0.15%) R189.2, 190, 191	All	All	All	All	All	All	All	All	All
Automatic crane scale Freight (0.5%) – R192	All	All	All	All	All	All	All	All	All
Conveyor belt scale - cheap commodities (0.5%) – R193	Material tests								

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

Required accuracy class of the standard – In Service									
Metric Device type – Automatic	**E_1**	**E_2**	**F_1**	**F_2**	**M_1**	**M_{1-2}**	**M_2**	**M_{2-3}**	**M_3**
Automatic scale (0.1%) R175	$E_1 \geq 10\,mg$	$E_2 \geq 50\,mg$	$F_1 \geq 200\,mg$	$F_2 \geq 1\,g$	$M_1 \geq 5\,g$	All	$M_2 \geq 50\,g$	$M_{2-3} \leq 5000\,kg$	—
Automatic hopper / tank scale (0.1 %) – R188	All	All	All	All	All	All	All	$M_{2-3} \leq 5000\,kg$	—
In-motion railway scale Static test (0.1%) R189, 175	All	All	All	All	All	All	All	$M_{2-3} \leq 5000\,kg$	—
In-motion railway scale (approx. 0.15%) R189.2, 190, 191	All	All	All	All	All	All	All	All	All
Automatic crane scale Freight (0.5%) – R192	All	All	All	All	All	All	All	All	All
Conveyor belt scale - cheap commodities (0.5%) R193	Material tests								

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

Required accuracy class of the standard – Acceptance

Avoirdupois Device type – Automatic	E_1	E_2	F_1	F_2	M_1	M_{1-2}	M_2	M_{2-3}	M_3
Automatic scale (0.075%) R174	NA	$E_2 \geq \begin{bmatrix} 1\,\text{grain} \\ 0.0002\,\text{troz} \end{bmatrix}$	$F_1 \geq \begin{bmatrix} 6\,\text{grain} \\ 0.01\,\text{tr oz} \\ 0.001\,\text{lb} \end{bmatrix}$	$F_2 \geq \begin{bmatrix} 30\,\text{grain} \\ 0.05\,\text{tr oz} \\ 0.005\,\text{lb} \end{bmatrix}$	$M_1 \geq \begin{bmatrix} 200\,\text{grain} \\ 0.05\,\text{tr oz} \\ 0.02\,\text{lb} \\ 0.5\,\text{oz} \end{bmatrix}$	All	$M_2 \geq \begin{bmatrix} 1000\,\text{grain} \\ 0.1\,lb \\ 2\,\text{oz} \end{bmatrix}$	---	—
Automatic hopper / tank scale (0.05%) – R188		All	All	All	All	All	All	—	—
In-motion railway scale Static test (0.075%) **R189, 174**		All	All	All	All	All	All	—	—
In-motion railway scale (approx. 0.15%) R189.2, 190, 191		All	All	All	All	All	All	All	All
Automatic crane scale Freight (0.5%) – R192		All	All	All	All	All	All	All	All
Conveyor belt scale - cheap commodities (0.5%) – R193	Material tests								

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

Required accuracy class of the standard – In Service									
Avoirdupois Device type – Automatic	**E_1**	**E_2**	**F_1**	**F_2**	**M_1**	**M_{1-2}**	**M_2**	**M_{2-3}**	**M_3**
Automatic scale (0.1%) R175	NA	$E_2 \geq \begin{bmatrix} 1\,\text{grain} \\ 0.0002\,\text{troz} \end{bmatrix}$	$F_1 \geq \begin{bmatrix} 3\,\text{grain} \\ 0.01\,\text{tr oz} \\ 0.001\,\text{lb} \end{bmatrix}$	$F_2 \geq \begin{bmatrix} 20\,\text{grain} \\ 0.05\,\text{tr oz} \\ 0.002\,\text{lb} \end{bmatrix}$	$M_1 \geq \begin{bmatrix} 100\,\text{grain} \\ 0.02\,\text{tr oz} \\ 0.02\,\text{lb} \\ 0.25\,\text{oz} \end{bmatrix}$	All	$M_1 \geq \begin{bmatrix} 600\,\text{grain} \\ 0.1\,\text{lb} \\ 2\,\text{oz} \end{bmatrix}$	$M_{2-3} \leq 10\,000\,lb$	—
Automatic hopper / tank scale (0.1%) – R188		All	All	All	All	All	All	$M_{2-3} \leq 10\,000\,lb$	—
In-motion railway scale Static test (0.1%) R189, 175		All	All	All	All	All	All	$M_{2-3} \leq 10\,000\,lb$	—
In-motion railway scale (approx. 0.15%) R189.2, 190, 191		All	All	All	All	All	All	All	All
Automatic crane scale Freight (0.5%) – R192		All	All	All	All	All	All	All	All
Coveyor belt scale - cheap commodities (0.5%) R193	Material tests								

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.

Revision

- The purpose of revision 1 was to remove all references to bulletin M-02, which has been revoked.