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Are You Confused by "Retroactivity?"

REVISITING NIST HANDBOOK 105-8, SPECIFICATIONS AND TOLERANCES FOR FIELD STANDARD WEIGHT CARTS

By Val Miller

NIST WMD recently received several questions regarding the retroactive requirement of NIST Handbook 105-8 "Specifications and Tolerances for Field Standard Weight Carts." It is hoped that this article will clarify the issues. Several other questions received are also addressed.

Excerpt from NIST HB 105-8

"1.2 Retroactivity
These specifications apply to new weight carts manufactured after the effective date of this publication (September 2003). A weight cart in service before the publication of this standard that maintains tolerance between verification tests shall continue to be acceptable, though some modifications may be required for continued acceptability under this standard. All weight carts in service must comply with those specifications that have an asterisk (*) following the title. These include requirements addressing tires, batteries, tolerances and fuel tanks. Existing components that comply with the requirements are acceptable for continued use. Weight carts in service at the time of this publication that do not conform to required sections, must be brought into compliance by December 31, 2005.

Weights and measures jurisdictions may require that a weight cart comply with nonretroactive specifications, if additional modifications are required to maintain a weight cart within tolerance. Weight carts that do not maintain the specified tolerance shall be removed from service until modifications are performed that enable the weight cart to maintain tolerance."

The intent of section 1.2, Retroactivity, was to require that all new weight carts, manufactured after the September 2003, the publication date of NIST HB 105-8, be in compliance with *all* of the requirements of HB 105-8.

However, the HB 105-8 work group understood that it would likely be cost-prohibitive to bring weight carts placed in service prior to September 2003 into *full* compliance with the standard. Thus, only those portions of the weight cart designs that contribute the greatest variability (errors) were designated retroactive, requiring correction for continued use of the weight carts. Retroactive items were identified in HB 105-8 with an asterisk following the section title and include: the tires, battery, fuel tank and associated components, and the calibration tolerances of the weight carts. In order to minimize or control the error in the weight cart calibration during use, these items *must* be retrofitted!

Just a reminder as to why these items were made retroactive:

Tires: Smooth surfaced tires are required to minimize the potential errors resulting from debris trapped in the tire surfaces and/or carried onto the scale deck during testing,
Battery: Sealed lead acid batteries are required to ensure that boil-off of battery water does not cause the large errors that are possible,
Fuel tank and associated components: Fuel tanks and fuel error weights were made retroactive so that compensation for the error caused by fuel consumed during a scale test was possible, and Tolerances: Tolerances were set so that the weight cart with its potential errors, used in combination with large weights, could still meet the requirements of HB 44, Fundamental Considerations, that the error of the standard not exceed one-third of the smallest tolerance tested. Weight carts are *not* NIST Class F field standards!

Retroactive items ***must*** be in compliance with HB 105-8 by December 31, 2005, if the weight cart is going to be continued for use.

All other portions of the standard were *not* made retroactive for existing weight carts unless a jurisdiction wishes to make them retroactive.

HB 105-8, Section 9, User Requirements
Though not indicated by an asterisk, NIST HB 105-8 Section 9, User Requirements, must also be met for all weight carts regardless of date of manufacture. These requirements were placed in the standard to provide a way of auditing the weight cart throughout its life cycle, providing a mechanism by which the integrity of the calibration value can be determined. All facilities calibrating weight carts should be evaluating the maintenance log and inspection sheets to determine if the weight cart is likely to be in tolerance between calibrations. This helps to ensure traceability of the scale calibrations in which the weight cart is used.

Must weight carts in service prior to September 2003 be adjusted to a 500-lb nominal increment?
It is not necessary that a weight cart have a mass of any particular value, except that it makes it easier for the user if it fits some even 500-lb increment as they are typically used with 500-lb, 1000-lb, and 2500-lb standards. The total load applied will be easier to calculate if the mass of the weight cart is one of the nominal values. Additionally, there is concern that odd nominal mass values, e.g., 4474 lb, would require the use of an excessive number of calibration standards resulting in increased calibration uncertainty and would make calibration of the weight cart more difficult and time consuming. But it is not required that a cart be adjusted to a nominal 500-lb increment unless the laboratory cannot perform the calibration with an uncertainty less than one-third of the calibration tolerance.

Can a Liquid-cooled Engine be used on a Weight Cart?
A question recently received related to use of liquid-cooled engines in weight carts. This issue was not addressed in HB 105-8 as no weight carts having liquid-cooled engines were known to exist at the time the standard was published. Though not expressly

prohibited by HB 105-8, the use of liquid-cooled engines is not recommended as they add another source of variability in the form of the cooling fluids. If a liquid-cooled engine is used, the radiator MUST have an overflow reservoir similar in design to the required fuel tank. The reservoir will require only one reference
mark and must be maintained at the reference mark when the engine is at ambient temperature. The overflow reservoir must have adequate capacity to ensure the engine coolant does not overflow the reservoir when the engine is at operating temperature. Use of liquid-cooled engines on weight carts is strongly discouraged because of the additional source of error.

One final caution:
A number of weight cart users have stated that rather than deal with the expense of retrofitting their weight cart to comply with the four retroactive sections of the standard, they will instead use the weight cart as tare during their scale calibration process. Even a weight cart used as tare *must* comply with all of the requirements of section 4.7, Fuel Tank, as fuel is a consumable, and correction for fuel consumed must be provided. Due to the short-term nature of a scale test, battery boil off, contamination carried onto the scale by the tires, and specific tolerances are not significant issues if the weight cart is used only as tare. Fuel consumption errors, however, can be very significant, depending on the rate at which the fuel is consumed. If a scale test takes sufficient time that one-quarter to one-half of the fuel capacity of a typical old-style fuel tank is consumed, the weight cart will have changed mass by more than the amount of error permitted by the fundamental considerations. Fuel tanks and fuel error weights *must* be considered retroactive for ALL liquid-powered weight carts regardless of how they are used in the process.

It is the desire of the work group that NIST Handbook 105-8 be understood and utilized. Any questions should be addressed to Val Miller, 301-975-3602 or val.miller@nist.gov.