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Updates to Handbooks 105-3 and 105-4

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Updated drafts of Handbooks 105-3 and 105-4 have been posted on the WMD website since 2004. Comment forms are posted on the website along with the drafts. Numerous opportunities for comment have been provided to metrologists at the Regional Measurement Assurance Program (RMAP) training sessions and through the W&M Quarterly. Individuals who have previously provided comments will have the compiled set of comments circulated to them in the near future to evaluate the proposed responses and remaining issues. Once feedback is obtained from prior reviewers, the set of compiled comments and remaining issues will be circulated more widely among metrologists and interested parties. Final issues will be discussed at the 2008 RMAP meetings.

Three of the issues pertaining to 105-3 to be discussed are:

(1) Requirement of bottom-drain sight flow gages;
(2) Decimal gallon indications; and
(3) Define "high-resolution" type test measures and provers.

Issue 1 – Bottom-drain Sight Flow Gauges
One of the main issues up for discussion for the next draft of 105-3 is the requirement of a bottom-drain sight flow gage. Currently, provers with bottom drains (versus hand-held "pour" types) have a system of valves and hosing that drain the fluid out the bottom of the prover. In order to ensure uniformity of residual liquid on the prover internal surface, documentary standards specify a "drain time," which is a time beginning after cessation of main flow. After the break in the main flow and the allotted drain time, the drain valve is shut. The remaining fluid retained in the prover is part of the calibrated volume. This calibrated volume is then used for verification of meters and for determining meter errors.

If the drain time is not uniform, different quantities of liquid are retained on the inside of the prover, thus, creating errors in repeatability and reproducibility of the device and incorrectly calculated meter errors. With bottom-drain provers, the traditional method of determining "cessation of main flow" and when to begin the "drain time" is simply listening for the sound of the flow breaking (as the pump sound changes on pump-off systems). This method relies heavily on hearing ability and training and varies widely among operators.

To combat the lack of uniformity in prover fluid retention due to uncertain or ambiguous starts of the drain-time count, and based on requests from some jurisdictions, some manufacturers have begun installing "sight-flow" indicators in the bottom drain lines. These indicators consist of inserting a clear section in the drain line so the user of the prover can clearly see when the main flow breaks and then accurately implement the drain time and reduce errors associated with retained liquids.

Mandatory bottom-drain sight flow indicators are being considered in the next draft of 105-3. Sight flow indicators will decrease the reliance on an operator's ability to hear the break in the flow and will make the use of the prover easier and more uniform between operators. It has also been suggested that this new requirement be retroactive, meaning all existing provers would need to be modified to contain a bottom-drain sight flow indicator. There would be an initial burden to modify these provers, but the gain in uniformity and the reduction of inherent errors would quickly outweigh the burden of modification.

Issue 2 – Decimal Gallon Indications
Decimal gallon graduations are being considered for Handbook 105-3. Decimal gallons are currently used for LPG provers in Handbook 105-4, but cubic inches are still used in 105-3. There are 231 cubic inches in one gallon. The motivation for this switch is that previous Handbook 44 tolerances were in cubic inches but have recently switched to percentages to be more in line with tolerances for other devices and international standards. Since the meters measure decimal gallons and the tolerances are given in percentages of gallons, cubic inch increments on the provers are cumbersome and unclear.

For example, when verifying a loading rack meter, let's say the technician stops the meter at 100.5 gallons instead of exactly on 100 gallons. The acceptance tolerance of the meter is 0.2 %. The prover reads +100 cubic inches after correcting the volume back to the reference temperature of 60 ºF (the temperature that it was calibrated to), but the technician ran the meter over by half a gallon. Using cubic inches, the calculations would be as follows:

Error = meter reading – prover reading = (100.5 gal *231in^3/gal) – (100 gal*231 in^3/gal +100 in^3) = 15.5 cubic inches over registration
Acceptance tolerance = 0.2 % * 100 gallons * 231 cubic inches/gallon = +/- 46.2 cubic inches

But if the prover were incremented by decimal gallons instead of cubic inches, giving a prover reading of 100.45 gallons (rounded up), the calculations would be as follows:

Error = meter reading – prover reading = 100.5 gal – 100.45 gal = 0.05 gallons over registration
Acceptance tolerance = 0.2 % * 100 gallons = gallons = +/- 0.2 gallons

The calculations become much simpler and easier using decimal gallons and may not even require the use of a calculator, unlike cubic inches which often require multiplication and division by 231 in^3/gal. This requirement would not be retroactive since it would not eliminate any inherent errors (like the previously mentioned issue) but would only make verifications easier to perform and errors easier to calculate, as well as bring the standard in alignment with other national and international tolerances.

<u>Issue 3</u> – High Resolution Definition
A third issue being considered is defining what is meant by "high-resolution" type test measures and provers. Traditionally, when manufacturers had requests for more "sensitive" provers with more resolution, the neck diameter was decreased and the neck length increased to provide more divisions from which to make a measurement. These test measures and provers have been called "high-resolution" type devices in the current Handbook 105-3. But, there is some confusion on what constitutes high-resolution versus normal resolution. A proposed solution is to define "high-resolution" by relating it to the maximum graduations listed in the tables in Handbook 105-3. An example would be to say that "high-resolution devices are those with graduations less than or equal to XX % of the maximum graduations listed in Table 2a-2b."

There is some concern that the definition of "high-resolution" devices is unnecessary and not worth the effort. Others contend that with the increased use of the term, it is important to have a definition that all can agree upon and reference. Without a clear and uniform definition, someone requesting a "high-resolution" prover from one manufacturer may receive something very different than if they made a similar request to another manufacturer.

Standardizing the definition of "high-resolution" type devices will ensure clarity and understanding when discussing provers and test measures. This definition will not be retroactive, but can be easily applied to previously made devices.

For Handbook 105-4 for LPG Provers, the main unresolved issue is whether to require new provers to be manufactured from stainless steel only. The cost difference of using stainless steel in place of mild steel is significant but there are several maintenance issues that are minimized by use of stainless steel. Users of stainless steel LPG provers are reporting that the sight gages are staying readable after as much as five years, while users of mild steel LPG provers are reporting problems with reading the sight gage after less than one year. At the time of calibration, metrologists are reporting that large quantities of contaminants (suspected to be metal flakes or other scale materials) are being removed from the bottom of the mild steel LPG provers, indicating a possible degradation of the prover wall material. The contamination has not been observed when calibrating stainless steel LPG provers. It is suspected that LPG provers made of stainless steel will have a longer and more stable calibration life cycle.

If you are interested in participating in additional reviews on these handbooks before we prepare a final draft, please contact Michelle Foncannon at (301) 975-3289 or michelle.foncannon@nist.gov.