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ABOUT THE E-SERIES ULTRASONIC METER

The Badger Meter E-Series® Ultrasonic meter is an electronic meter using ultrasonic technology and solid-state electronics contained in a compact, totally encapsulated, weatherproof and UV-resistant housing for residential and commercial applications. The ultrasonic measurement system has no moving parts, provides long-term accuracy and eliminates measurement errors due to sand, suspended particles, air pockets and pressure fluctuations.

The Ultrasonic meter can be installed using horizontal or vertical piping, with water flow in the up direction. The meter will not measure flow when an “empty pipe” condition is experienced. An empty pipe is defined as a condition when the flow sensors are not fully submerged.

The Ultrasonic meter for fire service applications (sizes 3/4 in., 1 in., 1-1/2 in. and 2 in.) is intended to comply with the requirements of UL Subject 327B, inferential type water meters used in residential fire service applications. These applications are regulated by local codes and requirements established by the Authority Having Jurisdiction (AHJ).

SAFETY INFORMATION

The installation of the E-Series Ultrasonic meter must comply with all applicable federal, state and local rules, regulations and codes.

Failure to read and follow these instructions can lead to misapplication or misuse of the E-Series Ultrasonic meter, resulting in personal injury and damage to equipment.

PRODUCT UNPACKING AND INSPECTION

Upon opening the shipping container, visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts or any other sign of damage that may have occurred during shipment.

NOTE: If damage is found, request an inspection by the carrier’s agent within 48 hours of delivery and file a claim with the carrier. A claim for equipment damage in transit is the sole responsibility of the purchaser.

REQUIREMENTS

IMPORTANT

For proper handling of the higher reading resolution and the extended status indicator capabilities of the HR-E-Series Ultrasonic meter, the following software versions are required for your reading system:

Reading Data Management Software

- *ReadCenter Data: Version 1.11.12.27 or higher (does not include extended status indicator capabilities)*
- *ReadCenter Analytics and ReadCenter Analytics Mobile: Version 2.12.7.6 or later*
- *ReadCenter Analytics Pro and ReadCenter Analytics+: Version 1.0.0 or later*

Mobile Reading Systems

- *ORS: Version 2.2.1 or later*

Handheld Reading Systems

- *Badger Field Application Suite: Version 2.2.3 or later*
- *ORION Field Application route reading software: Version 2.2.3 or later*
- *ORION Endpoint Utility programming & quick read software: Version 2.2.2 or later*

For assistance, please contact Badger Meter Technical Support at 1-800-876-3837 or the appropriate endpoint provider.

METER STORAGE MODE

All E-Series Ultrasonic meters are delivered in a storage mode so that a meter alarm is not triggered. During storage mode, the empty pipe shows up on the LCD display as an error message, but it will not trigger a meter alarm. The meter needs to sense a full pipe for 24 hours for the meter to go from storage mode to normal operation. If installed when the meter is still in storage mode, the meter will function as expected with the addition of also displaying “err” on the flow rate screen. The meter will display consumption and, if connected to AMR/AMI, will send a reading to the endpoint. When the meter is in normal operation, the meter alarm displays immediately upon detecting the empty pipe condition. The alarm clears immediately after the condition is corrected and the pipe is full. Systems that support the additional alarm conditions will be notified that an empty pipe condition has occurred.

METER PRE-INSTALLATION

Take into account the following considerations before you begin an installation:

- Inspect the piping around the meter for suitable conditions. The service line, valves, connections and meter must be watertight. Repair the piping system if pipes are corroded or damaged.
- Install the meter in the pipeline in a horizontal or vertical position so that the flow arrow on the meter housing points in the same direction as water flow. Registration should be upright and protected from damage, freezing and tampering.
- Position the meter so it is accessible for installation, removal and reading.
- Verify that a suitable, electrical grounding wire is properly attached to the upstream and downstream pipe connections of the meter. The grounding wire provides an alternative path for any electrical current that may exist across the opening in the line.
- Close the curb (shutoff) valve to relieve water pressure in the line before starting the cutting operation. Provide a high-quality upstream shutoff valve with a low pressure drop.
- When cutting into a new section of service pipe, flush the pipe to clear chips, pipe dope or other plumbing residue.
- For the 3/4 in. and 1 in. meters, the line opening for the meter should match the laying length of the meter, allowing slight additional space for coupling gaskets. The inlet and outlet sides of the meter should be axially aligned to the pipe.
- For the 1-1/2 in. and 2 in. meters, the line opening for the meter should match the laying length of the meter. For optimal performance and accuracy, it is also recommended that a minimum of five diameters of straight pipe be installed upstream of the meter.
- The installed meter must not be an obstacle or a hazard to the customer or interfere with public safety.

CAUTION

- **DO NOT ATTEMPT TO USE ANY METER AS A LEVER OR CROWBAR TO STRAIGHTEN A MISALIGNED METER POSITION. THIS COULD DAMAGE THE METER.**
- **DO NOT ATTEMPT TO INSTALL A METER INTO AN OPENING THAT IS TOO LONG BY FORCING THE PIPING INTO PLACE WITH THE METER'S COUPLING NUTS. THIS WILL CAUSE SERIOUS DAMAGE TO THE THREADED ENDS OF THE METER AND HOUSING.**
- **TO AVOID POTENTIAL PROBLEMS, CORRECT ANY IRREGULARITIES IN PIPE SPACING AND MISALIGNMENT BEFORE PLACING THE METER INTO ITS POSITION.**

SPECIAL INSTRUCTIONS FOR REMOVING A METER

⚠ WARNING

THE LINE MUST BE DEPRESSURIZED BEFORE STARTING ANY DISASSEMBLY OPERATION. REMOVING A METER THAT IS UNDER LINE PRESSURE CAN RESULT IN COMPONENTS BECOMING PROJECTILES, CAPABLE OF CAUSING PERSONAL INJURY.

SPECIAL FITTINGS AND ACCESSORIES

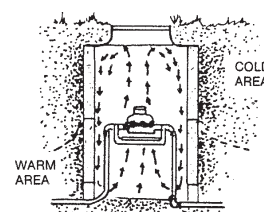
To accommodate installations for 3/4 in. and 1 in. meters, special fittings and accessories are available. Plastic swivel connections are available from Badger Meter to compensate for minor service pipe and position misalignment. Metal meter setters, re-setters, horns and meter yokes are available for holding the service pipe in proper alignment to the meter and laying length spacing. The metal setters and meter yokes can provide an electrical continuity to protect meters and consumers from electrical shocks. Using a meter setter for the 1-1/2 in. and 2 in. is possible—however, be aware that the setter may affect the accuracy of the meter.

INSTALLING E-SERIES ULTRASONIC METERS

Outdoor Installations

When installed outdoors in a meter box, the E-Series Ultrasonic meter should have a 2...3 in. clearance to avoid damage or strain to the service piping or meter, and to accommodate any "settling" that may occur after installation.

The service pipe in the meter box should be properly bedded to ensure that it is not axially misaligned and that it lays evenly on the bottom of the pipe trench. The backfill material covering the pipe should be placed appropriately to maintain pipe alignment in the event of eventual ground shifts. This will prevent damage to the pipe.



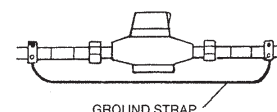
The service lines and the water meter must be protected from freezing. The earth covering the service line must be adequate to prevent frost penetration. Due to the smaller volume of water, service line pipes will freeze sooner than the main distribution line.

The meter box pit should be excavated below the frost line. Even though the meter itself may be positioned above the frost line, the warmer air rising from the earth below the frost line will reduce the possibility of freezing.

Indoor Installations

As a precautionary measure when working with metallic pipes, indoor settings must be checked for electrical continuity through the service pipe before you remove or service a meter. American Water Works Association (AWWA) policy specifies that service pipes must not be used as an electrical ground. Check your local codes and practices. A permanent ground strap or metal setter must be used if electrical grounding to water services is required in your community.

To prevent floor damage, close the valve downstream from the meter before installing or removing a meter.



Installation Instructions

To prepare for meter installation, follow these steps:

1. Close the meter's inlet-side valve.
2. Open a faucet and wait until water flow stops, to depressurize the system. Do not remove the meter until the flow stops.
3. Check valves and make necessary repairs to the curb (shutoff) valve or inlet side valve if necessary.
4. Before installing or removing a meter, close the outlet-side valve to relieve pressure. Protect the area around the meter against potential spills or leaks that could occur.
5. To replace an existing meter continue with Step 6. To install a new meter skip to Step 8.
6. Loosen the meter couplings or flange bolts and remove the meter and the old gaskets in the coupling nuts. You may choose to replace the old gaskets with the provided 9/64 in. thick rubber gaskets.
7. Clean the coupling nuts or flange bolts, removing any pipe dope or dirt from the threads or flange bolts.
8. Check the existing position for proper alignment and spacing. Correct any misalignment or spacing issues.
9. Place the connection gaskets inside the connection coupling nuts.
10. Install the meter in the pipeline in a horizontal or vertical position so that the flow arrow on the meter housing points in the same direction as water flow. Registration should be upright.

11. For 3/4 in. to 1 in. Straight

- a. Start the coupling nuts at the threaded meter ends. Verify that the nuts are properly aligned to avoid cross-threading or damage to the meter ends.
- b. An effective method for starting a coupling nut is:
 - i. Position the nut squarely against the meter's spud end.
 - ii. Turn the nut counterclockwise (in reverse) while holding the nut against the meter spud end. When the first threads on both the nut and the spud end coincide, you will hear a slight click and feel the nut move into the starting position.
 - iii. Tighten the nut by hand until it is "hand-tight."
 - iv. With an open-end wrench, apply a partial turn. Do not over tighten. For plastic swivel connections, a one-quarter turn beyond hand-tight is usually sufficient.

11. For 1-1/2 in. to 2 in. Elliptical Flange Ends

- a. With meter and gaskets in place, tighten the flange connection bolts. Verify the nuts are properly aligned to avoid damage to the flanged ends.
12. After the meter is installed, open the inlet shutoff valve until the meter is full of water and ensure that there are no leaks. (The more flow you allow through the meter, appropriate for the meter size, the better.)
13. Open the outlet valve until air is out of the meter and service line.
14. Open a valve downstream of the meter and verify that no foreign debris in the water obstructs the operations of the system.
15. Make sure the meter is installed with the *flow arrow on the meter pointing in the direction of flow*. Check the read on the meter to make sure it is registering a positive number. If it is not, make sure the meter is installed in the correct direction.
 - a. The meter is sent in Storage mode so that customers do not experience alarms during shipment or installation. In general, a meter may take up to 2 minutes to begin measurement once the meter senses a full pipe.
 - b. The meter itself does not require a quantity of flow to begin measurement, the meter just requires that the pipe is cleared of air and filled with water. If the customer is attempting to purge the meter at low flow rates, it would likely be more difficult and take longer.
16. When the meter starts recording positive flow, note the meter read for your records.

Protect Against Leakage

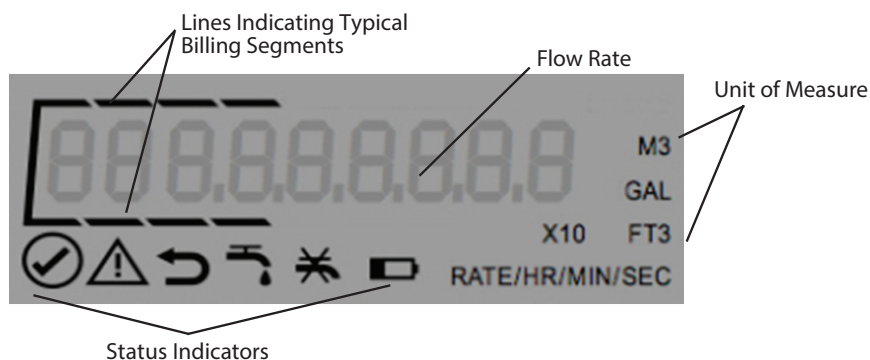
Before turning on the service water, use care to protect against potential leakage.

1. Shut off the valves on both the inlet and outlet sides of the meter.
2. Open the curb (shutoff) valve slowly to pressurize the service line to the meter.
3. Slowly open the meter's inlet-side valve to fill the meter.
4. Check for leaks around the meter and its connections.
5. Slowly open the meter's outlet-side valve to pressurize the consumer side of the system.
6. Open a faucet to allow entrapped air to escape.
7. Once water is flowing normally, turn off the faucet.

E-SERIES ULTRASONIC METER OPERATIONS

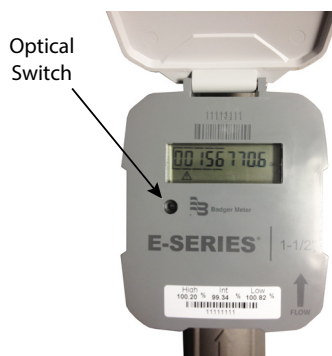
Meter Display

The Badger Meter E-Series Ultrasonic meters use a nine-digit Liquid Crystal Display (LCD) to show consumption, flow and alarm information. See the Status Indicators chart [on page 10](#) for detailed descriptions.



Activating the Display

The Ultrasonic meter's display illuminates when the register cover is opened. After a period of time, the display will revert to sleep mode. You can alternate the display between total flow and rate of flow mode by touching the optical display switch or by closing and opening the meter's lid. The optical switch is located just below the LCD on the left side of the register's face.



Unit of Measure

The unit of measure and resolution are factory programmed and options include gallons, cubic feet and cubic meters.

For 3/4 ... 1 in. meters, totalized flow displays up to 10 million gallons with a resolution of 0.01 gallons, one million cubic feet with a resolution of 0.001 cubic feet or 100 thousand cubic meters with a resolution of 0.0001 cubic meters.

For the 1-1/2 in. and 2 in. meters, totalized flow displays up to 100 million gallons with a resolution of 0.1 gallons, 10 million cubic feet with a resolution of 0.01 cubic feet or one million cubic meters with a resolution of 0.001.

Rate of Flow

The rate of flow is factory programmed for gallons per minute and meters cubes per hour, depending on the unit of measure selected. The LCD displays both the unit of measure and rate of flow. The rate of flow display also serves as the flow finder indicator. The rate of flow display is shown without leading zeros. When rate of flow is displayed it is updated every two seconds.

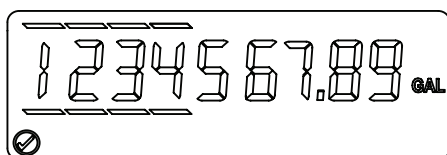
Flow Direction

The direction of water flow is noted on the face of the electronics housing and cast into the meter housing.

Consumption

The consumption display includes all nine digits, including leading zeros and a decimal point. The displayed value is the sum of the forward flow minus the reverse flow. This display also includes indicator lines above and below the digits to provide the electronic equivalent of white and black number wheels on mechanical registers. The following examples show typical displays for three different units of measure:

3/4 in. and 1 in. Meters



Meter reading to the nearest?

100th gallon =	1234567.89
10th gallon =	1234567.8
1 gallon =	1234567
10 gallons =	123456
100 gallons =	12345
1000 gallons =	1234

Typical Billing Units →

1-1/2 in. and 2 in. Meters

Gallons

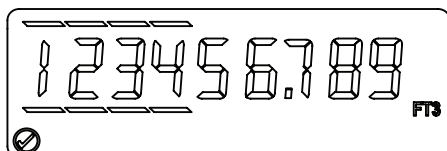


Meter reading to the nearest?

10th gallon =	12345678.9
1 gallon =	12345678
10 gallons =	1234567
100 gallons =	123456
1000 gallons =	12345

Typical Billing Units →

Cubic Feet



Meter reading to the nearest?

1000th ft³ =	123456.789
100th ft³ =	123456.78
10th ft³ =	123456.7
1 ft³ =	123456
10 ft³ =	12345
100 ft³ =	1234

Typical Billing Units →



Meter reading to the nearest?

100th ft³ =	1234567.89
10th ft³ =	1234567.8
1 ft³ =	1234567
10 ft³ =	123456
100 ft³ =	12345

Typical Billing Units →

Cubic Meters



Meter reading to the nearest?

10000th m³ =	12345.6789
1000th m³ =	12345.678
100th m³ =	12345.67
10th m³ =	12345.6
1 m³ =	12345
10 m³ =	1234

Typical Billing Units →



Meter reading to the nearest?

1000th m³ =	1234567.89
100th m³ =	1234567.8
10th m³ =	1234567
1 m³ =	123456
10 m³ =	12345

Typical Billing Units →

AMR/AMI Output

The Ultrasonic meter is an integrated design where the electronics are housed, fully potted and permanently sealed to the meter housing.

Programmed to the high resolution industry standard ASCII encoder protocol, the Ultrasonic meters have the ability to transmit meter status indicators to ORION Cellular, ORION Mobile M, ORION Fixed Network (SE) and ORION ME endpoints as part of the extended encoder/meter reading message. The details can also be read through an IR interface. The output protocol is indicated on the AMR output wire and is determined at the time of order.

The Ultrasonic meter is available with a wired lead, in-line connector or fully prewired to AMR/AMI devices.

Endpoint Reading Resolution

The reading resolution sent to the reading software is dependent on the endpoint to which the Ultrasonic meter is connected. Readings reported from the endpoints are the left-most significant digits of the LCD reading.

Technology	High Res E-Series ADE	E-Series ADE *	E-Series RTR *
ORION Cellular, ORION Mobile M	9 digit reading	6 digit reading	—
ORION Fixed Network (SE)	8 digit reading	6 digit reading	7 digit reading
ORION ME	8 digit reading	6 digit reading	7 digit reading
ORION Classic (CE)	7 digit reading	6 digit reading	7 digit reading
GALAXY	6 digit reading	6 digit reading	7 digit reading
Itron 100W	8/9 digit reading **	6 digit reading	7 digit reading
Itron 100W +	9 digit reading	6 digit reading	7 digit reading

* No longer for sale.

** 100W will transmit 9 digits through Itron's fixed network, but will truncate to the 8 left-most significant digits for standard mobile and handheld readings.

Status Indicators







Indicators and alarms appear in the display as symbols that illuminate when the condition is active and dim when the alarm condition is eliminated.

All E-Series Ultrasonic meters are delivered in a storage mode so that a meter alarm is not triggered. During storage mode, the empty pipe shows up on the LCD display as an error message, but it will not trigger a meter alarm. The meter needs to sense a full pipe for 24 hours for the meter to go from storage mode to normal operation. If installed when the meter is still in storage mode, the meter will function as expected with the addition of also displaying "err" on the flow rate screen. The meter will display consumption and, if connected to AMR/AMI, will send a reading to the endpoint. When the meter is in normal operation, the meter alarm displays immediately upon detecting the empty pipe condition. The alarm clears immediately after the condition is corrected and the pipe is full. Systems that support the additional alarm conditions will be notified that an empty pipe condition has occurred.

For the High Resolution E-Series Ultrasonic meter, ORION SE/ME endpoint firmware version 1.8 or higher is required.

The following chart indicates the E-Series Ultrasonic meter conditions when connected to Badger Meter ORION Cellular and ORION SE, ME, and Mobile M AMR/AMI endpoints.

The chart does *not* apply to ORION Classic (CE) or GALAXY endpoints. The E-Series will display the status indicators, but *Reverse Flow*, *Suspected Leak* and *30 Day No Usage* alarms are determined by the endpoint radio and are not obtained from the Ultrasonic meter.

Status Indicator	Icon	Alarm Description	High Resolution with ORION Cellular, SE, ME or Mobile M endpoints	Encoder Protocol with ORION Cellular, SE, ME or Mobile M endpoints	RTR with ORION SE, ME or Mobile M endpoints
Meter functioning correctly		Meter operating correctly.	Normal operation. Indicator not sent to endpoint.		
Meter alarm		Several potential conditions may exist, including: Empty pipe: "err" displays on LCD. Last known good read is displayed. Alarm clears when pipe is filled. Low Temperature limits exceeded: meter continues to operate but outside specified accuracy range. Alarm clears after 60 days unless alarm condition continues. Maximum flow rate is exceeded. No consumption is displayed until back within specified flow range. Both the meter functioning correctly and the meter alarm are active. Alarms clear after 60 days unless alarm condition continues. Other meter or sensor issue: last known good read is displayed and flow rate displays zero (0) flow. Alarm clears after 60 days unless alarm condition continues.	Consumption data is sent to the endpoint. Meter alarm is also sent.	Meter alarm is sent to the endpoint. NOTE: No consumption data is sent to endpoint when the alarm is active.	Consumption data is sent to the endpoint, except when Exceeding Max Flow alarm is set.
Reverse flow		The meter detects reverse flow and triggers the reverse flow alarm icon on the E-Series display. The alarm remains active for 60 days. The alarm automatically clears after 60 days if the condition has not recurred.	Meter detects reverse flow and sends alarm message to the endpoint.	Meter does not send the alarm. The endpoint detects and reports the reverse flow and will report the read exactly how it is received.	No alarm condition reported by the endpoint will only record positive, forward flow.
Suspected leak		Meter detects 24 hours without one 15-minute interval of no flow. The alarm clears automatically when a 15-minute no-flow interval occurs.	Meter detects suspected leak and sends alarm message to the endpoint.	Meter does not send the alarm. The endpoint detects continuous consumption over 24-hour period and reports suspected leak.	
30 day no usage		No measured flow in past 30 days. The alarm automatically clears once flow occurs.	Meter detects 30 day no usage and sends alarm to the endpoint.	Meter does not send the alarm. The endpoint detects no change in consumption over 30-day period and reports 30 day no usage.	
End of life battery indicator		Indicated battery life based on pre-calculated consumption. Alarm is activated after 19 years and 6 months and does not clear.	Meter sends alarm to the endpoint.	Meter does not send the alarm.	

NOTE: For meters manufactured prior to 5/2017, the meter alarms and reverse flow alarm were set to 35 days.

SPECIFICATIONS

3/4 in. and 1 in. Meters

E-Series Ultrasonic Residential Fire Service Certified under UL 327B Residential Fire Service Meters – File No. 15653, Control No. 4DP3	3/4 in. (20 mm)	1 in. (25 mm)
Normal Test Flow Limits (per UL Listing, at $\pm 1.5\%$ accuracy)	2...30 gpm (0.5...6.8 m ³ /hr)	2...50 gpm (0.5...11.4 m ³ /hr)
Normal Test Flow Limits	0.1...32 gpm (0.02...7.3 m ³ /hr)	0.4...55 gpm (0.09...12.5 m ³ /hr)
Minimum Test Flow Limits	0.05 gpm (0.01 m ³ /hr)	0.25 gpm (0.01 m ³ /hr)
Safe Maximum Operating Condition (SMOC)	32 gpm (7.3 m ³ /hr)	55 gpm (12.5 m ³ /hr)
Typical Pressure Loss	2.0 psi @ 15 gpm (0.14 bar @ 3.4 m ³ /hr)	1.8 psi @ 25 gpm (0.12 bar @ 5.7 m ³ /hr)
Reverse Flow - Maximum Rate	4.0 gpm (0.91 m ³ /hr)	7.5 gpm (1.70 m ³ /hr)
Operating Performance	In the normal temperature range of 45...122° F (7...50° C), new meter consumption measurement is accurate to: <ul style="list-style-type: none"> • $\pm 1.5\%$ over the normal flow range • $\pm 3.0\%$ from the extended low flow range to the minimum flow value 	
Storage Temperature	– 40...140° F (– 40...60° C)	
Maximum Ambient Storage (Storage for One Hour)	150° F (66° C)	
Measured-Fluid Temperature Range	34...140° F (1...60° C)	
Humidity	0...100% condensing	
Maximum Operating Pressure of Meter Housing	175 psi (12 bar)	
Register Type	Straight reading, permanently sealed electronic LCD; digits are 0.28 in. (7 mm) high	
Register Display	<ul style="list-style-type: none"> • Consumption (up to nine digits) • Rate of flow • Alarms • Unit of measure factory programmed for gallons, cubic feet and cubic meters 	
Register Capacity	<ul style="list-style-type: none"> • 10,000,000 gallons • 1,000,000 cubic feet • 100,000 cubic meters 	
Totalization Display Resolution	<ul style="list-style-type: none"> • Gallons: 0.XX • Cubic feet: 0.XXX • Cubic meters: 0.XXXX 	
Battery	3.6-volt lithium thionyl chloride; battery is fully encapsulated within the register housing and is not replaceable; 20-year battery life	

1-1/2 in. and 2 in. Meters

E-Series Ultrasonic Residential Fire Service Certified under UL 327B Residential Fire Service Meters – File No. 15653, Control No. 4DP3	1-1/2 in. (40 mm)	2 in. (50 mm)
Normal Test Flow Limits	1.5...100 gpm (0.34...22.7 m³/hr)	2...160 gpm (0.45...36.3 m³/hr)
Minimum Test Flow Limits	0.40 gpm (0.09 m³/hr)	0.50 gpm (0.11 m³/hr)
Safe Maximum Operating Condition (SMOC)	100 gpm (22.7 m³/hr)	160 gpm (36.3 m³/hr)
Typical Pressure Loss	3.8 psi (0.26 bar)	5.2 psi (0.36 bar)
Reverse Flow - Maximum Rate	12 gpm (2.73 m³/hr)	18 gpm (4.09 m³/hr)
Operating Performance	In the normal temperature range of 45...122° F (7...50° C), new meter consumption measurement is accurate to: <ul style="list-style-type: none"> • ±1.5% over the normal flow range • ±3.0% from the extended low flow range to the minimum flow value 	
Storage Temperature	– 40...140° F (– 40...60° C)	
Maximum Ambient Storage (Storage for One Hour)	150° F (66° C)	
Measured-Fluid Temperature Range	34...140° F (1...60° C)	
Humidity	0...100% condensing	
Maximum Operating Pressure of Meter Housing	175 psi (12 bar)	
Register Type	Straight reading, permanently sealed electronic LCD; digits are 0.28 in. (7 mm) high	
Register Display	<ul style="list-style-type: none"> • Consumption (up to nine digits) • Rate of flow • Alarms • Unit of measure factory programmed for gallons, cubic feet and cubic meters 	
Register Capacity	<ul style="list-style-type: none"> • 100,000,000 gallons • 10,000,000 cubic feet • 1,000,000 cubic meters 	
Totalization Display Resolution	<ul style="list-style-type: none"> • Gallons: 0.X • Cubic feet: 0.XX • Cubic meters: 0.XXX 	
Battery	3.6-volt lithium thionyl chloride; battery is fully encapsulated within the register housing and is not replaceable; 20-year battery life	

MAINTENANCE

The Badger Meter E-Series Ultrasonic meters are designed and manufactured to provide long-term service with no maintenance. The enclosure, which includes the electronic meter's ultrasonic sensors, battery and display, is completely potted, permanently sealed and non-removable.

SMART WATER IS BADGER METER

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