



TRU/FLO[®] Compound Meter 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.

TRU/FLO® Field Testing Guide

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1 Introduction

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 Considerations

Consider the following before testing the TRU/FLO[®] Compound Meter.

- Perform maintenance according to the American Water Works Association (AWWA) schedule.
- Perform at least three flows per meter, starting at the low flow.
- Run enough water to give one full revolution of the sweep hand.
- Repeat any poor test result.
- Minimize customer disruption by having a spare Unitized Measuring Element (UME) available.
- Verify isolation valve closure.
- Use calibration certificate of the reference meter.
- Clean the strainer.

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.
- Master Meter(s) — known good meter(s).

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.
- Calibrate scale annually.
- Does not require a wet tank.

Master 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 that some reference meters cannot test the full range of a meter.
- 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.

Failed Low Flow Test Can Indicate

Consider the following:

- Damaged throttle valve.
- Damaged o-ring on chamber inlet.
- Damaged main valve assembly allowing bypass.
- Clogged chamber strainer.
- Premature wear.

Failed Medium and High Flow Test Can Indicate

Consider the following:

- Proper straight pipe guidelines were not followed.
- Flawed test procedure.
- Water contains contaminants or foreign material.
- Time to change the UME.
- Testing is not in the crossover range for the meter.

Testing Low to High or High to Low

When testing low to high or high to low, take into consideration the low flow, crossover, and intermediate and high flow scenarios. See Figure 1 on page 4, Figure 2 on page 4, and Figure 3 on page 5.

Low Flow

At low flow, the main valve prevents water from flowing through the turbine measuring element. All water is diverted through the cover into the T-10 chamber and out the throttle tube. See Figure 1.

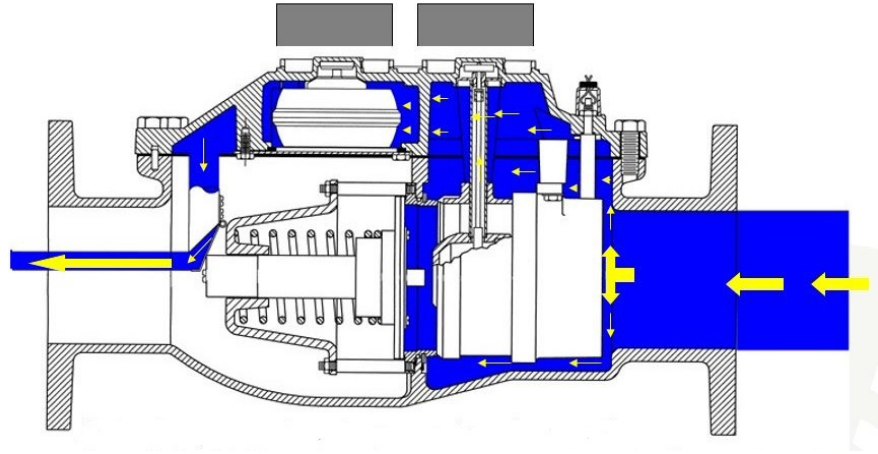


Figure 1 Low Flow

Crossover

The actuation of the valve piston and the subsequent reduction of flow through the T-10 chamber shunts a large volume of water through the turbine measuring element forcing the main valve open. Both the turbine and the T-10 are operating. See Figure 2.

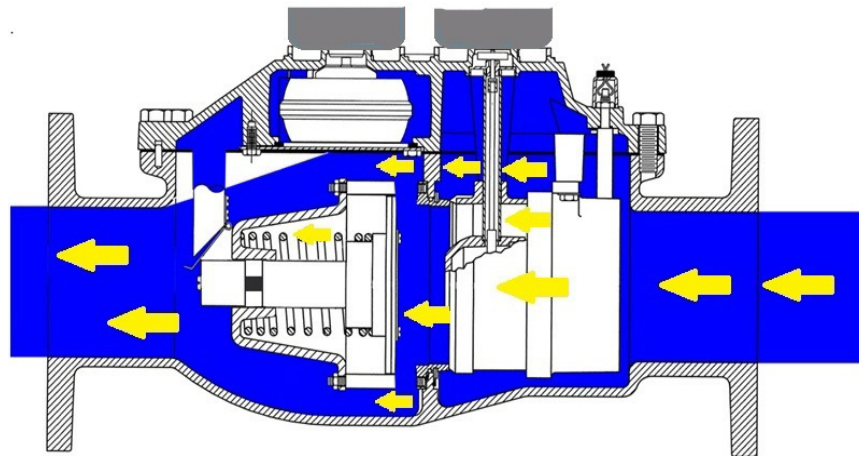


Figure 2 Crossover

Intermediate and High Flow

At intermediate and high flow rates, the main valve is fully open, and the majority of the water flows through the turbine. Water continues to flow through the T-10 at a greatly reduced rate. This helps flush the T-10 while simultaneously ensuring that it does not over-speed. See Figure 3.

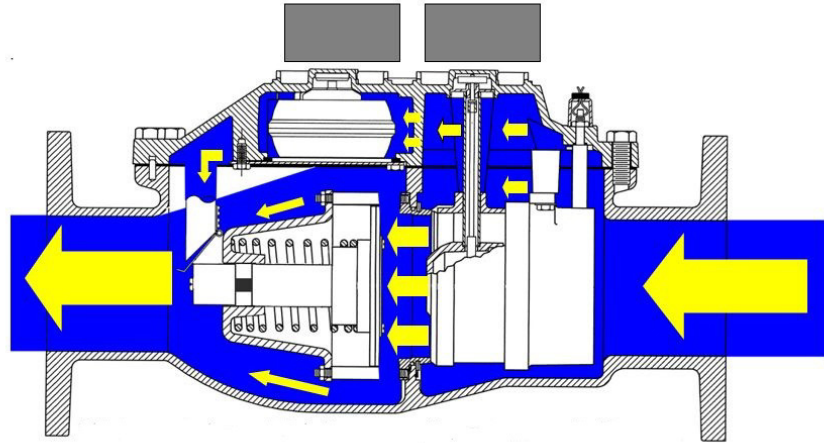


Figure 3 Intermediate and High Flow

Equipment Needed

This section discusses the equipment needed to test the meter.

Recommended Tools

Figure 4 shows the recommended tools you need to perform the field testing on the TRU/FLO compound meter



Figure 4 Recommended Tools

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

Table 1 Recommended Tools

Item	Description/ Recommendation	Use
Tool Kit	Contains standard tools including: <ul style="list-style-type: none">• Pipe wrenches• Crescent wrench• Hammer• Pliers	Various installation procedures performed by the utility
Flashlight		Activate the register LCD
Ladder		Get into a deep pit
Safety glasses		Protect eyes

2 Test Requirements

This chapter provides information on testing the TRU/FLO compound meter.

Required Tests

Testing a compound 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.

Recommended Flow Rates

This section provides recommended flow rates.

Table 2 Recommended Flow Rates

TRU/FLO Test Specification			
Size	Low Flow 95 - 101%	Crossover 90 - 103%	High Flow 98.5 - 101.5%
2	1/4 GPM	7 - 11 GPM	160 GPM
3	1/4 GPM	8 - 15 GPM	320 GPM
4	1/2 GPM	10 - 15 GPM	500 GPM
6	3/4 GPM	25 - 32 GPM	1000 GPM

- Accuracy limits shown in Table 2 were adapted from the AWWA M6 manual.
- Test numbers are adapted from AWWA manual *M6 Fifth Edition*.
- Your specific crossover can have slight variations depending on all elements present in the test setup.
- 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.

Recommended Volume Per Test

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

Table 3 Recommended Minimum Volume (in gallons) Per Test

Size	T-10 Low	T-10 Medium	High Flow
2	10	10	100
3	10	10	100
4	10	10	100
6	10	10	1000

- The volume indicates one sweep hand revolution of a traditional direct read register.
- The High Flow volume is the minimum that the turbine side register should register during the high flow test.
- The turbine side register should not turn for the T-10 Low and T-10 Medium tests.
- The T-10 and the turbine side register should register water for the High Flow test.

3 Preparing to Test

This chapter provides instructions for performing the test.

Test Meters

There are two types of meters used for testing.

- **Reference meter** - The meter you bring to the test site as a standard that the meter under test is checked against.
- **Meter under test** - The meter at the test site for which you are performing the field test.

Preparing the Test Area

Follow your utility's safety procedures at all times. Before you begin the test, be sure you mark off the area around the testing site with safety cones. See Figure 5.



Figure 5 Test Area Marked Off

Connecting the Fire Hose



Figure 6 Connecting the Fire Hose

Complete the following steps to connect the fire hose.

- 1 Install the test riser to the appropriate test port on the meter or in the test port on an inline test tee.
- 2 Connect a fire hose to the test riser. See Figure 6.



Figure 7 Tighten the Connection

- 3 Using a large pipe wrench, tighten the coupling connection. See Figure 7.



Figure 8 Hose Connection on Reference Meter

- 4 Connect the hose running from the outlet of the meter under test to the inlet of the reference meter. See Figure 8.

Opening the Bypass Valve



Figure 9 Opening the Bypass Valve

Complete the following steps to open the bypass valve.

- 1 Use a large pipe wrench to loosen the bypass valve. See Figure 9.
- 2 Continue opening the valve until water is flowing through the bypass.



Figure 10 Checking the Register Dials

- 3 Check the registers on the meter under test to make sure the dials are not moving and the bypass is open. See Figure 10.



- If the dials are moving, continue opening the bypass valve.
- If the bypass is fully open, the registers on the meter should not be registering flow.

Filling Test Equipment



Figure 11 Opening the Test Riser Valve



Figure 12 Filling the Test Equipment



Figure 13 Shutting the Outlet Valve

Complete the following steps to fill the test equipment.

- 1 Slowly open the test riser at the meter under test to start flow to the reference meter. See Figure 11.



This increases pressure at the reference meter. Opening the test riser slowly reduces the risk of damage.



It is important that there are no leaks in the test riser coupling. Even a small leak can affect accuracy. If any leaks exist, repair them before continuing.

- 2 Allow the fire hose to fill the reference meter. See Figure 12.

- 3 When the reference meter is loaded, shut down the valve on the outlet side of the meter under test. See Figure 13.

During this process, slightly open the outlet valve on the reference meter to flush out any air.



Figure 14 Viewing Inlet Pressure Gauge

- 4 Using the inlet pressure gauge on the reference meter, make sure that the reference meter has reached equal pressure with the meter under test. See Figure 14.
- 5 Very slowly open the outlet valve halfway on the reference meter to flush out all air from the test setup. Purging of air occurs for a few minutes.



If the line is filled with air, opening the meter all the way can cause a violent wrenching of the test setup. It is advised to open the valve slowly.



Figure 15 Open Reference Meter Outlet Valve

- 6 After the air has been flushed, open the low side valve of the reference meter to make sure all air is purged from the low side. See Figure 15.
- 7 Close the outlet valve.

At this point, you have flushed all the air from the line and the meter under test is ready to be tested.

4 Testing the Meter

This chapter provides information on testing the meter.

Before Testing

Complete the following steps to test the meter.

- 1 Make sure the inlet valve of the meter under test is in the full open position. See Figure 16.



Figure 16 Checking the Inlet Valve

- 2 Make sure the low and high side valves on the reference meter are closed.
At this point the reference meter is shut off, the water is going around the bypass, and there is no movement through the meter under test.
- 3 Take the initial reading from both registers on the meter under test. See Figure 17.



Figure 17 Initial Reading of the Meter Under Test

Low Flow Test

Complete the following steps for testing the low flow.



Figure 18 Meter Under Test

- 1 Record initial readings from the meter under test and the reference meter.
- 2 Run the low flow test according to the flow rates shown in Table 2 on page 7.
- 3 Open the reference meter valve until you match the flow rate in the table.
- 4 Run the test for at least one revolution of the dial on the meter under test. See Figure 18.



Figure 19 Meter Under Test Low Side Results

- 5 Stop the test by *slowly* closing the valve on the low side of the reference meter.
- 6 Take the final reading from the meter under test. See Figure 19.



Figure 20 Reference Meter Low Side Results

- 7 Record readings for the reference meter. See Figure 20.
- 8 Calculate the accuracy by dividing the consumption registered at the meter under test by the consumption at the reference meter.

High Flow Test



Figure 21 Meter Under Test



Figure 22 Meter Under Test High Side Results



Figure 23 Reference Meter High Side Results

Complete the following steps to record the high flow test results.

- 1 Run the high flow test according to the flow rates shown in Table 2 on page 7.
- 2 Open the reference meter valve until you match the flow rate in the table.
- 3 Run the test for at least one revolution of the dial on the meter under test. See Figure 21.

- 4 Stop the test by *slowly* closing the valve on the high side of the reference meter.
- 5 Take the final reading from the meter under test. See Figure 22.

- 6 Record readings for the reference meter. See Figure 23.
- 7 Calculate the accuracy by dividing the consumption registered at the meter under test by the consumption at the reference meter.



Run an additional test in crossover at your discretion. See Table 2 on page 7 for applicable crossover ranges. If you want to run more low or high flow tests, run them at your own discretion.

After the Test is Complete



Figure 24 Inlet Valve

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 24.



Figure 25 Back-flushing the Meter

- 4 Next slowly open the test riser.
- 5 Open the high side of the reference meter to back-flush the meter. See Figure 25.



Figure 26 Color of Back-flush Water

- 6 Run until the water coming out of the reference meter turns from brown to clear. See Figure 26 and Figure 27.



Figure 27 Clear Water After Back-flush

Breakdown and Cleanup



Figure 28 Test Riser Valve Attached to Meter Under Test

Complete the following steps:

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



Figure 29 High Side Valve on Reference Meter

- 2 Slowly open the high side valve on the reference meter.



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



Figure 30 Isolation Valve - Downstream of Meter Under Test

- 5 Open the isolation valve downstream of the meter under test.

- 6 Close off the bypass valve.



Figure 31 Bypass Valve

Full service is restored to the meter monitoring the site.

- 7 If flow is present, 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 way that this has to be done. The method used must meet the utility's accuracy standards.

5 Troubleshooting

This chapter provides information on how to avoid an unsuccessful 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.

- 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.
- Human error.

- Poor flow profile:
 - Is the install correct? Does the meter have the appropriate amount of straight pipe before and after the meter?
 - Are isolation valves fully open or fully closed as required?
- Leaky test setup.
- Isolation valves allowing water to bypass.
 - Are the isolation valves fully shutoff?
 - Has the reference meter registered more water than the meter under test?
 - Has a failed test occurred? 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.
- 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.

6 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: Strainer Cleaning and Maintenance

This appendix provides information on how to clean and maintain the TRU/FLO strainer.

Cleaning the Strainer

To clean the strainer, complete the following steps.

- 1 First remove the cover.
- 2 Pull the metal strainer out of the body and clean off any build up of debris.
- 3 If there is any debris in the bronze body, clean out the debris.
- 4 Replace the gasket between the cover and the body if necessary.





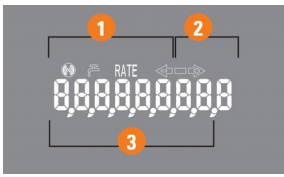
Figure 32 TRU/FLO Strainer

Notes

Appendix B: 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

	Flow/Leak indicator shows the direction of flow through the meter.	
	ON	Water in use.
	OFF	Water not in use.
	Flashing	Water is running slowly/low flow indication.
	OFF	No leak indicated.
	Continuous ON	Intermittent leak indicated. Water used during at least 50 of the 96 15-minute intervals during the previous 24-hour period.
	Continuous ON	Continuous leak indicated. Water used during all 96 15-minute intervals during the previous 24-hour period.
	Nine-digit LCD displays the meter reading in billing units of measure. The number is shown in odometer style, reading left to right.	
	<ol style="list-style-type: none"> 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. 	

Notes

Appendix C: 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.
- 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

AWWA	American Water Works Association
Calibrate	Correlated the readings of an instrument with those of a standard in order to check the instruments accuracy.
Cavitation	The rapid formation and collapse of vapor pockets in a flowing liquid in regions of very low pressure.
Gravimetric	Weighted scale.
Master Meter	Known good meters.
Meter Under Test	The meter at the test side for which you are performing the field test.
Reference Meter	The meter you bring to the test site as a standard that the meter under test is checked against.
SEER	Statistical Evaluation for Enhancement of Revenue.
UME	Unitized Measuring Elements
Volumetric	Calibrated tank.

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