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Comments Applicable to All Items Regarding Transfer Standards

- **All Items in Block 4**
- **Items LPG-4 and MFM-2**
- **All Items in Block 5 (B5: CLM-2, B5: CDM-2, B5: HGM-2 and B5: OTH-4)**

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1. Comments Applicable to All Items Regarding Transfer Standards

The Fundamental Considerations of Handbook 44 states the following:

> **3.2. Tolerances for Standards.** – Except for work of relatively high precision, it is recommended that the accuracy of standards used in testing commercial weighing and measuring equipment be established and maintained so that the use of corrections is not necessary. When the standard is used without correction, its combined error and uncertainty must be less than one-third of the applicable device tolerance.

This is often referred to as the one-third requirement, which means that any standard used without correction (or when the correction is used) and the uncertainty associated with the value of the standard, may be used as a (field) standard to test commercial weighing and measuring devices. However, it is not enough for a standard to be valid in a laboratory setting; the standard must be valid and stable when used in the field.

When testing commercial liquid measuring devices, any proposed standard must be accurate, valid and stable over the range of operating parameters and environmental conditions over which the commercial device is used and tested. For example, to test a liquid meter, the standard must be accurate over the range of field conditions that include:

- The range of flow rates at which the meter operates;
- The range of air temperatures
- The range of product temperatures;
- The range of temperature differences that may exist between the product, the standard and the air;
- The range of pressures at which the pumping systems operate;
- The different products measured by the meters; and
- Tests of multiple "standards" of the same type when used in different test system configurations (and "standards" of different sizes, if available) to verify that the results agree and are consistent.

Weights and measures officials must be confident that their test results are valid and that the standards that they use provide correct test results. The proposals to recognize additional transfer standards and field standards, and the proposals to change the references from transfer standards to field standards do not provide any explanation or justification for how these transfer standards

or field standards satisfy the one-third requirement over the range of operating parameters and environmental conditions in which meters are used and tested. **How are weights and measures officials going to determine or verify if proposed transfer standards and proposed field standards meet the one-third requirement? How do you know which ones are acceptable? How are weights and measures officials going to testify in court that the standards that they used and relied upon were accurate, especially when no data or justification exists to recognize the standards?**

2. All Items in Block 4

Position: These items should be made developing, because a great deal of study and discussion are needed to assess the ramifications of these proposed changes. Additionally, the criteria must be developed and specified to provide a uniform basis on which to evaluate the performance of transfer standards that would now be considered field standards under the OWM proposals.

Discussion: The proposals appear to eliminate the use of transfer standards, which have larger tolerances for commercial devices in contrast to when field standards are used. The elimination of transfer standards may greatly limit the options available to regulatory officials to test some commercial weighing and measuring devices.

Handbook 44, OIML R76 and OIML R117 have the basic principle that the same tolerances apply to all types of weighing and measuring devices used in the same applications regardless of the measurement technology that is used in the measuring devices.

Tolerances in Handbook 44 are established based on (1) the accuracy that is needed for each application and (2) the accuracy that can be achieved as a practical matter based upon the performance capabilities of the measurement technologies of the commercial devices, the standards that are available and the test methods that can be used. Transfer standards are typically recognized for use in situations where the test procedures are difficult, cumbersome and time consuming when field standards are used to achieve the desired accuracy in field tests. However, OWM correctly raises the issue that when transfer standards are used, along with the larger tolerances that apply, consumers and device owners probably do not realize that the commercial devices tested with transfer standards may not as accurate as other devices that were tested using field standards. One should now ask, if larger tolerances are permitted when transfer standards are used, then shouldn't the larger tolerances also be acceptable when field standards are used? Which tolerances are good enough for commercial measurement?

Another set of concerns exists regarding how to determine the performance characteristics of transfer standards at an acceptable level of confidence? The following list illustrates some of these concerns.

1. Is it the intent of OWM to require all "transfer standards" mentioned in the codes to be considered "field standards" and have to meet the one-third requirement for performance?
2. Does OWM intend to develop a 105 handbook for each of the transfer standards currently identified in Handbook 44?
3. It is assumed that any standard that is covered by a 105 handbook also meets and can prove that it satisfies the one-third performance requirement stated in the Fundamental Considerations of Handbook 44. There are major differences between the assessment of

an artifact as a field standard and assessing the performance of a weighing or measuring device (or test system) as a field standard.

4. The definition of field standard in Handbook 130 specifies that a field standard is a physical standard. I interpret this to mean that the standard is an artifact and not a weighing or measuring system. How do weights and measures officials interpret the definition?
5. The definition of field standard in Handbook 130 specifies that a field standard can be another suitable and designated standard that does not rely upon a NIST 105 handbook. I assume that this allows for the recognition of standards that comply with documentary standards from ASTM, ISO, OIML, etc. When weighing or measuring systems are proposed as field standards under these other documentary standards, is it safe to presume that the performance of the proposed standard has been evaluated to the one-third requirement of Handbook 44?
6. Will the proposed OWM changes effectively eliminate the use of those transfer standards currently recognized in Handbook 44 codes? I assume that the answer is yes, unless the transfer standard can prove its performance within the one-third requirement of Handbook 44.
7. How long does a field standard have to a valid reference; an hour, one day, one week or one year? Over which range of field parameters must the proposed field standard prove that it performs within the one-third requirement?
8. Which tests must be run, which data are needed and which analyses must be performed to demonstrate the acceptable performance of proposed field standards with respect to accuracy, repeatability and the effect of influence factors?
9. Commercial measuring devices must be tested as used in the field. If the commercial measuring devices are not tested as installed and used, then how do you know that the commercial measuring devices are accurate as used?

The following examples of transfer standards are provided to illustrate range of measurement issues associated with transfer standards.

Farm Milk Tank Code

Master meters are permitted to be used to the check the accuracy of the calibration chart of the milk tank, but specific verification procedures are required[1], since the master meters are not considered to be as accurate as field standards. Larger tolerances for milk tanks are specified when tested with master meters. "**N.5. Test Methods.** – Acceptance tests of milk tanks may be of either the prover method or the master meter method provided that the master metering system is capable of operating within 25 % of the applicable tolerance found in T.3. Basic Tolerance Values." This better performance is required for acceptance tests to maintain the minimum accuracy deemed acceptable for the commercial measurement process for milk tanks.

[1] **N.5.1. Verification of Master Metering Systems.** – A master metering system used to gauge a milk tank shall be verified before and after the gauging process. A master metering system used to calibrate a milk tank shall be verified before starting the calibration and re-verified at least every quarter of the tank capacity, or every 2000 L (500 gal), whichever is greater. The above process of re-verifying the master metering system may be waived if the system is verified using a NIST traceable prover with a minimum of two tests immediately before and one test immediately after the gauging process and that each test result is within 25 % of T.3. Basic Tolerance Values.

Odometers and Taximeters Codes

These two codes allow the use of a fifth wheel to determine the accuracy for distance measurement. However, in the definition the fifth wheel is identified as a transfer standard. NBS Handbook 137 explains why the fifth wheel is a transfer standard.

NBS Handbook 137, "Examination of Distance Measuring Devices," Issued December 1980

> **3.3. FIFTH-WHEEL TEST EQUIPMENT.** - The fifth wheel is a commercially-available distance-measuring device recommended for use by weights and measures officials as a field transfer standard for testing the accuracy of taximeters and odometers on rented vehicles. The instrument is an accurate distance-measuring device (its error is less than 10% of the smallest applicable tolerance (1%)). However, it requires calibration at periodic intervals to maintain its accuracy. A calibrated fifth wheel may also be used to layout a taximeter or odometer measured course.

The reasons why a fifth wheel requires frequent calibration are not given. The need for frequent calibration raises the issue of how long a standard must be stable to be considered appropriate as a field standard. This issue must be addressed along with the range of parameters over which the field standard must be accurate and stable.

Belt-Conveyor Scales Code

Although OWM does not propose any changes to the Belt-Conveyor Scales Code regarding transfer standards, the code contains several issues that illustrate issues related to transfer standards that should also be addressed. For example, is the material for the material test a transfer standard or must the material meet the one-third requirement for field standards? This is virtually impossible, so what methods would be acceptable to test belt-conveyor scales?

Is the material used in the material test a transfer standard? The material must be weighed on a reference scale to an accuracy of 0.1 %. Is the reference scale a field standard? Considering the limitations associated with testing railroad scales to the loaded capacity of railroad cars, can one assess the accuracy and uncertainty associated with the reference scale? The reference scale should be within a 24-hour period of transport from the belt-conveyor scale under test. Furthermore, care must be taken to ensure that material is not lost during transport due to leaks in the cars or due to wind. How are these assessments made?

Finally, the maintenance and acceptance tolerances of ±0.25 % for belt-conveyor scales are specified as **relative to the weight of the material.** The accuracy of a belt-conveyor scale is actually a scale-to-scale evaluation. The footnote associated with T.1. states that:

> "The variables and uncertainties included in the relative tolerance represent only part of the variables that affect the accuracy of the material weighed on belt-conveyor scales. If this tolerance was based on an error analysis beginning with mass standards through all of the test processes and following the principle expressed in Section 3.2. of the Fundamental Considerations in Appendix A, the tolerance would be 0.5 %."

3. Items LPG-4 and MFM-2

Position: These items should remain developing. Over the last several years, the proposal modified the sizes of the test drafts from two minutes to one minute without any explanation for the changes. The sizes of the test drafts conflict with the proposals contained in items New-25 and New-25. Again, no explanations or justifications are given for the sizes of the test drafts.

> **Proposed Addition of N.3.2.:** A major issue has been brought to our attention regarding the proposed addition of N.3.2. in the LPG and Anhydrous Ammonia Meter Code and the Mass Flow Meters Code. The text in the proposed N.3.2. reduces the size of the test draft for deliveries below the maximum flow rate to be only one minute of flow at the flow rate at which the tests are conducted. This is a major change to the test procedure and the performance of the proposed meters as standards must be evaluated and proven over the range of field conditions in which meters are used and tested.

Discussion: Items LPG-4 and MFM-2 use the term "transfer standard" in the effort to recognize master meters as "transfer standards," but the proposals do not include any expansion of the tolerances to recognize the variability (e.g., standard deviation) in the performance of the master meters. Consequently, the master meters are being proposed as field standards with the claim that they meet the "one-third" requirement of section 3.2. of the Fundamental Considerations. However, no data over the range of meter operating conditions and field environmental conditions has been provided to ensure weights and measures officials that the master meters comply with the "one-third" requirement. Until this is done, a master meter should not be used as a field standard.

The Office of Weights and Measures established a National Work Group on Alternative Test Methods. One objective of the Work Group is to identify the variables and parameters over which a proposed alternate standard must be tested and evaluated "to ensure that the methodologies and standards facilitate measurements that have metrological traceability." The Work Group will review a draft Handbook 105 for master meters to determine the tests and data needed to ensure that master meters demonstrate that they may be used as field standards.

Weights and measures officials must be confident that their test results are accurate, repeatable and truly reflect the accuracy of the meters that they test.

- Weights and measures officials must be able to prove that the results they obtain when testing commercial measuring devices are valid and legally defendable.

- Any field standard, for which the corrections and uncertainty meet the one-third requirement, may be used to test meters used in commercial measurement. However, data must be provided that prove that the proposed field standard (also called a transfer standard) meets the one-third requirement.

- Before a transfer standard may be used as a field standard, the manufacturer must prove that the transfer standard is accurate and repeatable over the range of products, flow rates, pressures, temperatures, other environmental conditions, and operating conditions over which meters are used. Transfer standards must also prove that they perform within the one-third requirement during the time between laboratory calibrations. No data or

explanations have been provided to demonstrate that the proposed transfer standards meet the one-third accuracy requirement.

- The types of meters to be used as transfer standards are not defined or identified. **How do you know which ones are acceptable?**

- No laboratory calibration procedures are specified for the transfer standards. The laboratory calibration procedures must reflect the accuracy of the transfer standard over the range of flow rates when the transfer standard is used to test meters.

Proposed Addition of N.3.2.:

In the 2017 S&T report, the submitter of these proposals stated the following:

> In some applications, transfer standard meters are not more accurate than the meters used in the dispenser. For that reason, longer test drafts and possibly more tests need to be run.

However, the text of the proposed N.3.2. would allow smaller test drafts than those currently required in the codes. The current codes require test drafts equal to deliveries of at least one minute of flow at the normal discharge rate. A review of a few NTEP Certificates of Conformance reveal that the minimum flow rates for some LPG meters are in the range of 2.5 to 12 gallons per minute. For an LPG meter with an acceptance tolerance of 0.6% at normal flow rates, the "transfer standard meter" would have to be accurate to 0.2% or better. For the special tests (slow-flow tests), the "transfer standard meter" must be accurate to 0.33% or better. For small test drafts, the quantities of volume associated with these tolerances are very small. How are "standard meters" suddenly able to perform much better (for accuracy and repeatability) than the commercial meters when the submitter states that these "transfer standard meters" are not more accurate than the meters used in the dispensers?

These smaller sizes of test drafts should not be allowed. Until the manufacturers of these proposed "transfer standard meters" provide data to show that the proposed "transfer standard meters" can perform at these higher levels of accuracy and smaller uncertainties (and verified by one or more independent laboratories), these proposed changes should not be considered.

4. All Items in Block 6

Position: These items should be made developing. The proposal does not identify the meters are proposed to be "field reference standard meters." No data are provided to prove that the proposed "field reference standard meters" can perform within the one-third performance requirement for field standards. No proof is provided, so no action on these proposals is warranted at this time. The proposal specifies the sizes of the test drafts to be two minutes without any explanation for the size of the test drafts. The sizes of the test drafts conflict with the proposals contained in items LPG-4 and MFM-2. No explanations or justifications are given for the sizes of the test drafts.

The definition for "field standard reference meter" is vague and insufficient. The requirements for accuracy and repeatability are not defined, a 105-series handbook is not required or recognized, nor are test procedures or parameters specified over which accuracy and repeatability must be demonstrated. The definition also opens up the possibility for "field

standard reference meters" for use in all codes. Much more study and assessment of these proposals are required before these proposals can be properly considered.

Discussion: Criteria and test procedures are needed to establish the foundation on which the evaluation of proposed field standards can be performed on a sound and uniform basis. The Office of Weights and Measures established a National Work Group on Alternative Test Methods. One objective of the Work Group is to identify the variables and parameters over which a proposed alternate standard must be tested and evaluated "to ensure that the methodologies and standards facilitate measurements that have metrological traceability." The Work Group will review a draft Handbook 105 for master meters to determine the tests and data needed to ensure that master meters demonstrate that they may be used as field standards.

Until data is provided and evaluated that shows that the proposed field standards can perform at the level needed for a field standard, no action should be taken on these proposals.