

This Badger® E-Series™ Meters Frequently Asked Questions (FAQ) is intended for Badger Meter personnel and distributors. This FAQ contains information that is *Confidential – For Internal Use Only*. This information is subject to change.

Ultrasonic Measurement Technology

Why are we using ultrasonic measurement technology?

Ultrasonic flow meters have been used commercially since the 1970s. They have primarily been used for large metering applications, such as raw water and treated water in various stages of the treatment process, and for custody-transfer applications. Ultrasonic meters have been accepted in large metering applications, including water applications and a variety of liquid, oil and natural gas applications.

Improvements in signal processing, piezoceramic transducers and computer technology have made ultrasonic meters suitable for small metering applications.

Ultrasonic meters offer the following advantages over mechanical meters:

- Wide measuring range or turndown (maximum flow/ minimum flow)
- High accuracy sustained over the meter's life
- High repeatability
- No moving parts to wear out
- Negligible pressure drop
- Unaffected by particles in the water and liquid deposits
- Minimal maintenance

How does an ultrasonic meter work?

An ultrasonic flow meter is an inferential device. It uses ultrasonic transducers to measure the velocity of the liquid or gas moving through a pipe. Volume is calculated by multiplying the measured velocity by the area of the cross-section of the pipe.

The ultrasonic signal's velocity measurement is affected by the temperature and the density, or viscosity, of the liquid or gas. These factors must be known and factored into the calculations. The flow must have minimal change in direction and minimal turbulence for the velocity measurement to be accurate.

Liquid and gas metering uses two ultrasonic technologies:

- **Doppler Shift** – measures the difference in frequency of the sound wave reflected off acoustic discontinuities or particles in the flow stream. Doppler shift is well suited for dirty water applications where suspended particles exist.

- **Transit Time** – measures the time differential between an ultrasonic signal sent upstream and a corresponding signal sent downstream. The time differential increases as flow increases. Transit time is well suited for clean water where minimal, suspended particles exist.

E-Series meters use transit-time ultrasonic technology.

Customer Benefits

What are the primary benefits of the E-Series meter?

The benefits of the E-Series meter for utility, small metering include:

- Long-term sustained accuracy (within ±1 percent).
- No moving parts — virtually eliminates mechanical wear.
- 20-year battery life — provides extended life as compared to mechanical meters.
- Wider measuring span than a positive displacement (PD) meter, including both a lower extended low-flow rate and a higher continuous flow rate.
- Display resolution of consumption to the hundredths of a gallon.
- Very low meter start-flow rate — can capture small leaks.
- Totally potted meter, including electronics, battery and display; virtually no maintenance.

As a result, a utility might achieve these **financial benefits**:

- **20-Year Life** — Potential to eliminate one meter change-out (cost of meter plus installation labor).
- **Long-Term Accuracy** — Minimize lost revenue.
 - Typical residential meter measures 127,400 gallons or 170 CCF per year.
 - If rates are \$2.00 per CCF, annual water cost is \$340 per year.
 - Over 20 years, a meter measures 2.54 million gallons, worth \$6,800 in revenue.
 - 1 percent error = \$68 unbilled
 - 5 percent error = \$340 unbilled
 - 10 percent error = \$680 unbilled
 - Increased revenue would depend on the type, condition and age of meters presently in use.
 - Lost sewer revenue could be the same or greater than the lost water revenue.

Regulatory Standards

Is there an American Water Works Association (AWWA) standard for small ultrasonic meters?

There is no AWWA standard for small ultrasonic meters. A volunteer committee is developing a standard for "static residential meters," similar to C700. This is expected to take several years to complete.

The E-Series meter was designed to exceed AWWA C700-02 standards for accuracy, repeatability, pressure loss and other applicable standards. **Note: There are two AWWA standards that exist but do not apply:**

- AWWA C713-05 *Fluidic Oscillator Meters*, which is a form of static metering.
- AWWA C750-03 *Transit-Time Flowmeters*, which applies to very large metering (non-billing) applications.

Does the E-Series meter comply with NSF-61 or Annex G?

The E-Series meter was designed to comply with National Sanitation Foundation (NSF) testing; NSF-61 testing is in process. Annex G certification first requires NSF-61 certification. We expect the E-Series meter to be certified under both standards.

Will the E-Series meter be certified for residential fire service?

UL327A, *Inferential Type Residential Water Flow Meters*, addresses meters used for residential fire service. UL is testing the E-35 and E-55 meters and we expect certification.

Product Features and Specifications

How does the measuring span (turndown) of the E-Series meter compare to an equivalent size Recordall® meter?

The E-Series meter has a much wider measuring span. The minimum extended low flow ratings of the E-Series meter are better than the equivalent Recordall meter, and the maximum continuous flow rates are higher.

What alarms are available?

Alarms indicated on the meter's display include:

- Meter operating properly
- Meter alarm/error
- Reverse flow
- Suspected leak
- No flow over 30 days
- Battery end of life

The meter alarm/error is triggered by several conditions, including an empty (less-than-full) pipe, low temperature or transducer (sensor) problem. All of the standard alarms that the AMR module provides today will be available when connected to an E-Series meter. Battery end-of-life indication can also be addressed through a spreadsheet noting serial numbers and date of manufacture.

What is the resolution of the meter display?

The display has nine digits, which allow visual resolution of the consumption value to the hundredths of a gallon (0.XX) or to the thousandths of a cubic foot (0.XXX). The AMR output, however, uses the conventional consumption string (and resolution) since the transmitters and data collection equipment are not configured to handle the meter's finer resolution. For the near term, E-Series meters will provide the same standard outputs that our ADE® and RTR® registers/encoders provide with conventional meters:

- ADE — Six-digit output
- RTR — Seven-digit output

How do I relate the LCD display to a conventional register with white and black number wheels? How do I read the display?

The display contains nine digits and a decimal point. The decimal position depends on the unit of measure as specified on the customer order. The unit of measure is programmed during manufacturing. At the LCD, there are lines above and below the digits that represent the "white wheels" on a conventional register.

Examples of typical displays for three different units of measure:

Gallons

| | | | | | | | | |
|---|---|---|---|---|---|----|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7. | 8 | 9 |
|---|---|---|---|---|---|----|---|---|

Visual meter reading for typical consumption/billing purposes: 1234 thousands of gallons.

Detailed visual meter reading with full display resolution: 1,234,567.89 gallons.

Cubic Feet

| | | | | | | | | |
|---|---|---|---|---|----|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6. | 7 | 8 | 9 |
|---|---|---|---|---|----|---|---|---|

Visual meter reading for typical consumption/billing purposes: 1234 hundreds of cubic feet.

Detailed visual meter reading with full display resolution: 123,456.789 cubic feet.

Cubic Meters

| | | | | | | | | |
|---|---|---|---|----|---|---|---|---|
| 1 | 2 | 3 | 4 | 5. | 6 | 7 | 8 | 9 |
|---|---|---|---|----|---|---|---|---|

Visual meter reading for typical consumption/billing purposes: 12345 cubic meters.

Detailed visual meter reading with full display resolution: 12,345.6789 cubic meters

Can the meter be built with AMR? Can I upgrade to AMR later?

Standard remote Badger Meter ORION® and GALAXY® transmitters can be factory wired and programmed as usual. Note that an in-line connector is required if AMR is not selected at the time of the customer's order. Once a meter is built, it cannot be modified, so the in-line connector facilitates an upgrade to AMR.

Can the rate of flow and water temperature be transmitted?

Rate of flow and temperature data is captured in the E-Series meter memory. However, the data structure of the message sent to the ORION and GALAXY transmitters does not accommodate rate of flow or temperature. This will be considered for future releases.

What are the lay lengths?

E-25 and E-35 — 7-1/2 inches

E-55 — 10-3/4 inches

Is there any way to lock down the register cover?

There is no provision to lock the lid.

What period of time triggers the no flow alarm?

The algorithms for leak suspicion and 30-day no flow is the same as that used with the ORION system. Leak suspicion monitors for one hour of no flow during a 24-hour period.

How does the low-battery alarm display?

Battery alarm is actually an “end-of-life” alarm and will be based on a calendar function starting with the date the meter is assembled. The trigger will be 19-1/2 years after the assembly date.

Will there be additional meter sizes? What about a 5/8-inch x 3/4-inch meter?”

We plan to develop larger meter sizes. A 5/8-inch x 3/4-inch meter will be released in the near term. However, a comparison of the 5/8-inch x 3/4-inch Recordall meter and the E-35 3/4-inch meter shows that the E-35 has better ratings for both the minimum, extended low-flow rate and the maximum continuous flow rate. The E-35 might be a better value.

Is there an optional 4-20 ma output?

No, nor is one planned.

How does the E-Series meter compare to typical PD meters?

Compared to a typical PD meter of the same size, an E-Series meter offers:

- Greater operating flow range
- Greater display resolution
- Lower extended low-flow limit
- Greater maximum continuous flow limit
- Tighter operating accuracy
- Reverse-flow capability
- Display of flow rate
- Higher operating temperature
- Smaller dimensions
- Lighter weight
- Potentially longer life

Applications**What is the temperature rating of the meter?**

The E-Series is a cold-water meter. The operating temperature of the meter and its electronics is 14° F to 140° F (-10° C to 60° C). There are no plans to develop a version for hot-water applications.

Will air in the line affect this meter?

A partially filled pipe will cause the meter to stop working and the alarm to trigger since water is needed for the ultrasonic signal. However, small air bubbles should not affect the meter. Bubbles will normally be at the top of the flow tube and the transducers are on the side, with the ultrasonic path running down the center of the tube.

Will a magnet cause any issues for the electronics?

There is nothing in the meter's circuit that a magnet would affect.

Will water-borne material and chemicals start to build up on the ultrasonic reflectors? Is accuracy affected?

The E-Series meter's basic design has been used in Europe as a hot-water meter for closed-loop systems, which are known to have scale and other chemistry issues. The reflectors and flow tube feature a unique, patented design, which allows the water to flow through the meter while keeping the reflectors clean.

The metering insert positions the stainless-steel ultrasonic reflectors in the center of the flow area to provide a turbulence-free flow of water through the tube and around the reflectors. The metering insert's patented design virtually eliminates chemical buildup on the reflectors, providing long-term accuracy. Note that the reflectors are not “mirrors” and the ultrasonic high-frequency signal is not an optical signal. Ultrasonic reflection can occur even if the stainless steel is coated with foreign material.

What other environmental issues might affect an ultrasonic meter's performance?

Ultrasonic technology has been applied to a variety of liquid and gas metering for over 40 years. As a result, much is known about performance issues. Some of the same issues might affect small meters for potable water. The E-Series meter's design has taken these into account.

• Measurement errors could occur if:

- The meter is not properly programmed for the liquid or gas being measured.
- The flow tube's cross section is reduced by chemical buildup.
- Water turbulence exceeds the meter's designed tolerance.

• Other potential issues include:

- Vibrations (acoustic noise) in the piping at the same frequency as the ultrasonic signal causing interference with the signals and creating measurement errors.
Since the ultrasonic signal is one MHz, it is highly unlikely vibrations at this frequency would occur. No such issues have been found in testing nor during regular use.

- Particles greater than two millimeter blocking the flow tube and/or creating turbulence.

The E-Series meter is more tolerant of particle intrusion than any product we make other than a mag meter.

- Installing the meter backwards causing an accuracy error.
The reverse-flow indication will show on the display as soon as the meter sees the reverse flow. As long as the flow rate is less than the maximum reverse-flow stated in the product specification, the meter will measure the flow, but at reduced accuracy. If the flow is greater than the stated maximum, the meter will be inaccurate.

- Temperatures beyond the specific range causing errors in the measurement and/or damage to the electronics.

The specifications are defined to allow the electronics to survive as well as the algorithm to properly adjust the measured velocity. Temperatures outside the range can cause accuracy issues.

- Air in the line interfering with the ultrasonic signal path and/or accurate velocity measurements.

If the pipeline is full of air, the meter will not register flow and will report an empty pipe error. For entrained air, the ultrasonic signal is relatively unaffected, but the meter could read a higher flow than the actual value since air is displacing water in the flow tube.

The E-Series meter is designed to either eliminate these issues or be unaffected by them. The actual effects would depend on the severity of the environmental issues.

Can the meter be used for other applications?

The E-Series meter is designed for potable, water-billing applications and residential fire service and reclaimed water. Industrial applications are not appropriate since the E-Series meter lacks features such as: ultrasonic algorithms for other liquids, extended temperature range, 4-20 ma output, serial outputs and pulsed outputs with finer resolution than one gallon/pulse.

Compatibilities

Is the E-Series meter touch-pad compatible?

No. While the E-Series meter supports ADE or RTR output protocol, it does not function with a touch pad.

Is the E-Series meter compatible with our 308 in-line connector?

Yes. The in-line connector is required if a factory-wired AMR endpoint was not ordered with the meter. There is no way to add the connector, so the in-line connector will be included when the meter is built. This will allow for a future AMR upgrade.

Is the Itron ERT compatible?

Not initially. The output of the E-Series meter is factory-programmed to be either that of an ADE or RTR. Both are compatible today with Itron. However, Itron will test the meter for compatibility before approving connectivity. We expect this to occur in the near term.

Can the splitter be used with the meter? Does it have an impact on battery life?

The splitter will work with the E-Series meter as long as the meter is built with the RTR protocol. Since the splitter has its own battery, there is no impact on the E-Series meter's battery.

How often does the E-Series meter update the meter reading of the AMR module?

The E-Series meter updates the AMR in exactly the same way as does a standard meter/register. With the RTR, the update is continuous. With the ADE, there is a one-hour latency period.

Packaging/Labeling

How will the customer know if the unit is programmed as RTR or ADE?

The lead wire from the meter to the AMR or 308 in-line connector is labelled to indicate either RTR or ADE.

How are E-Series meters packaged?

Assuming an AMR module is included with the meter:

E-25 and E-35 meters are packed six pieces per box — 16 boxes per pallet — 96 meters per pallet.

E-55 meters are packaged four pieces per box — 20 boxes per pallet — 80 meters per pallet.

Where is the Badger Meter serial number located?

The serial number is engraved on the outside of the lid and on the face of the meter (under the lid). There is the option for a "piggyback label" on the inside lid using either the Badger Meter serial number or a customer-supplied, 10-digit maximum, numeric serial number. The date of manufacture is engraved on the meter's face in MMY format.

Service Programming

Is there a field programming/service tool?

No. Since the E-Series meter cannot be repaired, a field service tool would serve no purpose.

What gets programmed at the factory?

All programming is done at the factory, during manufacturing. This includes:

- Register output protocol (ADE, RTR)
- Units of measure
- Visual billing resolution

These options need to be defined at the time of the order.

If the register is damaged, is it possible to get a reading?

Data can be read from a register at our facility, using a standard IR cable and appropriate software. However, a device that can read data from a register in the field is not available.



Please see our Web site at
www.badgermeter.com
for specific contacts.



BadgerMeter, Inc.

P.O. Box 245036
Milwaukee, WI 53224-9536
800-876-3837

infocentral@badgermeter.com • www.badgermeter.com