National Type Evaluation Technical Committee
Weighing Sector

August 30 to September 1, 2011, Sacramento, CA.
DRAFT Agenda (Revised August 16, 2011)

Glossary of Acronyms			
ABWS	Automatic Bulk Weighing Systems	NTEP	National Type Evaluation Program
AWS	Automatic Weighing Systems	NTETC	National Type Evaluation Technical Committee
CC	NTEP Certificate of Conformance	OIML	International Organization of Legal Metrology
CIM	Coupled-in-Motion (Railway Track Scales)	S&T	NCWM Specifications and Tolerances Committee
CWMA	Central Weights and Measures Association	SWMA	Southern Weights and Measures Association
ECRS	Electronic Cash Registers Interfaces with Scales	WG	Work Group
GIPSA	Grain Inspection Packers and Stockyards Administration	WMD	NIST Weights and Measures Division
NCWM	National Conference on Weights and Measures	WWMA	Western Weights and Measures Association
NEWMA	Northeastern Weights and Measures Association	WS	NTETC Weighing Sector
NIST	National Institute of Standards and Technology		
Unless Otherwise Stated:			

Glossary of Acronyms
- "Handbook 44" (HB-44) means the 2011 Edition of NIST Handbook 44, "Specifications Tolerances, and Other Technical Requirements for Weighing and Measuring Devices." - "Handbook 130" (HB-130) means the 2011 Edition of NIST Handbook 130, "Uniform Laws and Regulations in the areas of legal metrology and fuel quality." - "Publication 14" (Pub. 14) means the 2011 Edition of NCWM Publication 14 - Weighing Devices - Technical Policy - Checklists - Test Procedures.
Note: NIST does not imply that these acronyms are used solely to identify these organizations or technical topics.

Carry-over Items:

1. Recommended Changes to Publication 14 Based on Actions at the 2011 NCWM Annual Meeting

Source: The NIST Technical Advisor, Richard Harshman, has provided the Sector with specific recommendations for incorporating test procedures and checklist language based upon actions of the 2011 Annual Meeting of the 96th NCWM. The Sector is asked to briefly discuss each item and, if appropriate, provide general input on the technical aspects of the issues.

1.a. S&T Committee Item 310-1: HB 44 G-S.8. Provisions for Sealing Adjustable Components

Source: 2010 NTETC Weighing Sector

Background: At its August 2010 Annual Meeting, the WS: 1) reviewed the sealing procedures in Pub 14 Scales type evaluation checklist and procedures; 2) compared them with similar type evaluation criteria in Pub 14 for LMD; and 3) reviewed applicable HB 44 sealing requirements in the General, Scales, and LMD codes. Prior to the 2010 meeting of the WS, a small WG was formed to develop more detailed procedures for determining compliance of the methods for sealing and requested the WS to consider its recommendations for Pub 14, DES Section 10. The WS reviewed the recommendations and agreed with the revised proposal to amend Pub 14 Scale Section 10 and recommended it be forwarded to the S&T Committee and the SMA for consideration prior to the 2011 NCWM Interim Meeting. The WS also agreed to forward the amended language for Pub 14 to the S&T Committee with a recommendation that the S&T item be Withdrawn from the Committee's agenda. The final summary of the NTETC Weighing Sector may be reviewed in NTEP Committee's 2011 Interim Report, Appendix C.

At the 2011 NCWM Annual meeting the Committee agreed to add the following 2 paragraphs into the Report of the 96th NCWM to make clear its interpretation of G-S.8.:

> The current language in paragraph G-S.8. states: "A device shall be designed with provision(s) for applying 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 detrimentally affects the metrological integrity of the device can be made to any electronic mechanism."
>
> Thus, for parameters protected by physical means of security, once a physical security seal is applied to the device, it should not be possible to make a metrological change to those parameters without breaking that seal. Likewise, for parameters protected by electronic means of security, it should not be possible to make a metrological change to those parameters without that change being reflected in the audit trail. Since this philosophy addresses provisions for protecting access to any metrological adjustment, the philosophy should be applied consistently to all electronic device types.

During the 2011 Annual Meeting of NEWMA, Ross Andersen (retired Director of the New York Bureau of Weights and Measures) stated that he believed that the language that was added to Pub 14 is different than what's proposed for vote [See shaded text below]. Pub 14 allows a device with physical means of sealing to be sealed in the calibration or configuration mode if it provides a clear indication that it's in that mode. If NTEP

wants to say that an indicator light (which depicts a device is in the calibration or configuration mode) is acceptable, he recommends that the NCWM S&T Committee sanction that in their interpretation. Since NTEP policy must conform with HB44, it seems necessary to ensure the code also permits the indicator light. Thus that must be included in the interpretation of the Committee.

Pub 14 DES Section 10 - Sealing - General

In addition to satisfying the physical security sealing requirement; the presence of a physical seal shall ensure that the setup or configuration mode (any mode permitting access to any or all sealable parameters based upon the application of the *Philosophy for Sealing in Publication 14)* of the device cannot be accessed without additional actions (e.g., removal of a jumper, pressing a key or switch, etc.) is only possible after the removal of the seal.

If the use of a physical seal is the only approved method of sealing,; it shall not be possible to apply the physical seal with the device in the setup or configuration mode (any mode permitting access to any or all sealable parameters based upon the application of the *Philosophy for Sealing in Publication 14)* unless the device has a clear indication that the device is in this mode. See the list of acceptable and unacceptable indications below.

Recommendation: As a result of Mr. Andersen's comments, the 2011 S&T Committee asked that the WS review its most current interpretation of NIST Handbook 44 G-S. 8., which was approved by the NCWM for inclusion into the Report of the 96th NCWM, and verify that the WS's recent changes to Pub 14 are consistent with the Committee's interpretation.

The NIST Technical Advisor recommends that the sector review the language highlighted above from Pub 14 DES, ABWS, and AWS type evaluation procedures and checklists and the language that was added to the introductory sections of Pub 14 to confirm that existing language is aligned with the Committee's interpretation.

1.b. S&T Committee Item 320-1: HB 44 HB 44 Scales Code - T.N.4.5.1. Creep and Creep Recovery Requirements for Class III Scales with n > 4000 divisions.

Source: 2010 NTETC Weighing Sector

***Background*:** At the 2011 NCWM Interim Meeting, the Conference considered a proposal from the following language from the NTETC Weighing Sector to reduce the inconsistency between full load time dependence (creep) requirements in T.N.4.5.1. and return to zero requirements in T.N.4.3. Zero Return: Non-automatic Weighing Instruments (creep recovery).

During the 2011 NCWM Interim meeting open hearings, Mr. Flocken, Mettler-Toledo, speaking on behalf of the SMA supported this item. However, later, during S&T Committee deliberations, Mr. Flocken stated that after researching the item, including a discussion he had with another scale manufacturer, it was concluded that the proposal is not needed since the ultimate determination of compliance is the four-hour test (specified in subparagraph (b) of T.N.4.5.1.) regardless of the 0.5 or 0.83 e determinations. The S&T Committee withdrew this item based on this new information.

Recommendation: The Technical Advisor recommends that the WS take no further actions on this item.

1.c. S&T Committee Item 320-2: HB 44 Scales Code – T.N.4.7. Amend Creep Recovery Tolerances for Class III L Load Cells

Source: 2010 NTETC Weighing Sector

Background: Avery Weigh-Tronix reported that HB 44 Creep Recovery tolerances for Class III load cells with n > 4000 divisions in Scales Code paragraph T.N.4.7., is now greater than creep recovery tolerances

applicable to Class III L load cells. In terms of mV/V equivalency, a Class III/III L load cell can now pass Class III and fail Class III L creep recovery tolerances.

Prior to 2009, the tolerance for Class III load cells was 0.5v. This was increased by a factor of 5/3 to arrive at the 0.83 v tolerance in the current requirement. The recommendation proposed to increase the existing 1.5 v tolerance for Class III L load cells by the same 5/3 factor. Thus the new tolerance would be 1.5v x 5/3 or 2.5v.

The following is an example of a 50 000 lb load cell marked with both III and III L accuracy classes that illustrates the problem.

Class III:	Class III L
n_{max} = 5000	n_{max} = 10 000v
v_{min} = 10 lb	v_{min} = 5 lb

The Class III creep recovery tolerance is 0.83v (0.83v x 10 lb/v = 8.3 lb)
The Class III L creep recovery tolerance is 1.5v (1.5v x 5 lb/v = 7.5 lb)
The proposed Class III L creep recovery tolerance is 1.5v v 5/3 = 2.5v (2.5v x 5 lb/v = 12.5 lb)

Avery Weigh-Tronix also noted the increased cost involved with meeting Class III L VCAP (voluntary Conformity Assessment Program) requirements with a tolerance that is less than Class III. Multiplying the Class III L tolerance by 5/3, as was done with Class III, would be more cost effective for a load cell manufacturer. The WS agreed with Avery Weigh-Tronix and submitted language to the S&T Committee and regional weights and measures associations that would amend paragraph T.N.4.7. by changing the Class III L load cell creep recovery tolerance from 1.5 v to 2.5 v.

At the 2011 NCWM Annual meeting, members of the Conference adopted the following language submitted by the WS, which will be reflected in the 2012 version of NIST Handbook 44.

T.N.4.7. Creep Recovery for Load Cells During Type Evaluation. – The difference between the initial reading of the minimum load of the measuring range (D_{min}) and the reading after returning to minimum load subsequent to the maximum load (D_{max}) having been applied for 30 minutes shall not exceed:

(a) 0.5 times the value of the load cell verification interval (0.5 v) for Class II and IIII load cells;

(b) 0.5 times the value of the load cell verification interval (0.5 v) for Class III load cells with 4000 or fewer divisions;

(c) 0.83 times the value of the load cell verification interval (0.83 v) for Class III load cells with more than 4000 divisions; or

(d) 2.5 times the value of the load cell verification interval (2.5 v) for Class III L load cells.
(Added 2006) (Amended 2009 and 2012)

Discussion/Recommendation: The NIST Technical Advisor recommends the following changes to Section L. Subsection II, Item 9, Publication 14 Load Cells (Pub 14, pages 12 and 13).

L. Procedures

II. Determination of Creep and Creep Recovery, Test Procedure and Permissible Variations

9. **Permissible Variations of Reading for Creep Recovery**

a. The difference between the initial reading of the minimum load of the measuring range (D_{min}) and the reading after returning to minimum load subsequent to the maximum load (D_{max}) having been applied for 30 minutes shall not exceed:

1. 0.5 times the value of the load cell verification interval (0.5 v) for Class I, II, and IIII load cells.

2. 0.5 times the value of the load cell verification interval (0.5 v) for Class III load cells with 4000 or fewer divisions.

3. 0.83 times the value of the load cell verification interval (0.83 v) for Class III load cells with more than 4000 divisions.

4. ~~1~~2.5 times the value of the load cell verification interval (~~1~~2.5 v) for Class III L load cells.

2. DES Section 42 - Zero-Load and Tare Adjustment - Rounding of Intermediate Values in an Equation.

Source: Steven Cook, NIST WMD

***Background*:** Publication 14 DES Sections 42 - Zero-Load Adjustment - Monorail Scales currently reflects language in HB 44 regarding the setting of zero and tare value less than 5% of the scale capacity to within 0.02% of scale capacity according to HB 44 Scales Code paragraphs S.2.1.4 (Monorail Scales) and S.2.3.1.(Monorail Scales Equipped with Digital Indications). In other words, a 1000 lb x 1 lb monorail scale shall have the capability to set tare values up to 50 lb to within a resolution of 0.2 lb (1000 x 0.02%).

However, there are no procedures in Section 42 to verify that a correct zero-load balance or semiautomatic, keyboard entered, or stored tares are not rounded to the nearest value of d (1 lb) before the net weight is calculated. In the above example, a tare that is rounded before the net weight calculation introduces an extra 0.5 lb uncertainty in the net weight. This can be a problem if an average tare value of 7.6 lb for a series of trolleys is entered as tare. Objects (animal carcasses) will be consistently short weighed if the tare is rounded from 7.6 lb to 8 lb before the net weight is calculated. This may present economic harm to sellers or producers of livestock that are paid based on the weights from the monorail scale. Conversely, average tare weights that are rounded down to the nearest displayed scale division may present economic harm to the buyers, typically processors, that pay the producers based on the weights from the monorail scale.

Another question is whether the net weights are determined using the digital indicator's internal or displayed resolution of the gross weight in the calculation of the net weight.

The following is additional background information supporting the correct rounding (and significant digits) of values in an equation

NIST SP 811-Guide for the Use of the International System of Units (SI), Barry N. Taylor and Ambler Thompson (2008)

B.7.2 Rounding converted numerical values of quantities

The use of the factors given in Secs. B.8 and B.9 to convert values of quantities was demonstrated in Sec. B.3. In most cases the product of the unconverted numerical value and the factor will be a numerical value with a number of digits that exceeds the number of significant digits (see Sec. 7.9) of the unconverted numerical value. Proper conversion procedure requires rounding this converted numerical value to the number of significant digits that is consistent with the maximum possible rounding error of the unconverted numerical value.

Example: To express the value l = 36 ft in meters, use the factor 3.048 E−01 from Sec. B.8 or Sec. B.9 and write

$$l = 36 \text{ ft} \times 0.3048 \text{ m/ft} = 10.9728 \text{ m} = 11.0 \text{ m}.$$

Rounding guidelines found on the internet:

- In any math problem you should wait until the end to round; Only the final answer should be rounded. Carry as many significant digits as you can throughout the problem.

- Round Off Rule: Round only the final answer not the intermediate values that occur during the calculation. Carry at least twice as many decimal places as will be used in the final answer.
- Do the math, then round the answer so that the number of significant figures is equal to the least number of significant figures found in any one measurement in the equation.

During the 2010 WS meeting, WMD offered 3 recommendations to address the correct rounding of values during the calculation of net weight by a monorail scale as follows:

1) WMD requested that the WS consider adding language consistent with the rounding requirements in DES Section 12.3.2.3. to DES 42 to clarify that rounding is not performed until the last mathematical operation is completed. The WS agreed to recommend that Publication 14 Section 42 be amended to clarify rounding procedures for monorail scales.

2) WMD believes that that compliance with HB 44 paragraphs S.2.1.4 (Monorail Scales) and S.2.3.1. (Monorail Scales Equipped with Digital Indications) should be verified with documented and agreed upon test procedures. Thus, the NIST Technical advisor suggested that a small work group be formed that includes a member representing manufacturers of monorail scale digital indicating elements and a representative from GIPSA. The group may also want to address the appropriate method of calculating net weight using the digital indicator's internal or displayed resolution of the gross weight.

3) WMD suggested the WS submit or support a recommendation to the S&T Committee to amend Appendix A-Fundamental Considerations, Section 10. Rounding Off Numerical Values to state that intermediate values that occur during a calculation shall not be rounded. If intermediate values are to be rounded they should only be rounded so that the number of significant figures is equal to the least number of significant figures found in any one measurement or value in the equation.

Relative to WMD's 1st recommendation, the WS agreed to recommend that Publication 14 Section 42 be amended to clarify rounding procedures for monorail scales. At the 2011 NCWM Interim meeting, the NTEP Committee agreed to the WS's recommendation to amend Section 42 to reflect proper rounding procedures.

The WS agreed to take no action relative to WMD's 3rd recommendation because amended language for HB-44 had not been sufficiently developed.

Relative to WMD's 2nd recommendation, the WS agreed to form a small WG to develop test procedures for verifying correct rounding of net weight determinations on monorail scales. Steve Cook and Jim Truex agreed to contact holders of monorail NTEP CC's and request their involvement. The WS also agreed to consult with GIPSA will be on any recommendations proposed from the WG.

Discussion/Recommendation: Steve Cook or Jim Truex are asked to provide an update to the WS on progress made by the WG to develop test procedures for verifying correct rounding of net weight determinations on monorail scales relative to WMD's 2nd recommendation. The WS is to consider whether the language should be added to Appendix A-Fundamental Considerations, Section 10. Rounding Off Numerical Values stating that intermediate values that occur during a calculation shall not be rounded.

3. Acceptable Symbols/Abbreviations to Display the CC Number via a Device's User Interface.

Sources: 2009 NTETC Software Sector Agenda Item 3 and 2010 S&T Item 310-3 G-S.1. Identification. (Software)

2010 Final Report of the S&T Committee:
(http://www.nist.gov/pml/wmd/pubs/sp1115.cfm)
2010 Software Sector summary:
(http://ncwm.net/sites/default/files/meetings/software/2010/10_Software_Summary.pdf)
2011 Software Sector summary: (To be added)

Background: Local Weights and Measures inspectors need a means to determine whether equipment discovered in the field has been evaluated by NTEP. If so, the inspector needs to know at a minimum the CC number. From this starting point, other required information can be ascertained. HB 44 currently includes three options for marking of the CC:

1. Permanent marking
2. Continuous display
3. Recall using a special operation

Additional background information relative to this item can be found in 2011 NCWM Publication 16 at:
http://www.nist.gov/pml/wmd/pubs/upload/10-st-11-pub16-final.doc

During the 2010 WS Meeting, the WS reviewed an initial list of menu text and icons developed by the Software Sector and provided comments to the Software Sector as requested.

At the 2011 NCWM Annual Meeting, WMD suggested that the S&T Committee consider changing the status of the item from Informational to Developing in order to provide the Software Sector (SS) additional time to more fully develop the item based on the following points:

1. The current proposal is not developed enough for consideration by the S&T. Based on the diversity of comments heard on this issue, WMD believes the item is not close to a vote and that considerable work still needs to be done to develop the item before it could be considered for vote by the NCWM.
2. WMD interprets the current proposal to require software be marked with a nonrepetitive serial number when in fact it is not the intent of the SS to require such marking. Thus, it is believed that the language in current proposal will need modification to resolve this issue.
3. The draft of the March 2011 Sector Summary reported that several SS members envision G-S.1. being developed further to the extent that G-S.1.1. may not be needed.

The S&T Committee agreed to change the status of this item to Developing because the item was lacking enough information for full consideration and a full proposal has yet to be developed.

Discussion/Recommendation: The NIST Technical Advisor recommends that the WS take no additional action pending further development of this item by the Software Sector and notes that at the 2011 NCWM Annual Meeting the Conference adopted the recommendation of the S&T Committee elected to change the status of the associated agenda item from Informational to Developing to provide the Software Sector additional opportunity to develop the item.

New Items

4. DES - Section 63.4. Out-of-Level Tests (if applicable)

Source: Edward A. Payne Jr. / Maryland NTEP lab

Background: Maryland Weights and Measures reports that the NTEP labs have to verify the sensitivity of the level indicator on a scale that's been submitted for type evaluation under NTEP's Mutual Recognition Agreement (MRA) with Measurement Canada (MC). An MRA is an agreement whereby the test data from evaluation in either a NTEP authorized laboratory or Measurement Canada can be used by both countries in the issuance of their respective certifications. Since testing is already being performed by the NTEP labs on devices submitted under the MRA, Maryland is recommending that testing the sensitivity of a level indicator be expanded to include all portable scales, so equipped, that are submitted to NTEP for evaluation.

Recommendation: Amend Publication 14 test criteria in DES Section 63.4 to be equivalent Measurement Canada's test criteria and incorporate it into Section 63.4 of the DES. MC's current test criteria for verifying acceptable sensitivity of a scale's level indicating means is as follows:

Current MC test requirements:

MRA. LG-3.05 SUITABILITY OF THE LEVEL INDICATOR

Off Level: -X direction

REFERENCE

Sections 9, 10, 11 and 22 of the Non Automatic Weighing Devices Specifications

APPLICATION

This test is intended for complete portable or movable devices and weighing elements whose performance is affected when off level. Such devices must be equipped with a suitable level indicating means. This test is to ensure that the level indicating means is sensitive enough to accurately indicate the limit of inclination at which the device ceases to perform within tolerances.SETTINGS

- The AZT may be activated. It must be set so that the weight value that can be tracked at once does not exceed 0.6 e.
- If the IZSM range of the device does not exceed 20% of Max, the test will be performed with the IZSM set at the maximum of the range.
- If the IZSM range exceed 20% of Max, the test will be performed twice: the first test with the IZSM set to the lowest possible value; the second test with the IZSM set to the to the maximum of its range.

  NOTE: In the case of a multi-range device, it is 20% of Max of the lowest range; in the case of a multiinterval device, it is 20% of max of the first range.
- The device must be leveled using the level indicating means, and adjusted to as close to zero error as possible.
- If the device has an "enhance" resolution feature, perform the test with that feature activated; or use the small weight method to determine errors before rounding.
- This test is performed at ambient temperature only.

PROCEDURE

1. Incline the DUT in one direction (arbitrary referred to as -x) up to the point of limit where the level indicating means still indicates a level condition or at least 2/1 000 (0.12 degree) whichever is greater.

   LG-3.05 SUITABILITY OF THE LEVEL INDICATOR

   Off Level: X direction

   Off Level: Y direction

   Off Level: -Y direction

2. Set the device to zero if necessary; perform an increasing and decreasing load test. If necessary, use the small weight method to find errors before rounding. Record the results.
3. Record the angle with reference to the horizontal
4. Repeat the test described above for the other three inclinations (+x, -y, +y) (See the following illustrations).

INTERPRETATION OF RESULTS

The device meets the requirements if, at the limits of inclination in all four directions, it performs within applicable limits of error.

Proposed changes to Pub 14 DES Section 56

56 Level-Indicating Means - Portable Scales

Code Reference: S.2.4.

Portable wheel-load weighers and portable axle-load scales intended for law enforcement must weigh

accurately when placed out-of-level by 5%.*

A portable scale which is intended to be moved must either be equipped with a readily observable level-indicating means (typically a bubble level) or the scale must still weigh accurately when placed out-of-level by 5%.* Weighing accurately means that the results must be within acceptance tolerance.

The level-indicating means shall be rigidly mounted, located where it will be protected from damage but still be easily read in normal use, mounted so that its reference point for level will not change when pressure is applied to the level-indicator, and sensitive enough to indicate an out-of-tolerance condition that might affect the accuracy of the scale. A bubble level mounted on a swing-out bracket is not adequate. Portable floor scales (generally with capacities of more than 500 lb) shall have the level-indicating means visible without removing any scale parts.

**Note: 5% refers to 5% rise over run.*

Test Conditions:

- The AZT may be activated. It must be set so that the weight value that can be tracked at once does not exceed 0.5 e.
- If the IZSM range of the device does not exceed 20% of Max, the test will be performed with the IZSM set at the maximum of the range.
- If the IZSM range exceed 20% of Max, the test will be performed twice: the first test with the IZSM set to the lowest possible value; the second test with the IZSM set to the to the maximum of its range.

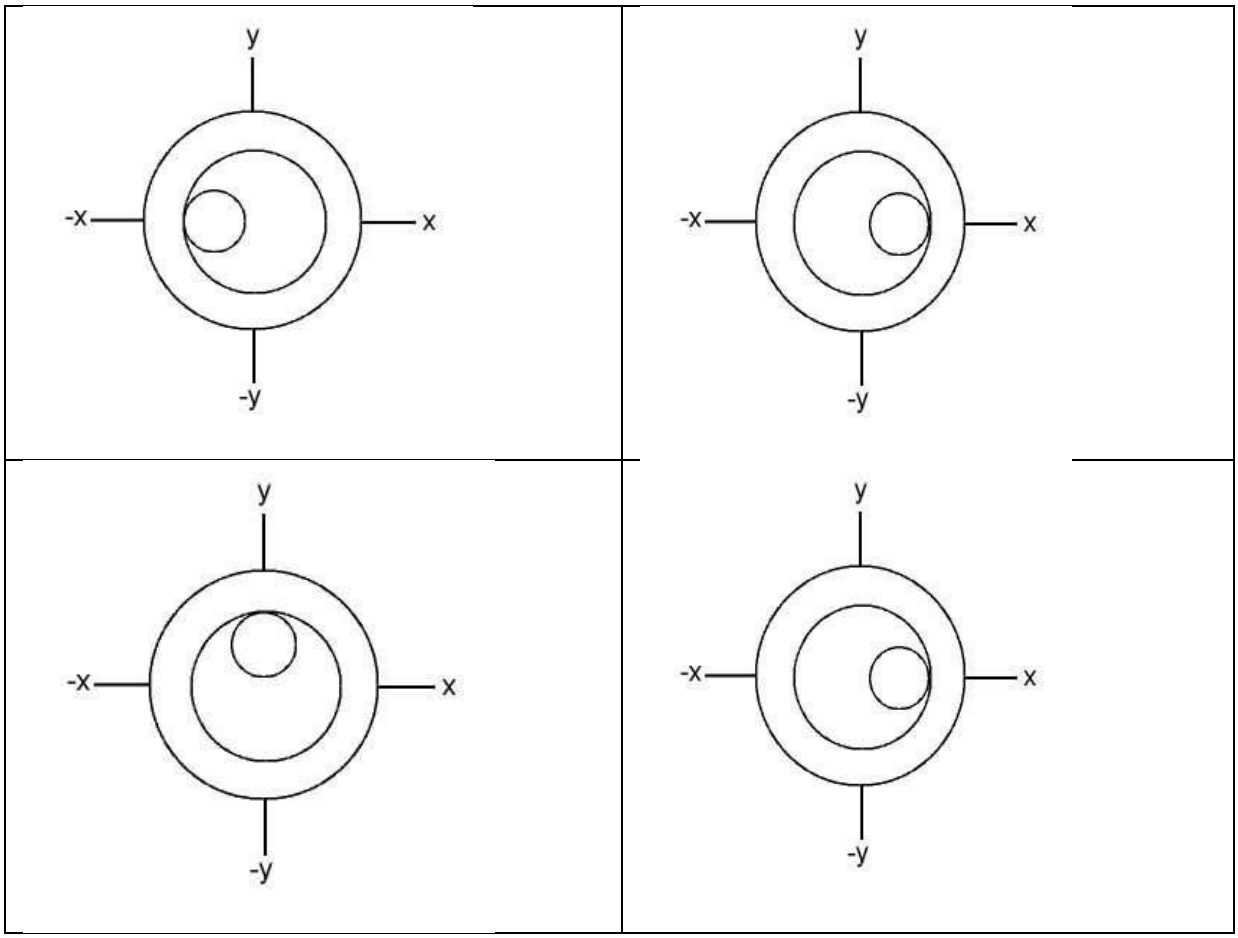
NOTE: In the case of a multi-range device, it is 20% of Max of the lowest range; in the case of a multiinterval device, it is 20% of max of the first weighing segment.

- The device must be leveled using the level indicating means, and adjusted to as close to zero error as possible.
- If the device has an "enhance/expanded" resolution feature, perform the test with that feature activated; or use the small weight method to determine errors before rounding.
- This test is performed at ambient temperature only.

56.1	Scales (other than wheel-load weighers and portable axle-load scales) must meet one of the following conditions:	
	56.1.1 The device is equipped with a level indicator as standard equipment? OR	☐ Yes ☐ No ☐ N/A
	56.1.2 The device complies with the provisions of S.2.4. The test procedure is given in "Performance Tests for Digital Counter (Bench) and Computing Scales."	☐ Yes ☐ No ☐ N/A
56.2	If the scale is equipped with a level-indicating means, it must be readily observable without mechanical disassembly that requires the use of tools. A bubble level placed under the scale platform of a portable floor scale mounted on wheels is not practical for the user of the scale.	☐ Yes ☐ No ☐ N/A
56.3	The level-indicating means is rigidly mounted, easily read, protected from damage, will not change its reference for level~~, and sufficiently sensitive~~.	☐ Yes ☐ No ☐ N/A
56.4	The level-indicating means is sufficiently sensitive.	☐ Yes ☐ No ☐ N/A
	56.4.1 Incline the DUT in one direction (arbitrary referred to as -x) up to the point of limit where the level indicating means still indicates a level condition or at least 2/1 000 (0.12 degree) whichever is greater.	

	56.4.2 Set the device to zero if necessary; perform an increasing and decreasing load test. If necessary, use the small weight method to find errors before rounding. Record the results.	
	56.4.3 Record the angle with reference to the horizontal. _____	
	56.4.4 Repeat the test described above for the other three inclinations (+x, -y, +y) (See the following illustrations).	
56.5	Wheel-load weighing and axle-load scales must weigh accurately when placed out-of-level by 5%.*	☐ Yes ☐ No ☐ N/A

Position of the Bubble Indicator:



5. Section 31 - Multi-Interval Scales

Source: Scott Davidson / Mettler-Toledo Inc.

Background: Mettler-Toledo has discovered a discrepancy in DES Section 31 relative to the maximum permissible tare value that can be taken on a multi-interval scale. There is 2 pair of sentences in this section that seem to contradict each other in regards to the maximum allowed tare value. Those sentences are as follows (and highlighted in the Section 31 excerpt pasted below):

Sentence 1: All tares must be taken in the minimum increment. Therefore, the maximum tare allowed is the maximum capacity of the smallest weighing segment.

Sentence 2: For multi-interval instruments, all tares, except for semi-automatic tare, must be taken in the minimum increment. Therefore, the maximum tare allowed is the maximum capacity of the smallest weighing range.

31. Multi-Interval Scales

A multi-interval scale is an instrument having one weighing range (W that is divided into partial weighing ranges (segments.) Each weighing range (segment) is defined by its division size, its minimum capacity, and its maximum capacity. The selection of the appropriate weighing range (segment) is determined automatically according to the load applied, both on increasing and decreasing loads. The shift test shall be conducted at 30% to 35% the capacity of the scale. Corner tests, if appropriate, shall be run at one-quarter of the scale capacity. The number of scale divisions, n, for each weighing range (segment) is determined by dividing the maximum capacity of the weighing range (segment) by e of the same weighing range (segment.) In the case of multi-interval scales, e must be equal to d. *See NIST Handbook 44 Scales section S.5.3.*

Example:

Minimum Capacity	Maximum Capacity	e	n	
0 kg	3 kg	1 g	3000	(3000/1)
3 kg	6 kg	2 g	3000	(6000/2)
6 kg	15 kg	5 g	3000	(15000/5)

The number of divisions for each weighing range (segment) must meet Table 3 of the Scales Code. The capacity and verification scale division must be conspicuously marked near the weight display.

Since weighing ranges (segments) on a multi-interval scale may not overlap, the capacity statement for each weighing range (segment) and the weight in the weight display (assuming that the scale indicates only gross weight) is a sufficient indication of the weighing range (segment) in use.

A multi-interval scale shall operate as follows:

- The motion detection requirement must be satisfied for each scale division. *See S.2.1.2.*
- The division size for the first weighing segment applies to the tests to determine the width of zero and the amount of the automatic zero setting mechanism.

The scale division must change when a lower weighing segment reaches its maximum value so that rounding occurs properly and the number of displayed decimal places does not change within the same weight indication.

Example: Suppose a scale has the following weighing ranges (segments.)

Capacity: 0 – 10 lb x 0.005 lb

10 – 30 lb x 0.01 lb

The scale indication for a 10-lb load must be 10.00 lb, not 10.000 lb: once the scale has exceeded an internal weight indication of 9.99975 lb, it must round to the next higher weight indication. If 10.000 lb were to be indicated, a load perceived internally as 10.003 lb would result in the scale indicating in some manner that it is no longer sensing 10.000 lb +/- 0.0025 lb, hence would then indicate 10.00 lb. This round-off problem is avoided by causing the scale to indicate 10.00 when sensing a load in excess of 9.9975 lb (based upon its internal resolution.) The scale will continue to indicate 10.00 lb until its internal resolution senses a load in excess of 10.005 lb, whereupon the weight display will update to 10.01 lb.

There are several considerations regarding the proper operation of tare on multi-interval scales.

- All tares must be taken in the minimum increment. Therefore, the maximum tare allowed is the maximum capacity of the smallest weighing segment.
- Whenever gross and tare weights fall in different weighing segments, (hence the scale divisions for the gross and tare weights differ), the net weight must be in mathematical agreement with the gross and tare weights that are indicated and recorded, (e.g., net = gross – tare.)
- Scales that display or record only net weight values (e.g., most computing scales) may semi-automatically (pushbutton) take tare values to either the internal resolution or the displayed scale division.
- Manually entered keyboard, thumb-wheel, and digital tare values must be entered to the displayed scale division.

In applying these principles, it is acceptable to:

- Round the indicated and printed tare values to the nearest appropriate net weight scale division. **OR**
- Display net weight values in scale divisions other than the scale division used in the display of gross weight, as when the gross and tare weights are in different ranges of the device. For example, a scale indicating in 2-lb divisions in the lower range and 5-lb divisions in the next higher range may result in net values ending in three or eight in the higher range. For example, a multi-interval scale may indicate and record tare weights in a lower weighing segment (WS) and net weights in the higher weighing segment as follows:

55 kg	Gross Weight (WS2 d = 5kg)	10.05 lb	Gross Weight (WS2 d = 0.05 lb)
-4 kg	Tare Weight (WSR1 d = 2 kg)	-0.06 lb	Tare Weight (WS1 d = 0.02 lb)
= 51 kg	The Mathematically Correct Net Weight	= 9.99 lb	The Mathematically Correct Net Weight

In every case, it is required to maintain the mathematically correct equation: net = gross – tare

For multi-interval instruments, all tares, except for semi-automatic tare, must be taken in the minimum increment. Therefore, the maximum tare allowed is the maximum capacity of the smallest weighing range.

Semi-automatic tare may be taken to the internal resolution of the scale and any indications or recorded representations of tare shall be rounded to the nearest verification scale division.

Recommendation: The intent of the requirement is to limit the tare value of all tare types except semi-automatic tare (i.e., push-button tare) to the maximum capacity of the first weighing segment of the device. Thus, to correct the discrepancy, delete the second sentence and replace the first sentence with the following sentence:

"Except for semi-automatic tare, all tare values shall not exceed the maximum capacity of the first weighing element (i.e., Max1)."

This change harmonizes the NTEP requirement with that of OIML R76 and Measurement Canada. The following pertinent clauses were copied from those documentary standards:

OIML R76-1 Edition 2006 Section 4.7.1:

"For a multi-interval instrument, the preset tare value shall be rounded to the smallest verification scale interval, e1, of the instrument, and the maximum preset tare value shall not be greater than Max1."

Measurement Canada Laboratory Manual Section 22.1.5:

"The maximum tare value that may be entered shall not exceed Max1." (Our understanding of the use of

the word "entered" in their sentence is describing the entery of a numeric value which would not exceed Max1 and all other tares could be taken to the maximum capacity of the device.)

6. DES Section 70 - Performance and Permanence Tests for Railway Track Scales Used to Weigh In-Motion

Source: Mr. Ed Luthy / Stock Equipment Company, Inc.

Background: Stock Equipment Company reports that they intend to offer for sale in the U.S. a commercial application weigh-in-motion railway track scale designed to accurately weigh railway track cars (i.e., within HB 44 tolerances) using new technology that utilizes continuous rails (no "rail gaps") on the approaches and weighing areas of the scale. They are currently unable to offer this device for sale in the U.S. in commercial applications because current NTEP type evaluation criteria and HB 44 requirements are written in such a way that makes it impossible for devices incorporating this new technology to comply. For example, HB 44 Scales Code paragraph UR.2.4. Foundations, Supports, and Clearance requires clearance be provided around all live parts to the extent that no contacts may result. DES Section 70, Inspect the Scale, Item 4 Rail Gaps states that "the rail gaps should be set at 3/8 inch." The *AAR Scale Handbook* includes language that allows 1/8 inch to 5/8 inch rail gaps. Stock Equipment notes that there is no clearance, nor are there any rail gaps in a continuous rail. Thus, existing requirements are preventing the marketing and sale of equipment utilizing new technology in commercial applications despite the fact that the equipment complies with current accuracy requirements when installed and used in accordance with the manufactures instructions.

Recommendation: Review NIST HB 44 requirements and Pub 14 type evaluation criteria that apply to rail gap clearance relative to WIM railway track scale installations and consider amending those requirements to eliminate existing barriers that are hindering the use of new technology. The NIST Technical Advisor notes that other requirements may need to be addressed by the manufacturer of this equipment to enable this equipment to be submitted to NTEP and ultimately be installed and used in commercial applications. The WS may want to consider reviewing other existing type evaluation criteria applicable to WIM Railway Track Scales and provide guidance to the submitter in other areas of concern.

To address the issue of clearance, the NIST Technical Advisor offers the following amendments/additions to HB 44 Scales Code paragraph UR.2.4. and Pub 14 Section 70 for WS consideration, comments, and recommendations:

NIST Handbook 44 Scales Code:

UR.2.4. Foundation, Supports, and Clearance. ~~The foundation and supports of any scale installed in a fixed location shall be such as to provide strength, rigidity, and permanence of all components, and clearance shall be provided around all live parts to the extent that no contacts may result when the load-receiving element is empty, nor throughout the weighing range of the scale. **On vehicle and livestock scales, the clearance between the load-receiving elements and the coping at the bottom edge of the platform shall be greater than at the top edge of the platform.*~~
~~*[*Nonretroactive as of January 1, 1973]*~~

UR.2.4.1. General. - Except for railway track scales that incorporate a continuous rail design (no rail gaps), the foundation and supports of any scale installed in a fixed location shall be such as to provide strength, rigidity, and permanence of all components, and clearance shall be provided around all live parts to the extent that no contacts may result when the load-receiving element is empty, nor throughout the weighing range of the scale. **On vehicle and livestock scales, the clearance between the load-receiving elements and the coping at the bottom edge of the platform shall be greater than at the top edge of the platform.*
*[*Nonretroactive as of January 1, 1973]*

UR.2.4.2. Railway Track Scales That Incorporate a Continuous Rail Design. Railway track scales that incorporate a continuous rail design (no rail gaps) shall be installed such that:

(a) Clearance shall be provided around all live parts to the extent that no other contacts with the live part of the scale may result when the weighing area element is empty, nor throughout the weighing range of the scale,

(b) The rail that introduces the rail cars to the weighing area and that carries away the rail cars away from the weighing area shall be maintained according to the manufacturer's recommendations, and

(c) The scale area shall be marked or identified with contrasting colors, or other suitable means shall be used to distinguish the weighing area from the area that carries rail cars away from the weighing area.

(Added 20XX)

Pub 14 DES Section 70 Inspect the Scale, Item 4

4. **Rail Gaps:**

   Except for railway track scales that incorporate a continuous rail design (no rail gaps) the rail gaps should be set at 3/8 inch. *AAR Scale Handbook* says from 1/8 inch to 5/8 inch is allowable. A closed rail gap will have a significant effect on the weight while a large rail gap will take its toll on the rail, load cells, and grout.

7. DES Section 57 - Device Tolerances

Source: **Paul Lewis, Rice Lake Weighing Systems**

Background/Discussion: Rice Lake Weighing Systems has identified a possible error in the acceptance tolerance example of tolerance for separable elements in DES Section 57. Device Tolerances. Rice Lake Weighing states that the tolerance for separable indicators and weighing element for devices with more than 4000 graduations is currently listed as 1 e. In the example for Class III elements with more than 4000 divisions, the tolerance listed is 2.5 divisions; the truncated division should for "2 e" when error weights are not being used and the scale cannot be put into an expanded mode. If the tolerance is rounded down the allowable error would be 2 not 1 as shown in the following table.

Example:

Test Indication In Divisions	Tolerance
0 – 500	0
501 – 2 000	0
2 001 – 4 000	1
4 001 – 10 000	~~±~~ 2

Steve Cook, NIST, notes that the referenced language and tables have been in Pub 14 since 1994. Mr. Cook also notes that HB 44 paragraph T.N.3.5. Separate Main Elements, Load Transmitting Elements, Indicating Elements, Etc. applies a 0.7 times the applicable tolerance for separable main elements and including elements. Rice Lake Weighing may be misinterpreting the language in Pub 14 by applying the full acceptance tolerances (1.0 factor) before truncating instead of applying the 0.7 factor to the acceptance tolerance before truncating. To reduce the possibility of future misinterpretations of the language, Mr. Cook asks the WS to review the following proposal to amend DES Section 57 by including applicable HB 44 code references, amending the Acceptance Tolerance Table to include tolerance for both complete devices and main elements, and deleting the "Example" table as follows.

57. Device Tolerances:

Code References: G-T. 1. (e), T.N.3.2., T.N.3.5., and Table 6.

The acceptance tolerances for complete scales are shown below and apply to complete devices and separable main elements during type evaluation.

Acceptance Tolerances (All values in this table are in scale divisions)				
Tolerance in scale divisions				
Complete devices	0.5	1.0	1.5	2.5
Separable main elements[1]	0.35	0.7	1.05	1.75
Separable Indicators w/o Expanded Resolution	0	0	1	1
Class	Test Load			
I	0 - 50 000	50 001 - 200 000	200 0001 +	
II	0 - 5 000	5 001 - 20 000	20 0001 +	
III	0 - 500	501 - 2 000	2 001 - 4 000	4 001 +
IIII	0 - 50	51 - 200	201 - 400	401 +
III L	0 - 500	501 - 1 000	(Add 1/2d for each additional 500d or fraction thereof)	

Note 1. When main elements (indicating elements and weighing/load-receiving elements) are tested separately, the tolerance applied to all laboratory tests (influence factors and permanence tests) are 0.7 times the acceptance tolerance for complete scales.

It is strongly recommended that indicating elements submitted separately for evaluation have a test mode providing reading indications to 0.1e to provide adequate resolution to apply the tolerance (expanded resolution). If the indicator provides indications to only the maximum number of divisions requested for the Certificate of Conformance, the tolerance will be truncated to the number of divisions that can be indicated. The following tolerances will be applied to class III (and III/III L) indicators.

~~The following tolerances will be applied to class III (and III/III L) indicators.~~ *(Delete "Example" table in lieu of amending the "Acceptance Tolerance" table.*

8. DES Section 76 - Acceptable Abbreviations for Short Ton & Long Ton

Source: **Paul Lewis, Rice Lake Weighing Systems**

Background/Discussion: Rice Lake Weighing Systems is recommending adding "tn" as an acceptable abbreviation for a U.S. short ton to the current list of acceptable abbreviation of "Ton" or "TN." Rice Lake Weighing is also recommending that "ln" be added to the list of acceptable abbreviations for a long ton. Rice Lake Weighing added that the Canadian Lab Manual, Part 2, Section Appendix-2A in the table for abbreviations and symbols accepted in Canada, metric ton is abbreviated by "t" and ton (short ton) is abbreviated by "tn."

9. DES Section D - Substitution of Load Cells

Source: **Paul Lewis, Rice Lake Weighing Systems**

Background/Discussion: Pub 15 Section D – Substitution of Load Cells paragraph states that metrologically equivalent load cells from the same or a different manufacturer may be substituted into a scale provided that the load cell to be substituted have a capacity that is not less than 85 percent of the capacity of the original cell. The current policy may exclude load cells from different manufacturers where the available capacities are not within 85% to 100" of the capacity of the original cell. Rice Lake Weighing states that in most load cell families, the next lower capacity cell may be less than 85% of the next larger load cell (assuming that the capacity of the original cell is not included in the load cell family of the different manufacturer). In most cases the percentage will be 80%, 75% or even 50%. If you were to look at a family of load cell the next smaller load might be 83% (300 lb to 250 lb), but in most cases the percentage is much less that the 85% allowed.

Rice Lake Weighing is recommending that the language in DES Section D paragraph 6 be amended to change the minimum capacity of the of load cell intended to be substituted in a scale from 85% to the "next lowest load cell in that family." Steve Cook, NIST, agrees that the differences between adjacent capacities in a manufacturer's load cell family are frequently lower than 85%. The following is from a Rice Lake Weighing load cell CC and demonstrates that the next lower capacity load cell is between 50% and 75% of the next higher capacity load cell. However, Mr. Cook adds that the intent of the original language is to help ensure the suitability of the replacement load cell, including parameters such as v_{min}. Mr. Cook also suggests that any change to the technical policy be supported by evaluating examples where a suitable capacity load cell is not available (e.g., original cell is in SI units and the potential replacement cell is in customary units).

Load Cell Parameters:

Capacity (lb)	n_{max}		
	Class III	Class III L	Class III
25	5 000	10 000	.003
50	5 000	10 000	.005
75	5 000	10 000	.007
100	5 000	10 000	.009
150	5 000	10 000	.015
200	5 000	10 000	.018
250	5 000	10 000	.030
300	5 000	10 000	.036
500	5 000	10 000	.060
750	5 000	10 000	.090
1000	5 000	10 000	.120
1500	5 000	10 000	.180
2000	5 000	10 000	.240
2500	5 000	10 000	.300
3000	5 000	10 000	.270
5000	5 000	10 000	.450
7500	5 000	10 000	.680
10 000	5 000	10 000	.900
15 000	5 000	10 000	1.35
20 000	5 000	10 000	1.80
25 000	5 000	10 000	2.25
30 000	5 000	10 000	2.70

Next Sector Meeting:

Appendix A - Attachments

Agenda Item 1.

10. Provision For Metrological Sealing of Adjustable Components or Audit Trail (2011 Pub14, page 27)

Code References: G-S.8.1. and S.1.11

Due to the ease of adjusting the accuracy of electronic scales, all scales (except for Class I scales) 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 device compliance with NIST 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 ~~see~~ *Appendix B for the Requirements for Metrological Audit Trails.*

The judgment of whether or not the method of access to an adjustment represents a "significant potential for fraud" and will normally require sealing for security will be made based upon the application of the *Philosophy for Sealing in Appendix A*.

Sealing - General

In addition to satisfying the physical security sealing requirement; the presents of a physical seal shall clearly indicate that the setup or configuration mode (any mode permitting access to any or all sealable parameters based upon the application of the *Philosophy for Sealing in Publication 14)* of the device can not be accessed without additional actions (e.g., removal of a jumper, pressing a key or switch, etc.) only possible after the removal of the seal.

If the use of a physical seal is the only approved method of sealing,; it shall not be possible to apply the physical seal with the device in the setup or configuration mode (any mode permitting access to any or all sealable parameters based upon the application of the *Philosophy for Sealing in Publication 14)* unless the device has a clear indication that the device is in this mode. See the list of acceptable and unacceptable indications below.

Technologist:		
Project number:		
Applicable for Devices Using a Physical Seal		
		Remarks:
Date		
Time		
Temp °C		
RH (%)		

Mechanism used to enter calibration / configuration				
Jumper	**Pushbutton (momentary switch)**	**Toggle / Slide Switch**	**Other (Describe in Remarks)**	**Meets requirements**
Yes☐ No ☐ N/A ☐	Yes☐ No ☐ N/A ☐	Yes☐ No ☐ N/A ☐	Yes☐ No ☐ N/A ☐	Yes☐ No ☐ N/A ☐

Mechanism effective upon exit of calibration / configuration in Approved Mode, when mechanism is properly set according to manufacturers specifications.				
Jumper	**Pushbutton (momentary switch)**	**Toggle / Slide Switch**	**Other (Describe in Remarks)**	**Meets requirements**
Yes☐ No ☐ N/A ☐	Yes☐ No ☐ N/A ☐	Yes☐ No ☐ N/A ☐	Yes☐ No ☐ N/A ☐	Yes☐ No ☐ N/A ☐

(**Note:** entering and exiting the calibration/configuration access mode shall be listed on the NTEP CC.)

Indications representing that the device is configured with the setup or configuration mode enabled (i.e., any mode permitting access to any or all sealable parameters) This list is not limiting or all-inclusive; other indications may be acceptable.	
Acceptable Clear Indications	**Indications NOT Acceptably Clear**
Unusable weight indications Example: **C100.05E**	**C 100.05 lb**
"not **HB 44**" annunciator	Any digit in the weight differentiated buy size, shape, or color
"CAL" annunciator (single or mixed case)	Weights w/o units Example. **100.05**
"Set-up" annunciator (single or mixed case)	Flashing weight value
"Config" annunciator (single or mixed case)	Weight with no annunciators displayed
	Weight all annunciators displayed

Audit Trails – General

10.1. Verify that… **(The remainder of Section 10 is unchanged.)**

Agenda Item 6.

42. Zero-Load and Tare Adjustment - Monorail Scales (2011 Pub 14 page 69)
Code References: S.2.1.4. and S.2.3.1.

Under the regulations of the Packers and Stockyards Administration, the rollers and hooks used on monorail scales within a facility are required to be nearly the same weight. Since monorail scales typically have scale divisions of 1 lb, a monorail scale must be capable of setting tare weights that are less than 5 percent of the scale capacity to a weight value less than the displayed scale division. This reduces the rounding error in the tare weight that would otherwise be present if the tare weight were rounded to the nearest displayed scale division.

42.1. Means must be provided for setting the zero-load balance and any tare value less than 5 percent of the scale capacity to within 0.02 percent of scale capacity. Yes ☐ No ☐ N/A ☐

42.2. For an in-motion system, the conditions above must be automatically maintained. Yes ☐ No ☐ N/A ☐

42.3. Rounding is not performed until the last mathematical operation to reduce the uncertainty of the net weight calculation. **Yes ☐ No ☐ N/A ☐**

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Appendix B - List of Attendees

National Conference on Weights and Measures / National Type Evaluation Program

Weighing Sector Final Attendee List

/Sacramento, California