


# Tolerance Verification vs Repeatability Testing

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[Back to Table of Contents](#)

 [NIST Handbook 44 Sec. 3.30.](#)  
Liquid-Measuring Devices,  
N.4.1.2. and T.3.

## Question/Issue

When is tolerance verification testing conducted and when is repeatability testing conducted for retail motor fuel dispensers? This procedure will assist the inspector with tolerance verification and with repeatability testing.

## Definitions

Verification of Accuracy Testing- Verification of 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.

Repeatability Testing- 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.

Therefore, repeatability testing should be conducted on the retail motor fuel dispenser when there is an indication of meter wear or mechanical failure. If the test results are unable to repeat, then the meter fails the test. This situation is different than a device that fails to meet accuracy requirements.

## Procedure

1. Verification of accuracy testing- If test results from a draft are at or near the tolerance limit (i.e. -5 cubic inch or larger negative errors on a 5-gallon test draft), additional verification of accuracy tests should be conducted.

### Evaluation of results examples:

- Example #1: If the first test draft is within tolerance and the second test draft is within tolerance and range of test results are within 2.5 cu inches of each other, the device can be approved without additional verification of accuracy testing.

Draft #1        -5 cu”

Draft #2        -5 cu”

- Example #2: If the first test draft is within tolerance and the second test draft is outside of tolerance and the range of test results are within 2.5 cu inches of each other, then conduct a third test draft. If the third draft is outside of tolerance and still within 2.5 cu inches of the first two drafts, then reject the device.

Draft #1	-6 cu”
Draft #2	-7 cu”
Draft #3	-7 cu”

- Example #3: If the first test draft is outside of tolerance and the second test draft is inside of tolerance and the range of test results are within 2.5 cu inches of each other, then conduct a third test draft. If the third draft is inside of tolerance and still within 2.5 cu inches of the first two drafts, then approve the device as correct.

Draft #1	-7 cu”
Draft #2	-5 cu”
Draft #3	-5 cu”

- Example #4: Omitting the first draft results, if the difference between individual verification of accuracy test draft results are greater than or equal to ( $\geq$ ) 2.5 cubic inches and all tests are within applicable tolerances, then conduct a repeatability test and use the second and third test drafts a drafts for the repeatability test (see section 2 below).

2. Repeatability test: The measuring devices code requires repeatability tests include a minimum of three consecutive test drafts of approximately the same size, conducted under similar conditions, where variables do not affect the results. Omit first draft results and conduct three consecutive test drafts at the same flow rate and test conditions. The repeatability tolerance specifies that the range of the test results shall not exceed 40 % of the absolute value of the maintenance tolerance. The maintenance tolerance on a 5-gallon test draft is  $\pm 6$  cubic inches. Thus, 40 % of the absolute value of the maintenance tolerance on a 5-gallon draft is 2.4 cubic inches.

Repeatability test example: Evaluate three consecutive 5-gallon drafts conducted at the same flow rate and conditions, maintenance tolerances applied, with the following test draft readings:

Initial Draft (omit initial draft from range consideration)	
Repeatability Draft #1	+ 1 cu”
Repeatability Draft #2	- 2 cu”
Repeatability Draft #3	- 3 cu”

\*The range of results between repeatability draft # 1 and repeatability draft #3 is 4 cubic inches. Although all the individual test results are within applicable tolerances, the range of the test results exceeds the allowable limits for repeatability tolerance testing and the device fails the repeatability test.

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