Agenda
Combined Meeting:
USNWG R50 & NTETC Belt Conveyor Scales
February 25-26, 2009

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I. USNWG Meeting:

Weds. Feb. 25th 1:00-5:00pm – Thurs. Feb. 26th 8:00-12:00pm

A. 2009 Handbook 44 Changes:

Review recommendations of the USNWG February 2008 meeting incorporated into 2009 HB44

1. N.2.3. Minimum Test Load:

(This item was adopted)

Source: Western Weights and Measures Association (WWMA)
Proposal: Amend NIST HB 44, Section 2.21. Belt Conveyor Scales (BCS) Systems Code, paragraph N.2.3. as follows:

N.2.3. Minimum Test Load. – Except for applications where a normal weighment is less than 10 minutes, t~~T~~he minimum test load shall not be less than the largest of the following values.

(a) 800 scale divisions,

(b) the load obtained at maximum flow rate in one revolution of the belt, or

(c) at least 10 minutes of operation.

For applications where a normal weighment is less than 10 minutes (e.g., belt-conveyor scale systems used exclusively to issue net weights for material conveyed by individual vehicles, and railway track cars) the minimum test load shall be the normal weighment that also complies with (a) and (b).

The official with statutory authority may determine that a smaller minimum totalized load down to 2 % of the load totalized in 1 hour at the maximum flow rate may be used for subsequent tests, provided that:

1. the smaller minimum totalized load is greater than the quantities specified in (a) and (b), and

2. consecutive official testing with the minimum totalized loads described in N.2.3. (a), (b), or (c) and the smaller minimum test load has been conducted that demonstrates the system complies with applicable tolerances for repeatability, acceptance, and maintenance.
(Added 2004) (Amended 2008)

Background/Discussion: In 2004 NIST HB 44 paragraph N.2. Conditions of Test. was amended, and the minimum totalized load (MTL) requirements were amended and renumbered to N.2.3. Since 10 minutes of operation in N.3.2.(c) typically results in a test load larger than (a) or (b), the 10 minutes MTL is used for most BCS installations. Additionally, the words "or a normal weighment" were deleted from MTL requirements; the words were no longer needed since language was developed to allow a smaller material test load provided the scale demonstrated compliance with BCS tolerances with the MTL and the smaller test load.

As a result of deleting the words "or a normal weighment," it has been reported that the revised MTL requirements are not suitable for BCS installations that issue individual weights for vehicles and railcars. This is due to limitations of the installation and uncertainties in determining the net weights of several vehicles or railcars to compare material test results of the 10 minutes MTL with the alternate test load of "2 % of the load totalized in 1 hour."

The restoration of the words "or a normal weighment" allows operation of such BCS systems used exclusively to issue net weights for material conveyed by individual vehicles and railway track cars, provided the systems comply with tolerance and repeatability requirements. It should be noted that the 10-minute test could still be used on installations that do not need to start and stop product flow to continuously fill and issue a totalized weight for several vehicles or railcars (unit trains).

At its 2007 Annual Meeting, the WWMA heard comments from a BCS manufacturer in support of the proposal and, consequently, recommended this proposal move forward as a voting item on the NCWM S&T Committee Agenda.

During the 2008 Interim Meeting, the Committee heard comments from Bill Ripka, Thermo Fisher Scientific, supporting the proposal. The Committee agreed to present the proposal for a vote at the Annual Meeting.

At its February 2008 meeting, the NW&SA WG on BCS reviewed the proceedings from the Committee's 2008 Interim Report. This led to discussion regarding the comparison and alignment of the recommendation in the Interim Report to similar requirements in OIML R 50 – "Continuous totalizing automatic weighing instruments (belt weighers)" section 2.5 - Minimum Test Load. The WG believes the statement "at least 10 minutes of operation" should be removed and could be brought into alignment with OIML R 50 use of 2% load in one hour at maximum flow rate. Additionally, the test load listed in OIML R 50 must be understood as the minimum amount needed for a materials test and is based on the systems maximum flow rate. However, this recommendation was too large of a change to the proposal. Recognizing the urgency of the proposed language, the WG decided to submit their recommendation to align the MTL requirements with R 50 at a later time. The WG recommended changing the proposed language in paragraph N.2.3. to clarify that the minimum test load for applications when the normal weighment is less than 10 minutes still indicate at least 800 scale divisions or one belt revolution.

At its 2008 spring meeting, the CWMA S&T Committee supported the item as written in the Interim Report and recommended that the item move forward to a vote.

At the 2008 Annual Meeting, the Committee heard comments that the proposed language in the Interim Report appeared to indicate that BCS systems would issue weights for the individual vehicles or railway cars. The Committee agreed that the intent was for the belt-conveyor scale system to issue "net weights" for materials conveyed by vehicles and railway track cars. The Committee also agreed with the NW&SA WG recommendation to make the exception for applications for small normal weighments. Consequently, the Committee amended proposal to read as shown in the recommendation above.

2. UR.2.2. (n) Conveyor Installation - Belt Alignment.
(This item was adopted.)

Source: Carryover Item 321-1. (This item originated from the SWMA and first appeared on the Committee's 2007 agenda.)

Recommendation: Modify paragraph UR.2.2.(n) as follows:

UR.2.2. Conveyor Installation

(n) Belt Alignment. – The belt shall not extend beyond the edge of the outermost roller of any carry side (top) roller in any area of the conveyor nor touch the conveyor structure on the return (bottom) side of the conveyor. (Amended 1998 **and 2008**)

Background/Discussion: During the 2006 NCWM Interim Meeting, the Committee considered the recommendations from the NCWM review panel and the comments from industry regarding this proposal. The review panel indicated the proposal should have included national data that demonstrated a need for modifying paragraph UR.2.2. and should be a Developing item until such data are provided. At that time, one representative from the belt-conveyor scale service industry indicated there are too many factors that influence belt tracking to ensure a belt is centered at all times. The service representative recommended that the belt should not extend beyond the edge of the idler roller in any area of the conveyor on the carrying side or touch holding brackets on the return side to reduce any detrimental effects on accuracy. Industry representatives indicated the design of idlers and scales are such that the belt is not intended to stay in the exact center. Industry also indicated there was no mechanism available to monitor the belt's tracking 24 hours a day, 7 days a week. Industry requested specifications for what constituted either "center" or an acceptable "range of center" for belt tracking. Although the 2005 SWMA reported the proposal was ready for national consideration, the Committee agreed it was more appropriate to make the proposal a Developing item until there was some clear indication that belt alignment could be tracked for maintenance and accuracy purposes.

During the 2007 NCWM Annual Meeting, the Committee heard testimony that a work group of the NW&SA was addressing this item. The NW&SA, in a letter dated July 31, 2007, submitted a recommendation to the Committee for consideration during the 2008 NCWM Interim Meeting.

In that letter, the NW&SA WG stated there was insufficient evidence of the effect of small lateral movement of the belt to establish a valid requirement narrower than the edge of the idler roller on belt-conveyor scale systems other than the short conveyors used by the original submitter. The WG added that no practical devices were available to measure such lateral alignment changes and recommended the language added to the original proposal above be withdrawn. However, the WG made the recommendation to modify UR.2.2.(n) to include language to clarify that the belt shall not come into contact with any part of the conveyor structure.

At its 2007 Annual Meeting, the WWMA discussed the letter from the NW&SA and heard from a belt-conveyor scale manufacturer supporting the recommendation from the NW&SA WG because it provided guidance for the user to better maintain the zero condition of the scale and helped prevent damage to the belt. As a result, the WWMA recommended that the NW&SA WG version of UR.2.2. move forward as a voting item on the NCWM S&T Committee Agenda.

At its 2007 Annual Meeting, the SWMA heard that Montana and the WWMA support the position and alternate proposal from the NW&SA. The SWMA recommended that the NCWM S&T Committee present the alternate proposal shown above and move forward as a voting item on the NCWM S&T Committee Agenda.

During the 2008 NCWM Interim Meeting, the Committee heard from Bill Ripka, Thermo Fisher Scientific, who supported the intent of the July 31, 2008 alternate proposal, but noted that the language needed some additional refining. The NIST Technical Advisor reported on a letter submitted by the WG on October 19, 2007 that addressed Mr. Ripka's concerns that revised their proposal to clarify that the belt shall not extend beyond the edge of the outermost roller (i.e., wing roller) of the idler since idlers typically include more than one roller. The Committee agreed with the comments and the revised recommendation in that letter and agreed to present the amended proposal as shown in the recommendation for a vote at the Annual Meeting.

At the 2008 Annual Meeting, the Committee reviewed comments from the NW&SA WG on Belt-Conveyor Scales and the CWMA agreeing with the proposed changes made by the Committee and supported the adoption of the proposed amendment to paragraph UR.2.2.(n).

For additional background information, refer to the Committee's 2007 Annual Report.

B. S&T Committee Items:

Review of Handbook 44 Recommended changes moved forward as voting items 2009 NCWM Annual Meeting:

1. UR.3.2.(c) Maintenance: Zero Load Tests:

Source: 2008 Western Weights and Measures Association (WWMA) (This item last appeared on the 2008 Committee's Developing agenda as item 360-2 Part 3 Item 1.)

Recommendation: Modify UR.3.2.(c) as follows:

UR.3.2. Maintenance. – Belt-conveyor scales and idlers shall be maintained and serviced in accordance with manufacturer's instructions and the following requirements:

Zero-load and load (simulated or material) tests,~~S~~simulated load tests, or material tests, and zero load tests shall be conducted at periodic intervals between official tests in order to provide reasonable assurance that the device is performing correctly. **The minimum interval for periodic zero-load tests and simulated load tests shall be established by the official with statutory authority or manufacturer recommendations.**

The action to be taken as a result of the zero-load tests is as follows:

- **if the change in zero is less than ± 0.25 %, adjust the belt-conveyor scale system to zero and proceed to a simulated load test or return the conveyor to operation.**

- **if the change in zero is ± 0.1 % to ± 0.25 % to ± 0.5 %, inspect the conveyor and weighing area for compliance with UR.2. Installation Requirements and repeat the zero-load test.**

- **if the change in zero is greater than ± 0.5 %, inspect the conveyor and weighing area for compliance with UR.2. Installation Requirements, repeat the zero-load test, and reduce the interval between zero-load tests.**

(Alternate Format)

Change in Zero Reference Point (Δ 0)	Action to be taken
If the change in zero is less than ± 0.25 % (Δ 0 ≤ 0.25%)	Perform zero adjustment and proceed to simulated load test
If the change in zero is ± 0.25 % to ± 0.5 % (0.25% < Δ 0 ≤ 0. 5%)	Inspect the conveyor and weighing area for compliance with UR.2. Installation Requirements and repeat the zero-load test
If the change in zero is greater than ± 0.5 % (Δ 0 > 0. 5%)	Inspect the conveyor and weighing area for compliance with UR.2. Installation Requirements, repeat the zero-load test, and reduce the interval between zero-load tests.

The action to be taken as a result of the **simulated load or** material tests **or simulated load tests** is as follows:

(Amended 2002 **and 200X**)

- if the error is less than 0.25 %, no adjustment is to be made;

if the error is at least 0.25 % but not more than 0.6 %, inspect the conveyor and weighing area for compliance with UR.2. Installation Requirements and repeat the test, adjustment may be made if the official with statutory authority is notified;
(Amended 1991 **and 200X**)

- if the result of tests, after compliance with UR.2. Installation Requirements is verified, remain greater than ± 0.25 %, a span correction shall be made and the official with statutory authority notified;

- if the error is greater than 0.6 % but does not exceed 0.75 %, inspect the conveyor and weighing area for compliance with UR.2. Installation Requirements, and repeat the test;
(Amended 1991 **and 200X**)

if the result of tests, after UR.2. Installation Requirements compliance is verified, remains greater than ± 0.25 %, a span correction shall be made, the official with statutory authority shall be notified, and an official test shall be conducted;

if the error is greater than 0.75 %, an official test is required.
(Amended 1987 **and 200X**)

(Alternate Format)

Change in Reference Point established in N.3.3. (b)	Action to be taken
If the error is less than 0.25 % (Δ N.3.3. (b) < 0.25%)	No Action
If the error is at least 0.25 % but not more than 0.6 % (0.25% ≤ Δ N.3.3. (b) ≤ 0.6 %)	Inspect the conveyor and weighing area for compliance with UR.2. Installation Requirements and repeat the test. If the result of tests, after compliance with UR.2. Installation Requirements is verified, remain greater than ± 0.25 %, a span correction shall be made and the official with statutory authority notified.
If the error is greater than 0.6 % but does not exceed 0.75 % (0.6% ≤ Δ N.3.3. (b) ≤ 0.75%)	Inspect the conveyor and weighing area for compliance with UR.2. Installation Requirements, and repeat the test. If the result of tests, after UR.2. Installation Requirements compliance is verified, remains greater than ± 0.25 %, a span correction shall be made, the official with statutory authority shall be notified, and an official test shall be conducted.
If the error is greater than 0.75 % (Δ N.3.3. (b) > 0.75%)	An official test is required.

Discussion: HB 44 gives limited guidance on what to do with zero-load test results. Belt loss is not the only factor which may require the scale operator to make physical adjustments to the belt-conveyor system to correct for deficiencies. For example, a dirty scale structure or a worn belt scraper will increase the zero-reference number and the test results may exceed tolerances.

The scale user/owner has to protect his interest between weighing transactions. At present, some belt-conveyor systems may have errors greater than 0.5 % in zero reference over a 24-hour period. The belt is part of tare (net load) on any empty running system and the system must be maintained to within tolerance at all times.

During its 2006 meeting, the WWMA recommended the alternate industry proposal shown above. The WWMA also recommended the alternate proposal be considered at a future meeting of the USNWG on Belt-Conveyor Scale Systems. The WWMA recommended the alternate proposal remain a Developing item to allow sufficient time for a review by the WG. The CWMA and the SWMA concurred with the WWMA's recommendation.

During the 2007 NCWM Annual Meeting, the Committee heard testimony that a WG of the National Weighing and Sampling Association was working on this item and would have a recommendation for the WWMA prior to its 2007 Annual Meeting.

Participants in the WG include:

Phil Carpentier, PTC Consulting, LLC	ptcarpentier@att.net
Paul Chase, Chase Technology, Inc.	mjc@emily.net
Al Page, Montana Weight & Measures (retired)	awp88bb@gmail.com
Peter Sirrico, Thayer Scale	psirrico@thayerscale.com
Bill Ripka, Thermo Ramsey	bill.ripka@thermofisher.com

This WG agrees that there is a need to establish some zero-load test interval for the normal use of a belt-conveyor scale system and that there is also a need to vary that interval (longer interval if the scale is stable; shorter if the zero-load tests require frequent adjustment). The WG has reviewed and discussed this Developing item and submitted a revised proposal to the NIST technical advisor to the S&T Committee.

At its 2007 Annual Meeting, the WWMA heard comments from a BCS manufacturer that the NW&SA WG version was superior to current language. However, the manufacturer stated that this item needed additional development and subsequent review by the entire NW&SA. The WWMA believed this item was not sufficiently developed and did not have a consensus from the NW&SW WG and therefore recommended this remain a Developing item on the NCWM S&T Committee agenda.

At its 2007 Interim Meeting, the CWMA recommended this item be Withdrawn.

During the 2008 NCWM Interim Meeting, the Committee was informed that the USNWG on Belt-Conveyor Scales is going to further develop the proposal during their next meeting on February 27 - 28, 2008, in St. Louis, Missouri. During that meeting, the WG further amended the proposal as shown in the above recommendation and believes that this item is sufficiently developed to be added to the NCWM S&T Committee Agenda as a Voting item.

At its 2008 Annual Technical Conference, the WWMA heard comments from the BCS USNWG that the item is sufficiently developed. The WWMA agreed with the comments and proposed change to add "and after a repair or mechanical adjustment to the conveyor system" in (c) as shown in the above proposal and recommends that this proposal move forward as a Voting item.

At the 2009 NCWM Interim Meeting, the Committee heard comments from Bill Ripka, Thermo Ramsey, recommends that this item move forward as a voting item since recent changes to the Belt-Conveyor Scale Systems Code have increased attention to the accuracy of the zero reference on belt-conveyor scales and raised questions on how frequently the zero reference and simulated tests be conducted between official testing. The language in this proposal would require that users perform tests to monitor the scales performance at a frequency that would be established either by the official or by recommendations from the manufacture. Jack Kane, Montana, was concerned that the proposed language appears to rely only on the officials experience and expertise and suggested the scale manufacturer be able to provide input to the frequency of testing. Julie Quinn, Minnesota, stated that this language by itself would imply record keeping requirements. The NIST Technical Advisor stated that the requirements for record keeping are supported in paragraph UR. 3.3. Retention of Maintenance, Test, and Analog or Digital Recorder Information. The NIST Technical Advisor added all the belt-conveyor scale proposals will be reviewed by the belt-conveyor scale work group during their February 2009 meeting.

The Committee agreed with the comments from Jack Kane an amended the proposal as shown in the Committee's recommendation to include manufacture recommendation in determining the frequency of zero and simulated tests between official tests and recommended that this item move forward as a voting item.

2. N.3.1.4. Check for Consistency of the Conveyor Belt Along Its Entire Length:

Source: 2008 Western Weights and Measures Association (WWMA) (This item last appeared on the 2008 Committee's Developing agenda as item 360-2 Part 3 Item 2)

Recommendation: Amend NIST Handbook 44, Section 2.21. Belt Conveyor Scales (BCS) Systems Code, paragraph N.3.1.4. as follows:

N.3.1.4. Check for Consistency of the Conveyor Belt Along Its Entire Length. – During a zero-load test, the total change indicated in the totalizer during one revolution of the belt shall not exceed 0.18 % of the load that would be totalized at scale capacity for the duration of the test. The end value of the zero-load test must meet the ± 0.06 % requirement of paragraphs N.3.1.2. Initial Stable Zero and N.3.1.3. Test for Zero Stability. ~~**After a zero-load test with flow rate filtering disabled, the totalizer shall not change more than plus or minus (± 3 d) 3.0 scale divisions from its initial indication during one complete belt revolution.**~~

(Added 2002) (Amended 2004 **and 201X)**

Discussion: The BCS WG agrees that the existing language in N.3.1.4. results in an excessive allowance for the variation in a belt. However, for belt-conveyor scales that can benefit from a smaller minimum division, the 3-division requirement can impose an excessively narrow restriction. It should be noted that variations in belt weight tend to be sinusoidal. In other words, the error caused by belt variations would be canceled if the material test were conducted using complete revolutions. The maximum belt variation would occur at 0.5, 1.5., 2.5, etc., revolutions. However, material tests are rarely conducted using complete revolutions of the belt.

The current tolerance of plus or minus 3 divisions can allow belt weight variation to contribute too large a portion to the 0.25 % belt-conveyor scale tolerance. The actual quantity represented by 3 divisions can vary with the belt-conveyor scale application. Paragraph N.2.3. Minimum Totalized Load (b) allows a material test load to be the amount of material to be weighed during one revolution of the belt. If the tolerance for the material test is 0.25 %, then on a root-sum-square basis, the variation in zero resulting from changes in the weight of the belt itself should not exceed 0.18 % (0.25 % times { $\sqrt{2}$ } / 2).

Some rationale other than root-sum-square could result in a different allowable variation due to belt weight.

The following example illustrates the difference between divisions and percent for this purpose:

Belt length	= 800 ft,
Division size	= 0.1 ton,
Maximum capacity	= 800 tons/hr, and
Belt speed	= 400 ft/min

These minimum totalized load (MTL) values in paragraph N.2.3. are in a feasible range for an actual application.

N.2.3. (a)	800 divisions	= 80.0 tons
N.2.3. (b)	one revolution	= 26.67 tons, which is (66.67 lb/ft * 800 ft)
N.2.3. (c)	ten minutes	= 133.3 tons

The materials test tolerance (T.1.) based on the MTL in N.2.3.(b) = 0.07 tons.

The allowable variation due to belt weight is ± 3 divisions or ± 0.3 tons. Using ± 0.3 ton error in zero allows a total delivery error that can exceed maintenance tolerance in paragraph T.1. Tolerance values because of acceptable belt weight variation of 0.6 tons currently in HB 44 paragraph N.3.1.4. This tolerance exceeds the 0.25 % tolerance of the weighing system without weighing any material. Even for a 10 min MTL (N.3.1.4.(c)), the allowable error is 0.45 % of 133.3 tons.

The proposed language changes the tolerances in N.3.1.4. from ± 3 divisions to 0.18 %. In the above example, the allowable change in the totalizer readings could be no greater than 0.048 tons [0.18 % x 26.67 tons (MTL)].

NIST HB 44 paragraph N.2. Conditions of Test was amended, and the minimum totalized load (MTL) requirements were amended and renumbered to paragraph N.2.3. Since 10 min of operation in N.3.2.(c) typically results in a test load larger than (a) or (b), the 10 min MTL is used for most BCS installations. Additionally, the words “or a normal weighment” were removed from MTL requirements because, at that time, it was thought the words were no longer needed since language was developed to allow a smaller material test load provided the scale demonstrated compliance with BCS tolerances with the MTL and the smaller test load.

As a result of removing the words “or a normal weighment,” it has been reported that the revised MTL requirements were not suitable for BCS installations that issue individual weights for vehicles and railcars. This is due to limitations of the installation and uncertainties in determining the net weights of several vehicles or railcars to compare material test results of the 10 min MTL with the alternate test load of “2 % of the load totalized in 1 hour.”

The current NIST HB 44 paragraph N.2.3. permits “a smaller minimum totalized load down to 2 % of the load totalized in 1 hour….” In the above example the minimum load would be 16 tons for this criterion so the belt variation is even a larger percentage of the weighed load.

The change to 0.18 % is a better criterion in several ways.

1. It defines the allowable excursion of the totalized value during the zero procedure. Plus or minus requires some reference value and it is not known at the start of a zero test whether that portion of the belt is heavy or light.
2. It is independent of division size. (But the division size must be small enough to resolve the variation.)
3. It is in harmony with OIML R 50.

In the above example 0.18 % of 26.67 tons is 0.048 tons. This is quite different from 3 divisions or ± 3 divisions.

At its 2008 Annual Technical Conference, the WWMA heard comments that the item is sufficiently developed and is an improvement over the existing language in HB 44. The Committee agrees and recommends that this proposal move forward as a Voting item.

During the 2009 NCWM Interim Meeting, the Committee heard a comment from Bill Ripka, Thermo Ramsey, supporting the proposal as written in the Committee's recommendation and added that the current language in HB 44 stating that the current 3 scale interval deviation from an initial indication can lead to significant errors in scale accuracy.

The Committee agreed with the comments from Bill Ripka and recommended that this item move forward as a Voting item.

(See also the Committee's 2008 Annual Report for additional background information.)

3. S.1.3.1. For Scales Installed After January 1, 1986 (Value of the Scale Division):

Source: 2008 Western Weights and Measures Association (WWMA)

Recommendation: Amend HB 44 Section 2.21 paragraph S.1.3.1.

S.1.3.1. For Scales Installed After January 1, 1986. – The value of the scale division shall not be greater than **0.125 % ($^{1}/_{800}$)** ~~**0.1 %**~~ ~~$^{1}/_{1000}$~~ of the minimum totalized load.
[Nonretroactive as of January 1, 1986] ~~*(Added 1985)*~~ (Amended 2010)

The USNWG on BCS recommended that the above change be made to reconcile the value of the minimum scale division (0.1 % of the minimum totalized load) with the value of the minimum test load (800 divisions) listed in paragraph N.2.3.(a).

At its 2008 Annual Technical Conference, the WWMA heard support for this item as written in its agenda and recommends that the proposal move forward as a Voting item.

During the 2009 NCWM Interim Meeting, the Committee heard support from this item from Bill Ripka, Thermo Ramsey, and recommended that this item move forward as a Voting item.

4. S.1.6.1. Zero-load Indicator:

Source: 2008 Western Weights and Measures Association (WWMA)

Recommendation: Add new paragraph S.1.6.1. to HB 44 Section 2.21. as shown:

S.1.6.1. Zero-load indicator. – The integrator shall display an indication that defines a zero-balance condition when the unloaded condition of the belt over a unit revolution or revolutions is within ± 0.12 % of the rated scale capacity.
(Nonretroactive as of January 1, 2011)
(Added 201X)

Background/Discussion: It is apparent to owners, manufacturers, and service agents associated with belt-conveyor scale systems that on systems (particularly those equipped with automatic zero mechanisms) running at a "no-load" level of operation, that a zero shift may occur and not be readily observed. At its February 2008 meeting, the USNWG on BCS recommended language that would require an indication be present which indicates a zero condition during these low-flow periods when no material is being totalized by an integrator. The recommended addition of the paragraph S.1.6.1. as shown above would require an indication that would notify an operator of an out-of-zero condition and also define the limit of the width of zero for that device.

At its 2008 Annual Technical Conference, the Committee heard support for this item as written in the agenda along with a request to allow additional time for manufacturers to make necessary changes to hardware or software. The Committee agreed with the comments and request and recommends the proposal be amended and moved forward as a Voting item with a 2011 nonretroactive date as shown in the recommendation (effective 18 months after adoption).

During the 2009 NCWM Interim Meeting, the Committee received written comments from Alabama stating that indicator should serve as a means to alert the operator that a zero condition during low-flow periods has occurred. However, if this indicator is activated, the operator and /or service person should make every effort to locate the possible zero change source before making a zero change/adjustment. The indicator could be indicating an electronic problem, a belt loss condition or another source of zero error. In many cases, problems of a mechanical or material handling nature occur that does affect the zero balance condition. In these cases, zero changes or adjustments must not be made until repairs, adjustments or cleaning has been accomplished. It should also be understood that all conveyor belt scale operators be required to maintain a constant and thorough inspection process during operation of the scale conveyor system. This would help to reduce unwarranted electronic adjustments to the scale system.

The Committee agrees with the comments from Alabama Weights and Measures Division and that any indications such as a change in the zero reference condition of the scale should be acted upon by the user. The Committee suggests that the Belt-Conveyor Scale WG or Alabama Weights and Measures Division develop a proposal for the Committee to consider a separate user requirement similar to Scales Code paragraph UR. 4.1. Balance Condition that requires the user to maintain the zero balance condition when the belt is unloaded, and to include the inspections suggested in the Alabama comments.

The Committee also heard support from this item from Bill Ripka, Thermo Ramsey, supporting the proposal as written in the Committee's recommendation. The Committee agreed to recommend that this item move forward as a Voting item.

5. N.2. Condition of Tests and N.2.1. Initial Verification:

Source: 2008 Western Weights and Measures Association (WWMA)

Recommendation: Amend NIST HB 44 Section 2.21. paragraph N.2. and N.2.1. as follows:

N.2. Conditions of Tests. – A belt-conveyor scale shall be tested after it is installed on the conveyor system with which it is to be used and under such environmental conditions as may normally be expected. Each test shall be conducted with test loads no less than the minimum test load. **Before each test run, check the zero setting, and if necessary perform a zero-load test. Zero adjustment between test runs shall not exceed the tolerance of T.1.1.**

(Amended 1986 and 2004 **and 201X)**

N.2.1. Initial Verification. – A belt-conveyor scale system shall be ~~tested~~verified with a minimum of two test runs at each of the following flow rates:

1. normal use flow rate,
2. 35 % of the maximum rated capacity, and
3. an intermediate flow rate between these two points.

Test runs may also be conducted~~The system may also be tested~~ at any other rate of flow that may be used at the installation. ~~If the~~The official with statutory authority may determine that a minimum of four test runs may be conducted at only one flow rate if evidence is provided that the systems is used to operates at a single flow rate that does not vary by more than ± 5% of the maximum rated capacity (excluding the time that the flow rate is ramping up or down).

~~***(Added 2004)***~~ ~~*(Amended 201X)*~~

N.3.2. Material Tests. – Material tests should be conducted using actual belt loading conditions. These belt loading conditions shall include, but are not limited to conducting materials tests using different belt loading points, all types and sizes of products weighed on the scale, at least one other belt speed, and in both directions of weighing.

~~**On initial verification, at least three individual material tests shall be conducted.**~~ On subsequent verifications, at least two individual tests shall be conducted. The results of all these tests shall be within the tolerance limits.

Either pass a quantity of pre-weighed material . . .

(Amended 1986, 1989, 1998, 2000, 2002 and 2010)

Background/Discussion: WMD has received inquiries and comments pertaining to whether or not rezeroing of the belt-conveyor scale under evaluation can be done between tests. Additionally, WMD has received requests to provide clarification in a particular test requirement impacts the complete official verification test or individual test runs that performed during the official test. There is inconsistency between jurisdictions in the way that tests are performed regarding these questions. Due to the requirement (HB 44 Section 2.21. paragraph N.2.1.) during an initial verification, which states that tests (runs) are to be performed at three flow rates and that they must be of 10 minute durations, many hours may be required to complete the testing. This presents a problem with determining if the BCS need to be rezeroed after each test run regardless of the change in zero or if the BCS only needs to be rezeroed if the change exceeds the requirements in paragraph T.1.1. Tolerance Values - Zero Stability.

Paul Chase (member of the USNWG on Belt-Conveyor Scales) has collected some historical data on two belt-conveyor scale systems where temperature and zero information are available that show a clear trend with temperature (See graphs 1 and 2 in the appendix to this document). These data indicate that testing over a period of many hours can be affected by a zero shift that occurs during the testing. This could be a result of day-to-night temperature variation. A belt-conveyor scale that exhibits this property should be re-zeroed during normal operation as required to maintain the belt-conveyor scale within tolerance.

The expectation that a device will maintain a consistent zero under these conditions is considered by manufacturers and the USNWG to be an unfair performance standard. At its February 2008 meeting, USNWG recommended that HB 44 be amended as shown in the recommendation above. In addition the wording recommended as shown above in paragraph N.2.1. serves to clarify the required number of test runs which are to be conducted at various flow rates also bringing HB 44 towards aligning with OIML R 50 Section A.9.3.1.

At its 2008 Annual Technical Conference, the WWMA heard comments supporting this item along with a recommendation from Bill Ripka (Thermo-Ramsey) to clarify when testing only at a single flow rate is permitted. The WWMA noted that the proposed change to the language is consistent with testing at different flow rates in paragraph N.2.2. Subsequent Verification. The WWMA agreed with the comments and recommends that this proposal move forward as a Voting item.

During the 2009 NCWM Interim Meeting, the Committee received written comments from Alabama Weights and Measures Division expressing their opposition to this proposal as recommended in the Interim Agenda and stated that all conveyor belt scales being tested for initial verification within the State of Alabama will be tested as follows:

Three (3) individual tests will be performed at each of the following:
- at normal use flow rate,
- 35% of the maximum rated capacity, and
- at an intermediate flow rate between these points.

The total number of test runs for this initial verification will be nine (9). Alabama believes that in order to establish a pattern of repeatability upon initial verification that three (3) individual tests at each flow rate be performed and that the conduct of these tests are only a “snapshot in time” indicating that the scale and scale system as a whole operated or failed to operate as required at that point. Therefore Alabama believes that the requirement for strong repeatability testing must remain.

Bill Ripka, Thermo Ramsey, supported that item as written as in clarifies the number of tests at each flow rate. He added that language should be included to address the ramping up and down of flow rates on installations that run predominately at a single flow rate and suggested that the proposed last sentence in paragraph could be amended similar to current paragraph N.2.2. Subsequent Testing. which provides additional guidance when testing at multiple flow rates may be waived.

The Committee considered the comments from Alabama Weights and Measures Division and stated that the proposed language is considered a minimum test and that additional testing may be required. Consequently, the Committee amended that proposal as shown in the Committee’s recommendation to clarify that the pairs of tests at each flow rate are a minimum test and to provide additional guidance on proposed language in determining when testing at three flow rates may be waived. The Committee also amended the proposal in its recommendation to delete the 3rd sentence in paragraph N.3.2. Material Tests. since the sentence conflicts with the language in the current and proposed language in paragraphs N.2.1.

The NIST Technical Advisor added this amended proposal will be reviewed by Alabama and by the belt-conveyor scale WG during their February 2009 meeting. The Committee recommends that item move forward as a Voting item unless it receives information to the contrary from the WG.

6. <u>T.1.1. Tolerance Values – Test of Zero Stability:</u>

T.1.1. Tolerance Values - Test of Zero Stability

Source: 2008 Western Weights and Measures Association (WWMA)

Recommendation: Amend HB 44 Section 2.21. (Belt Conveyor Scale Systems Code) paragraph T.1.1. to coincide with amendment recommended to paragraphs N.2. and N.2.1. in agenda item 321-5 as follows:

T.1.1. Tolerance Values - Test of Zero Stability. – Immediately after material has been weighed over the belt-conveyor scale during the conduct of ~~the~~ **<u>any</u>** material~~s~~ test **<u>run</u>**, the zero-load test shall be repeated. The change in the accumulated or subtracted weight on the Master Weight Totalizer during the zero test shall not exceed 0.12 % of the totalized load at full scale capacity for the duration of the test. **<u>If the total range of zero adjustment during a complete (official) verification test exceeds 0.18 %, the official with statutory authority may establish an interval for zero-load testing during normal operation.</u>**

(Added 2004 **<u>and 201X</u>**)

Background/Discussion: The recommendation to amend the paragraphs N.2. and N.2.1. would necessitate the amendments shown above to reflect the consideration of a tolerance associated with a zero shift in the scale. The U.S. National Work Group on BCS recognized the need and recommends the above wording changes.

At its 2008 Annual Technical Conference, the WWMA heard a comment from a jurisdiction that the proposal places an additional burden on the field inspector having to verify compliance with the frequency of zero and accuracy tests between official tests in order to monitor zero references and calibration stability. WMD noted that paragraph UR.4. Compliance already requires the user to retain records of these tests and that the proposal is only intended to give the inspector some guidance on establishing the frequency of these intermediate tests.

The WWMA considered the comments and recommends that this proposal move forward as a Voting item since it provides the official with regulatory authority with guidance in determining the frequency for conducting zero-load tests between official tests.

During the 2009 NCWM Interim Meeting, the Committee received written comments from Alabama Weights and Measures Division stating that the proposed change from "the materials test run" to "a material test run" seems to indicate that only one material test run be required prior to performing a zero load test. The State of Alabama requires that when performing initial and follow-up verification tests that three (3) separate material test runs be performed and recommends that the current wording should remain "as is" in order to be able to establish a pattern of repeatability and to insure that the scale is weighing with as much accuracy as possible.

The NIST Technical Advisor reviewed the summary of the May 2001 Belt-Conveyor Scale Seminar where the original language was developed. The discussions indicated that the participants believed that the zero-load reference be verified after any material test run and developed the language to coincide with language for UR.3.2. Maintenance subparagraph (c) Zero Load Reference Information. that the zero-load test be conducted immediately before and after a delivery when the zero load information is recorded as part of a delivery.

Bill Ripka, Thermo Ramsey, supports the item as written in the Interim Agenda and does not have a problem with the restrictions, but stated that he believes that the zero reference should be allowed to drift provided the material test accuracy repeats within tolerances.

The Committee considered the comments and agreed to amend the proposal to clarify that the zero-load test is to be conducted after any material test run and recommended that this item move forward as a Voting item.

7. <u>N.3.1.2. Initial Stable Zero, N.3.1.3. Test of Zero Stability, and S.3.1.1. Automatic Zero-Setting Mechanism:</u>

Delete N.3.1.2. and amend N.3.1.3. as follows:

N.3.1.2. Initial Stable Zero. – The conveyor system shall be run to warm up the belt and the belt scale shall be zero adjusted as required. A series of zero-load tests shall be carried out until three consecutive zero-load tests each indicate an error which does not exceed ± 0.06 % of the totalized load at full scale capacity for the duration of the test. No adjustments can be made during the three consecutive zero-load test readings.

~~**(Added 2002) (Amended 2004)**~~

N.3.1.2~~3~~. Test of Zero Stability. – The conveyor system shall be run to warm up the belt and the belt scale shall be zero adjusted as required. A series of zero-load tests shall be carried out **before weighing material** immediately before the simulated or materials test until three consecutive zero-load tests each indicate an error which does not exceed ± 0.06 % of the totalized load at full scale capacity for the duration of the test. No adjustments can be made during the three consecutive zero-load test readings. **If operable, the automatic zero-setting mechanism shall not obscure any change in zero for integrators manufactured on or after January 1, 201X.**

(Added 2002) (Amended 2004 **and 201X**)

N.3.1.3~~4~~. Check For Consistency of the Conveyor Belt Along Its Entire Length. – After a zero-load test with flow rate filtering disabled, the totalizer shall not change more than plus or minus 3.0 scale divisions (± 3 d) from its initial indication during one complete belt revolution.

(Added 2002) (Amended 2004) **(Renumbered 201X)**

Add new paragraph S.3.1.1. as shown below:

S.3.1.1. Automatic Zero-Setting Mechanism. – The automatic zero-setting mechanism shall not obscure any change in zero.
(Added 201X)

Background/Discussion: At its 2008 Annual Technical Conference, the WWMA reviewed a proposal from the USNWG on Belt Conveyor Scale Systems recommending that paragraphs N.3.1.2. and N.3.1.3. be combined since they are nearly identical in language and to reduce redundant language and to clarify that any change in zero is to be indicated to verify that the total range of zero adjustment during an official test complied with paragraph T.1.1. This combination would result in one paragraph identified as "N.3.1.2. Test of Zero Stability." The group also recommends that paragraph S.3.1.1. be added so that specification requirements within the code coincide with the amendments to paragraph N.3.1.2. The WWMA heard support for the item and recommends that the proposal moves forward as a Voting item.

During the 2009 NCWM Interim Meeting, the Committee heard from Bill Ripka, Thermo Ramsey, support the item as written in the Committee's recommendation since eliminates redundant language in the handbook. The Committee agreed to recommend that this item move forward as a Voting item.

C. Carry-Over Items from '08:

1. Use of "Minimum Test Load" or "Minimum Totalized Load":

Background: In the Appendix D-Definitions of HB 44, there are two definitions associated with the minimum totalized load:

minimum delivery. The least amount of weight that is to be delivered as a single weighment by a belt-conveyor scale system in normal use and is greater than or equal to the MTL.[2.21]

minimum totalized load. The least amount of weight for which the scale is considered to be performing accurately.[2.21]

There is not a definition for "minimum test load" but that terminology is used in N.2.3

OIML R117 uses the term "Minimum Measured Quantity" to describe the smallest quantity of liquid for which the measurement is metrologically acceptable for that system. That is a definition very similar to the Minimum Totalized Load for belt conveyor scales and is perhaps more descriptive. The word "liquid" would need to be changed to "material" or something similar.

Historically, the terms "Minimum Totalized Load" and "Minimum Test Load" have been used interchangeably. This may be because many of the belt-conveyor scales were used to load trains, not individual trucks or railcars. A clear distinction between the two terms can provide for simple direct language concerning "normal weighment" and "belt uniformity."

N.2.3 for a number of years included a phrase "or a normal weighment." This, in effect, established the "normal weighment" as the minimum totalized load.

As HB 44 currently reads, no new belt-conveyor scale can be approved with a smaller test load than 10 minutes of operation. This really precludes the use of a belt-conveyor scale for some loadout applications, because a shorter loading time than 10 minutes is required for effective operation.

Discussion and recommendation: The definition and use of "Minimum Totalized Load" needs clarification. N.2.3 is titled "Minimum Test Load" but HB 44 has no definition for "Minimum Test Load.

"Minimum Totalized Load" is listed in HB 44 definitions. For belt-conveyor scales used to load individual containers by weight, for example trucks, railcars, or barges, the container size defines the Minimum Totalized Load for that application. See also "Minimum Measured Quantity" above.

Suggested wording for definition of “Minimum Test Load:”

Minimum test load. The minimum quantity of material, not smaller than the minimum totalized load that can be used for verification testing.

For belt-conveyor scale applications that operate continuously, for example unit-train loading or loading into or out of stockpiles, the term "Minimum Test Load" applies because the test quantity is the smallest amount of weight normally delivered across that belt-conveyor scale. That is the way the HB 44 requirements have usually been applied.

Suggested that paragraph N.2.3 be amended s follows:

N.2.3. Minimum Test Load. - The minimum test load shall not be less than the largest of the following values.

(a) 800 scale divisions,
(b) the load obtained at maximum flow rate in one revolution of the belt, or
(c) at least 10 minutes of operation <u>or the Minimum Totalized Load.</u>

The official with statutory authority may determine that a smaller minimum totalized test load down to 2 % of the load totalized in 1 hour at the maximum flow rate may be used for subsequent tests, provided that:

1. the smaller minimum **totalized** **<u>test</u>** load is greater than the quantities specified in (a) and (b), and

2. consecutive official testing with the minimum **totalized** **<u>test</u>** loads described in N.2.3. (a), (b), or (c) and the smaller minimum test load has been conducted that demonstrates the system complies with applicable tolerances for repeatability, acceptance, and maintenance.

(Added 2004 <u>200x</u>)

Note: N.2.3 (a) defines the Minimum Test Load as 800 divisions. S.1.3.1 requires that the scale division "not be greater than 0.1% of the minimum totalized load." These two values need to be reconciled.

UR.1.1 would be more clearly stated as:

UR.1.1. Minimum Totalized Load. - Delivered quantities of less than the minimum **<u>totalized </u>test** load shall not be considered a valid weighment.

Perhaps the Minimum Totalized Load should be added to the Marking Requirements.

Another question related to Material Testing is the required test quantity. As shown in the definitions above, the minimum test quantity may be less than the minimum load weighed by the scale. In many applications the belt-conveyor scale is used to load trains where the total weight of the train is really the "Minimum Totalized Load" for practical purposes in normal operation of the scale. The 10 minute test quantities can provide accuracy and repeatability, but require either multiple trucks or multiple railcars.

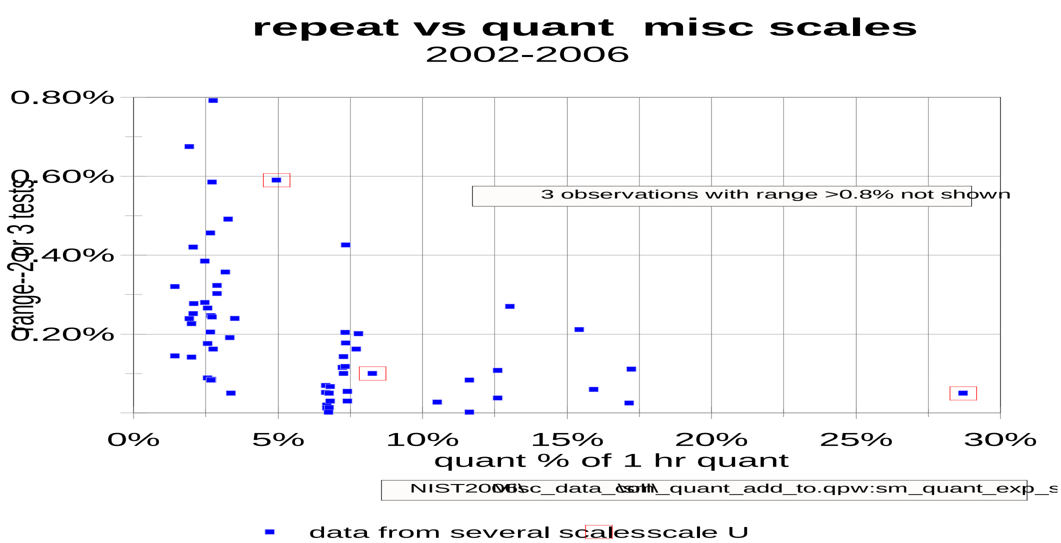
Smaller test quantities have the potential for lower cost testing using on-site weigh bins as a reference scale. As currently written N.2.3 requires that the initial verification test fulfill the 10 minute operation requirement. This requires that the facility provide capability for the 10 minute test to achieve initial verification even if a smaller test quantity is anticipated for subsequent use.

An on-site bin can also provide improved confidence in the belt-conveyor scale accuracy because material tests can readily be used in place of simulated tests to monitor scale performance between official tests.

Some limited testing by Paul Chase for NIST using smaller test quantities is shown in the following graph:

The belt-conveyor scales tested as shown in the above graph show repeatability of 0.25% or less for all but one of the tests performed at about 7% to 7.5% of the quantity delivered in one hour. These tests were performed on belt-conveyor scales normally tested with a 10-minute test. The measure of repeatability is the range of error, some for two tests, and some for three tests so the data are not rigorously comparable. Note that HB 44 tests would be rejected if the range exceeded 0.25% so there could be tests with a range larger than 0.25%, but they would not be used or reported.

Current HB 44 requirement is for 10 minutes operation or about 16% of hourly capacity. In many installations the test is performed at normal operation and might be at about 80% of capacity or 13% of the quantity delivered at scale capacity in 1 hour. The above graph indicates that without any extra attention to the test



procedure the test quantity could be reduced to about 7% of the 1 hour quantity and still repeat within 0.25%.

This would allow a 100 ton weigh bin, for example, to be used as a reference scale for a 1400 tph belt-conveyor scale.

Additional data are available concerning testing with smaller quantities. Smaller quantities can be affected by the ramp-up and shut down of material on the belt in some cases. Information from Control Systems Technology indicates that many of the belt-conveyor scales in Australia are tested to OIML standards using a weigh bin of about 60 metric tons.

At the USNWG 2008 meeting the group agreed the wording used should be consistent and more suitable for the context in which it is used. The group could not however reach a consensus on whether to use OIML definitions and/or wording, nor reach a consensus on a recommendation for changes to Handbook 44 wording.

2. Need for initial test after belt replacement- amend UR.2.2.(l):

Background: NIST WMD was asked whether an official test is required following replacement of a conveyor belt. HB 44[2.21] does not specifically address the question.

Discussion and recommendation: The most noticeable effect of changing a conveyor belt is the change in zero-balance. Material load sensing can also be affected by the change in belt stiffness, perhaps a tension change, and so the calibration could be affected. Replacing a belt is not performed by belt-scale service agents. Additionally, belts are run for a break-in time before the service agents come and perform realignment and other mechanical adjustments to the system.

One possible place to include this requirement is:

UR.2.2(l)

(l) Belt Composition and Maintenance. - Conveyor belting shall be no heavier than is required for normal use. In a loaded or unloaded condition, the belt shall make constant contact with horizontal and wing rollers of the idlers in the scale area. Splices shall not cause any undue disturbance in scale operation (see N.3.). **<u>An official test is required if the belt is partially or totally replaced.</u>**

(Amended 1998, 2000, and 2001 and 200x)

Further discussion took place at the USWG 2008 meeting as to whether a list of procedures needs to be developed which would require testing or retesting. Disscussion also took place as to whether testing needed to follow a total or partial replacement of the belt. The alternate recommendation would be to compose a more "generic" requirement which would provide guidance as to when testing needed to be performed.

An alternate recommendation for amending Handbook 44 was developed as follows:

UR.2.2.(l)

(l) Belt Composition and Maintenance. - Conveyor belting shall be no heavier than is required for normal use. In a loaded or unloaded condition, the belt shall make constant contact with horizontal and wing rollers of the idlers in the scale area. Splices shall not cause any undue disturbance in scale operation (see N.3.). **<u>An official test is required if the belt is totally replaced.</u>**

UR.3.2. Maintenance. - Belt-conveyor scales and idlers shall be maintained and serviced in accordance with manufacturer's instructions and the following:

Simulated load tests or material tests, and zero load tests shall be conducted at periodic intervals between official tests**<u>, and after a repair or mechanical adjustment to the conveyor system</u>** in order to provide reasonable assurance that the device is performing correctly.

The 2008 USWG meeting concluded with no consensus between members.

D. Other Items:

1. Development of EPO for Belt Conveyor Scales.

Gather input from members and determine volunteers to review and comment on the draft.

2. Update of OIML Activities:

Discussion of topics considered during TC9/SC2 meeting held Feb. 4th & 5th, 2009

II. NTETC Belt Sector Meeting:

Thursday 2/26 1:00pm-3:00pm

A. Carry-Over Items from '08:

1. Review and comments on Pub. 14 draft (B. Ripka)

As shown below:

** 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

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 as 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:

A. 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, the following criteria must be satisfied:

- 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.
- All MWT laboratory tests must be performed on the replacement MWT, including temperature testing, and
- During the test, the device must be within the acceptance tolerance, and
- An field test will be performed meeting new initial installation testing criteria, and
- A field permanence test will be performed, and
- 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
- application limits such as capacity and speed ranges established during the original type evaluation will not be amended.

E. Checklist and Test Procedures

1. Indicating and Recording Elements

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 aboratory and in the field permanence test.	Yes ☐ No ☐ N/A ☐

Test Procedure

1.31	Accumulate a measured quantity on the MWT and stop the flow of material. Note the reading.	Yes ☐ No ☐ N/A ☐
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 ☐
	The scale division shall be in increments of 1, 2, or 5 times 10k where k is an integer.	

1.7 Yes ☐ No ☐ N/A ☐

Table T.1	
Unit	**Abbreviation**
_____ pounds	Lb or LB
_____ U.S. short ton	Ton or T
_____U.S. long ton	LT
_____ Metric ton	T
_____ kilograms	kg

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

2. Recording Element

2.1	The MWT shall incorporate or be capable of interfacing with a recording element.	Yes ☐ No ☐ N/A ☐
2.1	The value of the scale division for the recording element shall be the same as for the MWT.	Yes ☐ No ☐ N/A ☐
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 ☐

All weight values shall be recorded as digital values.

Information required on the ticket:

2.4 Yes ☐ No ☐ N/A ☐

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

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 ☐

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

2.6 Yes ☐ No ☐ N/A ☐

~ 3 percent of the maximum flow rate, or
~ The flow rate at which the MWT is engaged unless the weight value 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 printed document includes two weight values to represent the initial and final values.	Yes ☐ No ☐ N/A ☐

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.

The system must have both a rate of flow indicator and rate of flow recorder.

3.1 The rate of flow recorder is: Yes ☐ No ☐ N/A ☐
_____ 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

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 ☐
	Record the values at which the alarm is triggered:	
4.2	Low alarm:_______________ High alarm_______________	Yes ☐ No ☐ N/A ☐
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:	Yes ☐ No ☐ N/A ☐
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 ☐
	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 ☐
	5.1.4	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:		Yes ☐ No ☐ N/A ☐
	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 ☐
	5.2.3	Zero the scale.	
	5.2.4	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. 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	Yes ☐ No ☐ N/A ☐

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 automatic-zero setting mode or as manually adjusted.	Yes ☐ No ☐ N/A ☐
5.3	The zero-setting operation shall be performed only after a whole number of belt revolutions and at least 3 minutes of operation.	Yes ☐ No ☐ N/A ☐
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 ± 5% of the capacity of the scale without breaking a security means.	Yes ☐ No ☐ N/A ☐
5.6	An audio or visual signal shall be given when the automatic and semi-automatic Zero-setting mechanisms reach the limit of adjustment.	Yes ☐ No ☐ N/A ☐

6. Sensitivity at Zero Load

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:

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

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)

Yes ☐ No ☐ N/A ☐

6.2	Operate the scale for a time equal to the time required to deliver the minimum totalized load.	Yes ☐ No ☐ N/A ☐
6.2.1	Record the time period: ___________ minutes.	Yes ☐ No ☐ N/A ☐
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.	Yes ☐ No ☐ N/A ☐

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

7. Marking Requirements

7.1	The marking of the MWT shall meet the requirements established during the initial CC evaluation.	Yes ☐ No ☐ N/A ☐

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

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 operation of the different forms of audit trail, see the Appendix 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 ☐

10. Laboratory Test Procedures

A. 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.

B. Initial Tests

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

C. 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.

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.

D. 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)

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

E. Temperature Tests

13. Run a zero test
14. Do not reset zero or adjust the span at any time after the start of this test.
15. Adjust the load simulating device to achieve the desired load representations.
16. 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)

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:

F. 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 are compared to the reference value for accuracy.

16. Change the temperature to -10 ºC (14 ºF) at a rate no faster than 1º C/min following the “soak requirements”.
17. Repeat the simulated dynamic tests.
18. Change the temperature to 40 ºC (104 ºF) at a rate no faster than 1º C/min following the “soak requirements”.
19. Repeat the simulated dynamic tests.
20. Change the temperature to 20 ºC (68 ºF) at a rate no faster than 1º C/min following the “soak requirements”.
21. Repeat the simulated dynamic tests.

G. 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 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 as defined in Handbook 44 are to be followed. The results of all tests must be within acceptance tolerances.

12. Permanence Test

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.

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)(0.0007)(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
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)(0.45)(0.005)(TL)	AWE			ton

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)(0.45)(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

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

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

<table>
<tr><th colspan="8">Table T.10</th></tr>
<tr><th></th><th colspan="2">Low Temperature</th><th colspan="2">High Temperature</th><th colspan="2">20 ºC</th><th rowspan="7">Performance limit for temperature effect on zero test, AZE, per 10 ºC</th></tr>
<tr><td>Previous Temperature T_P</td><td colspan="2">20 ºC</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>Current Temperature T_C</td><td colspan="2"></td><td colspan="2"></td><td colspan="2">20 ºC</td></tr>
<tr><td>Change in Temperature ($T_C – T_P$)</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td></td><td>Divisions</td><td>lb</td><td>Divisions</td><td>lb</td><td>Divisions</td><td>lb</td></tr>
<tr><td>Zero load indication at T_P</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Zero load indication at T_C</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Change in zero							
Change in zero per 5 ºC (9 ºF)							

Date: ___________________

Indicator Model Number:________________ **Indicator Serial Number:**________________

______________________________________ ________________________________

Signature **Title**

2. Develop list of sealable parameters for BCS:

Paul Chase will share submissions he has received from manufacturers.

The following excerpt from NCWM Publication 14 is provided for a basis of discussion and recommendations:

Requirements for Metrological Audit Trails

Scope

This discussion lists the requirements for the acceptable forms of metrological audit trail which are recognized by the National Conference on Weights and Measures as providing acceptable security for commercial weighing and measuring devices. The criteria adopted by the NCWM in July 1993 further define the minimum forms of metrological audit trail that would be acceptable under the General Code paragraph G-S.8. Provisions for Sealing Electronic Adjustment Components.

Remote configuration capability of commercial weighing and measuring devices was a major consideration in developing the criteria ultimately adopted by the NCWM. Weights and measures officials are concerned that using such new features might lead to increased fraudulent use of devices unless new, more appropriate means of sealing are also implemented.

The following specifications are based upon requirements adopted by the NCWM July 1993. These requirements are intended to be incorporated in NCWM Publications 14.

Definitions

The following definitions apply to the discussion of metrological audit trails. Those definitions which were added to NIST Handbook 44 as a result of NCWM action in July 1993 are indicated by italicized type.

Adjustment mode. An operational mode of a device which enables the user to make adjustments to sealable parameters, including changes to configuration parameters.

Adjustment. A change in the value of any of a device's sealable calibration parameters or sealable configuration parameters.

Audit trail. A electronic count and/or information record of the changes to the values of the calibration or configuration parameters of a device. (The term addresses all forms of audit trail described in this paper.)

Calibration parameter. Any adjustable parameter that can affect measurement or performance accuracy and, due to its nature, needs to be updated on an ongoing basis to maintain device accuracy, e.g., span adjustments, linearization factors, and coarse zero adjustments.

Configuration parameter. Any adjustable or selectable parameter for a device feature that can affect the accuracy of a transaction or can significantly increase the potential for fraudulent use of the device and, due to its nature, needs to be updated only during device installation or upon replacement of a component, e.g., division value (increment), sensor range, and units of measurement.

Enabling/inhibiting sealable hardware. Physically sealable hardware, such as a two-position switch, located on a remotely configurable device, that enables and inhibits the capability to receive adjustment values or changes to sealable configuration parameters from a remote device.

Event. An action in which one or more changes are made to configuration parameters or adjustments are made to one value (or values for a set of values) for a calibration parameter, (e.g., adjustments for a set of calibration factors to linearize device output), while in the adjustment mode. If no adjustment is made, then there is no event. In the case of a centralized audit trail, the same values for the same parameter sent to multiple devices shall be considered to be the same event. If changes are made to individual devices rather than to all attached devices, the event logger must identify both the device and the parameter that was changed.

Event counter. A nonresettable counter that increments once each time the mode that permits changes to sealable parameters is entered and one or more changes are made to sealable calibration or configuration parameters of a device.

NOTE: An event counter shall have a capacity of at least 1000 values [e.g., 000 to 999].

Event logger. A form of audit trail containing a series of records where each record contains the number from the event counter corresponding to the change to a sealable parameter, the identification of the parameter that was changed, the time and date when the parameter was changed, and the new value of the parameter.

Physical Seal. A physical means, such as lead and wire, used to seal a device to detect access to those adjustable features that are required to be sealed.

Remote configuration capability. The ability to adjust a weighing or measuring device or change its sealable parameters from or through some other device that is not itself necessary to the operation of the weighing or measuring device or is not a permanent part of that device.

Remote device. A device that (1) is not required for the measurement operation of the primary device or computing the transaction information in one or more of the available operating modes for commercial measurements or (2) is not a permanent part of the primary device. In the context of this paper, a remote device has the ability to adjust another device or change its sealable configurable parameters.

Remotely configurable device. Any weighing or measuring device with remote configuration capability that permits sealable configuration or calibration parameter values to be deleted, appended to, modified, or substituted in whole or in part by downloading over any type of communications link from another device, such as a geographically local or remote console or computer, whether or not the secondary apparatus is part of the network connecting the devices.

Seal. As a verb, to seal a device is to secure a device so that access to adjustments and other sealable parameters will be detectable.

Sealable parameters. Calibration and configuration parameters that are required to be sealed.

Unrestricted access to sealable parameters. Unrestricted access means that a physical security seal is not present, so that access to the sealable parameters is available from a remote device at any time at the request of an authorized operator subject to the operating status of the receiving device.

Categories of Device: Three Forms of Audit Trail

Three forms of the audit trail have been established; the form of audit trail acceptable for a device depends on the capability to adjust the device or change sealable parameters. The form that applies to a particular device depends upon the availability of remote configuration capability and, if so, whether or not there is virtually unrestricted access to the configuration or calibration parameters of the device. Three categories of device are listed below with the category designation numbered to correspond to the capability and ease of changing sealable parameters from a remote device.

Category 1. A device that does not have remote configuration capability. These devices may be sealed with either a physical security seal or an audit trail. If an audit trail is used, then the minimum form of audit trail must be provided (see next page).

Category 2. If a device has remote configuration capability, but the activation of the remote configuration capability is through physical hardware (such as a switch) that can be sealed with a physical seal, then the device may be sealed using a physical seal or the minimum form of the audit trail.

Because the event logger (see category 3 below) requires significant memory and many device manufacturers want to provide remote configuration capability for at least some of the sealable parameters, a "hybrid" form of audit trail was established. Restricted access to the hardware inhibiting and activating the remote configuration capability eliminates the need for the event logger as the form of audit trail for this category of device.

The second category of device specifies that, when the device is in the remote configuration mode, there must be a clear and continuous indication to that effect. The objective is that the device shall not be (erroneously) sealed with the remote communication capability operational. The clear and continuous indication is intended to reduce this possibility. A "clear and continuous indication" that the device is in the remote configuration mode must be of such a nature that it discourages the use of the device for normal transactions when in this mode. This may be a partial obscuring of the numbers, an alternating display message, or some other obvious indication. The lighting of an annunciator is not sufficient. If values can be printed when in the configuration mode, the system shall record a message to indicate that the system in the configuration mode. Manufacturers may want to display decipherable information because the scale will be in this mode of display when it is tested, and the indicated weight values may be needed for reference when adjusting the scale.

Category 3. A device that allows virtually unrestricted access to configuration parameters or calibration parameters must have an **event logger** as its minimum form of the audit trail.

An **event logger** contains detailed information on the parameters that have been changed and documents the new parameter values. An event logger requires a significant amount of memory; however, it is anticipated that any device to which unrestricted access is given, will be part of sophisticated measurement process that will have considerable memory available. A centralized audit trail may be used, but additional criteria apply.

Scales Code:

S.1.11. Provision for Sealing.

(a) Except on Class I scales, provision shall be made for applying a security seal in a manner that requires the security seal to be broken before an adjustment can be made to any component affecting the performance of an electronic device.

[Nonretroactive as of January 1, 1979.]

(b) Except on Class I scales, a device shall be designed with provision(s) to apply a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that affects the metrological integrity of the device can be made to any electronic mechanism.

[Nonretroactive as of January 1, 1990.]

(c) Except on class I scales, audit trails shall use the format set forth in the Table S.1.11.

[Nonretroactive and enforceable as of January 1, 1995.]

A device may be fitted with an automatic or a semi-automatic calibration mechanism. This mechanism shall be incorporated inside the device. After sealing, neither the mechanism nor the calibration process shall facilitate fraud.

(Amended 1989, 1991, 1993)

Table S.1.11. Categories of Device and Methods of Sealing

Categories of Device	**Method of Sealing**
Category 1: No remote configuration capability	*Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.*
Category 2: Remote configuration capability, but access is controlled by physical hardware. *Device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode.*	*The hardware enabling access for remote communication must be at the device and sealed using a physical seal or two event counters: one for calibration parameters and one for configuration parameters.*
Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password)	*An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change , and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)*

[Nonretroactive and enforceable as of January 1, 1995.] (Table added 1993)

Minimum Form of the Audit Trail

The minimum form of the audit trail shall consist of two event counters; one for configuration parameters and one for the adjustment (calibration) parameters (000 to 999 for each counter).

The maximum number of values or parameters that must be retained in event logger memory is 1000. (This limit may not apply to centralized event loggers. See the section titled "Centralized Event Loggers" for details.)

Event Loggers: Acceptable Form of Audit Trail for Category 3 Devices

1. The event logger is the minimum form of audit trail for Category 3 devices (those that have unrestricted remote access to the configuration or calibration parameters.) The event logger shall contain the following information:

Event counter	Date and time	Parameter ID	New value

2. This information shall be automatically entered into the event logger by the device. In the case of centralized event loggers, the parameter identification shall include the device identification to which the event applies. Additional relevant information is permitted, e.g., the identification of the person who made the adjustment or the old value of the parameter that was changed.

3. The date and time shall be presented in understandable format. The date shall include month, day, and year. The time shall include the hour and minutes.

4. A hard-copy printout of the contents of the event logger shall be available upon demand from the device or an associated device on the site of the device installation. The display or printing of the event logger contents shall exclude other nonmetrological information, such as transaction data, operator inventory records, shift totals, etc.

5. An event logger shall retain a minimum of 10 entries for each sealable parameter; it is not required to retain more than 1000 events for all parameters combined. This limit applies to devices for which the event logger is dedicated to a single device (See the section titled "Centralized Event Loggers").

Centralized Event Logger

Remote configuration will be used most frequently when several devices are interfaced with a host computer or other host device. A centralized event logger may be used when several "satellite" devices are interfaced with a host device. The following criteria must be satisfied if a centralized event logger is to be used:

1. If electronic parameters monitored by the event logger are changed at the device rather than through the device containing the centralized audit trail, the changes shall be transferred to and maintained in the centralized audit trail. It shall not be possible to circumvent the unit containing the audit trail. For example, if the audit trail unit is disconnected or inhibited, the attached network devices shall be inoperable and impossible to adjust electronically when in the network configuration. Mechanical adjustments are not expected to be monitored by the event logger because there will probably not be an electrical connection from the mechanical adjustment to the event logger. Sealable mechanical adjustments must be secured by a physical security seal.

2. If the same values for change to a parameter (e.g., the division value for scales) are sent from the host device to several satellite devices, this shall be represented as one event in the logger. If changes are made to individual devices rather than to all attached devices, the event logger shall identify both the parameter and the device that was changed. Identification may be by individual devices, groups of devices, or designated as all devices.

3. If a device can be installed in a stand-alone operation, it must have the minimum form of audit trail when installed in the stand-alone mode.

4. A system shall be capable of providing, on demand, a hard copy of the event logger through the device or through another on-site device.

The display or printing of the event logger contents shall exclude other nonmetrological information such as transaction data, operator inventory records, shift totals, etc.

5. If a centralized audit trail is used for a large number of devices on a network, the logger capacity of 1000 events is not sufficient in this case, at least 1000 events per device is required.

General Requirements for Metrological Audit Trails

When an audit trail is the form of security, minimum forms of audit trail are specified for different categories of devices. The following general requirements for metrological audit trails must be satisfied as part of all three minimum forms of audit trail.

1. The adjustment mode shall address only sealable parameters in order to avoid entering the adjustment mode to access non-sealable parameters that must be routinely changed as part of the normal use of the device. Because the audit trail requirements are intended to satisfy the weights and measures requirements of the U.S. and Canada, any parameters required to be sealed in one country, but not the other, may be included in the adjustment mode and still comply with this requirement. Manufacturers should consult with the weights and measures authority to discuss those parameters that may be questionable as to whether or not the parameter must be sealed. Manufacturers may choose to incorporate the capability to set a software "switch" that determines whether or not a parameter is sealable. If this is done, then the software switches (that determine whether or not a parameter is sealable) shall be sealable.

2. When a remotely configurable device is in the remote configuration mode, that is, capable of receiving changes to sealable parameters, the device shall either:

   a. not indicate or record (if equipped with a printer); or

   b. provide a clear and continuous indication that it is in remote configuration mode. Any printed ticket or receipt shall include a message with each ticket or receipt that the device is in the calibration mode.

   A "clear and continuous indication" that the device is in the remote configuration mode must be of such a nature that it discourages the use of the device for normal transactions when in this mode. This may be a partial obscuring of the numbers, an alternating display message, or some other obvious indication. The lighting of an annunciator is not sufficient. If values can be printed when in the configuration mode, the system shall record a message to indicate that the system in the configuration mode.

3. An event counter shall have a capacity of at least 1000 values, (e.g., 000 to 999).

   a. The event counter for calibration parameters shall increment only when a change is made to at least one sealable calibration parameter during an event (during the time when in the adjustment mode); the counter shall increment only once regardless of the number of changes made while in the adjustment mode. When the calibration mode is entered, but no changes are made, this does not constitute an event and the counter must not increment.

   b. the event counter for configuration parameters shall increment only when a change is made to at least one sealable configuration parameter during an event (during the time when in the configuration mode); the counter shall increment only once regardless of the number of changes made while in the configuration mode. When the configuration mode is entered, but no changes are made, this does not constitute an event and the counter must not increment.

c. In the case of the event logger, the event counter shall increment once for each change to a sealable parameter since each new value must be retained in the event logger.

NOTE: The criteria in items 3(a) and 3(b) specify the minimum requirements for event counters. A device may have a separate event counter for each sealable parameter in this case, the corresponding event counter must increment once each time its sealable parameter is changed.

4. When the storage memory of the event logger has been filled to capacity, any new event shall cause the oldest event to be deleted. The event counter provides the necessary information to indicate the number of records that have been overwritten in the event logger as new information overwrites the old records.
5. The audit trail data shall be:

   a. stored in non-volatile memory and shall be retained for at least 30 days if power is removed from the device; and

   b. protected from unauthorized erasure, substitution, or modification.

6. Access to the audit trail information for the purpose of viewing or printing the contents must be "convenient" for the enforcement official.

   a. Accessing the audit trail information for review shall be separate from the calibration mode so there is no possibility for the weights and measures official to change or corrupt the device configuration or the contents of the audit trail.

   b. Accessing the audit trail information shall not affect the normal operation of a device before or after accessing the information.

   c. A key (for a panel lock) may be required to gain access to the means to view the contents of the audit trail. Access may be through the supervisor's mode of operation of the device.

   d. Accessing the audit trail information shall not require the removal of any additional parts other than normal requirements to inspect the integrity of a physical seal.

7. The displayed or printed form of the audit trail information shall be readily interpretable by the inspector.
8. The information from an event logger shall be displayed or printed in order from the most recent event to the oldest event. If a device is not capable of displaying all the information for a single event on one line or at one time, the information shall be displayed in blocks of information, which are readily understandable.