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Applying Correct Tolerances

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Consider the scenario in which a commercial weighing or measuring device has been in service for more than 30 days and is being routinely tested within 30 days of having its performance adjusted. Assuming this is not a follow-up test of equipment under official rejection, what tolerances (maintenance or acceptance) apply? This question is one which seems to raise a lot of controversy within the weights and measures community. Although it may seem reasonable to think that acceptance tolerances should apply, this is not what NIST Handbook 44 (HB 44) necessarily requires. However, a case can be made for the application of either tolerance. The question is "why."

According to HB 44 Fundamental Considerations, two sets of tolerances (acceptance and maintenance) were established to apply to classes of equipment on which the magnitude of the errors of value or performance may be expected to change as a result of use. Acceptance tolerances are applied to new or newly reconditioned or adjusted equipment and are usually one-half the value of maintenance tolerances. Maintenance tolerances provide an additional range of inaccuracy within which equipment can be approved on subsequent tests, thereby permitting a limited amount of deterioration before the equipment will be officially rejected for inaccuracy and before reconditioning or adjustment will be required. A single set of tolerances is typically established for equipment that maintains its original accuracy regardless of use, such as glass milk bottles or graduates.

The following tolerances are taken directly from NIST Handbook 44:

G-T.1. Acceptance Tolerances. - Acceptance tolerances shall apply to:

(a) equipment to be put into commercial use for the first time;
(b) equipment that has been placed in commercial service within the preceding 30 days and is being officially tested for the first time;
(c) equipment that has been returned to commercial service following official rejection for failure to conform to performance requirements and is being officially tested for the first time within 30 days after corrective service;
(d) equipment that is being officially tested for the first time within 30 days after major reconditioning or overhaul; and
(e) equipment undergoing type evaluation.
(Amended 1989)

G-T.2. Maintenance Tolerances. - Maintenance tolerances shall apply to equipment in actual use, except as provided in G-T.1.

NIST Handbook 44 G-T.1. Acceptance Tolerances and G-T.2. Maintenance Tolerances

The various conditions under which acceptance and maintenance tolerances apply to commercial equipment are specified in HB 44 General Code paragraphs G-T.1. Acceptance Tolerances and G-T.2. Maintenance Tolerances. Paragraph G-T.1. specifies five different conditions under which acceptance tolerances apply. Note that only two of those conditions apply to equipment that has been in service for more than 30 days. The first condition—G-T.1.(c)—applies to equipment that has been returned to service following official rejection and is being tested within 30 days after corrective service. The second—G-T.1.(d)—applies to equipment that is being tested for the first time within 30 days after major reconditioning or overhaul. Paragraph G-T.2. specifies that maintenance tolerances shall apply to equipment in actual use, except as provided in G-T.1.

Why wouldn't HB 44 require the application of more stringent tolerances (i.e., acceptance tolerances) to commercial devices that have recently been adjusted or calibrated even when those devices had been in service for more than 30 days? A likely reason is that doing so would unfairly penalize that group of device owners who were diligent about maintaining the accuracy of their equipment. For example, device owners who were conscientious about having the accuracy of their devices properly maintained would suffer the unfortunate consequence of having officials apply acceptance tolerances to those devices (providing testing occurred soon after adjustments were completed). Device owners who were less diligent about maintaining the accuracy of their equipment would benefit because maintenance tolerance would continue to apply to that equipment. Thus, different tolerances could apply based upon how one elected to maintain their equipment. In summary, an unfair advantage would be created for those less diligent about maintaining the accuracy of their equipment and an improper message would be conveyed.

Another specification comes into play when considering the General Code user requirement of HB 44. G-UR.4.3. Use of Adjustments reads:

> **G-UR.4.3. Use of Adjustments.** – Weighing elements and measuring elements that are adjustable shall be adjusted only to correct those conditions that such elements are designed to control, and shall not be adjusted to compensate for defective or abnormal installation or accessories or for badly worn or otherwise defective parts of the assembly. Any faulty installation conditions shall be corrected, and any defective parts shall be renewed or suitably repaired, before adjustments are undertaken. Whenever equipment is adjusted, the adjustments shall be so made as to bring performance errors as close as practicable to zero value.

Does this mean that Handbook 44 requires the application of maintenance tolerances when conducting routine testing of devices that have recently been adjusted and have been in service for more than 30 days? The correct answer is "not necessarily." Although G-T.1. and G-T.2. would require maintenance tolerance to be applied to such devices, General Code paragraph G-UR.4.3. Use of Adjustments, grants officials the

discretion of setting the defining limits of how close to zero error devices are to be adjusted. This paragraph specifies that whenever equipment is adjusted, the adjustments shall be so made as to bring performance errors as close as practicable to zero value. Thus, on one hand, HB 44 requires maintenance tolerances to be applied when routine tests are conducted on devices that have recently been adjusted and have been in service for more than 30 days. On the other hand, whenever these (or any other) devices are adjusted, officials are granted the authority to specify how close to zero value the performance errors are to be set, providing the degree of accuracy required is practicable. Thus, if an official deems it is reasonable for a particular device that has been in service for more than 30 days to be adjusted to within acceptance tolerances or better, the official may require, in accordance with HB 44, that when that device is adjusted, it be adjusted to within those limits. Paragraph G-UR.4.3. prevents a device owner from taking advantage of the tolerances by selectively adjusting a device to within a limit of his/her own choosing of the permissible tolerance. For example, if you find a device that has recently been adjusted and that is barely within maintenance tolerances, this might suggest the device owner is making a minimum effort to make the adjustments, and therefore, taking advantage of the tolerances.

Note: Given the amount of liberty granted officials in setting the defining limits of such performance adjustments, some weights and measures administrators have developed guidelines outlining the tolerances to be applied when testing recently adjusted devices that have been in service for more than 30 days. These guidelines often differ depending upon the type of device being tested and the number of days that have elapsed since adjustment occurred. These guidelines may also include instructions detailing the actions to be taken by field officials when security seals have been removed from an adjusting mechanism or audit trail information has been altered without authorization.

Thus, when trying to determine the appropriate tolerance to apply following an adjustment to the performance of a device, one must consider not only whether acceptance or maintenance tolerances apply, but also what adjustments are reasonable (i.e., practicable) for the particular device being tested. It is only after consideration of each of these points that the proper tolerances can be established and applied.

For additional information regarding the correct application of HB 44 tolerances, please contact Rick Harshman at 301-975-8107 or by email at richard.harshman@nist.gov.