HP PROTECTUS® III Field Testing Guide
HP PROTECTUS® III Field Testing Guide
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Changes or modifications not expressly approved by the party responsible for compliance can void the user's authority to operate the equipment.

Professional Installation
In accordance with section 15.203 of the FCC rules and regulations, the MIU must be professionally installed by trained utility meter installers. Changes or modifications not expressly approved by the party responsible for compliance can void the user's authority to operate the equipment.
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Notes:
1 Introduction

This chapter provides general information on field testing, testing methods, and flow tests for the High Performance (HP) PROTECTUS® III Fire Service Meter (subsequently referred as HP PROTECTUS III meter).

Field Testing

The only way to determine whether a specific meter is operating efficiently is to test it. Establishing a meter maintenance program is recommended for all utilities. In a utility, large meters move the most water, so they in turn generate the most revenue. Maintaining the accuracy of these meters means maintaining or improving revenue for the utility.

Testing Best Practices

Consider the following before testing the HP PROTECTUS III meter.

- Perform maintenance according to the American Water Works Association (AWWA) schedule.
- Perform at least three flows per meter, starting at the low flow.
- Ensure the T-10® bypass is open. It should always be open during the test. The HP PROTECTUS III meter uses the bypass at all flow rates. When operating normally, at medium to high flow rates, the meter uses the turbine and T-10 bypass in unison. They must both be open and active when testing the meter.
- Check to see if a test tee is installed downstream of the meter. If no test tee is present, the meter should be tested out of the test port on top of the knuckle valve housing.
- Ensure the bypass and isolation valves inline with the meter are fully closed. If the meter appears to be under registering, make sure the downstream isolation valve is fully closed. This can be done by opening and closing the valve several times to break loose any buildup on the valve seat.
- Calculate the total meter usage by adding the accumulation from the T-10 bypass and mainline turbine.

Factors to Consider

AWWA recommends on-site testing of large meters on a regular basis. Cost of performing maintenance is relatively small compared to the revenue generated from properly functioning large meters.
Testing Methods

Accuracy is determined using a point of reference. The following are three common points of reference:

• Volumetric — calibrated tank
• Gravimetric — weight scale
• Reference Meters — known good meters

Volumetric

Consider the following.

• Make sure to have a calibrated tank.
• Calibrate volumetric tanks annually.
• Wet the tanks prior to conducting initial tests.

Gravimetric

Consider the following.

• Uses a weight scale.
• Calibrates scale annually.
• Does not require a wet tank.

Reference Meter

Consider the following.

• Keep calibration certificates up to date on known good meters.
• Run a volume-to-volume comparison.

Things to Remember

Consider the following.

• Keep in mind the test provides a snap shot only.
• Start at low flow, then medium, and high flow rates.
• Repeat any failed test to verify the result.
• Keep in mind that isolation valves are fully sealed off and do not allow any unaccounted-for flow to seep through.
• Avoid cavitation (maintain 20-30 psi at reference meter).
• Remember that a reference meter is not always 100% accurate at all flow rates.

• Make sure the reference meter has a calibration certificate.

• Make sure reference meter setup recommendations are followed.

Flow Tests

There are three primary flow tests on the HP PROTECTUS III.

• Low Flow
• Crossover
• Medium to High Flow

Low Flow

Consider the following.

• Varies depending on meter size
• Captures the flow through the T-10 bypass
• Allows the utility to accurately capture a very large flow range moving through the meter

Crossover

AWWA defines crossover as, “the beginning of the crossover is when the accuracy of registration falls below 97% caused by the operation of the automatic valve mechanism (knuckle valve), and the end of the changeover is when the accuracy of registration again reaches 97%” (AWWA C703-11 Section 4.2.6.1).

• Varies depending on meter size
• Occurs when the flow rate is increasing to a rate that it can begin to open the knuckle valve
• Allows water to begin to register on the turbine measuring element

The flow rate through the T-10 begins to be choked by the throttle valve at the beginning of crossover. This protects the T-10 and helps the meter transition through crossover.

There is a slight accuracy drop when transitioning through crossover.
Medium to High Low

Consider the following.

- Knuckle valve is fully open and water is registering on the turbine measuring element.
- Water is captured through the T-10 bypass.
- T-10 bypass is regulated by the throttle valve.
- Water is still moving through the T-10, but is limited.

Equipment Needed

This section discusses the equipment needed to test the meter.

Recommended Tools

Figure 1 shows the recommended tools you need to perform the field testing on the HP PROTECTUS III meter.

![Figure 1 Recommended Tools](image)

Table 1 lists the recommended tools you need to successfully test the TRU/FLO.

### Table 1 Recommended Tools

<table>
<thead>
<tr>
<th>Item</th>
<th>Description/ Recommendation</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tool Kit</td>
<td>Contains standard tools including: P/N: 5500-153, or 154, or 155 (depends on meter size)</td>
<td>Perform various installation procedures.</td>
</tr>
<tr>
<td>Flashlight</td>
<td></td>
<td>Activate the register LCD.</td>
</tr>
<tr>
<td>Ladder</td>
<td></td>
<td>Get into a deep pit.</td>
</tr>
<tr>
<td>Safety glasses</td>
<td></td>
<td>Protect eyes.</td>
</tr>
<tr>
<td>Retainer Clip</td>
<td></td>
<td>Use for knuckle valve assembly.</td>
</tr>
</tbody>
</table>
2 Test Requirements

This chapter provides information on testing requirements.

Required Tests

Testing a fire service meter requires at least three tests.

• One flow test on the low side
• One medium flow test on the low side above low flow, but below the beginning of crossover
• One flow test on the high side

A test performed within crossover range is acceptable, but not always necessary.

Recommended Flow Rates

This section provides in-field testing performance specifications.

Table 2 HP PROTECTUS III In-Field Testing Performance Specifications

<table>
<thead>
<tr>
<th>Size</th>
<th>Low Flow (95 - 101%)</th>
<th>Crossover (no less than 85%)</th>
<th>High Flow (98.5 - 101.5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>¾ GPM</td>
<td>15 - 25 GPM</td>
<td>300 GPM</td>
</tr>
<tr>
<td>6</td>
<td>1 ½ GPM</td>
<td>35 - 45 GPM</td>
<td>625 GPM</td>
</tr>
<tr>
<td>8</td>
<td>2 GPM</td>
<td>50 - 65 GPM</td>
<td>1000 GPM</td>
</tr>
<tr>
<td>10</td>
<td>2 GPM</td>
<td>55 - 65 GPM</td>
<td>1625 GPM</td>
</tr>
</tbody>
</table>

• Accuracy limits shown in Table 2 are adapted from the AWWA M6 manual.
• Test numbers are adapted from AWWA manual M6 Fifth Edition.
• Crossover can have slight variations depending on all elements present in the test setup.
Test Requirements

- Cavitation is more likely to occur during a high flow test when using a reference meter. Be sure that you are maintaining 20 - 30 psi at the reference meter during the high flow test.

- AWWA allows a minimum accuracy of 90% for repaired meters.

- AWWA M6 states that testing of high rates of flow can be achieved by testing the meter at 25% of the meter’s rating if the manufacturer’s original test certificate indicates a linear curve between 25% and 100% of the rated flow range.

**Recommended Volume Per Test**

This section provides information on the recommended minimum volume (in gallons) for each test.

<table>
<thead>
<tr>
<th>Size</th>
<th>T-10 Low</th>
<th>T-10 Medium</th>
<th>High Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>10</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>100</td>
<td>100</td>
<td>1000</td>
</tr>
<tr>
<td>8</td>
<td>100</td>
<td>100</td>
<td>1000</td>
</tr>
<tr>
<td>10</td>
<td>100</td>
<td>100</td>
<td>1000</td>
</tr>
</tbody>
</table>

- The quantity run should never be less than 3 minutes running, and should be at least one full revolution of the register’s sweep hand.

- The volume indicates one sweep hand revolution of a traditional direct read register. If a sweep hand revolution is complete before 3 minutes have elapsed, continue running the test to the 3 minute mark.

- The high flow volume is the minimum amount that the turbine side of the meter should register during the test.

- The turbine side register should not turn for the T-10 low and T-10 medium flow tests.

- The T-10 and the turbine side register should both be turning during the turbine high flow test.
3  Testing the Meter

This chapter provides information on testing the meter. AWWA M6 manual recommends that a fire service meter tested in the field should have an accuracy with 95-103%. The acceptable accuracy range can be determined specifically by each utility. However, potential error during in-field test setup should always be taken into account.

Preparing to Test

This section gives instructions on how to set up the meter for testing. The meter should be tested out of the test port on top of the knuckle valve housing. Figure 2 shows a gate valve installed on the extension coming out of the test port.

1  Attach the test hose to the test riser. See Figure 3.
Testing the Meter

2 Attach the fire hose to the reference meter. See Figure 4.

Figure 4 Reference Meter

3 Open the bypass valve around the meter under test to continue servicing the customer, if available.

With the bypass around the meter fully open, you should not see either register on the meter counting flow.

4 Slowly open the gate valve at the meter under test to pressurize the reference meter. See Figure 5.

Opening the valve too quickly could cause the hose and reference meter to lurch violently.

Figure 5 Gate Valve

5 Shut off the downstream isolation valve behind the HP PROTECTUS III.

Work the valve open and closed several times to ensure a good seal.

Release Trapped Air

1 Release trapped air from the reference meter by slowly opening the high side valve of the reference meter. See 3.

Releasing trapped air can cause the reference meter to jerk violently.

Figure 6 Release Trapped Air - High Side
2 Run the meter for several minutes to vent all air.

3 Release trapped air in the low side of the reference meter by slowly opening the low side valve. See Figure 7.

4 Shut off the high side valve and low side valve on the reference meter.

   With the upstream valve in front of the HP PROTECTUS III meter open and the downstream valve behind the HP PROTECTUS III off, you should not see any flow through the meter.

5 Record the meter readings from the low side and the high side registers.

   At this point, neither the low side or high side should be running.

6 Add the numbers from the low side and high side to get the total starting volume for the meter.
Low Flow Test

This section provides steps to complete a low flow test.

1. Open the low side valve on the reference meter.
2. Run this test for one full revolution of the sweep hand for a minimum of 3 minutes.

Test according to Neptune’s performance chart. See Table 2 on page 5.

3. Stop the low side test by shutting off the low side valve on the T-10.
4. Record your results from the reference meter and from the HP PROTECTUS III low side register.

5. Calculate the accuracy by dividing the water registered on the HP PROTECTUS III by the water registered on the low side of the reference meter.

You should not see any registration on the HP Turbine side of the HP PROTECTUS III. All of the consumption should have been on the T-10 side.

Medium Flow Test

This section provides steps to complete a medium flow test.

1. Record the consumption on the T-10 of the HP PROTECTUS III and the consumption on the turbine side of the HP PROTECTUS III.

This is your meter reading before beginning the medium flow test.
2 Open the valve on the low side of the reference meter and set the flow at the medium flow rate according to Table 2 on page 5.

The medium flow test should be below crossover, but above the minimum T-10 flow rate.

3 Run this test for one full sweep hand of the register for a minimum of 3 minutes.

4 Close the low side valve on the reference meter, after the test is complete.

5 Record the final flow on the low side of the reference meter and the final flow on the T-10 side of the HP PROTECTUS III.

6 Calculate the accuracy by dividing the HP PROTECTUS III registration by the reference meter registration.

You should not see any registration on the HP Turbine side of the HP PROTECTUS III. All of the consumption should have been on the T-10 side.

High Flow Test

This section provides steps to complete a high flow test.

1 Record the flow from both the low side and high side of the HP PROTECTUS III meter. This is your starting volume.

2 Record the flow from the low side and high side of the reference meter. This is your starting volume.

3 Open the valve on the high side of the reference meter (as shown in Figure 12, and set the flow at the high flow rate according to Table 2 on page 5.

When running this test, both the T-10 and the HP Turbine on the HP PROTECTUS III register flow.

4 Run this test for one full sweep hand revolution of the turbine side register for a minimum of 3 minutes.
Testing the Meter

5 Turn off the high side valve on the reference meter.

6 Record the reading on the high side and the low side of the reference meter.

7 Record the readings from both the HP Turbine side and the T-10 side of the HP PROTECTUS III.

8 Add the two readings together.
   This is the total flow that went through the HP PROTECTUS III.

9 Calculate the accuracy by comparing this value to the amount consumed on the high side and the low side of the reference meter.

After the Test is Complete

After completing the test, back-flush the line to avoid sending dirty water to the customer.

1 Close the test riser.

2 Shutdown the inlet valve of the meter under test.

3 Reopen the inlet valve upstream of the meter under test.
   This breaks up any debris built up on the seat of the isolation valve upstream of the meter. See Figure 13.

4 Slowly open the test riser.

5 Open the high side of the reference meter to back-flush the meter.
   See Figure 14.

6 Run until the water coming out of the reference meter turns from brown to clear. See Figure 15 and Figure 16 on page 13.

Figure 13  Inlet Valve

Figure 14  Back-Flushing the Meter

Figure 15  Color of Back-flush Water
Figure 16 shows clear water after back-flush.

**Breakdown and Cleanup**

Complete the following steps:

1. Close the valve at the test riser attached to the meter under test.

2. Open the high side valve on the reference meter slowly.

The reference meter and the fire hose running from the meter under test to the reference meter are depressurized.

3. Inspect the pressure gauge at the reference meter to make sure all pressure has been vented before disconnecting the fire hose. See Figure 18.

4. Disconnect the fire hose from the test riser and the reference meter and remove it from the test site.

5. Open the isolation valve downstream of the meter under test.
6 Close the bypass valve.

    Full service is restored to the meter monitoring the site.

7 Ensure the registers on the meter that was tested are registering flow.

---

### How to Calculate Overall Meter Accuracy

AWWA recommends that the total meter accuracy is calculated by the average of the accuracy results of the high flow turbine side test, the medium test on the T-10 chamber, and the low flow test on the T-10 chamber.

The recommendations stated above come from the AWWA M6 manual. Utilities use many different methods to calculate the overall meter accuracy, but there is no one method that has to be done. The method used must meet the utility’s accuracy standards.

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### Test Results

This section provides information on possible reasons a test can fail.

#### Failed Low Flow Test

In the case of a failed low flow test, the meter can be tested directly out of the plug on the T downstream of the T-10. When performing this test, the operator should be aware that the throttle valve in the T-10 regulates the amount of flow so tests above 15 GPM are not possible when testing from the port on the bypass T. See Figure 21.

Also, consider the following.

- The knuckle valve could be bad, allow the water to bypass the knuckle and flow out of the meter instead of being pushed through the T-10. Open the knuckle valve housing and check to make sure the valve is fully seated against the valve seat. Look for any signs of damage.

---

Figure 20  Bypass Valve

Figure 21  Port on the Bypass T
Testing the Meter

- The T-10 chamber needs to be replaced.
- The small white strainer located inside the T-10 needs to be cleaned.
- The large UL/FM basket strainer needs to be cleaned.

Failed Medium Flow Test

Consider the following.

- Make sure you are not in crossover and expecting a different accuracy result.
- Make sure you have sufficient line pressure and are not having cavitation.
- Maintain at least 20 to 30 psi at the reference meter inlet.

Failed High Flow Test

Consider the following.

- Check the turbine measuring assembly. It could need to be replaced.
- Check the pressure at the reference meter.
- Check the meter for cavitation.
- Maintain at least 20 to 30 psi at the reference meter inlet.
- Close the bypass ball valves so that you are testing the high side of the meter in isolation. This allows you to check the HP Turbine measuring element and verify its performance without bringing the T-10 into the test.

Failed All Tests

Consider the following.

- Does the meter have four to five pipe diameters of straight pipe with no obstruction up stream?
- Does the meter have four to five pipe diameters of straight pipe with no obstruction downstream?

If the HP PROTECTUS III turbine assembly is inaccurate, it can be replaced with a HP PROTECTUS III UME (P/N 9719-XXX). The UME is factory tested, and comes with a new test ticket and register. The UME allows for quick, and easy maintenance with minimal down time.
• Does the reference meter have an up-to-date calibration certificate?

• Are the registers located on the high side and low side correct?

The high side register should have a dial face marking of HPT P3 or HPT PIII, with the appropriate meter size shown. The low side dial face should say T-10 with the appropriate meter size shown.
4 Troubleshooting

This chapter provides information on how to run a successful test.

Before and During the Test

Before and during a test, ensure the following.

- Start with low flow then move to high flow for a used meter.
- Start with high flow then move to low flow for a new meter.
- Be aware of an AWWA recognized accuracy dip when testing in crossover.
- Check the pressure gauge at the reference meter to be sure it maintains 20-30 psi to avoid cavitation, which causes faulty results.
- Require calibration certificates for all reference meters. If the reference meter is inaccurate, then it shows the meter under test to be inaccurate.
- Check all connections, hoses, and meters for any leaks. Leaks can cause the meter under test to appear inaccurate.

Sources of Error

The following is a list of possible sources of error.

- Sign of Cavitation
  - Make sure you are not pulling too much water through the 2-inch test port on top of the knuckle valve housing if the error is at high flow.
  - Try slightly decreasing the flow rate.
- Reading resolution of registers on the reference meter and meter under test.
  The error related to reading resolution of the meter is lessened as more water is run through the reference meter and the meter under test
- Reading resolution of tank/reference unit
  - A volumetric test consists of capturing the water run through the meter under test in a volumetric tank.
– The water captured in the tank is usually read with a sight gauge. The accuracy of this reading is dictated by the resolution on the sight gauge.

– The error associated with reading the sight gauge is lessened as more water is run through the reference meter and into the tank.

– The tanks should be wetted before beginning the test.

• Human error

• Poor flow profile
  – Is the install correct? Does the meter have the appropriate amount of straight pipe before and after the meter?
  – Is the UL/FM strainer clean or clogged?

• Leaky test setup

• Isolation valves allowing water to bypass
  – Are the isolation valves fully shut off?
  – Has the reference meter registered more water than the meter under test?
  – Has a test failed? You are advised to work the isolation valves fully closed and then open. Doing this helps to break debris from the valve seat of the isolation valve ensuring complete isolation of the meter under test.

• Isolation valve leaks. To check for leaks:
  – Completely close the upstream valve and the downstream valve on the meter.
  – Leave the gate valve coming out of the test port of the meter under test open.
  – If the upstream and downstream isolation valves are sealed properly, no water is registered on the reference meter.

• Pressure loss between meter under test and reference meter causing cavitation

• Testing from improper meter plug or port

• Maximum flow exceeding the test setup capacity

If erroneous results occur, repeat test setup checks.

• Make sure the test results are repeatable.

• Check for cavitation or loss of pressure at the reference meter.

• Check the setup for any leaks.

• Make sure that the downstream isolation valve is closed.

• Make sure at least one full sweep hand of consumption was run.
Cavitation occurs when the water passing through the meter has dropped in pressure to a point where it can “cavitate”. This can occur at any flow rate if pressure at the inlet is low. In effect, the water is boiling because the pressure has become too low.

In order to ensure you are not cavitating, a pressure gauge should be maintained at the reference meter that shows the psi at or above 20-30 psi. If the pressure is close to 30 psi at the reference meter, and has a poor accuracy test, it is recommended to adjust the test setup until the pressure is above 30 psi.

This can be accomplished by either adjusting the flow rate of the high flow test or repositioning the reference meter, so that the pressure loss between the meter under test and reference meter is minimized.
5 Contacting Neptune Customer Support

Within North America, Neptune Customer Support is available Monday through Friday, 7:00 AM to 5:00 PM Central Standard Time by telephone, email, or fax.

By Phone

To contact Neptune Customer Support by phone, complete the following steps.

1 Call (800) 647-4832.

2 Select one of the following options:
   - Press 1 if you have a Technical Support Personal Identification Number (PIN).
   - Press 2 if you do not have a Technical Support PIN number.

3 Enter the six digit PIN number and press #.

4 Select one of the following options.
   - Press 2 for Technical Support.
   - Press 3 for maintenance contracts or renewals.
   - Press 4 for Return Material Authorization (RMA) for Canadian Accounts.

You are directed to the appropriate team of Customer Support Specialists. The specialists are dedicated to you until the issue is resolved to your satisfaction. When you call, be prepared to give the following information.

- Your name and utility or company name.
- A description of what occurred and what you were doing at the time.
- A description of any actions taken to correct the issue.

By Fax

To contact Neptune Customer Support by fax, send a description of your problem to (334) 283-7497. Please include on the fax cover sheet the best time of day for a customer support specialist to contact you.

By Email

To contact Neptune Customer Support by email, send your message to hhsupp@neptunetg.com.
Appendix A: Reading a Register

It is important to become familiar with the information available from the meter. To identify this information, the following icons and displays are helpful.

**Table 4 Icons and Displays**

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow/Leak</td>
<td>Shows the direction of flow through the meter.</td>
</tr>
<tr>
<td>ON</td>
<td>Water in use.</td>
</tr>
<tr>
<td>OFF</td>
<td>Water not in use.</td>
</tr>
<tr>
<td>Flashing</td>
<td>Water is running slowly/low flow indication.</td>
</tr>
<tr>
<td>Leak</td>
<td>Displays a possible leak.</td>
</tr>
<tr>
<td>OFF</td>
<td>No leak indicated.</td>
</tr>
<tr>
<td>Flashing</td>
<td>Intermittent leak indicated. Water used during at least 50 of the 96 15-minute intervals during the previous 24-hour period.</td>
</tr>
<tr>
<td>Continuous ON</td>
<td>Continuous leak indicated. Water used during all 96 15-minute intervals during the previous 24-hour period.</td>
</tr>
<tr>
<td>Nine-digit LCD</td>
<td>Displays the meter reading in billing units of measure. The number is shown in odometer style, reading left to right. 1. First four digits - Typical billing digits. 2. Last three digits - Testing units used for meter testing. 3. Fifth and sixth reading digits - Reading units.</td>
</tr>
</tbody>
</table>
Notes
Appendix B: Analytical Tool

This appendix discusses Neptune’s analytical tool called Statistical Evaluation for Enhancement of Revenue (SEER®).

SEER

During its more than 15 years in operation, the Neptune Technology Services Group tested over 10,000 large meters of various makes, sizes, and ages. Neptune ran these test results through a multiple linear regression analysis to determine which factors affected meter accuracy. This analysis showed key variables that impact water meter accuracy.

The result of this study is Neptune’s analytical tool called SEER. The SEER model can determine meter accuracy to within a 95% confidence interval. This allows the utility to quickly determine which meters to replace first and how quickly the resulting increase in revenue pays for the cost of installing a new meter.

Key Features

SEER has several key features.

- Provides analysis for large meters and residential positive displacement meters
- Offers meter accuracy to within a 95% confidence interval
- Highlights misapplication of meters
- Provides reporting functions
- Offers importing and exporting features

Key Benefits

SEER has several key benefits.

- Identifies which meters need attention
- Establishes priorities based on revenue gain and payback
- Allows implementation of targeted revenue enhancement programs
- Indicates possible meter failures, wrong-sizing, and theft
**Benefits to the Utility**

Increased revenue can be used by the utility to focus on:

- Changing out meters
- Managing operating costs
- Improving infrastructure
- Handling rising water demands
- Preventing increases in water rates
- Reducing water loss
- Increasing meter reading efficiencies
- Recovering revenue
- Implementing effective meter maintenance programs
- Increasing resources
- Replacing an aging meter population
- Updating meter databases

**Reporting Function**

Often utilities know that their meters are inaccurate but are not sure of the level of inaccuracy. SEER makes it easy for the utility manager to determine meters that need to be replaced and to set replacement priorities. SEER allows for easy presentation of the information gained from the program. The program allows you to import meter data and capture and import screens into a presentation or a text document. Analysis results can also be exported and printed using the reporting function within SEER.

**Software**

The SEER software can be found on-line at www.neptunetg.com. Each user is required to complete an on-line registration form. Upon approval, the user is granted a level of access to features within the program. Features include SEER data entry, storing of SEER reports, import and export, serial number look-up tables, as well as charting and graphing capabilities.

All registered users have access to the latest desktop version of SEER and it can be obtained at the following link on the Neptune website.

http://www.neptunetg.com/water-meters/online-tools/
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>AWWA</td>
<td>American Water Works Association</td>
</tr>
<tr>
<td>calibrate</td>
<td>Correlated readings of an instrument with those of a standard in order to check the instruments accuracy</td>
</tr>
<tr>
<td>cavitation</td>
<td>Rapid formation and collapse of vapor pockets in a flowing liquid in regions of very low pressure</td>
</tr>
<tr>
<td>crossover range</td>
<td>When the meter transitions from low flow to high flow</td>
</tr>
<tr>
<td>gravimetric</td>
<td>Weighted scale</td>
</tr>
<tr>
<td>reference meter</td>
<td>Known good meters</td>
</tr>
<tr>
<td>meter under test</td>
<td>Meter at the test side for which you are performing the field test</td>
</tr>
<tr>
<td>reference meter</td>
<td>Meter you bring to the test site as a standard that the meter under test is checked against</td>
</tr>
<tr>
<td>SEER</td>
<td>Statistical Evaluation for Enhancement of Revenue</td>
</tr>
<tr>
<td>UME</td>
<td>Unitized Measuring Element</td>
</tr>
<tr>
<td>volumetric</td>
<td>Calibrated tank</td>
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