

NCSLI U.S. Measurement Requirements Committee

Summary Report of an Ad Hoc Focus Group Meeting on: “Magnetism in Mass Measurements”

September 12, 2003

Background

A number of issues surrounding the measurement of magnetism in mass measurements have created frustration for mass calibration laboratories and for accreditation bodies. A meeting was established at the Tampa, NCSLI Workshop and Symposium to bring together interested parties to discuss the issues with the intent on coming to some resolutions for how to handle the various issues. Dr. Richard Davis, BIPM was invited and attended the meeting to provide background technical information and guidance. In addition, Dr. Davis submitted a reserve paper on this issue that was presented in session 8A (the paper was published on the Conference Proceedings CD). The participants had an excellent discussion on the topics noted below. A number of resolutions were developed that are noted later in this summary.

Discussion Topics

1. Scientific basis for magnetism measurements and handling magnetism effects in the uncertainty analysis for calibration of mass standards.
2. Cost factors for routine magnetism surveillance (cost of doing tests, cost of not doing tests and the impact).
3. Impact of magnetism testing on/for laboratory accreditation.
4. Possible round robin “experiments”.
5. Agreements/resolutions on issues.

Resolutions

1. Laboratories should not include an uncertainty component for magnetism measurements in mass calibrations.
2. NVLAP’s position is that for Echelon I and II measurements (corresponding to OIML R 111 classes E₁, E₂, F₁, F₂) laboratories should 1) state on their reports whether or not they are screening for magnetism, and 2) state that no component is included in their uncertainty statement for magnetism effects, and 3) include a discussion/written agreement as to the laboratory’s practice regarding magnetism screening (or lack of screening) as a part of normal contract review with laboratory customers.
3. Some experimentation needs to be done to evaluate (confirm/modify) the reproducibility of the procedures in R 111 to gain experience in the procedures and better understand the limitations.
4. We all agreed that we don’t know how best to quantify magnetic effects of masses and the uncertainties associated with calibration.
5. We don’t know the level (quality/cost) of gaussmeter that is needed yet.

Discussion Highlights

- Permanent magnetization and magnetic susceptibility are separate quantities. Although each quantity may be problematic for mass calibrations, permanent magnetization is often the more troublesome of the two.
- Permanent magnetization is easier to test (with a gaussmeter) than magnetic susceptibility (magnetic susceptometer). However, the susceptometer can also provide a measure of the permanent magnetization as a byproduct of the susceptibility measurement.
- What needs to be considered is the force reaction between a weight and another field (e.g., a balance, a table with steel rebar, a force machine with other weights).
- Options to limit the problems include: shield the balances better; manufacture weights with limited magnetic susceptibility and negligible permanent magnetization.
- Late model mass comparators with increased resolution can “see” more of the problems due to magnetized weights. Not all balances/scales have adequate resolution to note any effects due to magnetized weights.
- Recent work was done by the PTB to “map” a number of balances to consider the impact of magnetized weights. This work allowed increases in the allowable magnetic susceptibility to maintain errors at less than 1/10 of the maximum permissible errors (tolerances).
- We can recognize problematic weights through testing, but we can’t adequately quantify the effect or correct for the errors.
- Some labs routinely screen; others screen when asked to add this service or when problems are observed; others do not screen. Estimates are that fewer than 1 % of the weights in the system have a problem.
- Old weights are generally “rejected” or taken out of service if problems are observed (which is causing some frustration among laboratory customers who have used their weights for years with no apparent problems).
- Testing should result in pass/fail qualitative result rather than quantifying a measurement.
- The type and cost of gaussmeters vary from \$600 models to \$5,000 models. The question of recalibration came up and the fact that the probes degrade over time.
- ASTM E 617-97 will need to be updated as soon as OIML R 111 becomes final because magnetism limits were included before the latest revisions. E 617-97 is currently more stringent than the latest R 111 draft.
- NOAA (National Oceanic and Atmospheric Agency) in the Department of Commerce has online information about the earth’s magnetic fields.
- Degaussing is not easy, especially for hard magnetic materials like stainless steel. Some laboratories have experimented with this and found that if the material is susceptible – it remagnetizes quickly and to a greater extent than it was prior to the degaussing attempt.

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