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

October 29, 2019 Hyannis, MA

Introduction

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

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

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

Glossary of Acronyms and Terms

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

I. New Items

A. Changes to NIST Handbook 44 Belt-Conveyor Scale Systems Code:

Source:

NIST Technical Advisor, John Barton

Proposal:

Develop recommendations for amendments to NCWM Publication 14 to correspond with changes adopted in NIST HB 44 at the NCWM Annual Meeting in July 2019.

Background:

During a 2016 meeting of the USNWG on Belt-Conveyor Scales, the USNWG recognized that there has been a difference of opinion in the interpretation of tolerance application among regulatory officials, manufacturers, and users of belt-conveyor scale type systems. The work group confirmed through their discussions that the tolerance prescribed in Handbook 44 Section 2.21. are being applied to the range of test run results by some evaluators as a "plus or minus" tolerance while others are taking a more conservative position and applying the tolerance as an absolute value. This lack of clarity in the Belt-Conveyor Scale Systems Code and the difference in interpretation of how the tolerance is to be applied was identified as a source of inconsistency in the regulation of this type of dynamic weighing systems. Since the USNWG recently amended the Belt-Conveyor Scale Systems Code to recognize systems that operate using multiple rates for the flow of material, this inconsistency was considered to be a significant issue that the work group should address.

The USNWG consulted past records of work group meetings, NTEP Sector meetings, and NCWM conference reports, along with other resources in attempts to determine the correct and intended application of the allowable variation between consecutive test runs when material tests are conducted. The USNWG was unable to arrive at any definitive conclusion on this issue through this research but they agreed it is necessary to amend the Belt-Conveyor Scale Systems Code to clearly identify the proper application of tolerances under specific sets of test conditions.

After lengthy discussion and much deliberation, the USNWG arrived at a consensus and agreed the existing tolerance should be applied as an absolute value when comparing test results performed under practically identical conditions (referring primarily to the flow rate of material). They also concluded that when comparing test results from test 1 runs performed under different conditions, the tolerance should be applied as a plus or minus value to the range of 2 test results.

The changes included in the attached proposal are intended to clarify how the prescribed tolerances are to be applied when comparing totalization operations during material tests on a "belt-conveyor scale system" or a "weigh-belt system." The recommended changes will specify the application of tolerances when material test runs are performed under practically identical conditions, and the proper application of tolerances when those test runs are performed under different conditions.

During deliberations on the issue of how tolerances are to be applied in a comparison of material test results, the USNWG acknowledged that advances in design and technology have resulted in belt-conveyor scale systems and weigh-belt systems capable of performing within more stringent tolerances. The work group also recognized that the international recommendation OIML (R50) incorporates different accuracy classes for these types of systems. It was also noted the Handbook 44 Scales Code (Section 2.20.) incorporates different accuracy classes for weighing devices regulated under that code. The members of the work group agreed there were benefits to introduce different accuracy classes for belt-conveyor scales and weigh-belt systems in Handbook 44 Section 2.21., believing that adding another accuracy class of dynamic weighing systems would provide more alternatives for determining the weight of various products in a wider array of commercial applications.

The additional changes in this proposal recommending the introduction of two different accuracy classes would retain the existing performance requirements (0.25 % relative to the weight of reference material used) and add a second accuracy class for devices/systems capable of complying with more stringent performance requirements (0.1 % relative to the weight of the reference material). In addition to introducing a new accuracy class with a smaller tolerance, other changes are included in this proposal to accommodate the addition of a second accuracy class. This proposal also recommends changes to account for differences in minimum scale division size, marking requirements, minimum test load size, and requirements pertaining to zero-tests (see attached document). These changes to the U.S. standards will harmonize more closely with international recommendation OIML R50 and bring the Belt-Conveyor Scale Systems Code in alignment with certain requirements in the Scales Code in Handbook 44. There may be opposing arguments from some that do not support allowing a "plus or minus" application of tolerances to the range of results from consecutive material test runs when those runs are performed under different flow rates.

In proportion to the number of these types of systems in commercial use, there are relatively few systems that are installed in a manner with the intent and/or ability to alter the flow rate of material.

Ensuring compliance with the provisions outlined in Section 3.2. in the Fundamental Considerations of Handbook 44 may prove challenging in some installations, depending upon the available equipment for weighing reference materials and conducting the test of the belt-conveyor scale system or weigh-belt system. The USNWG has received information however, from a device manufacturer (and member of the USNWG) that has demonstrated that these requirements are achievable.

In 2019 the NCWM S&T Committee considered a proposal from the USNWG to make multiple changes in the NIST HB 44 Belt-Conveyor Scale Systems Code to address the decisions outlined above. In July 2019, the NCWM voted on and adopted those proposed changes. The NTEP Belt-Conveyor Scales Sector is now being asked to develop recommended changes in NCWM Publication 14 that will align that publication with the adopted changes to HB 44.

The Annex attached to this agenda is a draft of recommended changes to Publication 14 that the Sector will be asked to review and comment on.

B. New Test Procedures for Reference Scales

Source:

NIST Technical Advisor, John Barton

Proposal:

Develop test procedures for use in verification of reference scales used during material tests on Class 0.1 belt-conveyor scales and weight-belt systems. New procedures are necessary to include in NCWM Publication 14 as well as for routine field examinations to certify reference scales that are to be held to a 0.035 % accuracy.

Background:

With the adoption of changes to the HB 44 Belt-Conveyor Scale Systems Code in July 2019, belt-conveyor scales (and weigh-belt systems) will need to be marked with accuracy classes beginning in January 2020. New devices designed to meet the current 0.25 % accuracy requirements will be marked Class 0.25 and devices manufactured to meet the more stringent accuracy requirements (0.1 %) will be marked as Class 0.1. The material tests for those new devices marked Class 0.1 will require reference scales used to weigh the test material that will meet an accuracy of 0.035 %. The verification of reference scales to an accuracy of 0.035 % will present the evaluators with a number of challenges.

Reference scales will need to precisely weigh the test material needed as the minimum test load (MTL) and as the nominal capacity increases for the belt-conveyor scale under test, so does the amount of material needed for

the MTL. In general, smaller capacity scales will be less difficult to certify as accurate than larger capacity scales due to the amount of test weight necessary used to verify reference scales.

In many cases, larger capacity scales used for commercial purposes are not routinely tested to capacity using an amount of test weight equivalent to the scale's capacity since it is less likely that those larger amounts of test weight are: readily available; easily transported; and satisfactorily placed on the load-receiving element. It should be recognized however, that these scales are not held to the level of accuracy required from a reference scale.

The Sector will be asked to consider methods available to certify the accuracy of reference scales. Included below are a few options.

1. Test to capacity (or at least used capacity) using test weights in the amount equal to that capacity.
2. Test to capacity using a lesser amount of test weight but performing either substitution tests or strain-load tests.
3. Use a smaller capacity reference scale tested to capacity using a full complement of test weights but weighing the MTL in multiple drafts.
4. Testing the reference scale as a mass comparator rather than performing a test to certify the scale's full weighing range.
5. Testing the reference scale using error weights or in an expanded resolution mode.

Some of the above examples may only resolve a portion of all the issues involved and may need to be used in conjunction with other methods to complete the task. In addition, most of the examples above will introduce additional uncertainties to the process that will subtract from the tolerance allowed for the reference scale.

Another measure that the Sector may consider as a more practical approach to test the larger capacity, higher accuracy class of belt-conveyor scales would be to reduce the required MTL. The USNWG on Belt-Conveyor Scales and the Sector have discussed this option in previous meetings, noting that under the OIML R50 standard minimum test loads required are smaller. The 2020 edition of Handbook 44 requirements for Class 0.1 belt-conveyor scales will require that the MTL shall not be smaller than the largest value from the following:

- 2000 scale divisions;
- the load obtained during one full revolution of the belt; or
- the load obtained during 10 minutes of operation.

The parameter listed in the third bullet (10 minutes of operation) will typically be the most frequently used value for the required MTL.

Since the reduction in the size of the MTL will generally facilitate a more readily achievable verification of the reference scale, this may be an option that could be submitted as a proposal to change the MTL requirements in HB 44. Comparing HB 44 and OIML R50 requirements, the first two bullets as shown above are shared by both standards. However, the third option in OIML R50 is a MTL of 2 % of the load totalized in one hour at maximum flowrate instead of HB 44's the load obtained in 10 minutes of operation. In most cases, 2 % of the load totalized in one hour of operation would represent a greatly reduced value for the MTL when compared to the 10 minutes of operation currently appearing in HB 44 requirements.

While a reference scale does not need to meet all requirements that a commercial device must comply with its accuracy and repeatability must be established with great precision. Any error observed in the reference scale must be accounted for. If the error can not be eliminated through adjustments, it must be accounted for when establishing the weight of the reference material used. Errors that are not corrected must be subtracted from the 0.035 % tolerance allowed for the reference scale.

A scale that is incapable of repeating indications for the same test load is not suitable for use as a reference scale. It is recommended that repeatability be established by applying the same test load to the same location on the load-receiving element in a series of consecutive weighments, returning to a zero-balance between each application of the load. Using multiple weighments in this series will produce a more precise value for the standard deviation. Calculating the standard deviation of all weighments made during the repeatability test will be used to establish the uncertainty value attributed to the scale's repeatability. The value of the standard deviation will also be subtracted from the allowable 0.035 % tolerance.

Using the reference scale with its indicated weight in an expanded mode or by using error weights to more precisely determine the weight value of the load applied will help reduce the uncertainty involved in establishing

the value of the MTL. Reading the indications using a resolution of 0.1d reduces the effect of rounding by a factor of ten.

There must be an adequate means to account for the added uncertainties introduced through the test procedures used that will reduce the allowance of the relatively small tolerance that a reference scale will be held to when used to test Class 0.1. The following are some examples of uncertainties that will subtract from the total budget for tolerance allowed (0.035 %) for the reference scale.

- Use of test weights will subtract 0.0001 % for each individual test weight used. Class F test weights are calibrated using this tolerance.
- Each individual draft made on the reference scale (when any error in the scale is corrected for) is subject to an uncertainty of 0.5 d due to the rounding of scale indications. As mentioned above, this can be reduced through the use of error weights to determine the change-over points between increments or by placing the scale indicator in an expanded resolution mode.
- Substitution tests will include the total uncertainty value for each substitution operation due to the scales rounding.
- Of course, there are many variables contributing to uncertainty of the weighments that the evaluator is (to some extent) in control of such as:
    - the precision and correct use of test equipment;
    - environmental factors (e.g., wind affecting the scale's operation); and
    - loss or contamination of reference material during transport.

The Sector members will be asked to consider all of the above issues when working to develop detailed testing procedures for the new Class 0.1 belt-conveyor scales.