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Accuracy and Repeatability Testing – What’s the Difference?

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Since 2003 all NIST Handbook 44 Section 3 Measuring Device Codes include requirements for repeatability tests with associated tolerances. Occasionally, some field officials question the number of tests that are necessary or when repeatability test requirements apply to multiple test results. When conducting repeatability tests and accuracy tests, one should remember that, while both tests address device performance, the focus and purpose of the two tests are different.

Accuracy testing determines whether or not the device is installed and adjusted to perform within applicable tolerance limits; failure to meet accuracy requirements typically indicates that the device is not adjusted or installed properly. However, that failure might also be linked to other problems in the measuring system such as problems with an air eliminator.

During accuracy testing, consider these outcomes for the following scenarios:

- If test results from a run are at or near the tolerance limit, the test should be repeated.
- If first test run is within tolerance and the second test run is within tolerance, the device can be approved without additional accuracy testing.
- If both test results are near the limit and in favor of the device user/owner and you believe there is the possibility that the device user/owner is taking advantage of the tolerance, you might consider further investigation based on your jurisdiction’s policy to ensure compliance with General Code paragraph G-UR.4.1. Maintenance of Equipment.
- If test results of two runs are significantly far apart, this raises concern about the repeatability of the device. You may decide to do repeatability testing. In this example, at least one more test run is necessary under the same conditions.
- If first test run is in tolerance and the second test run is out of tolerance, then at least a third test should be run to confirm that the results are either in or out of tolerance.

Action can be taken on a device for failing to meet the accuracy requirements based on two tests alone if both tests are out of tolerance. The basis for rejecting the device in this case is for failing to meet the accuracy requirements, rather than for failing to meet repeatability tolerances.

Typically, if a device fails to meet accuracy tolerances, but is able to repeat its results, then a simple adjustment can usually bring the device back within applicable tolerances. If the device fails to meet repeatability tolerances, it may not be possible to use the adjustments on the device to bring it back into a condition where the device consistently performs within tolerance and repeats its results; more extensive work may be needed on the device.

Repeatability testing determines whether or not a device is capable of repeating its indications and recorded representations within a certain limit under the same conditions; failure to meet repeatability would typically indicate a more serious problem with the device such as a worn measuring chamber. In order to take official action on a device for failing to meet the repeatability requirements, you must run at least three consecutive tests under the same conditions. The test drafts should be approximately the same size and flow rate. For example, three or more tests at the highest flow rate, where the draft size of each test run is the same. All three or more tests should be performed under controlled conditions to minimize the effects of variables on the results. Variations in factors such as temperature, pressure, and flow rate should be reduced so they will not have an effect on the test results. The test results from repeatability testing must be within a specified allowable range for the repeatability tolerance and each individual test result must also be within the allowable accuracy tolerance. The inability of the device to repeat its results or indications might indicate wear in the meter and this situation is different from simply failing to meet accuracy requirements.

In an upcoming issue of *Weights and Measures Quarterly* look for tips on how to apply repeatability tolerances to the test results and the applicable tolerances to each individual test result when repeatability testing.