NIST Handbook 105-1 REVISED! What Now?

PART II

Byline: Micheal Hicks and Val Miller

NIST Handbook 105-1, Specifications and Tolerances for Field Standard Weights was published in 2019 by NIST OWM and has been implemented across the nation for going on two years. Within the Legal Metrology community, there have been some questions and challenges to come up for discussion during this period. The purpose of this article is to provide some guidance to the Legal Metrology community regarding these questions and challenges to make all aware of the state of implementation of the standard.

The recurring questions and challenges include the following:

- The conformity assessment of Class F Echelon III weights is a challenge to the implementation of the standard. NIST Handbook 105-1 (2019) clearly states that no new Class F weights are to be accepted into service after January 1, 2020 for legal metrology applications. Only existing, prior to January 1, 2020, Class F field standards may continue to be used provided that they demonstrate mass stability, are properly maintained, and are correctly evaluated to the 1990 version of the Handbook 105-1. However, their suitability will still be limited to use as field standards for verification of NIST Handbook 44 weighing systems meeting the requirements of Classes III, IIIL, and IIII. If a customer purchases new Class F weights from a manufacturer and requests them to be calibrated for Legal-for-Trade applications, the Metrologist should reject the work request in accordance to NIST Handbook 105-1 (2019). "NIST" Class F no longer exists as part of the 2019 version of Handbook 105-1. NIST Handbook 105-1 (1990) has been withdrawn and is maintained and available solely as a reference document. The above does not apply to customers purchasing new Class F weights for non-Legal-for-Trade applications. It will be up to the laboratory and the local policies as to whether the laboratory should provide service to a non-Legal-for-Trade customer with new Class F weights. If a laboratory provides service to a customer pursuing non-Legal-for-Trade applications, it is recommended for the following statement (or something similar) to be provided VISIBLY on the calibration certificate: "The weights included on this Calibration Certificate, labeled as Class F, do not comply with current regulatory requirements and may not be used within the state of ____ for legal calibration and testing of commercial weighing devices." The calibration of new Class F weights will have to be tracked with care to ensure they do not get mixed in with the prior to January 1, 2020 Class F weights acceptable for commercial Weights and Measures applications.

- The conformity assessment of ASTM E617 (2018) Class 6 and Class 7 weights is another challenge. These two classes have different listed maximum permissible errors (or tolerances) but their material specification is the same. The ASTM E617 standard does a poor job of prescribing the material requirements of Class 6 and Class 7 weight standards. It clearly specifies the material requirements for cylindrical weights less than 100 g and all weight types above 5 kg, but it omits requirements for non-cylindrical weights less than 100 g or nominal weights between 100 g and 5 kg. Therefore, for these two classes, it permits the manufacturing of small (less than 100 g) non-cylindrical weights made of material of lower hardness and/or resistance to corrosion than steel. The same goes for weight types between the nominals of 100 g and 5 kg. This is an issue and is not the true intent of the standard. OWM will work with the ASTM E41 committee to update the E617 standard to have, at minimum, ASTM Class 6 reflect the characteristics of the former Class F weights since Class 6 currently closely resembles the specifications of Class F (i.e., conforming with the 1990 version of Handbook 105-1 material limitations).

- In addition, NIST OWM is working to update the ASTM E617 (2018) Class 6 tolerances to match Class F (i.e., 1990 Handbook 105-1). This is being done due to the current ASTM Class 6 not listing maximum permissible error (or tolerance) values for small weight nominals. The currently listed tolerances for ASTM Classes were derived from the historical Circular 547 standard of 1954. There are some inconsistencies found in these tolerances where no explanations were recorded nor can be offered by the legal metrology community (e.g., at nominals less than 1 oz, ASTM Class 5 tolerances are greater than ASTM Class 6). The proposal is to align the ASTM Class 6 tolerances closer to those of Class F over the full range and center ASTM Class 5 between the new ASTM Class 6 tolerances and current ASTM Class 4 tolerances, to make an

approximate 2:1 relationship. The approval vote of these changes is scheduled to go out for ballot after disputes and justification of the changes are resolved within the ASTM E41 committee. OWM hopes that the ballot will go out for vote soon. ASTM members are encouraged to place their vote once the ballot is released.

- NIST Handbook 105-1 (1990) directed Metrology laboratories to use lead as a filler/adjustment material for Class F weights:

  "6.2. The sealing cap shall be of soft, noncorrosive material so that it can easily be removed when adjusting a weight. Lead sealing caps are recommended for weights larger than 5 kg/10 lb. Aluminum is recommended for smaller weights. For weights above 50 kg/100 lb the sealing cap shall be at least 1/8 inch thick."

  7.1. Any metal in the form of shot or solid, may be used to adjust weights. Lead is preferred. Molten, poured metal is not acceptable. A grit size of 32 or larger is permitted for adjusting material."

  However, the ASTM E617 standard directs laboratories to adjust weights with the same material they are made of or with material as stable and of similar density as the base material (see section 5.8.2). Laboratories should consider using other filler material than lead or make sure the lead is not oxidizing and gaining weight at a quicker rate than the weight being adjusted, as was found to occur with lead of large grit size (i.e., the grit size of powder). Larger diameter shot are preferred because of the smaller ratio of surface area to mass that results.

- Laboratory Master Documents, Reference lists, and calibration certificates must correctly reference the documentary standards. All Class F weights in current service must clearly reference the NIST Handbook 105-1 (1990). New standards will need to reference the 2019 version. As such, both documents will need to be retained on laboratory reference lists. ASTM and OIML classes should reference the applicable title and year of publication for those documentary standards as well. It is especially important to note applicable dates of the documentary standards because tolerances have changed and as they become more standardized and change further, it is important to provide a distinction for all users of the calibration certificates.

Laboratories are reminded to never attempt to reclassify weights as emphasized in Handbook 105-1. This should be left for the manufactures to determine due to the complexity of the process. In addition, laboratories should continue to interpolate between nominal masses to determine intermediate tolerances when they are not assigned. For additional questions or concerns, please contact the OWM Laboratory Metrology Program (**Micheal.Hicks@nist.gov**).