National Type Evaluation Program (NTEP)
Weighing Sector Meeting Agenda

August 22-23, 2017 / Houston, TX

INTRODUCTION

The charge of the NTEP Weighing 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, 2.20 Scales, 2.22 Automatic Bulk Weighing Systems, and 2.24 Automatic Weighing Systems. The Sector's recommendations will be 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 National Conference on Weights and Measures (NCWM) Specifications and Tolerances (S&T) 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***.

Table A
Table of Contents

Table B
Glossary of Acronyms and Terms

Acronym	Term	Acronym	Term
ABWS	Automatic Bulk Weighing Systems	NCWM	National Conference on Weights and Measures
AREMA	American Railway Engineering Maintenance-of-Way Association	NIST	National Institute of Standards and Technology
AWS	Automatic Weighing Systems	NTEP	National Type Evaluation Program
CC	Certificate of Conformance	OIML	International Organization of Legal Metrology
DES	Digital Electronic Scales	OWM	Office of Weights and Measures
HB 44	NIST Handbook 44	R	Recommendation
IZSM	Initial Zero-Setting Mechanism	SS	National Type Evaluation Program Software Sector
LMD	Liquid Measuring Device	S&T	Specifications and Tolerances Committee
MC	Measurement Canada	SMA	Scale Manufacturers Association
MRA	Mutual Recognition Agreement	WS	National Type Evaluation Program Weighing Sector

---

Details of All Items
(In order by Reference Key)

CARRY-OVER ITEMS

1. Recommended Changes to NCWM Publication 14 Based on Actions at the 2017 NCWM Annual Meeting

Source:
Mr. Richard Harshman, National Institute of Standards and Technology (NIST) Technical Advisor will provide the Sector with specific recommendations for incorporating test procedures and checklist language based upon actions of the 2017 NCWM Annual Meeting. The Sector is asked to briefly discuss each item and, if appropriate, provide general input on the technical aspects of the issues.

1.a.   3200-2 Verification Scale Interval

Source:
2017 S&T Committee Final Report

Background/Discussion:
At its 2017 Annual meeting, the NCWM voted to add a new NIST Handbook 44 Scales Code subparagraph S.1.2.2.2. Class I and II Scales used in Direct Sales, which requires the value of the scale division (d) to be equal to the value of the verification scale interval (e) on all Class I and II scales used in a direct sale application. The new subparagraph that was adopted is shown below. It is non-retroactive as of January 1, 2020, to be become retroactive January 1, 2023.

> ***S.1.2.2.2. Class I and II Scales used in Direct Sales. When accuracy class I and II scales are used in direct sale applications the value of the displayed division "d" shall be equal to the value of the verification scale interval "e."***
>
> **(Added 2017)** *(**Nonretroactive as of January 1, 2020. To become retroactive as of January 1, 2023**</br>*

Note that existing Scales Code subparagraph S.1.2.2.2. Class III and IIII Scales was renumbered S.1.2.2.3. as a result of adding this new subparagraph to the Handbook.

OWM's understanding of new subparagraph S.1.2.2.2. is that it will require the value of the scale division (d) to be equal to the value of the verification scale interval (e) on Class I and II scales manufactured as of January 1, 2020, when these scales are used in direct sale applications. Additionally, the value of "d" and "e" will be required to be equal on all Class I and II scales used in a direct sale application as of January 1, 2023, regardless of when they were manufactured.

OWM's review of some active NTEP CC's corresponding to Class I and II scales in the NCWM NTEP CC database revealed that within some of the tables providing indication of specific models, capacities, and division values for a particular scale, there exists certain models/types of Class I and II scales in which the value of "d" and "e" are different and other models in which they are the same. For example, consider the entries in the table below copied from NTEP CC number 05-078A2, which corresponds to a Mettler-Toledo Non-Computing Counter/Bench, Digital Electronic scale:

Specific Models, Capacities, and Division Sizes

Model/Type	Capacity	e	d	Class
JL602-G/Ayy	610 g	0.1g	0.01g	II
JL802-G/Ayy	810 g	0.1g	0.01g	II
JL1103-C/Ayy	220 g /1100 ct	0.001 g / 0.001 ct	0.001 g / 0.001 ct	I
JL1501-G/Ayy	1510 g	0.1 g	0.1 g	II
JL3001-G/Ayy	3100 g	0.1 g	0.1 g	II
JL6001-G/Ayy	6100 g	1 g	0.1 g	II
JL6001-G/LAyy	6100 g	1 g	0.1 g	II

Based on OWM's interpretation of new subparagraph S.1.2.2.2., the first- and last- two models of scales shown in this table could not be placed into a direct sale application (as of Jan. 1, 2020) because the manufacturer has designated a different value of "d" than "e." It would not be permissible for someone to simply turn off (or disable) the "d" resolution on one of the scale models referenced in this table in which the "d" value is different than the "e" value and change the marking to indicate that the value being displayed is "d." It would, in fact, be of concern if someone were to be able to simply turn off or deactivate the "d" resolution and change the marking on a scale to reflect that the value being displayed is "d" instead of "e" because it is OWM's understanding that deactivation of a "d" resolution on a Class I or II scale equipped with a value of "d" that differs from "e" causes a scale roundoff problem on some scales. That is, once the "d" resolution has been deactivated, "e" values do not round to the nearest minimum increment, which subparagraph G-S.5.2.2. Digital Indication and Representation requires. Thus, it is a reasonable expectation, in OWM's judgement, that the proposal requires the value of "d" and "e" to be equal.

Technical Advisor's note: OWM checked with one U.S. scale manufacturer concerning whether or not the Class I and II scales they currently produce would round properly if the "d" resolution were disabled (or deactivated) on those Class I and II scales in which the value of "d" differed from "e." The manufacturer reported that there is no possible way of disabling the "d" resolution on any of the models of Class I and II scales that they manufacture in which the value of "d" and "e" are different. It should not be concluded, however, from the reporting of one scale manufacturer that the "d" resolution on scales produced by other U.S scale manufacturers cannot be deactivated, and if it can be, whether or not the "e" resolution would round properly.

Due to the possible roundoff problem created by deactivating a "d" resolution on a Class I or II scale equipped with a value of "d" that differs from "e," OWM plans to submit a new NCWM Form 15 proposal to add a new subparagraph beneath S.1.2.2. Verification Scale Interval to be considered in the next Conference cycle. The following draft subparagraph was developed by OWM for submission to the NCWM for consideration:

S.1.2.2.3. Deactivation of a "d" Resolution. - It shall not be possible to deactivate the "d" resolution on a Class I or II scale equipped with a value of "d" that differs from "e" if such action affects the scale's ability to round digital values to the nearest minimum unit that can be indicated or recorded as required by paragraph G-S.5.2.2.

OWM believes new paragraph S.1.2.2.2. is consistent with OIML R 76 Non-automatic weighing instruments, which prohibits the use of an auxiliary indicating device (e.g., an indicating device with a differentiated scale division) and extended indicating device (e.g., expanded resolution) for direct sales to the public.

Discussion/Recommendation:
No specific recommendation is being made to the Sector at this time because it is believed the adopted changes to the Scales Code do not impact any of the type evaluation criteria in NCWM Publication 14. Members of the Sector should, however, consider the impact of these changes when considering the sale of high accuracy scales that are destined for or could eventually find their way into direct sale applications. The NIST advisor believes a discussion on how non-retroactive requirements apply and the impact of including a date in which the new

requirement becomes retroactive might be beneficial to some members of the Sector. A review of the Handbook 44 definition of "direct sale" might also be helpful.

2. NCWM Publication 14 DES Section 31 Multi-Interval Scales

Source:
Measurement Canada/Canada (2015)

Background:
This item appears as Agenda Item 10 on the 2015 NTEP Weighing Sector Agenda. During the 2015 Weighing Sector Meeting, Mr. Pascal Turgeon (MC) identified conflicts in various parts of NCWM Publication 14, DES Section 31. Multi-Interval Scales and suggested some changes be made to NCWM Publication 14 based on the type evaluation criteria developed and used by MC in their evaluation of a tare feature on a multi-interval scale. The conflicts identified by MC were disclosed during a routine general maintenance of the Canadian documents, and in particular, the requirements pertaining to multi-interval scales. Noting the importance of being careful not to change something that could conflict with Handbook 44 or NCWM Publication 14 because of the US and Canadian Mutual Recognition Agreement, MC requested an interpretation of the following sections of NCWM Publication 14, which it viewed as conflicting:

- The preamble to Section 31. contains examples and clauses that conflict with the requirements set out in 31.1. and 31.2. For example, the tare calculation example shows a net weight value that is not consistent with the scale interval of the weighing segment in which it falls, but both 31.1. and 31.2. require that it be consistent. The preamble also states that "Except for semi-automatic tare, all tare values shall not exceed the maximum capacity of the first weighing segment" whereas as 31.1.5. states "Tare may be taken to the maximum capacity of the smallest weighing range (segment) of the scale," leading to another contradiction

- Another issue with Section 31. is the applicability of 31.1. vs 31.2. It seems to be implied that either one or the other applies, depending on how the device operates, but it is not clear. It seems that 31.1. applies to devices that display all three values, while 31.2 is for devices that only display in one mode. However, review of the sub-clauses in each section show that this isn't correct (e.g. 31.1.9. refers to scales that only show net weight). We feel that section 31 needs to be reviewed to consolidate redundant clauses and clearly state the applicability of 31.1. and 31.2.

The Sector was asked at its 2015 meeting to review NCWM Publication 14, Section 31. for consistency and recommend changes as needed to resolve any conflicts or ambiguous parts. Members of the Sector concluded there are conflicts within Section 31. and it was generally accepted that at least some of the conflicts identified are the result of grouping together the different requirements that apply to the various types of tare, e.g., semi-automatic, keyboard, etc., used with multi-interval scales and scales designed with a single versus dual weight display.

Mr. Rick Harshman (NIST Technical Advisor) noted that the tare requirements contained in the Scales Code of NIST Handbook 44 do not provide the same level of detail as those in the Publication 14 checklist. Members of OWM's Legal Metrology Devices Program believe more work is needed to further develop requirements that apply to tare taken on multi-interval scales. Mr. Darrell Flocken (NCWM) suggested a small work group be formed to further develop the checklist and eliminate the conflicts in Section 31. of Publication 14 DES. Mr. Harshman suggested a review of the requirements in Section 31. to determine their intended application, e.g., those intended to apply to scales equipped with semi-automatic tare versus keyboard tare, etc. He further noted that he believed that much of this work had already been completed by the Sector in previous meetings.

The Sector agreed with Mr. Flocken's suggestion to form a small work group to further develop the checklist and eliminate the inconsistencies that had been identified. The following members of the Sector volunteered to participate on the work group:

Tom Buck (OH)
Scott Davidson (Mettler-Toledo)
Paul Lewis (Rice Lake Weighing)
Pascal Turgeon (MC) or (Justin Rae)
Rick Harshman (OWM)

Mr. Harshman agreed to host the first work group tele-conference and it was agreed that the work group would attempt to develop a proposal for the Sector to consider at next year's meeting.

A final recommendation made by Mr. Pascal at the 2015 Sector meeting was to move 31.1.9. and all of its subparts to 31.2. since all of 31.1.9. applies to scales that display or record only net weight values and 31.2. applies to scales that indicate in only one mode (gross or net). This recommendation to be considered by the work group as part of their review and further development of Section 31.

Prior to the 2016 NTEP Lab Meeting, Mr. Harshman developed a draft document titled "Principles of Tare - Multi-Interval and Multiple Range Scales" to be reviewed at the 2016 NTEP Lab Meeting with the NTEP weighing evaluators and those members of the small work group formed by the WS (to further develop the checklist and eliminate inconsistencies) in attendance at the meeting. This draft document was created with the thought that if agreement could be achieved on some basic principles of tare for the different types of tare operation, e.g. keyboard, push-button, etc., it might make it easier to identify in NCWM Publication 14 those requirements that deviate from the agreed upon principles that they could then be eliminated. The draft document was reviewed at the 2016 Lab Meeting, feedback provided, and a revised version of the document was completed.

At the 2016 WS Meeting, members of the Sector were asked to review the revised draft document titled, "Principles of Tare - Multi-Interval and Multiple Range Scales" and provide feedback on whether or not they agreed or disagreed with the different tare principles specified in the document and to identify any remaining gaps that needed to be addressed. The revised draft document was provided as an attachment to the Sector's 2016 agenda and is also included as an attachment to this agenda. Providing the Sector can achieve agreement on basic principles of tare, it was further recommended that members of the Sector review the specific portions of DES Section 13 that MC had previously identified as being in conflict and recommend corrective action as necessary.

The Sector may also want to consider recommending that a final completed version of this draft document be inserted as an Appendix to the DES Section of NCWM Publication 14 for future reference.

During the 2016 WS meeting, Mr. Rick Harshman (NIST Technical Advisor) provided a review of the different portions of NCWM Publication 14 DES Section 31 that had previously been identified by MC as being in conflict with one another. He stated that the tare requirements in HB 44 applicable to single range scales are easy to understand and apply because for most scale types, the value of the tare division must equal the value of the scale division. If an attempt is made to enter a tare to a value that differs from the value of the scale division, the scale must either reject the entry or round the entry to the value of the nearest scale division. Either option is considered acceptable for single range scales and will typically result in a net weight indication that is mathematically correct (i.e., gross – tare = net).

The subtraction of tare from a gross load on a multi-interval and multiple range scale becomes more complicated because tare can be taken in a weighing segment or range that differs from the weighing segment or range of the gross load applied. Consequently, the value of the scale division in the range where tare is taken is often different than the value of the scale division in the range where the gross load happens to fall. NCWM Publication 14 restricts the maximum tare that can be taken to the capacity of the smallest weighing range or segment. Thus, when a tare is taken in the smallest weighing range or segment and the gross load applied is in a higher weighing range or segment, how the scale treats that tare entry to provide an accurate net weight indication (result) is of concern. If the scale has been designed to round the tare to the nearest scale division of the weighing range or segment in which the gross load falls, the tare could round to zero, and some could conceivably argue that by doing so, facilitates the perpetration of fraud. Additionally, a different net weight can result depending on whether the scale rounds the tare before subtracting it from the weight of the gross load or rounds the net weight result after tare has been subtracted from the weight of the gross load. This issue is made even more complex

when considering the different types of tare, e.g. semi-automatic, keyboard, digital, etc., and the fact that the determination of net weight might be different depending on the type of tare being operated.

Mr. Harshman noted too that HB 44 contains a provision (Scales Code S.1.2.1.) which exempts multi-interval and multiple range scales from having to present net weight indications in divisions of 1, 2, or 5, (or a decimal multiple or submultiple of 1, 2, or 5) when the net weight indication is calculated from gross and tare weight indications that have different scale division values. Mr. Harshman stated that to his knowledge very few multi-interval and multiple range scales are designed to operate in this fashion (perhaps only a single model from one manufacturer). Mr. Harshman stated that he did not believe Canadian requirements included such a provision. Mr. Turgeon acknowledged agreement.

Mr. Harshman stated that he believed if U.S. scale manufacturers could agree on some basic principles of how tare is to operate on multi-interval and multiple range scales, these principles could quite possibly help resolve the conflicts that had been identified by MC in Publication 14. They might also be used to help establish a means of grouping together the different tare requirements in Publication 14 by tare type, should someone wish to take on this effort, so they are better organized and can be more easily followed. Mr. Harshman then initiated a review of a draft document that he had prepared titled, "Principles of Tare – Multi-Interval and Multiple Range Scales" to try and determine if different U.S. scale manufacturers represented at the meeting were consistent in how they had designed their scales to calculate a net weight indication from a tare taken in a lower weighing range or segment than the weighing range or segment of the gross load. He asked the various members of the Sector, and in particular, those representing a US scale manufacturer, to review the example calculations shown in the draft document and to explain how their scales determined the net weight result. Several of the scale representatives, upon being asked to provide input, indicated that they were not familiar with how their scales determined net weight and would need to consult with engineering staff and report back sometime later. Consequently, it was agreed this item could not be concluded during the meeting because it required additional input from the US scale manufacturers. As a result, the Sector agreed this item would remain on its agenda in 2017 as a carryover item.

In concluding the discussions on this item, Mr. Harshman indicated that although he wished to remain an active member of the tare work group, he preferred not to lead it in 2017 due to a current staffing shortage within the Legal Metrology Devices Program of OWM and there being no indication of when that situation might improve. Mr. Darrell Flocken (NTEP Specialist) offered to assume lead of the work group and the Sector accepted his offer. All 2016 members of the tare work group agreed to continue participation on the work. group. Mr. Robert Meadows (KS) and Mr. Eric Golden (Cardinal Scale Manufacturing, LLC) volunteered and were added as new participants on the work group.

Discussion/Recommendation:
Mr. Flocken to provide an update to the Sector on the progress of the tare work group since the last WS meeting.

NEW ITEMS

3. **NCWM Publication 14 DES - Minimum Platform Area (Section Lengths) Parameter Sections 8.1., 8.2., and 8.3.**

Source:
J. Eric Golden (Cardinal Scale Manufacturing Company)

Background:
At the 2009 Weighing Sector meeting, Mr. Ed Luthy (Brechbuhler Scales) submitted an item for consideration that would affect NCWM Publication 14 DES Sections 8.1, 8.2, and 8.3. The Sector agreed to the proposal, though only Section 8.1 was changed. The submitter believes it was an accidental omission to not also update Sections 8.2 and 8.3

and is recommending these sections be amended since they too, were part of the proposal. He is also recommending that the changes be retroactive back to 2009; the date in which the proposal was originally considered by the WS.

The submitter is recommending the following changes:

Proposed changes to Section 8.2:

8.2.   Additional criteria for vehicle scales, railway track scales, combination vehicle/railway track scales, and other platform scales greater than 200 000 lb.

A CC Will Apply to All Models Having:
     a.   <u>Nominal capacities</u> no greater than the evaluated capacity.
     ~~b.   A **platform area for any two section portion no less than 50% of smallest two section portion incorporated in the device evaluated.**~~
     b.~~c~~   <u>Widths</u> up to 120% of the width of the platform tested ~~that of the device tested.~~[3]
     c.~~d~~   <u>Lengths</u> **no shorter than 7' and up** to 100% of the length of the platform tested (for railway track and railway track portion of combination scales length to 150% of device evaluated.)
     d.~~e~~   <u>Spans</u> between sections of not more than 20% greater than the equipment evaluated (for vehicle scale no greater than the device evaluated.)

*Notes For **d** ~~e~~:*

- On a combination Vehicle/Railway Track Scale, a test of the CLC for the vehicle portion of the scale is not required provided the scale has been evaluated as a Railway Track Scale.
- The device must be evaluated using the smallest emin value that will be listed on the certificate. This may require the use of a multiple range weight indicator for combination vehicle/railway track scales.
- The CLC for the vehicle scale portion of the device must not exceed the maximum test weight used for the section test of the railway track scale. The CLC listed on the CC shall be no greater than what would be permitted in Section 8.d.)

_____

[3]*For scales with widths greater than 12 feet, this policy on range of widths may not be applied retroactively unless the criteria in DES 67 or 68 have been performed. Test procedures for scales wider than 12 feet will be addressed by NTEP management and the NTEP laboratories on a case-by-case basis.*

Proposed changes to Section 8.3:

8.3. Modular Load-Cell Vehicle, Livestock, or Railroad Track Scales
Note: These criteria apply if the scale is …

Modular Scale
A vehicle, livestock or railroad track scale made up of individual …

8.3.1. Modular Scale to be Tested
        The following criteria must be satisfied …

8.3.2. Range of Parameters for Modular Scales
        The following range of parameters will be used to establish the sizes and capacities of modular load cell vehicle, livestock, or railway track scales that will be covered on a CC based upon the test of a single scale.

   a. Nominal capacities not more than 1.5 times CLC for a two-section scale to 135% of capacity of the device evaluated. The nominal capacity for the railroad track scale in a modular vehicle/railroad combination will be no greater than the capacity of the device submitted for evaluation.

   b. ~~Platform area not less than 50% of smallest two-section (four-cell) module incorporated in the device evaluated.~~ **Platform lengths no shorter than 7'.** Increased lengths for scales with two or more modules are not restricted as long as the width complies with 8.3.2. (e) and the load cells meet the vmin formula (e.g., $vmin \leq d / \sqrt{N}$ where "N" is the number of load cells in a single independent weighing/load receiving element. Independent means with a weighing/load receiving element not attached to adjacent elements and with its own A/D circuitry and displayed weight.) Additional modules to increase length must be of the same type as those used in the device submitted for evaluation (e.g., 4-cell, 2-cell, and 0-cell.)

   c. **…**

Recommendation: Review the contents of Agenda Item 11. in the Sector's 2009 Meeting Summary to determine if the submitter's recommended changes to Sections 8.2. and 8.3. are appropriate. The entire contents of Agenda Item 11. from the 2009 WS Meeting Summary have been copied and inserted as an attachment to this item in Appendix A.

Note from NIST Technical Advisor: *Although the title of Agenda Item 11 from the 2009 WS Agenda references Sections 8.1., 8.2., and 8.3, it does not appear that the Sector considered or discussed changing Sections 8.2. or 8.3. during the meeting. The only changes made note of in the Sector's Summary Report and the NIST Technical Advisor's DRAFT Brief Summary and Action Items Report are to Section 8.1. Additionally, the Background information for Agenda Item 11. provides only the submitter's recommendation to amend Section 8.1.*

4. **Identification of Certified Software - NCWM Publication 14 DES Section 3. Additional Marking Requirements- Not Built-for-Purpose Software-Based Devices**

Source:
NTEP Software Sector (2017)

Background:
At the 2017 NTEP Software Sector Meeting, members of the Software Sector agreed that the second paragraph of the Note shown in NCWM Publication 14 DES Section 3. Additional Marking Requirements-Not Built-for-Purpose Software-Based Devices be part of the checklist applicable to software that is submitted for NTEP certification rather than part of a Note, as is the case now. The following reflects the current text in Section 3.:

3. Additional Marking Requirements- Not Built-for-Purpose Software-Based Devices

Identification of Certified Software:

Note: Manufacturers may choose to separate metrologically significant software from non-metrologically significant software. Separation would allow the revision of the non-metrological portion without the need for further evaluation. In addition, non-metrologically significant software may be updated on devices without breaking a seal, if so designed. Separation of software requires that all software modules (programs, subroutines, objects, etc.) that perform metrologically significant functions or that contain metrologically significant data domains form the metrologically significant software part of a measuring instrument (device or sub-assembly). If the separation of the software is not possible or needed, then the software is metrologically significant as a whole.

The manufacturer must describe and possibly demonstrate how the version or revision identifier is directly and inseparably linked to the metrologically significant software. Where the version revision identifier is comprised of more than one part, the manufacturer shall describe which portion represents the metrological significant software and which does not.

The following reflects the changes proposed by the SS:

X. Additional Marking Requirements- Not Built-for-Purpose Software-Based Devices

Identification of Certified Software:

X.X. The manufacturer must describe and possibly demonstrate how the version or revision identifier is directly and inseparably linked to the metrologically significant software. Where the version revision identifier is comprised of more than one part, the manufacturer shall describe which portion represents the metrological significant software and which does not.   ☐ Yes ☐ No ☐ N/A

Note: Manufacturers may choose to separate metrologically significant software from non-metrologically significant software. Separation would allow the revision of the non-metrological portion without the need for further evaluation. In addition, non-metrologically significant software may be updated on devices without breaking a seal, if so designed. Separation of software requires that all software modules (programs, subroutines, objects, etc.) that perform metrologically significant functions or that contain metrologically significant data domains form the metrologically significant software part of a measuring instrument (device or sub-assembly). If the separation of the software is not possible or needed, then the software is metrologically significant as a whole.

Recommendation:
Members of the Sector are requested to consider the changes suggested by the SS and determine if they are appropriate. This proposal was also submitted to the Grain Analyzer Sector and the Measuring Sector for consideration at their 2017 meetings and if approved, all of text in the proposal will be added to respective portions of NCWM Publication 14**.**

ATTACHMENTS

Attachment to Agenda Item 2. Principles of Tare – Multi-Interval and Multiple Range Scales

Principles of Tare – Multi-Interval and Multiple Range Scales

Multi-Interval Scales

Digital, Keyboard, and Programmable Tare

- It shall not be possible to enter or program a tare value that exceeds the capacity of WS1
- All tare values shall be equal to the value of the displayed scale division of WS1
  - If an attempt is made to enter a tare to a different value of d of WS1, the scale shall either reject the tare entry or round the tare entry to the nearest value of d of WS1
- Which of the following two bullet points in the box below is a correct statement (i.e. principle of tare) or should it be specified that either "rounding" method is appropriate?

---

1. A tare entered (or programmed) to the value of the displayed scale division of WS1 will automatically round to the closest value of the displayed scale division of the WS in which the net weight happens to fall once a gross load has been applied; *or*
2. A tare entered (or programmed) to the value of the displayed scale division of WS1 will be subtracted from the weight of a gross load and the net result then rounded to the closest value of the displayed scale division of the WS in which the net result happens to fall.

The example below provides indication of the difference in the net weight results depending on which value (tare or net) gets rounded.

Consider the following capacity statements marked on a multi-interval scale for this example:
WS1   0-1000 lb x 2 lb
WS2   1000 – 5000 lb x 5 lb

	Displayed and/or Printed	
	Actual	Acceptable
Gross	1010 lb	1010 lb
Tare	- 12 lb	- 12 lb

Net	998 lb	1000 lb

In this example, <u>if the scale rounds tare</u> to the closest value of the displayed division in the range of the resulting net weight, it would round the 12 lb tare to 10 lb and the net result would be 1 000 lb. However, if it is the <u>net weight that gets rounded</u> after subtraction of tare, the net weight would round to the closest 2 lb and the result would be 998 lb.

The decision is important becasuse if it decided that rounding is to the net weight (i.e., after subtraction of tare) then there is only one correct answer and that is 998 lb. If rounding of tare is permitted, then both net results would be considered correct (that is, 998 would still be considered acceptable due to the exception allowed by Scales Code paragraph S.1.2.1.)

NCWM Pub 14 DES Section 31. currently specifies the following:

In applying these principles, <u>it is acceptable to</u>:

- **Round the indicated and printed tare values <u>to the nearest appropriate net weight scale division.</u>**

In reviewing this example during the 2016 NTEP Lab meeting, Darrell indicated that the net result could be either 998 lb or 1 000 lb. For the net result to be 1 000 lb, the 12 lb tare must round to the nearest value of d in the second weighing range (10 lb). That is, rounding would have to occur before subtraction of tare from gross. If rounding occurred after subtraction, then the only acceptable answer would be 998 lb. A 2 lb rounding error is significant because it represents approximately 0.2 % of the net load. Review answers again with Darrell just to confirm he believes both answers are correct.

Which is correct? What is the rule or principle that applies?

- The value of the scale division for the net weight, whether positive or negative, must be displayed in scale divisions consistent with the weighing segment in which the net weight falls.
- If a tare value can be cleared when a load is on the platform, a clear indication that the tare value has been eliminated must be provided.
- In all cases, any displayed or recorded net weight value must be in mathematical agreement with the gross and tare values indicated or recorded (i.e., gross - tare = net).
  - This applies to both when a tare value and the resulting net weight value fall in the same WS (i.e., WS1) and when a tare value and the resulting net weight value fall in different WSs (e.g., tare in WS1 and the resulting net weight in WS2)
- A multi-interval scale may indicate and record tare weights in a lower weighing segment (WS) and net weights in a higher WS and provide a mathematically correct net weight

result in accordance with the examples provided in HB 44 Scales Code paragraph S.1.2.1. Digital Indicating Scales, Units.

The following examples are provided to better show how these principles apply:

Consider the following capacity statements marked on a multi-interval scale for Examples A-D shown in the table below:

WS1   0-5 lb x 0.002 lb

WS2   5 – 10 lb x 0.005 lb

WS3   10 – 30 lb x 0.01 lb

Example A Displayed and/or Printed		
	Actual	Acceptable
Gross	13.38 lb	13.38 lb
Tare	- 0.122 lb	- 0.122 lb
Net	13.258 lb	13.26 lb

In the "Acceptable" column 13.258 lb has been rounded up to the nearest scale division of WS3.

Example B Displayed and/or Printed		
	Actual	Acceptable
Gross	13.38 lb	13.38 lb
Tare	-0.004 lb	-0.004 lb
Net	13.376 lb	13.38 lb

In the "Acceptable" column 13.376 has been rounded up to the nearest scale division of WS3. *In this case, the scale clears the tare value once the load is applied. The scale is required to provide a clear indication of that it has done so.*

Example C Displayed and/or Printed		
	Actual	Acceptable
Gross	13.38 lb	13.38 lb
Tare	-0.006 lb	- 0.006 lb
Net	13.374 lb	13.37 lb

In the "Acceptable" column 13.374 has been rounded to the nearest scale division of WS3.

Example D Displayed and/or Printed		
	Actual	Acceptable
Gross	10.54 lb	10.54 lb
Tare	- 0.626 lb	- 0.626 lb
Net	9.914 lb	9.915 lb

In the "Acceptable" column 9.914 has been rounded to the nearest scale division of WS2.

In each of the examples shown above, the net values shown beneath both "Actual" and "Acceptable" would be considered the only acceptable results given the principles of tare on a multi-interval scale.

Push-button (Semi-automatic) Tare

- There are no capacity limitations for semi-automatic tare. Tare may be taken to the capacity of any WS.
- A semi-automatic tare rounds the weight of the object being tared to the closest value in the range where taken.
- Entries of tare shall be to the value of the displayed scale division of the WS in which the tare is taken and then rounded to the closest value of the displayed scale division in the WS in which the net weight results once a load is applied.
- In all cases, any displayed or recorded net weight value must be in mathematical agreement with the gross and tare values indicated or recorded (i.e., gross - tare = net).
- The value of the scale division for the net weight, whether positive or negative, must be displayed in scale divisions consistent with the weighing segment in which the net weight falls.

Multiple Range Scales

- It is important to think of each weighing range of a multiple range scale as if a single scale. There are multiple range scales in which the range is manually selected and there are those in which the range changes automatically with the amount of load applied.
    - o   For those in which the range is manually selected, tare can only be taken to the value of the displayed scale division of the range selected.   An attempt to enter a keyboard (or programmable) tare value that differs from the value of the displayed scale division can either be rejected or rounded and accepted to the closest value of the displayed scale division.
    - o   For those in which the range changes automatically, the scale must only accept a tare entry to the displayed scale division of the range in which the tare value falls. A tare entry accepted in a lower WR will automatically round to the nearest displayed scale division of a higher weighing range once the application of a load causes the net weight indication to breach the higher WR. However, if the applied load is then decreased, the value of the tare scale division (that was previously rounded to the higher WR) must not change, nor shall the value of the displayed net weight scale division change to that of the lower WR.
    - o   If a tare value can be cleared when a load is on the platform, a clear indication that the tare value has been eliminated must be provided (*What constitutes a clear indication that tare has been removed?*

Both Multi-Interval and multiple range scales

- The tare mechanism shall only operate in a backward direction with respect to the zero-load balance condition of the scale.

- Scales must provide a clear indication that tare has been taken.

- If tare is set to zero, there must be a clear indication that tare has been removed.

- If a tare value can be cleared when a load is on the platform, a clear indication that the tare value has been eliminated must be provided. What is not known is how the scale will identify the quantity being displayed once tare is erased. I believe some scales revert back to a gross. What constitutes a clear indication that tare has been removed? Under what conditions would NTEP accept the deletion of a tare entry?

- Scales designed to automatically clear tare, shall be designed to prevent the clearing of tare until a complete transaction has been indicated.

- A pre-programmed tare cannot replace a manually entered tare without obvious indication.

- The tare weight plus the net weight must always equal the gross weight. In all cases, any displayed or recorded net weight value must be in mathematical agreement with the gross and tare values indicated or recorded (i.e., gross - tare = net).

- Keyboard and programmable tare entries must be visible at some point in the transaction so the entry can be verified. (Re: DES Section 48). Do you agree that this principle also applies to multi-interval and multiple range scales?

Attachments to Agenda Item 3 Minimum Platform Area.

- **Pdf copy of the 2009 proposal submitted by Mr. Luthy (Brechbuhler Scales)**

- **Excerpt from the 2009 Weighing Sector Meeting Summary**

---

11. **PUB 14 - MINIMUM PLATFORM AREA (SECTION LENGTHS) PARAMETER SECTIONS 8.1., 8.2., AND 8.3.**

Source*:* Mr. Ed Luthey, Brechbuhler Scales

Background: Brechbuler Scales is questioning why the minimum platform area on a vehicle scale is limited to 50 % of the device that was tested. For example, a 70' x 10', 3-section vehicle scale was evaluated and passes type evaluation. The CC would then list the minimum platform size as 350 ft^2 or list the minimum L x W scales that would comply with the Pub 14 criteria. Under the Pub 14 language, the applicant would have to submit a smaller second scale if they wanted 10' x 10', 2-section scale listed on the CC.

The submitter of the item believes that there is no technical justification for the limitation. Brechbuhler Scales submitted a proposal to eliminate the 50 % minimum platform area restriction as shown in the recommendation below:

> 8.1. **Additional criteria for vehicle scales, railway track scales, combination vehicle/railway track scales, and other platform scales over 30 000 lb and up to and including 200 000 lb.**
>
> A CC will apply to all models having:
>
> a. **nominal capacities** up to 135 % of evaluated capacity;
> b. ~~a platform area for any two section portion no less than 50 percent of smallest two section portion incorporated in the device evaluated.~~
> c. **widths** up to 120 % of the width of the platform tested;
> d. **lengths** 150 % of the length of the platform tested;
> e. a **span** between sections is not more than 20 % greater than the equipment evaluated;

Discussion: Mr. Steve Cook, NIST Technical Advisor, reported on past Publication 14 language and WS discussions on this item. Mr. Cook noted that the above referenced language has been in Publication 14 since its earliest publication. Additionally, he found references to the current language as far back as 1983 in the notes of the National Type Approval work group. The National Type Evaluation work group included NIST, Weights and Measures Officials, scale manufacturers, and load cell manufactures. Mr. Cook contacted some of the work group participants (Richard Suiter and Henry Oppermann) to inquire if they recall the justification for the accepted language and report any additional information during the WS meeting. They recalled that it was agreed that a lower limit was needed and that the selections of the 50 % lower limit was not based on any technical justifications. Mr. Truex was concerned that completely eliminating the lower limit for platform area may result in variations in sizes that may be used in unsuitable applications (e.g., a small Class III L vehicle scale used in a Class III platform scale application.). The WS agreed with Mr. Langford's suggestion of seven-foot minimum length.

Conclusion: The Sector agreed to amend the criteria in DES Technical Policy 8.1.b and c by deleting 8.1.b. and adding "lengths <u>no shorter than 7"</u> . . ." to 8.1.c. since the <u>platform area</u> is deleted. This recommendation can be found in Appendix A - Agenda Item 11.

Appendix A: Agenda Item 11.

    8.1.   **Additional criteria for vehicle scales, railway track scales, combination vehicle/railway track scales, and other platform scales over 30 000 lb and up to and including 200 000 lb.**

A CC will apply to all models having:

    a.   **nominal capacities** up to 135 % of evaluated capacity;
    b.   ~~a platform area for any two section portion no less than 50 percent of smallest two section portion incorporated in the device evaluated~~.
    b~~c~~.   **widths** up to 120 % of the width of the platform tested**;**
    c~~d~~.   **lengths** **no shorter than 7' and up to** 150 % of the length of the platform tested**;**
    d~~e~~.   a **span** between sections is not more than 20 % greater than the equipment evaluated;

- **Excerpt from the 2009 WS Meeting Report of DRAFT Brief Summary and Actions Items as reported by Steve Cook (NIST Technical Advisor, retired)**

National Type Evaluation Technical Committee
Weighing Sector
August 25-27 2009, Columbus Ohio
DRAFT Brief Summary and Action Items

Item	Subject	Conclusion/Action[1]	Who	Date
1	Load Cell Creep Recovery	Sector supports proposed changes to Pub 14.	Cook	11-09
		Sector supports proposed editorial changes (as amended) to Pub 14.	Cook	11-09
...	…	…	…	…
11.	Pub. 14 - Minimum Platform Area (Section Lengths) Parameter Sections 8.1., 8.2., and 8.3.	The Sector agreed to amend the criteria in DES Technical Policy 8.1.b and c by deleting 8.1.b. and adding "no shorter than 7' to c.	Cook	11-09
…	…	…	…	…

[1]Recommended changes to Publication 14 will be submitted by the NIST Technical Advisor to the NTEP Administrator for review and distribution to the NTEP Committee prior to the 2010 NCWM Interim Meeting.

ATTENDEE LIST 2017 MEETING

Tom Buck Ohio Department of Agriculture 8995 East Main Street Reynoldsburg, OH 43068 **P.** (614) 728-6290 **F.** (614) 728-6424 **E.** tom.buck@agri.ohio.gov	**Richard Harshman** NIST, Office of Weights and Measures 100 Bureau Drive, MS 2600 Gaithersburg, MD 20899 **P.** (301) 975-8107 **E.** richard.harshman@nist.gov
Kevin Chesnutwood NIST, Office of Weights and Measures 100 Bureau Drive, MS 8222 Gaithersburg, MD 20899 **P.** (301) 975-8107 **E.** kevin.chesnutwood@nist.gov	**Scott Henry** Zebra Technologies 809 Ashland Falls Drive Monroe, GA 30656 **P.** (770) 800-1187 **E.** scott.henry@zebra.com
Bill Danderand FedEx 1479 Town Center Drive, Ste D214 Lakeland, FL 33803 **P.** (630) 347-7745 **E.** william.danderand@fedex.com	**Takashi Kawazoe** New Brunswick Interinational, Inc. 76 Veronica Avenue Somerset, NJ 08873 **P.** (732) 577-3876 **E.** TKService@nbidigi.com
Scott Davidson Mettler-Toledo, LLC 1150 Dearborn Drive Worthington, OH 43085 **P.** (614) 438-4387 **E.** scott.davidson@mt.com	**Robert Meadows** Kansas Department of Agriculture 1320 Research Park Drive Manhattan, KS 66502 **P.** (785) 564-6681 **E.** robert.meadows@kda.ks.gov
Holger Ferst WIPOTEC-OCS, Inc. 825 Marathon Parkway Lawrenceville, GA 30046 **P.** (678) 232-0745 **F.** (678) 344-8030 **E.** holger.ferst@wipotec-ocs.com	**Eric Morabito** New York Weights and Measures 10B Airline Drive Albany, NY 12206 **P.** (518) 457-3452 **E.** eric.morabito@agriculture.ny.gov
Darrell Flocken National Conference on Weights and Measures 1135 M Street, Suite 110 Lincoln, NE 68508 **P.** (614) 620-6134 **E.** darrell.flocken@ncwm.net	**Ben Raham** WIPOTEC-OCS, Inc. 825 Marathon Parkway Lawrenceville, GA 30046 **P.** (678) 344-8300 **E.** ben.raham@ocs-cw.com
Eric Golden Cardinal Scale Manufacturing Co. 203 East Daugherty Street Webb City, MO 64870 **P.** (417) 673-4631 x 211 **E.** egolden@cardet.com	**Sam Sagarse** Emery Winslow Scale Company 4530 North 25th Street Terre Haute, Indiana 47805 **P.** (812) 466-5265 **E.** srsagarsee@winslowth.com

Robert Upright VPG Transducers 42 Countryside Road North Grafton, MA 01536 **P.** (508) 615-1185 **E.** rob.upright@vpgsensors.com	
Jerry Wang A&D Engineering, Inc. 1756 Automation Parkway San Jose, CA 95131 **P.** (408) 518-5113 **E.** jwang@andonline.com	

NEXT MEETING:

The Sector agreed to hold its next meeting **…TBD**