National Type Evaluation Program (NTEP)
Belt-Conveyor Scale (BCS) Sector Meeting Summary

February 20, 2014 / Pittsburgh, PA

Introduction

The charge of the BCS Sector is important in providing appropriate type evaluation criteria based on specifications, tolerances and technical requirements of *NIST Handbook 44* Sections 1.10. General Code and 2.21. BCS Systems. The sector's recommendations are presented to the National Type Evaluation Program (NTEP) Committee each January for approval and inclusion in *NCWM Publication 14 Technical Policy, Checklists and Test Procedures* for national type evaluation.

The sector is also called upon occasionally for technical expertise in addressing difficult *NIST Handbook 44* issues on the agenda of the National Conference on Weights and Measures (NCWM) Specifications and Tolerances Committee. Sector membership includes industry, NTEP laboratory representatives, technical advisors and the NTEP Administrator. Meetings are held annually, or as needed and are open to all NCWM members and other registered parties.

Suggested revisions are shown in **bold face print** by ~~**striking out**~~ information to be deleted and **underlining** information to be added. Requirements that are proposed to be nonretroactive are printed in ***bold faced italics***.

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Glossary of Acronyms and Terms

Acronym	Term	Acronym	Term
BCS	Belt-Conveyor Scale	NTEP	National Type Evaluation Program
MTL	Minimum Test Load	NTETC	National Type Evaluation Technical Committee
NCWM	National Conference on Weights and Measures	OWM	Office of Weights and Measures
NIST	National Institute of Standards and Technology	USNWG	U.S. National Work Group

Details of All Items
(In order by Reference Key)

I. Carry-over Items

A. Belt-Conveyor Scale NTEP Checklist

Source:

USNWG on Belt-Conveyor Scales

Proposal:

Amend *NCWM Publication 14 Belt-Conveyor Scales* by incorporating recommended changes that primarily were intended to allow for the evaluation of master weight totalizers (MWT) as a component of a belt-conveyor scale system. This was intended to facilitate the certification of MWT's as replacement instruments and would not necessarily include testing on the entire belt-conveyor scale system.

Background:

Prior to the 2009 BCS Sector meeting, Mr. Bill Ripka, Chair submitted a draft of an amended *NCWM Publication 14* Belt-Conveyor Scales Technical Policy, Checklists, and Test Procedures to the sector members for review. The proposed changes in this draft related primarily to Master Weight Totalizers intended to be installed as substitutions within a BCS system in addition to a number of other minor editorial changes. Among the recommended changes that were included in this draft were changes involving procedures used when evaluating semi-automatic and automatic zero-setting mechanisms.

This proposed draft has been offered to be used on a trial basis by NTEP labs when evaluating manufacturer's replacement instruments (Master Weight Totalizers) that are scheduled to undergo NTEP evaluation. Some device manufacturers within the sector have indicated that they may have instruments ready to be submitted to NTEP for evaluation.

The NTEP program has been provided with the draft of proposed changes to *NCWM Publication 14* Belt-Conveyor Scales Technical Policy, Checklists, and Test Procedures and the NTEP laboratories have agreed to use the amended checklist in order to identify gaps or necessary changes within the draft. Feedback from evaluators who have used this amended checklist is needed so that sector members are able to determine the need for further development of the proposed changes.

During the 2012 NTEP Belt-Conveyor Scale Sector meeting, the members agreed to request that a report be provided to the sector by NTEP evaluator(s) that have used the draft of proposed changes that would detail any gaps in the draft and recommend further amendments if necessary. Any input and additional comments from NTEP evaluators that are available will be discussed.

Discussion/Conclusion:

At the 2014 BCS Sector meeting, it was reported by the NTEP officials that there has not been any devices submitted for type approval that could appropriately evaluated using the proposed amended checklist. The NIST Technical Advisor accepted the task of reviewing the draft for an amended checklist to ensure that any references to requirements in *NIST Handbook 44* were current with the most recent edition of that publication. This review is to be completed by April 30, 2014 and any updates that are necessary will be forwarded to the NTEP Administrator for distribution to the NTEP labs.

Since there has been no applications for type approval of devices that would serve as candidates for a trial of the proposed amended checklist, the Sector had no further comment on this issue.

NIST Technical Advisor's note:

Following the February 2014 Sector meeting, the NTEP Belt-Conveyor Scale Sector members were contacted by the Sector Chair, Mr. Bill Ripka and were asked to participate in teleconference scheduled for June 16, 2014. This teleconference was arranged for the Sector to deliberate on possible further changes to the proposed amendments of *NCWM Publication 14 Belt-Conveyor Scales Technical Policy, Checklists, and Test Procedures* as stated above in this item. The Sector was asked to consider additional changes to the proposal that were intended to expedite the evaluation of Master Weight Totalizers (MWT) installed as a retrofit or substitute instrument within an existing BCS system.

The primary focus of this teleconference was for the members to consider a change that would eliminate a required field permanence test as part of a type evaluation for a MWT being placed into service as a replacement device. These changes would not eliminate any type of testing performed under laboratory conditions but would remove the requirement for a field permanence test once the substitute instrument had been installed in a previously evaluated conveyor system.

The Sector agreed that a permanence test is needed for the proper evaluation of an entire belt-conveyor scale system when installed however, the suggested revision of this proposal is based on the notion that a permanence test is not warranted for a MWT that is installed as an upgrade or replacement instrument for an existing system.

Following the teleconference and follow-up email exchanges among the Sector members, the Sector was asked to respond via a ballot which would indicate whether or not this revision to the original proposal was supported.

The balloting was conducted through email where the results indicated that all active members of the Sector supported these latest recommended changes. The Sector agreed that in addition to the removal of a required permanence testing during a type evaluation for a MWT, several minor editorial changes were also approved. The Sector Chair agreed to forward the revised proposal to the NTEP Administrator for NTEP Committee consideration for Pub 14. The proposed addition is included in Attachment A..

B. Linearization Feature for BCS:

Source:

USNWG on Belt-Conveyor Scales

Proposal:

Develop recommended test procedures for *NCWM Publication 14 Belt-Conveyor Scales* to evaluate the use of any linearity correction feature when used in a belt-conveyor scale system.

Background:

Manufacturers and service agents of belt-conveyor scales have voiced support for the use of electronic instruments equipped with a linearity correction feature (i.e. multiple point calibrations) to reduce span errors that deviate from a linear pattern. It has been reported by some sector members that this practice may be considered as non-compliant in some jurisdictions with established weights and measures requirements. Some members of the Sector have asked for clarification from the National Institute of Standards and Technology (NIST), Office of Weights and Measures (OWM) on the use of this type of feature and question whether it is (or should be) permitted under existing U.S. standards.

The U.S. National Work Group (USNWG) on BCS has deliberated on the use of a linearization feature for enhancing the performance of belt-conveyor scale systems and considered whether there is a need to develop additional requirements in *NIST Handbook 44* to address its use. At the 2011 BCS Sector Meeting, some members agreed to participate in a sub-group to develop a draft of recommended test procedures that would be submitted to the NTEP Committee as proposed changes within *NCWM Publication 14.* This group was to also consider the scope for the application of any newly developed test procedures (i.e. whether the test procedures will be applied retroactively to devices that has already received NTEP approval).

Following the February 2012 NTEP Sector meeting the sub group met via teleconference. During this conference (conducted on June 7, 2012) the sub-group agreed that any testing of a linearity correction feature could be performed either in controlled laboratory conditions or in a field installation. The group agreed that if the function of this feature was verified under controlled conditions during type evaluation, it should then be clearly noted on the Certificate of Conformance (CC) for the device. The sub-group also concluded that verification of this feature during field testing, could be accomplished through material tests such as those typically performed during routine official examinations.

In addition, the sub-group agreed that this feature would need to be a sealable function within the instrument. Other points regarding this issue that were discussed at the sub-group's teleconference in June 2012 included:

- The correction factor (linearization factor) must be applied at a minimum of three points or flow rates.
- It is to be determined if there is to be a limitation on the amount of correction permitted. If there is to be a limit established, the sub-group suggests that a limit of +/- 0.4% of scale capacity may be appropriate.
- The group determined that lab testing should be performed at pre-specified percentages of device capacity to ensure the feature is capable of performing correctly throughout the operating range of the device.
- The group recommended that testing be performed using predetermined correction factors. For instance:
    - flow rates equal to 25%, 50%, 75% and 90% of full scale;
    - tests for loading of +/- 0.5%, +/-1%, +/-1.5% and +/-2% of full scale at each flow rate.

Discussion:

At the 2014 BCS Sector meeting, the members discussed the advantages and disadvantages of conducting a test both in the field and in the laboratory to verify the function of a linearity correction. Sector Chair, Mr. Bill

Ripka stated that to perform this test in the field would be simplified due to the fact that practically every installation of belt-conveyor scale systems will have a certain amount of non-linear performance. This is attributed to various unaccounted influences from the installation and operational details. The test of a linearization correction could therefore be conducted in the field simply by observing the operation of the system while this feature is disabled and then again when the correction has been enabled and comparing these results. If the system is evaluated under controlled conditions in a laboratory environment, a non-linear performance may have to be artificially induced through the use of error weights placed on or removed from the weighing elements while the system is operated.

Also discussed was a limit placed on the amount of correction that would be allowed by a linearization correction feature. It had been suggested by the sub-group that a limit of +/- 0.4% of scale capacity would be an appropriate value. Some members agreed in general with this limit, however others suggested that this restriction is arbitrary and that it may be overly prescriptive to place any limitation on the amount of correction allowed to the linearity.

While considering a preliminary draft for a test procedure, the sector could not agree on certain other points regarding all points of the procedure including what tolerance should be applied to the output of a system when linearization is being corrected through the use of this feature.

Conclusion:

The BCS Sector agreed that this item needs to be further developed. The original sub-group formed to develop this item agreed to continue work on this item and to produce a draft test procedure that would be circulated for review by the Sector. This draft is scheduled to be available by April 30, 2014 and will then be sent via email to the Sector members.

C. Conveyor Belt Profiling:

Source:

USNWG on Belt-Conveyor Scales

Proposal:

Develop recommended test procedures for *NCWM Publication 14 Belt-Conveyor Scales* to evaluate the use of a belt profiling feature to provide a zero-load reference when used in a belt-conveyor scale system.

Background:

This method of establishing a zero-condition for a totalization operation enables the belt-conveyor scale to synchronize the application of an individual “tare” weight values associated with distinct segments of the belt to the movement of those belt segments over the scale portion of the conveyor. If this alternative to averaging the weight of segments of the belt carcass is used there is a potential need to establish a procedure to evaluate its effectiveness, to ensure that it functions as intended, and is maintained during operation of the BCS.

NISTOWM has received inquiries seeking guidance on whether this type of feature is permitted under U.S. standards. It is also being reported by some members of the USNWG BCS that some regulatory field officials will not issue an approval for devices equipped with this feature when it is not listed as a standard feature or an option on the NTEP Certificate of Conformance.

During the February 2011 meeting the sector members were asked to consider if there is there is a need for procedures to evaluate the effectiveness of belt profiling and to ensure that correct operation is maintained during totalization. A majority of sector members voiced their opinion that this feature should receive some level of evaluation, and that at a minimum the ability to enable or disable any belt profiling feature should be protected by some form of security seal.

Members at the 2011 BCS Sector meeting also concluded that it may be preferable to have the analysis and necessary action(s) for the consideration of belt profiling features taken on by the same work group formed under the previous agenda item.

Discussion:

During the 2014 meeting, the BCS Sector was informed that the same sub-group which was assigned to develop procedures for verifying the operation of a linearization correction had also been assigned to develop a procedure for testing the function of belt profiling. No draft procedures have been developed at the time of the 2014 BCS Sector meeting.

Similar to the previous item (linearization correction), the sector members acknowledged that this feature could readily be tested in the field and would most likely be more costly to test in a laboratory setting. All of the sector members agreed that this feature must be one protected by a type of security seal.

Conclusion:

The sector agreed to ask the sub-group originally tasked with developing test procedures for the evaluation of this type of feature to continue work on this and to have a draft available by April 30, 2014. This draft will then be shared with sector members who hold (or have held) regulatory positions for their review and comment. The regulatory-background members will review and prepare their comments by August 1, 2014 at which time the sub-group responsible for developing the draft procedures base the need for further development on those and any other comments provided by Sector members. A final draft will be presented to the sector at its next meeting for review.

D. Field Test Procedures for Reference Scales

Source:

NIST/OWM

Proposal:

To amend test procedures outlined in *NCWM Publication 14 Belt-Conveyor Scales* with regard to minimum test weights required to certify hopper scales as a reference scale to be used in a materials test. And to align the values provided for minimum test weights with those values as stated in *NIST Handbook 44 Scales Code.*

Background:

Procedures listed in *NCWM Publication 14* for conducting evaluations of belt-conveyor scale systems using material tests, include the following statements:

13. Field Test Procedure

Test of the Reference Scale

Hopper Scales
Hopper scales must be tested to the used capacity using substitution tests. Test weights equal to a minimum of 10% of scale capacity are needed; more test weight is recommended. The scale must be accurate to 0.1% and adjusted if necessary.

During the 2012 BCS Sector meeting, it was noted that the minimum test weight amount of 10% of scale capacity as stated in *NCWM Publication 14* is in conflict with *NIST Handbook 44* Scales Code, Table 4 where it is required that, for scales of greater than 3000 lb capacity the minimum test weight required is 12.5% of scale capacity. The sector was asked to consider whether these values should be reconciled. The sector originally agreed that the statement of 10% minimum test weight required in *NCWM Publication 14* should be amended to coincide with the minimum test weight required under Table 4 – *NIST Handbook 44* Scales Code (e.g., 12% of scale capacity).

Further deliberation on this item at the 2012 meeting addressed the fact that *NIST Handbook 44* contains no requirement to specify a minimum capacity for a reference scale used and that the only specific requirement related to the reference scale is that the scale used must produce weighments within 0.1% accuracy. Consequently, the members agreed to recommend that *NCWM Publication 14* be amended to delete the reference to a 10% minimum test weight and simply specify that no more than three substitutions can be used during the testing of a hopper scale used a reference scale, and that the hopper scale be tested according to *NIST Handbook 44* procedures. These recommended changes are shown below.

13. Field Test Procedure (page BCS-17)

Test of the Reference Scale

Hopper Scales

Hopper scales must be tested to the used capacity using **a maximum of three** substitution tests **according to NIST Handbook 44 procedures**. ~~**Test weights equal to a minimum of 10% of scale capacity are needed; more test weight is recommended.**~~ The scale must be accurate to 0.1% and adjusted if necessary.

After the 2012 NTEP BCS Sector Meeting, the NIST Technical Advisor received comments from the former technical advisor to the sector regarding concerns about this item and the conclusions of the sector. These comments were related to the proposed deletion of a stated minimum required test weight and expressed concern that this type of scale may be tested using test weight in amounts that are smaller than what has been established as minimum. Mr. Ripka, BCS Sector Chair and Mr. Truex, NTEP Administrator were consulted with regard to the concerns expressed, and a decision was reached that these concerns have merit and that since this item is not a critical issue currently preventing a manufacturer from completing an NTEP evaluation, it would be best to table this issue as a carry-over item to be further addressed at the next sector meeting.

Discussion:

At the 2014 meeting, the BCS Sector was asked to re-evaluate the conclusions made during the 2012 meeting and to consider concerns expressed over the proposal to eliminate any statement of required minimum test weights needed.

There was a general discussion regarding variations between the minimum test weight requirement in this particular section of *NCWM Publication 14* and the minimum test weight required on hopper-type scales of a capacity and division size that would be commonly used as a reference scale in a material test on BCS systems. Additional points made were that during an NTEP test of this type of weighing device, a minimum test weight of 25% of scale capacity is required.

Other comments made during the 2014 meeting pointed out the disparity of applying a minimum of 10% of scale capacity and the confidence in test results when the scale is used much closer to its nominal capacity, even when substitution testing is performed on this type of device.

Conclusion:

The BCS Sector agreed that a statement regarding the minimum amount of test weight required for a test on a hopper scale used as a reference scale to test BCS systems should be retained. It was also agreed that the minimum test weight required in this section of *NCWM Publication 14* should be aligned with the minimum test weight requirements (12.5% of nominal scale capacity) as stated in *NIST Handbook 44* for this type of weighing device. The following revised draft will be forwarded to the NTEP Administrator as a recommendation from the Sector for a change in the appropriate location in *NCWM Publication 14*.

13. Field Test Procedure (page BCS-17)

Test of the Reference Scale

Hopper Scales

Hopper scales must be tested to the used capacity using **a maximum of three** substitution tests **according to NIST Handbook 44 procedures**. Test weights equal to a minimum of ~~**10%**~~ **12.5%** of **nominal** scale capacity are needed; more test weight is recommended. The scale must be accurate to 0.1% and adjusted if necessary.

II. New items

A. 2014 NIST Handbook 44 Changes

Source:

USNWG on Belt-Conveyor Scales

Proposal:

Amend *NCWM Publication 14 Belt-Conveyor Scales* to correspond with changes that have occurred in the most recent edition of *NIST Handbook 44*.

Background:

The following items involve changes that were adopted through the NCWM and are now incorporated into the 2014 edition of *NIST Handbook 44*. The content of *NCWM Publication 14 for BCS* Checklists and Test Procedures for BCS Systems should reflect any relevant changes occurring in the current edition of *NIST Handbook 44*. The BCS Sector was asked to review and comment on the recommended changes to *NCWM Publication 14* that would align these publications. The proposed changes to *NCWM Publication 14* are shown in the following two items listed under II.A.1). and II.A.2). in this summary.

1) Appendix C – Units of Mass (ton)

Source:
Mr. Paul Lewis, Rice Lake Weighing Systems, Inc./NTEP Weighing Sector

Background:

Adopted changes to the 2014 edition of *NIST Handbook 44* include the results of efforts to standardize abbreviations used for the term "short ton." These changes affected the Units of Mass Table appearing on pages C-19 and C-20 of Appendix C. This change resulted in the elimination of abbreviations for the term "short ton" other than "tn" when used on equipment manufactured after the effective date of January 1, 2014. Equipment manufactured between January 1, 2008 and December 31, 2013 may use an abbreviation other than "tn."

The amendment also included the addition of a footnote to the Table mentioned above intended to clarify that abbreviations for "net" or "short" ton other than "tn" are considered appropriate for use with older equipment as follows:

Units of Mass	
1 ton, metric (t)	2204.623 pounds 0.984 gross ton 1.102 net tons
1 ton, net or short (**tn**)[21]	2000 pounds (exactly) 0.893 gross ton 0.907 metric ton

[21]**As of January 1, 2014, "tn" is the required abbreviation for short ton. Devices manufactured between January 1, 2008 and December 31, 2013 may use an abbreviation other than "tn" to specify short ton.**

An additional change associated with this item was made in NIST Handbook 44 in the Avoirdupois Units of Mass heading on page C-6 of Appendix C as shown below.

Avoirdupois Units of Mass

[The "grain" is the same in avoirdupois, troy, and apothecaries units of mass.]

1 µlb	= 0.000 001 pound (lb)
$27^{11}/_{32}$ grains (gr)	= 1 dram (dr)
16 drams	= 1 ounce (oz)
	= 437½ grains
16 ounces	= 1 pound (lb)
	= 256 drams
	= 7000 grains
100 pounds	= 1 hundredweight (cwt)[6]
20 hundredweights	= 1 ton ~~(t)~~**<u>(tn)</u>**[x]
	= 2000 pounds[7]

In "gross" or "long" measure, the following values are recognized:

112 pounds (lb)	= 1 gross or long hundredweight (cwt)[7]
20 gross or long hundredweights	= 1 gross or long ton
	= 2240 pounds[7]

[6] When necessary to distinguish…
[7] When the terms "hundredweight" and……

<u>[x]As of January 1, 2014, "tn" is the required abbreviation for short ton. Devices manufactured between January 1, 2008 and December 31, 2013 may use an abbreviation other than "tn" to specify short ton.</u>

To align *NCWM Publication 14* for *Belt-Conveyor Scales* (BCS) with the changes above, it is recommended that sections 1.8 and 2.5 in the *NCWM Publication 14 for BCS* Checklists and Test Procedures be amended as follows.

1 Indicating and Recording Elements

…

.

1.8 The scale division shall be in increments of 1, 2, or 5 times 10k where k is an integer and shall not be greater than 0.125 % (1/800) of the minimum totalized load. ☐ Yes ☐ No ☐ N/A

What is a scale division?

Unit	Abbreviation
pounds	lb or LB
U.S. short ton	ton or ~~T~~**tn**
U.S. long ton	LT
Metric ton	t
kilograms	kg

2 Recording Element

:

2.5 Information required on the ticket ☐ Yes ☐ No ☐ N/A

MASTER START TOTAL	05 06 92
MASTER STOP TOTAL	15:30
QUANTITY	44113.5 ~~T~~**tn**
	44300.5 ~~T~~**tn**
	187.0 ~~T~~**tn**

While considering this item at their 2013 meeting, the NTEP Weighing Sector reviewed the list of acceptable abbreviations/symbols found in Appendix C of Publication 14 - Digital Electronic Scales (DES). The Weighing Sector proposed changes to this document and forwarded those proposed changes to the Belt-Conveyor Scale Sector for additional input recognizing that these proposed changes might impact BCS manufactures more significantly than manufacturers of other types of scales.

The Weighing Sector has recommended changes to the *NCWM Publication 14 for DES* Appendix C – Acceptable Abbreviations/Symbols as follows:

From NCWM Publication 14 for DES:

[Note: the following excerpt from NCWM Publication 14 has been edited to include only the portions relevant to this agenda item.]

In addition the Weighing Sector considered the appropriate use of the entire word "ton" under this item. It is now being recognized that the word "ton," when used by itself should be used only in conjunction with the unit "short ton" and should not be intended, nor should it be permitted, to represent any other version of the ton unit (e.g. long ton, metric ton).

Appendix C
Acceptable Abbreviations/Symbols
This list does not standardize the abbreviations/symbols that must be used, rather, it identifies abbreviations/symbols that are routinely acceptable. This list is not limiting or all-inclusive; other abbreviations/symbols may be acceptable.
Additionally, the following lists of abbreviations and symbols should be used as a guide; style differences are acceptable (e.g. shapes of arrows,)

Device Application	**Term**	**Acceptable**	**NOT Acceptable**
General	value of scale division (displayed)	d	
	value of verification scale division	e	
	number of scale divisions	n	
	gross	gross, G, GR	
	Semi-automatic (push-button) tare	tare, T, TA	
	Keyboard, Programmable and Stored tare	tare, T, TA, PT	
	net	net, N, NT	
	pieces	pieces pc, pcs	
	count	count cnt or pc(s) *is encouraged or ct symbol for pieces ct is acceptable NIST Handbook 130*	C
	carat or carat troy – 200 mg	c *NIST Handbook 44 and NIST Guide for the Use of International System of Units (SI)*	ct *not permitted if used as the abbreviation for carat and count on a scale with an enable count feature*
	short ton	**ton or tn**	
*Exceptions to General Tables of *NIST Handbook 44*	carat or carat troy – 200 mg	ct *common jewelry industry abbreviation and is the only acceptable abbreviation in Canada*	ct *not permitted if used as the abbreviation for carat and count on a scale with an enable count feature*
	U.S. short ton	~~**ton,**~~ TN~~**, or tn**~~ - *for belt-conveyor scales the abbreviation "T" is acceptable*	
	U.S. long ton	LT	
	Grain	grain, GRN, grn, GN	
Belt-Conveyor Scales	U.S. short ton (different from "General" application)	T	

Discussion:

During the BCS Sector meeting in February 2014, the members acknowledged the changes that occurred in *NIST Handbook 44* and that the use of multiple abbreviations to identify the term "short ton" can lead to misunderstandings. It was also pointed out that the use of the upper case "T" as an abbreviation for this unit could be confused with the use of that abbreviation in connection with the term "tare" on certain indicating or recording elements. At the 2014 meeting, sector members also considered the changes to *NCWM Publication 14 (DES)* recommended by the Weighing Sector.

The BCS Sector had few additional comments on this item however, the importance for the alignment of *NCWM Publication 14* and *NIST Handbook 44* was recognized by the members.

Conclusion:

At the 2014 meeting, the BCS Sector members indicated their support for the proposal to amend sections 1.8 and 2.5 in the *NCWM Publication 14 for BCS* Checklists and Test Procedures as shown above. They also agreed with the Weighing Sector and supported the changes to Appendix C of *NCWM Publication 14 - Digital Electronic Scales (DES)* as noted above.

2) Deletion of required maximum/minimum conveyor lengths

Source: USNWG on Belt-Conveyor Scales

The 2014 edition of *NIST Handbook 44* BCS code has been amended by the deletion of paragraph UR.1.2.(h). This amendment eliminated the sub-paragraph that previously provided the allowable limits for maximum and minimum conveyor length in commercial BCS systems. To reflect this change, it is recommended that section 9.7.1 in *NCWM Publication 14 for BCS* be changed as shown below:

Code Reference: UR.2.2.1.

9.7. The design and installation of the conveyor leading to and from the belt-conveyor scale …

⋮

~~**9.7.1. The conveyor shall be no longer than 1000 ft (300 m) or shorter than 40 ft (12 m) from head to tail pulley. [Nonretroactive as of January 1, 1986]**~~ ~~☐ **Yes** ☐ **No** ☐ **N/A**~~

Discussion/Conclusion:

During the 2014 meeting, the BCS Sector had no additional comments on this item. The members agreed to support the recommended changes to *NCWM Publication 14 for BCS* as shown above.

B. Proposals recommended by the NTEP Software Sector

Source:

NTEP Software Sector

Proposal:

Amend *NCWM Publication 14* to address perceived gaps in the identification, protection/security, and the maintenance of software used in electronic weighing systems.

Background:

The NTEP Software Sector has made three proposals regarding the regulation of software used in electronic weighing devices. These proposals have been circulated to the other NTEP Sectors for review and comment. The three proposals are listed individually below and were considered as separate items during the 2014 BCS Sector meeting.

[Technical Advisor's note: The discussions and conclusions regarding each of the three items are shown below under "Discussion" and "Conclusion" in the order that the items were presented to the Sector at its 2014 meeting]

1) Identification of Certified Software

This item originated as response to the question "How does the field inspector know that the software running in the device is the same software evaluated and approved by the lab?" It has been recognized that the international community has already addressed this issue (i.e., through WELMEC and OIML).

There was a discussion at the 2012 NTEP Software Sector Meeting, focusing on where the terminology regarding inextricably linking the software version or revision to the software itself belonged. The Software Sector recommended adding the following to *NCWM Publication 14* and forward to NTEP Weighing, Measuring, and Grain Analyzer Sectors for feedback:

> Identification of Certified Software:
>
> Note: Manufacturers may choose to separate metrologically significant software from non-metrologically significant software. Separation would allow the revision of the non-metrological portion without the need for further evaluation. In addition, non-metrologically significant software may be updated on devices without breaking a seal, if so designed. Separation of software requires that all software modules (programs, subroutines, objects, etc.) that perform metrologically significant functions or that contain metrologically significant data domains form the metrologically significant software part of a measuring instrument (device or sub-assembly). If the separation of the software is not possible or needed, then the software is metrologically significant as a whole. The conformity requirement applies to all parts and parts shall be marked according to Section G-S-X.X.
>
> The manufacturer must describe and possibly demonstrate how the version or revision identifier is directly and inseparably linked to the metrologically significant software. Where the version revision identifier is comprised of more than one part, the manufacturer shall describe which portion represents the metrological significant software and which does not.

The BCS Sector is being asked to review and comment on a proposal developed by the NTEP Software Sector. This proposal recommends that marking requirements be established for software-based electronic equipment that will enable field verification of the appropriate version or revision for metrological software. This proposal would include changes to language in *NIST Handbook 44* so that U.S. standards would be more closely aligned with international requirements found in standards published by WELMEC (European Cooperation in Legal Metrology) and OIML (International Organization of Legal Metrology).

The Software Sector recognized a number of points during the development of this proposal including:

- It is the opinion of the Software Sector that a specific method of identification of software version or revision should not be defined but rather that the manufacturer should utilize a method and demonstrate the selected identification mechanism is suitable for the purpose.
- A category III or some comparable means of providing a seal for metrological software would provide an indication to the weights and measures inspector that any changes have been made to the software.

The Software Sector has requested that the other NTEP Sectors review this proposal and provide feedback.

2) Software Protection / Security

The Software Sector is proposing that the existing audit trail and physical seal provisions used in the U.S. to provide security of the software used in software-based devices needs to be enhanced. To accomplish this, the Software Sector has referenced the international WELMEC Document as shown below:

Protection against accidental or unintentional changes
Metrologically significant software and measurement data shall be protected against accidental or unintentional changes.

Specifying Notes:
Possible reasons for accidental changes and faults are: unpredictable physical influences, effects caused by user functions and residual defects of the software even though state of the art of development techniques have been applied.

This requirement includes consideration of:

a) Physical influences: Stored measurement data shall be protected against corruption or deletion when a fault occurs or, alternatively, the fault shall be detectable.

b) User functions: Confirmation shall be demanded before deleting or changing data.

c) Software defects: Appropriate measures shall be taken to protect data from unintentional changes that could occur through incorrect program design or programming errors, e.g. plausibility checks.

Required Documentation:
The documentation should show the measures that have been taken to protect the software and data against unintentional changes.

Example of an Acceptable Solution:

- The accidental modification of software and measurement data may be checked by calculating a checksum over the relevant parts, comparing it with the nominal value and stopping if anything has been modified.
- Measurement data are not deleted without prior authorization, e.g. a dialogue statement or window asking for confirmation of deletion.
- For fault detection see also Extension I.

The Software Sector is in the process of developing a checklist for inclusion in NCWM Publication 14. This checklist is based roughly on a checklist contained in the international standard for non-automatic weighing instruments, OIML R 76 – 2. The information requested by this checklist is currently voluntary, however, it is recommended that NTEP applicants comply with these requests or provide specific information as to why they may not be able to comply. Based on this information, the checklist may be amended to better fit with NTEP's need for information and the applicant's ability to comply.
The California, Maryland and Ohio laboratories agreed to use this check list (shown below) on one of the next devices they have in the lab and report back to the sector on what the problems may be. North Carolina's laboratory was also given a copy of the check list to try.

1. **Devices with ~~Embedded~~ Software ~~TYPE P (aka built-for-purpose)~~**

1.1. Declaration of the manufacturer that the software is used in a fixed hardware and software environment. **AND**	☐ Yes ☐ No ☐ N/A
1.2. Cannot be modified or uploaded by any means after securing/verification.	☐ Yes ☐ No ☐ N/A
Note: It is acceptable to break the "seal" and load new software, audit trail is also a sufficient seal.	
1.3. The software documentation contains:	
1.3.1. Description of all functions, designating those that are considered metrologically significant.	☐ Yes ☐ No ☐ N/A
1.3.2. Description of the securing means (evidence of an intervention).	☐ Yes ☐ No ☐ N/A
1.3.3. Software Identification**, including version / revision**	☐ Yes ☐ No ☐ N/A
1.3.4. Description how to check the actual software identification.	☐ Yes ☐ No ☐ N/A
1.4. The software identification is:	
1.4.1. Clearly assigned to the metrologically significant software and functions.	☐ Yes ☐ No ☐ N/A
1.4.2. Description how to check the actual software identification.	☐ Yes ☐ No ☐ N/A
1.4.3. Provided by the device as documented.	☐ Yes ☐ No ☐ N/A
1.4.4. Directly linked to the software itself.	☐ Yes ☐ No ☐ N/A

2. **~~Personal Computers, Instruments with PC Components, and Other Instruments, Devices, Modules, and Elements with Programmable or~~ Loadable Metrologically Significant Software ~~TYPE U (aka not built-for-purpose)~~**

2.1. The metrologically significant software is:	
2.1.1. Documented with all relevant (see below for list of documents) information.	☐ Yes ☐ No ☐ N/A
2.1.2. Protected against accidental or intentional changes.	☐ Yes ☐ No ☐ N/A
2.1.3. Evidence of intervention (such as, changes, uploads, circumvention) is available until the next verification / inspection (e.g., physical seal, Checksum, **Cyclical Redundancy Check (**CRC**)**, audit trail, etc. means of	☐ Yes ☐ No ☐ N/A

security).

3. **Software with ~~Closed Shell (~~no access to the operating system and/or programs possible for the user~~)~~**

3.1. Check whether there is a complete set of commands (e.g., function keys or commands via external interfaces) supplied and accompanied by short descriptions. ☐ Yes ☐ No ☐ N/A

3.2. Check whether the manufacturer has submitted a written declaration of the completeness of the set of commands. ☐ Yes ☐ No ☐ N/A

4. **Operating System and / or Program(s) Accessible for the User**

4.1. Check whether a checksum or equivalent signature is generated over the machine code of the metrologically significant software (program module(s) subject to legal control Weights and Measures jurisdiction and type-specific parameters). ☐ Yes ☐ No ☐ N/A

4.2. Check whether the metrologically significant software will detect and act upon any unauthorized alteration of the metrologically significant software using simple software tools (e.g., text editor). ☐ Yes ☐ No ☐ N/A

5. **Software Interface(s)**

5.1. Verify the manufacturer has documented:

5.1.1. The program modules of the metrologically significant software are defined and separated. ☐ Yes ☐ No ☐ N/A

5.1.2. The protective software interface itself is part of the metrologically significant software. ☐ Yes ☐ No ☐ N/A

5.1.3. The functions of the metrologically significant software that can be accessed via the protective software interface. ☐ Yes ☐ No ☐ N/A

5.1.4. The parameters that may be exchanged via the protective software interface are defined. ☐ Yes ☐ No ☐ N/A

5.1.5. The description of the functions and parameters are conclusive and complete. ☐ Yes ☐ No ☐ N/A

5.1.6. There are software interface instructions for the third party (external) application programmer. ☐ Yes ☐ No ☐ N/A

The NTEP laboratories have used the above checklist on a limited basis and already have provided some feedback to the Software Sector. Work is ongoing on this item with the intent that it eventually will be incorporated as a checklist in NCWM Publication 14; again the laboratories are requested to try utilizing this checklist for any evaluations on software-based electronic devices. The revised checklist will be distributed to the laboratories for additional review.

The other NTEP Sectors are being asked to review and provide additional feedback.

3) Software Maintenance and Reconfiguration

The Software Sector has requested that the other NTEP Sectors review the recommended changes to *NCWM Publication 14* with regard to the means used by device manufacturers to insure the integrity of the software in their devices.

The Software Sector asked the question: "What do the software-based device manufacturers use to secure their software?" The following items were reviewed by the sector and passed to the other sectors for review.

1. Verification that the update process is documented (OK)

2. For traced updates, installed Software is authenticated and checked for integrity

   Technical means shall be employed to guarantee the authenticity of the loaded software (i.e. that it originates from the owner of the type approval certificate). This can be accomplished (e.g. by cryptographic means like signing). The signature is checked during loading. If the loaded software fails this test, the instrument shall discard it and either use the previous version of the software **or become inoperative**.

   Technical means shall be employed to guarantee the integrity of the loaded software i.e. that it has not been inadmissibly changed before loading. This can be accomplished e.g. by adding a checksum or hash code of the loaded software and verifying it during the loading procedure. If the loaded software fails this test, the instrument shall discard it and either use the previous version of the software **or become inoperative**.

   Examples are not limiting or exclusive.

3. Verify that the sealing requirements are met

   The sector asked, "What sealing requirements are we talking about?"

   This item is **only** addressing the **software update**, it can be either verified or traced. It is possible that there are two different security means, one for protecting software updates (software log) and one for protecting the other metrological parameters (Category I II or III method of sealing). Some examples provided by the sector members include but are not limited to:

   - Physical Seal, software log
   - Category III method of sealing can contain both means of security

4. Verify that if the upgrade process fails, the device is inoperable or the original software is restored

   The question before the group is, Can this be made mandatory?

   The manufacturer shall ensure by appropriate technical means (e.g. an audit trail) that traced updates of metrologically significant software are adequately traceable within the instrument for subsequent verification and surveillance or inspection. This requirement enables inspection authorities, which are responsible for the metrological surveillance of legally controlled instruments, to back-trace traced updates of metrologically significant software over an adequate period of time (that depends on national legislation). The statement in italics will need to be reworded to comply with US weights and measures requirements.

The sector **agreed** that the two definitions below for Verified update and Traced update were acceptable.

Verified Update
A verified update is the process of installing new software where the security is broken and the device must be re-verified. Checking for authenticity and integrity is the responsibility of the owner/user.

Traced Update
A traced update is the process of installing new software where the software is automatically checked for authenticity and integrity, and the update is recorded in a software update log or audit trail.

Note: It's possible that the Philosophy of Sealing section of NCWM Publication 14 may already address the above IF the definitions of Verified and Traced Updates (and the statement below) were to be added. The contrary argument was that it may be better to be explicit).

Use of a Category 3 audit trail is required for a Traced Update. A log entry representing a traced software update shall include the software identification of the newly installed version.

The sector recommended consolidating the definitions with the above statement thus:

Verified Update
A verified update is the process of installing new software where the security is broken and the device must be re-verified. Checking for authenticity and integrity is the responsibility of the owner/user.

Traced Update
A traced update is the process of installing new software where the software is automatically checked for authenticity and integrity, and the update is recorded in a ~~**software update log or**~~ Category 3 audit trail. The audit trail entry shall include the software identification of the newly installed version.

In 2012, the Sector recommended that as a first step, the following be added to *NCWM Publication 14*:

The updating of metrologically significant software, including software that checks the authenticity and integrity of the updates, shall be considered a sealable event.

Though the Software Sector is currently considering only that the single sentence (shown above) be incorporated into *NCWM Publication 14* there may be additional changes proposed in the future.

Discussion:

II,B.1. Identification of Certified Software:

During the 2014 meeting the BCS Sector was provided with background information and explanation of these three items by NTEP Administrator, Mr. Jim Truex. Each of the three items was considered by the

BCS Sector members separately and the discussion and conclusions from the BCS Sector members regarding each item are listed in the same sequence as they appear in the above background information.

The sector members were informed that language that had been drafted regarding the identification of certified software represented a recommendation to notify software developers/providers that it may be beneficial to separate software developed for use with commercial weighing and measuring devices into two components. One of the components would be associated with the general function of the equipment and the other component would consist of any software affecting metrological features of a device. This separation would facilitate the ability to provide a means for sealing (physical or electronic) the metrological significant functions while allowing the general-purpose functions and features to remain with unrestricted access. This separation of different parts of software may have more significance if and when software programs that are associated with legal metrology devices are type evaluated under NTEP.

Some sector members who are device manufacturers indicated that this approach may be of no consequence to their operation due to the fact that the software used in the devices they produce is developed for the sole purpose of operating their weighing equipment. Therefore, all portions of the software will have metrological effect and will need to be protected by means of a security seal. None of the sector members however, objected to including this language as a general statement to provide an indication of what is anticipated to be incorporated as regulation in the future.

<u>II.B.2. Software Protection / Security:</u>

At their 2014 meeting the BCS Sector members were informed by Mr. Truex that this proposal from the Software Sector provides a checklist to be used in type evaluation of software used in association with commercial weighing and measuring devices. This checklist has been derived from principles found in the WELMEC Document 2.3 and details in OIML R76 and is being proposed to be included in *NCWM Publication 14*.

Also at the 2014 meeting, the sector was informed that this checklist has been used on a trial basis by NTEP laboratories in the U.S. The trial implementation of the checklist in these NTEP laboratories has reportedly identified some problems as well as a certain amount of usefulness. Also noted was that some portions of the checklist were not clearly understood by the evaluators. The sector was also provided with a number of objections to this checklist that were identified by the Weighing Sector during their review of this proposal. These objections are as follows:

~~2~~• This proposal would seem to apply to all devices and is not applied in a non-retroactive fashion;

~~3~~• The distinction between software that has, and that which does not have metrological effects is not clear in the proposal – particularly regarding the need to break security seals when loading software;

~~4~~• All elements of this checklist are not supported by requirements currently found in *NIST Handbook 44;* and

~~5~~• Some terms used in the proposed checklist are not defined or clearly understood.

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<u>II.B.3. Software maintenance and reconfiguration:</u>

The Sector was in general agreement with the notion that software updates should be recorded as changes within an electronic sealing means (i.e., audit trail). The members however expressed concern over their lack of understanding for the meaning of the portion of this proposed language that states: "…including software that checks the authenticity and integrity of the updates." Some Sector members questioned whether software that has been installed in the system to only validate updates to metrologically significant software would actually be considered as a parameter to be tracked in an audit trail. The Sector generally agreed that this wording is not clear in the proposal and suggested that this point be clarified.

Another point discussed by the Sector members was whether this proposal would apply to all devices retroactively. They agreed that this would be problematic if devices already in service would need to be reprogrammed to comply with this proposal.

Conclusions:

II.B.1 Identification of Certified Software:

The BCS Sector agreed to support the inclusion of the information as shown under “Identification of Certified Software” in to *NCWM Publication 14*. The members did however recommend that the last sentence of the first paragraph (“The conformity requirement applies to all parts and parts shall be marked according to Section G-S-X.X.”) be omitted. This recommendation is in support of the recommendation made by the Weighing Sector in their review of this item.

II.B.2 Software Protection / Security:

The BCS Sector members agree with the conclusions of the Weighing Sector and do not support the proposed inclusion of the checklist within *NCWM Publication 14*.

II.B.3 Software Maintenance and Recognition:

The BCS Sector members had questions regarding this proposal and do not believe that it has been sufficiently developed. The meaning of the last portion of the proposed additional language “…including software that checks the authenticity and integrity of the updates, shall be considered a sealable event” is unclear. The BCS Sector agrees largely with the conclusions of the Weighing Sector and does not support the proposed inclusion of the checklist within *NCWM Publication 14* at this time.

C. Review of NCWM Publication 14 List of Sealable Parameters for BCS Systems

Source:

USNWG on Belt-Conveyor Scales.

Proposal:

To review and further develop (if necessary) a list of features associated with a belt-conveyor scale system (and weigh-belt systems) that will categorize those features as either sealable or non-sealable.

Background:

The list shown below was developed during the 2009-2010 NTETC BCS Sector meetings. The table was then incorporated in the 2011 edition of Publication 14. NTEP laboratories were asked to report back to the sector with comments and recommended amendments for improvement. Since there has not been any responses received by the sector at this point, it is not known if any manufacturers' devices have been submitted for NTEP approval to apply this list to during any evaluations.

Belt-Conveyor Scale Features and Parameters	
Typical Features to be Sealed	**Typical Features and Parameters Not Required to be Sealed**
Official verification zero reference Official verification span/calibration reference Linearity correction values Allowable range of zero (if adjustable) Selection of measurement units Division value, d Range of over capacity indications (if it can be set to extend beyond regulatory limits) Alarm limits for flow rate (high/low) Automatic zero-setting mechanism (on/off) Automatic zero-setting mechanism (range of a single step) Configuration (speed, capacity, calibrated test weight value if applicable, pulses per belt revolution, load cell configuration,)	Display update rate Baud rate for electronic data transfer Communications (Configuration of input, output signal to peripheral devices)
NOTE: *The above examples of adjustments, parameters, and features to be sealed are to be considered "typical" or "normal." This list may not be all inclusive, and there may be parameters other than those listed which affect the metrological performance of the device and must, therefore, be sealed. If listed parameters or other parameters which may affect the metrological function of the device are not sealed, the manufacturer must demonstrate that the parameter will not affect the metrological performance of the device (i.e., all settings comply with the most stringent requirements of Handbook 44 for the applications for which the device is to be used).*	

Discussion:

In view of the proposals submitted by the NTEP Software Sector that are included in this agenda, it was recommended by Mr. Ripka, (Chair) that the sector members review this table for completeness.

During the 2014 BCS Sector meeting, it was recommended that belt-profiling should be added as a sealable parameter in the table. No objections were heard regarding this suggested amendment.

There were a variety of other features discussed that in certain circumstances could be considered as sealable features in a BCS system. Mr. Peter Sirrico suggested that communications should not be located under the non-sealable parameters as it currently appears in the table but should rather be listed as a sealable parameter due to the ability in some devices to input changes to metrological features of the device through the communications portal. Additionally, it was suggested that baud-rate should also be relocated from the non-sealable parameters column to the sealable parameters column. Most members conceded that if the communications portal offered a means of input to change metrological features, then the communications (i.e., configuration of connection to metrologically significant peripheral devices) should appear in the sealable column. Not all members were in support of the similar change suggested regarding the baud rate.

There was additional discussion regarding the effects that the various features or functions in this table have on metrological aspects of a BCS system which led the Sector members to conclude that an argument could be made to place practically all features/functions under the sealable parameters column in the table.

Conclusion:

There was no consensus among sector members to finalize any revision to the existing table in *NCWM Publication 14* and it was agreed that the table should undergo a trial usage by NTEP evaluators when possible and that any necessary changes would be addressed by the BCS Sector afterwards. The discussion for the amendment of this table will be placed on the agenda of the next sector meeting.

III. Attendance:

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Attachment A – BCS Pub 14 Checklist for Master Weight Totalizers (MWT)

Recommended change / addition to NCWM Publication 14 Belt Conveyor Scales

July 10, 2008

Revised 6-16-2014

For Providing MWT testing as a stand-alone device

Technical Advisor's note: This draft was originally developed largely upon existing NCWM Publication 14 content. This document is intended as an appendix to the existing Pub 14 for the evaluation of master weight totalizers (MWT) to be used as replacement instruments for retrofit in existing belt-conveyor scale systems. This revision of the original (July 2008) document contains those changes considered by NTEP Belt-Conveyor Scale Sector members via e-mail correspondence and teleconference in June 2014. The new changes that are now recommended by the Sector are shown below ***in bold type****. Deleted language is shown in* ~~***strikethrough font***~~ *and newly added language is* ***underlined****.*

Appendix C

Evaluation of stand-alone master weight totalizers

(A MWT submitted for approval as a stand-alone device can only be accepted as an addition to an existing CoC for a complete Belt Conveyor Scale System.)

A. Models to be Submitted for Evaluation

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A type is a model or models of the same design, as defined in the NTEP Policy and Procedures. A complete list and description of all models of a type to be included in the Certificate of Conformance (CC) shall be submitted with the request for type evaluation. All options and features to be included on the CC must be submitted for evaluation. If the CC is to include ore than one model of the same type, the submitter shall contact the evaluation agency to determine which model or models will be evaluated. A CC will be amended when new models of the same type meeting the specified criteria, are applied for by the manufacturer.

The models to be submitted for evaluation shall be those having:

a. Laboratory Test – A master weight totalizer (MWT) or integrator that, at a minimum meets the requirements of the original evaluation, with defined enhancements and additional options indicated. The submitter shall also provide all necessary devices or instruments to represent the load receiving and speed sensing elements.

b. Field Test – The field test shall be performed with a previously "approved for commercial use" weighbridge model by the same manufacturer.

B. Certificate of Conformance Parameters

A Certificate of Conformance (CC) will apply to all models that have:

- Equivalent hardware and software
- Subsets of standard options and features of the equipment evaluated.

Metrological features not recognized by Handbook 44, but capable of being used as the basis for commercial transactions, shall be capable of being disabled and sealed before the device can receive an NTEP Certificate of Conformance.

C. Replacement Parts

The policy for addressing the conformance of replacement parts with the parts being replaced is:

1. If a Master Weight Totalizer (MWT) has received an NTEP evaluation and an NTEP Certificate of Conformance, it must be repaired with parts that are consistent with the design or metrologically equivalent parts.

D. Substitution of the Master Weight Totalizer

For a master weight totalizer (MWT) to be considered an appropriate substitute for the MWT tested during the original type evaluation of a belt-conveyor scale system, **each of** the following criteria must be satisfied:

1. The MWT must be tested in the laboratory using appropriate load and speed signal simulators capable of being adjusted within the tolerances indicated in the checklists and tables in this document;
2. All MWT laboratory tests must be performed on the replacement MWT, including temperature testing;
3. During the test, the device must be within the acceptance tolerance;
4. A field test will be performed meeting ~~**new initial installation**~~ **NIST Handbook 44, Belt-Conveyor Scales Systems Code sections N.2., N.3.1. and N.3.2.** testing criteria;

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5. A field permanence test will be performed, and

56 A separate Certificate of Conformance (CC) will not be issued for the new MWT. Instead, the original CC will be amended to include the new MWT as an option; and

67 Application limits such as capacity and speed ranges established during the original type evaluation will not be amended.

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E. Checklist and Test Procedures

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1. Indicating and Recording Elements

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The integrator of a belt conveyor scale normally includes the master weight totalizer (MWT) and a rate of flow indicator and rate of flow alarms. The master weight totalizer must have adequate resolution to be able to establish a valid zero reference value and must have sufficient capacity to totalize loads over a reasonable period of time. The integrator may also have a resettable partial totalizer for indicating the mass of loads conveyed over a limited period of time and may have a supplementary totalizer with a scale interval greater than that of the master weight totalizer that will indicate the mass of loads conveyed over a fairly long period of operation. The partial totalizer is normally used for indicting the values for the zero test, simulated load tests, materials tests, and individual measurements of interest to the scale owner.

The master weight totalizer shall be equipped with provisions for applying a security seal that must be broken or another approved security means before any change that affects the metrological integrity of the device can be made to the master weight totalizer.

1.1 The scale must have a master weight totalizer yes ☐ No ☐ N/A ☐

1.2 The MWT shall not be resettable without breaking a security means. yes ☐ No ☐ N/A ☐

1.3 A power failure test must be conducted on digital electronic MWT's both in the yes ☐ No ☐ N/A ☐
laboratory and in the field permanence test.

Test Procedure

1.3.1 Accumulate a measured quantity on the MWT and stop the flow of yes ☐ No ☐ N/A ☐
material. Note the reading.

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1.3.2 Disconnect power to the MWT yes ☐ No ☐ N/A ☐

1.3.3 Connect Power to the MWT yes ☐ No ☐ N/A ☐

1.3.4 The quantity indication shall return to the previously displayed quantity within 1 division. yes ☐ No ☐ N/A ☐

Laboratory Test: The accumulated measured quantity for the MWT is retained in memory during a power failure of 24 hours and is displayed again when power is returned.

~~**Field Test: The accumulated quantity for the MWT is retained in memory during a power failure of 10 seconds up to 24 hours and is displayed again when power is returned.**~~

1.4 The capacity of the MWT shall be at least 10 hours times the maximum rated Flow rate indicated on the original CC. yes ☐ No ☐ N/A ☐

1.5 The value of the scale division shall be capable of being established for a value less than or equal to 0.1 percent of the minimum totalized load. yes ☐ No ☐ N/A ☐

1.6 The MWT shall indicate in one or more of the weight units indicated in table T.1 [check the applicable unit(s)]. yes ☐ No ☐ N/A ☐

1.7 The scale division shall be in increments of 1, 2, or 5 times 10k where k is an integer. yes ☐ No ☐ N/A ☐

Table T.1	
Unit	**Abbreviation**
____ pounds	Lb or LB

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U.S. short ton	Ton or Ttn
U.S. long ton	LT
Metric ton	Ttn
kilograms	kg

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1.8 The indicated weight value must be expressed without the use of a multiplier. yes ☐ No ☐ N/A ☐

1.9 The MWT may have a no-flow lockout provided the lockout is limited to not more than 3 percent of the rated belt loading in terms of weight per unit length. The no-flow lockout must be deactivated during the zero test. yes ☐ No ☐ N/A ☐

1.9.1 During normal operation, the MWT shall advance only when the belt conveyor is in operation and under load. yes ☐ No ☐ N/A ☐

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1.9.2 If a no-flow lockout is provided, verify that it is limited to not more than 3% of the rated belt loading. yes ☐ No ☐ N/A ☐

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1.9.3 It must be possible to deactivate the no-flow lockout during the zero test. yes ☐ No ☐ N/A ☐

2. Recording Element

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2.1 The MWT shall incorporate or be capable of interfacing with a recording element. yes ☐ No ☐ N/A ☐

2.2 The value of the scale division for the recording element shall be the same as for the MWT. yes ☐ No ☐ N/A ☐

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2.3 The recording element shall record the initial indication and the final indication of the MWT, the quantity delivered, the unit of measurement, (i.e., kilograms, tones, pounds, tons, etc.), the date and time. (see Table T.2) This information shall be recorded for each delivery. The indicated and recorded weight values must agree to the nearest scale division. yes ☐ No ☐ N/A ☐

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2.4 All weight values shall be recorded as digital values. yes ☐ No ☐ N/A ☐

Information required on the ticket: yes ☐ No ☐ N/A ☐

Table T.2	
Date	05 06 2008
Time	15:30
Master Start Total	44113.5 ~~Ttn~~
Master Stop Total	44300.5 ~~Ttn~~
Quantity	187.0 ~~Ttn~~

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2.5 If a reset to zero mechanism is incorporated, there must be an interlock to Prevent the zeroing of the device between the printing of the initial and final values of the totalized weight. yes ☐ No ☐ N/A ☐

2.6 The printing of weight values shall be inhibited when the flow rate is greater than either:

2.6.1 3 percent of the maximum flow rate, or yes ☐ No ☐ N/A ☐

2.6.2 The flow rate at which the MWT is engaged unless the weight value yes ☐ No ☐ N/A ☐

is identified as a subtotal, in process weight, or the equivalent.

2.7 The recorded weight value must be expressed without the use of a multiplier. yes ☐ No ☐ N/A ☐

2.8 The printer must automatically sequence through a print cycle so that each yes ☐ No ☐ N/A ☐

printed document includes two weight values to represent the initial and

final values.

3. Rate of Flow Indicator and Recorder

A rate of flow indicator and recorder are required. The MWT shall incorporate or be capable of interfacing with a rate of flow indicator and recorder. They may express the rate in weight units per hour or as a percent of capacity. The indicator and recorder may be either analog or digital.

3.1 The system must have both a rate of flow indicator and rate of flow recorder. yes ☐ No ☐ N/A ☐

The rate of flow recorder is:

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_____ analog

_____ digital

3.2 If a digital flow rate recorder is provided, the readings must be taken at time intervals not exceeding 10 seconds. yes ☐ No ☐ N/A ☐

3.3 The rate of flow indicator must indicate from zero to at least 100% of capacity. yes ☐ No ☐ N/A ☐

3.4 The rate of flow recorder shall record from zero to at least 100% of capacity. yes ☐ No ☐ N/A ☐

4. Rate of Flow Alarms

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The system shall be equipped with a permanent means to provide an audio or visual alarm (signal) when the rate of flow is equal to or less than 20 percent and equal to or greater than 100 percent of the rated capacity of the scale. The alarm shall be located such that it will be noticed by the operator during normal operation.

The rate of flow alarm is:

_____ both audio and visual _____ audio _____ visual

4.1 The alarm (signal) is located so it will be noticed during normal scale operation. yes ☐ No ☐ N/A ☐

4.2 Record the values at which the alarm is triggered:

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Low alarm: ______________

High alarm ________________

4.2.1 Is the alarm triggered when the rate of flow is equal to or less than 20 percent and equal to or greater than 100 percent of the rated capacity of the scale? yes ☐ No ☐ N/A ☐

4.3 Access to the parameters for setting the alarm limits shall be through a security means. yes ☐ No ☐ N/A ☐

5. Zero-Setting Mechanism

The zero-setting mechanism may be either a manual or automatic mechanism. If the zero-load reference is recorded at the beginning and end of a delivery, the range of the zero-setting mechanism shall not be greater than ± 5% of the rated capacity of the scale. Where the zero-load reference is not recorded at the beginning and end of a delivery, the range of the zero-setting mechanism shall be limited to ± 2% of the rated capacity of the scale. If a greater adjustment is needed, the access to the adjustment must be through some security means. An audio or visual signal shall be given when the automatic and semi-automatic zero-setting mechanisms reach the limit of adjustment. The zero-setting mechanism must be constructed such that the zero-setting operation is done only after a whole number of belt revolutions (a minimum of three minutes). The completion of the zero-setting operation must be indicated. The low-flow lockout must be deactivated for this test.

5.1 To verify the ± 5% range of the zero setting mechanism and the zero load reference recording capability:

5.1.1 Verify that the zero-setting range is limited to ±5 percent. yes ☐ No ☐ N/A ☐

5.1.2 Adjust the load simulating device to represent 8% of the scale capacity. yes ☐ No ☐ N/A ☐

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5.1.3 Zero the scale. yes ☐ No ☐ N/A ☐

5.1.4 Adjust the load simulating device representative of a 1% of scale capacity decrease; the automatic-zero-setting mechanism shall reset the zero of the scale and the recording element shall indicate the change in zero.. Adjust for another 1% of scale capacity decrease. Again, the MWT shall reset the zero and the recording element shall indicate the change. Continue to decrease the load simulating device in 1percent increments until the automatic-zero-setting mechanism no longer resets the zero. Record the total amount of adjustment. Return the load simulating device to the value initial zero value. Increase the load simulating device in 1 percent increments, verifying zero corrections and recordings until the MWT will no longer automatically reset the zero. Record the value where automatic zero correction is restricted. The total range of the automatic-zero-setting mechanism shall not exceed 10 percent of the scale capacity. yes ☐ No ☐ N/A ☐

5.1.5 The zero should move a maximum of ± 5 percent either in its Automatic-zero setting mode or as manually adjusted. yes ☐ No ☐ N/A ☐

5.2 To verify the ± 2% range of the zero setting mechanism:

5.2.1 Verify that the zero-setting range is limited to ±2 percent. yes ☐ No ☐ N/A ☐

5.2.2 Adjust the load simulating device to represent 5% of the scale capacity. yes ☐ No ☐ N/A ☐

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5.2.3 Zero the scale. yes ☐ No ☐ N/A ☐

5.2.4 Adjust the load simulating device representative of a 1% of scale yes ☐ No ☐ N/A ☐

capacity decrease; the automatic-zero-setting mechanism shall reset the zero of the scale. Adjust for another 1% of scale capacity decrease. Again, the MWT shall reset the zero. Continue to decrease the load simulating device in 1percent increments until the automatic-zero-setting mechanism no longer resets the zero. Record the total amount of adjustment. Return the load simulating device to the value initial zero value. Increase the load simulating device in 1 percent increments, verifying zero corrections, until the MWT will no longer automatically reset the zero. Record the value where automatic zero correction is restricted. The total range of the automatic-zero-setting mechanism shall not exceed 4 percent of the scale capacity.

5.2.5 The zero should move a maximum of ± 2 percent either in its yes ☐ No ☐ N/A ☐

Automatic-zero setting mode or as manually adjusted.

5.3 The zero-setting operation shall be performed only after a whole number of belt yes ☐ No ☐ N/A ☐

revolutions and at least 3 minutes of operation.

5.4 The completion of the automatic zero-setting operation must be indicated. yes ☐ No ☐ N/A ☐

5.5 The range of the zero-setting mechanism must be limited to ± 2 percent or yes ☐ No ☐ N/A ☐
± 5% of the capacity of the scale without breaking a security means.

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5.6 An audio or visual signal shall be given when the automatic and semi-automatic yes ☐ No ☐ N/A ☐
Zero-setting mechanisms reach the limit of adjustment.

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5.7 A belt-conveyor scale shall be equipped with a zero-ready indicator that yes ☐ No ☐ N/A ☐
produces an audio or visual signal when the zero balance is within ± 0.12 %

of the rated capacity of the scale during an unloaded belt condition.

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6. Sensitivity at Zero Load

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The purpose of this requirement is to assure that the MWT has sufficient resolution and sensitivity to establish a good zero reference value. The manufacturer may specify an alternate test procedure to demonstrate the required sensitivity. The no-flow lockout must be deactivated for this test.

6.1 Adjust the load simulating device to represent the weight required to determine compliance based on the equation:

$$\frac{2 * W_C}{C_m}$$

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Example: $\frac{2 * 500 \text{ lb}}{1000} = 1 \text{ lb}$

Where: C_m = counts in dynamic weighing scale divisions required for the minimum totalized load

W_C = weight required to reach the static scale capacity of the weighbridge.

Static scale capacity = (maximum weight/foot)(length of weighbridge)

6.2 Operate the scale for a time equal to the time required to deliver the minimum totalized load.

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6.2.1 Record the time period: ___________ minutes.

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6.3 The totalizer shall advance at least one but not more than three divisions. yes ☐ No ☐ N/A ☐

6.3.1 Record the quantity registered: _________ divisions.

6.4 The MWT has the sensitivity specified at zero. yes ☐ No ☐ N/A ☐

7. Marking Requirements

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The marking of the MWT shall meet the requirements established during the initial CC evaluation.

8. Provisions for Metrological Sealing of Adjustable Components or Audit Trail

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Due to the ease of adjusting the accuracy of electronic Master Weight Totalizers, all MWT's must provide for a security seal that must be broken or provide an audit trail, before any adjustment that detrimentally affects the performance of the electronic device can be made. Only metrological parameters that can affect the measurement features that have a significant potential for fraud and features or parameters whose range extends beyond that appropriate for the device compliance with Handbook 44 or the suitability of equipment, shall be sealed.

For additional information on the proper design and operatin of the different forms of audit trail, see the Appendis for Audit Trail

8.1 The device has the capability for a physical seal yes ☐ No ☐ N/A ☐

8.2 The device meets the requirements for Audit Trail yes ☐ No ☐ N/A ☐

9. RFI/EMI Environment

The equipment shall be suitable for the environment in which it is intended to be used, including resistance to electromagnetic and radio-frequency interference generated by electromechanical equipment, portable hand-held radio transmitters and citizen's band transmitting equipment (if normally used at the site of installation).

9.1 The instrument meets standard NTEP RFI/EMI influence requirements. yes ☐ No ☐ N/A ☐

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10. Laboratory Test Procedures

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Technical Policy

The MWT is to be placed in the environmental chamber to determine performance with respect to influence factors. It is not necessary to re-rest a previously type approved weighbridges, speed sensors or ancillary devices. It is not necessary, nor recommended, that signal simulators for load and speed be located in the chamber. The simulated test loads to be used for the MWT evaluation shall be equal to the signal levels from the actual tests loads used during the initial type evaluation.

Initial Tests

1. Determine and record the load simulating device setting for zero and full scale ranges.

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2. Calibrate the MWT at 20 ºC.
3. Conduct the sensitivity test at zero load.
4. Verify that the range of the automatic zero setting mechanism(s) do not exceed ±2 percent and ±5 percent of capacity.
5. Test the alarms for flow rates below 20 percent and above 100 percent of rated capacity.

Once the laboratory test is started, after completion of the voltage tests, neither the zero nor the span are to be adjusted. The data should be normalized for the many tests.

The laboratory tests consist of a combination of simulated dynamic tests. These tests require adjusting a load simulating device and a speed simulating device to pre-calculated values and conducting a simulation of belt travel distances, integrating the weight on the MWT.

Soak Requirements

The laboratory test is to be run at 20 ºC, the upper temperature limit and the lower temperature limit. The surface temperature of the MWT is to be measured. In consultation with the manufacturer, place the temperature sensor on the portion of the MWT that is expected to be the last part to reach thermal equilibrium. After the surface temperature has reached the test temperature, allow the equipment to soak for at least an additional two hours, but not more than six hours, before starting the test. For convenience of the test, however, an overnight period may be used for the soak period before running the next temperature test.

1. Stabilize the temperature at 20 ºC.
2. Enable the speed simulating device for a constant signal level.
3. Deactivate the automatic zero setting mechanism and no-flow lock-out.
4. Zero the MWT.

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The MWT shall have sufficient resolution (that is a sufficiently small dynamic scale division) to permit this test to be completed in the greater of 20 minutes, or for a time equivalent to the test time required for the test run at 35 percent of the minimum static capacity.

The beginning and ending MWT indications shall not change more than ± 1 scale division.

Voltage Tests

Verify the line power source, AC or DC, is set to the manufacturers recommended nominal value (i.e.: 120 VAC or 24 VDC)

1. Run an accuracy test at 98 percent of scale capacity for the time to deliver 800d.
2. Reduce the line power supply to 85% of nominal (i.e.: 100 VAC or 20.4 VDC).
3. Run a zero test.
4. Run an accuracy test at 98 percent of scale capacity for the time to deliver 800d.
5. Increase the line power supply to 110% of nominal (i.e.: 130 VAC or 26.4 VDC).
6. Run a zero test.
7. Run an accuracy test at 98 percent of scale capacity for the time to deliver 800d.
8. Return the line power supply to the nominal value.

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Temperature Tests

1. Run a zero test
2. Do not reset zero or adjust the span at any time after the start of this test.
3. Adjust the load simulating device to achieve the desired load representations.
4. Test the MWT simulating dynamic operation of the belt conveyor scale system at the following "flow rates" (all percent values represent percent loads of static scale capacity (SSC)):

   0 (zero test), 35 percent (SSC_{min}), 35 percent, 70 percent, 98 percent,

   Leave the MWT under simulated load for 1 hour, then:

   98 percent, 70 percent, 35 percent, 35 percent (SSC_{min}), and 0 (zero test)

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Table T.3

Percent of Static Scale Capacity	**Nominal Time (Minutes)**	**Equivalent Belt Travel**
0	20 minutes, or $MTL_{min}/[(0.35)(BL_{min})$(belt speed for test)], whichever is greater	________
35% of SSC_{min}	20 minutes, or $MTL_{min}/[(0.35)(BL_{min})$(belt speed for test)], whichever is greater	________
35% of SSC_{max}	Time to deliver 800d	
70% of SSC_{max}	Time to deliver 800d	
98% of SSC_{max}	Time to deliver 800d	

Leave MWT under simulated load for 1 hour		
98% of SSC $_{max}$	Time to deliver 800d	
70% of SSC $_{max}$	Time to deliver 800d	
35% of SSC $_{max}$	Time to deliver 800d	
35% of SSC $_{min}$	20 minutes, or MTL_{min}/[(0.35)(BL_{min})(belt speed for test)], whichever is greater	________
0	20 minutes, or MTL_{min}/[(0.35)(BL_{min})(belt speed for test)], whichever is greater	________

The tolerance to be applied for the laboratory test is set at 0.45 times the tolerance for the complete installation times 0.3 (30%). The formula is shown in Table T.4 to illustrate the process. The reference value for a particular accuracy test is the simulated load times the simulated belt travel distance. The values to be used for the laboratory test are shown in the following example:

98% load – Zero load test = difference

Proportion the effect of the zero-load test to the time of the tests for each simulated load. The values for the differences represent the simulated material measured by the MWT and is compared to the reference value for accuracy.

1. Change the temperature to -10 ºC (14 ºF) at a rate no faster than 1º C/min following the "soak requirements".
2. Repeat the simulated dynamic tests.
3. Change the temperature to 40 ºC (104 ºF) at a rate no faster than 1º C/min following the "soak requirements".
4. Repeat the simulated dynamic tests.
5. Change the temperature to 20 ºC (68 ºF) at a rate no faster than 1º C/min following the "soak requirements".
6. Repeat the simulated dynamic tests.

Data Analysis

1. The data are evaluated on the Simulated Dynamic MWT Test Work Sheet, Item 14 and 15, for pass or fail.

11. Field Test

A field test is required prior to final type approval. The field test ~~**can**~~ **must** be performed as a retrofit on a previously approved for commercial use belt-conveyor scale system or in a new application. The Field Test Procedures as defined in ~~**paragraph 13 of the initial belt-conveyor scale Type Evaluation section of Publication 14 and**~~ **Sections N.2, N.3.1., and N.3.2. of** Handbook 44 are to be followed. The results of all tests must be within acceptance tolerances.

12. Permanence Test

Since this policy is intended for use only during the evaluation of master weight totalizers and not for the material handling system in which they will be installed, there is no field permanence test required. Permanence testing on the MWT instrument will take place during laboratory evaluations listed under Section E in this document.

~~**A permanence test is conducted to determine the accuracy of the device in use over a period of time. The permanence test shall be conducted after a minimum of 20 days after successful completion of the initial performance test, and after a minimum volume of material has been transported across the belt-conveyor scale. This minimum volume of material shall be no less than the maximum scale capacity times 8 hours times 20 days. (i.e.: A system with a maximum scale capacity of 1000 TPH requires a minimum volume of 160,000 tons [1000 * 8 * 20] to have been transported prior to the permanence test.). The results of all tests must be within acceptance tolerances.**~~

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~~**The permanence test shall include:**~~

- ~~**Initial stable zero tests**~~
- ~~**at least two test loads at normal use capacity**~~
- ~~**simulated load tests**~~
- ~~**verification of audit trail recorded events**~~

13. Data Sheet and Lab Test Procedure

Temperature Testing: Belt-Conveyor Scale Code paragraphs T.3.1., T.3.1.1., T.3.1.2. The accuracy of the MWT is to be adjusted at 70% of the static scale capacity (SSC). A weight display of 0.01 percent (1 part in 10,000) is required for the laboratory tests. The allowable error is adjusted to 30 percent of the allowable error for the entire system type approval. If tests are run for a time greater than that needed for the minimum test load (MTL), substitute the totalized load (TL) for the MTL in the tolerance calculation in Test Conditions, step 3 (Table T.4)

Table T.4

Device Parameters	**Abbrev.**	**Maximum**	**Minimum**	**Dim**
1. Load per unit length from existing Certificate of Conformance; corresponds to the largest capacity and the lowest capacity rating	BL			lb/ft
2. Length of the weighbridge (inches) from existing Certificate of Conformance				In
3. Belt Speed from existing Certificate of Conformance	SP			ft/min
4. Determine scale capacity in units per hour SC=SP*BL*60/2000 (must correspond to existing Certificate of Conformance)	SC			ton/hr
5. Record the static scale capacity in units of weight SSC=(maximum weight per foot)(length of weighbridge)	SSC			lb
6. Allowable zero error for temperature change of 10 ºC (18 ºF) AZE= ~~**(.003)**~~**(0.3)**(0.0007)(SC_{min})(time)/60 where "time" is the time of the zero test in minutes	AZE			ton
7. Size of scale division required for zero	SD			ton

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8. Determine the minimum and maximum totalized loads	MTL			ton
Test Conditions		**Abbrev.**		
1. Determine the time n minutes to acquire MTL with the test load to be simulated in the laboratory	Test load, pound/foot			lb/ft
	Test load, total			lb
	Time (minutes) to deliver MTL (at least 10 minutes)	Time		min
2. Determine number of belt travel sensor revolutions required for the above time. Manufacturer to provide revolutions per foot or pulses per foot as appropriate to determine 3 belt revolutions and a delivery of 800d.		BTR		revolutions
3. Allowable weighing error (units of weight) for simulated dynamic tests which will be divisions on master weight totalizer. AWE = ~~(0.003)~~**(0.30)**(0.45)(0.005)(TL)	AWE			ton

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Table T.5
Initial Tests
1. Set up the unit at 20 ºC (68 ºF), zero the MWT and adjust the span following the manufacturer's procedure.
2. Conduct the sensitivity test at zero load.
3. Verify that the range of the automatic zero setting mechanism(s) do not exceed ±2% and ±5% of capacity.
4. Test the alarms for flow rates below 20% and over 100% of scale capacity.

Table T.6

Laboratory Tests
1. Stabilize the temperature at 20 ºC
2. Enable the speed simulator to represent 100% speed
3. Deactivate the automatic zero setting mechanism and zero the MWT
4. Run a zero test
Voltage tests
5. Run an accuracy test at 98% of scale capacity for the time to deliver 800d
6. Reduce the live voltage to 85% of nominal
7. Run a zero test
8. Run an accuracy test at 98% of scale capacity for the time to deliver 800d
9. Increase the line voltage to 110% of nominal
10. Run a zero test
11. Run an accuracy test at 98% of scale capacity for the time to deliver 800d
12. Return the live supply to nominal
Temperature Tests
13. Run a zero test. Do not reset zero or adjust the span at any time after the start of this test.
14. Adjust the load simulating device to represent normal loading of the scale (70% of scale capacity)
15. At 20 ºC, test the MWT dynamically with simulation of the load and speed. Test the MWT at the following "flow rates" (all percent values represent percent loads of static scale capacity): 0 (zero test), 35 percent(SSC_{min}), 35 percent, 70 percent, 98 percent, leave the MWT at full load for 1 hour, 98 percent, 70 percent, 35 percent, 35 percent((SSC_{min}), and 0 (zero test)

Table T.7

Percent of Static Scale Capacity	Time (Minutes)	Totalaized Load TL (ton)	Tolerance AWE= ~~(0.003)~~(0.30)(0.45)(0.005)(TL)
0	20 minutes, or MTL_{min}/[(0.35)(BL_{min})(belt speed for test)], whichever is greater		
35% of SSC_{min}	20 minutes, or MTL_{min}/[(0.35)(BL_{min})(belt speed for test)], whichever is greater		
35% of SSC_{max}	Time to deliver 800d		
70% of SSC_{max}	Time to deliver 800d		
98% of SSC_{max}	Time to deliver 800d		

Leave MWT under simulated load for 1 hour			
98% of SSC_{max}	Time to deliver 800d		
70% of SSC_{max}	Time to deliver 800d		
35% of SSC_{max}	Time to deliver 800d		
35% of SSC_{min}	20 minutes, or $MTL_{min}/[(0.35)(BL_{min})$(belt speed for test)], whichever is greater		
0	20 minutes, or $MTL_{min}/[(0.35)(BL_{min})$(belt speed for test)], whichever is greater		

Table T.8
Laboratory Tests *(continued)*
16. Change the temperature to -10 ºC (14 ºF) at a rate no faster than 1 ºC/min. Follow soak requirements.
17. Repeat the simulated dynamic tests performed in step 15 (Table T.6)
18. Change the temperature to 40 ºC (104 ºF) at a rate no faster than 1 ºC/min. Follow soak requirements.
19. Repeat the simulated dynamic tests performed in step 15 (Table T.6)
20. Change the temperature to 20 ºC (68 ºF) at a rate no faster than 1 ºC/min. Follow soak requirements
21. Repeat the simulated dynamic tests performed in step 15 (Table T.6)
Data Analysis
1. The data are evaluated on the following Simulated Dynamic MWT Test Work Sheets for pass or fail
2. Approval is for addition of MWT to existing Certificate of Conformance without changes to minimum and maximum ranges.

14. Dynamic MWT Test Work Sheet and Laboratory Test Procedure No. 1

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The calibration point is the 70 percent load for the initial room temperature (20 ºC) test. Because the weight indication when in the test mode may not be at zero and may not be adjusted to indicate n weight values (e.g., the quantity indication may be voltage output or "counts", the table provides for calculations to convert indications into weight units). The scale indication shall not be zeroed during the test process. Corrections for the change in zero tests are to be done by calculation.

Places to record information needed for the test and the formulae needed to compute table entries are given below.

Static Scale Capacity, SSC = (maximum weight per foot)(length of weighbridge) = ________________ lb.

Test load for 70 percent SSC = _______________ lb.

Weight/foot = (static scale load)/(length of weighbridge) = Static scale capacity)/(length of weighbridge)

Start and end readings are in divisions and must be converted to weight values.

Conversion factor for divisions to weight = (change in static weight indication from zero to 70% SSC load) / (70% SSC load in pounds)

Change in zero = (Total change of zero during zero test({(time of test for applied load)/(time of zero test)}

Indication corrected for change of zero = (Indicated change) – (Change of zero)

Scale indication in lb = (Indication corrected for change of zero) / (Conversion factor)

Actual weight = {(Applied load)/(length of weighbridge)}(speed)(time)

Note: Speed and time must use the same units of time (e.g., feet per minute and minutes)

Error = Scale indication – actual weight

Tolerance is from the Belt-Conveyor Scale Data Sheet and Laboratory Test Procedure, step 3.

15. Dynamic MWT Test Work Sheet and Laboratory Test Procedure No. 2

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Scale indication at zero load (static scale indication) = _______________ divisions

(Not required if MWT can display static weight)

Scale indication at 70 percent SSC (static scale indication) = _______________ divisions

(Not required if MWT can display static weight)

Conversion factor = (change in static weight indication from zero to 70% SSC load) / (70% AAC load in pounds) = divisions/lb

Temperature__________ ºC Type of Tests________________ Signature____________________

Table T.9

Test Load (lb)	Applied load (lb)	Time of test in minutes	Reading in counts		Indicated Change = End – Start	Change in Zero	Indication corrected for change in zero	Scale Indication (lb)	Actual Weight	Error (lb)	Tolerance (lb)
			End	Start							
Zero test	0										
35% SSC_{min}											
35% SSC_{max}											
70% SSC_{max}											
98% SSC_{max}											
Leave scale under simulated load for 1 hour											
98% SSC_{max}											
70% SSC_{max}											
35% SSC_{max}											
35% SSC_{min}											
Zero test	0										

16. Zero Change with Respect to Temperature

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Table T.10

	Low Temperature		High Temperature		20 °C		Performance limit for temperature effect on zero test, AZE, per 10 °C
Previous Temperature T_P	20 °C						
Current Temperature T_C					20 °C		
Change in Temperature $(T_C - T_P)$							
	Divisions	lb	Divisions	lb	Divisions	lb	
Zero load indication at T_P							

Zero load indication at T_C							
Change in zero							
Change in zero per 5 °C (9 °F)							

Date:_______________

Indicator Model Number:_______________ Indicator Serial Number:_______________

____

Signature Title

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