



Memo

To: Clay Pearson, City Manager
From: John Hines, Distribution & Collections Superintendent
CC: Trent Epperson, Assistant City Manager
Clarence Wittwer, Public Works Director
Eric Hammond, Assistant Director of Public Works
Date: February 2, 2021
Re: Meter Testing

Executive Summary

The purpose of this memo provides information related to water meter testing and an overview of tests conducted upon request, since February of 2020.

Highlights

The City Council awarded a contract for a Water Meter Change Out Project in October of 2017 to ITRON. That project included the replacement of water meters (5/8" through 8") within the City, due to the varying age of the assets and over 60% of the meters being in excess of 10 years old. American Water Works Association (AWWA), the guidance agency at the national level, has a standard to replace water meters when they are over 10 years old or more than 1.0 million gallons of water have passed through the meter. During the development of the meter change out program, the City elected to transition from a mechanical water meter, which utilized moving parts within the meter to measure water consumption, to a solid state (electronic) meter which had no moving parts. Previous technology that utilized moving components to measure water often resulted in worn or damaged parts over time which slow the meter down and leads to less accurate water measurement. Another component of the meter change out project includes the transition to the advanced metering infrastructure (AMI) that will facilitate the automated reading and communication of real-time water meter data from the source to the Utility Billing Department.

Water meter testing is a component of public water system management. With exception to large water meters which are tested annually, small meter testing has been provided on an as needed bases prior to and throughout the meter change out project.

Detail

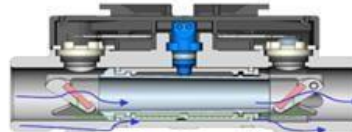
Water meter operations - As part of the meter change out process, the City transitioned from traditional mechanical water meters such as positive displacement and compound meters to a more advanced solid-state electronic meter (no moving parts). Traditional water meters measured consumption based on moving parts within the meter that calculate the flow of water through the use a specific sized chamber and magnets to spin the dials. Thus relying on parts that wear over time, resulting in less accurate measurement of water consumption. The wearing of moving parts reduces the original tolerances of the moving parts which often leads to the reading of less water flow, which is why an increase in consumption is often realized when a new meter is installed. Solid state water meters have no moving parts and measure water consumption by sending a signal up and downstream within the meter tube to calculate the usage utilizing a signal to measure the velocity of the water measured over a specific distance and time. The image below captures the water consumption measuring process.

Image of Water Consumption Measurement Process



Ultrasonic Measurement Technology

- E-Series Ultrasonic meters use transit-time technology
- How it works:
 - Measures the time **differential** between **signal sent upstream** and a corresponding **signal sent downstream**. The **differential** is directly **proportional to the velocity** of the water.
 - Internal clock calculates the time between the two, and since the distance is known, the microprocessor can calculate the velocity
 - $\text{Velocity} \times \text{Cross Section Area} = \text{Volume}$



Water meter testing - The intent of water meter testing is to insure the accuracy of the meter's ability to measure water consumption within the parameters of the AWWA standards. The process of testing begins when the meter is manufactured. As soon as the meter has been assembled, it passes through a water meter testing process as recommended by AWWA. This testing is intended to ensure the meter meets all minimum AWWA parameters for performance, prior to distribution and installation into the water system. Confirmation of this manufacturer's testing is attached to each meter by both serial number reference and via the barcode with testing results affixed to each meter. An example of this sticker is included in the image below.

Image of Badger Water Meter with Barcode & Testing Results at time of Manufacture



Testing Parameter – There are three basic elements of a water meter test to verify accuracy of the meter

- Three different rates of flow over the operating range of a meter are required to determine overall meter efficiency.
- The quantities of water necessary at the various test rates to provide reasonable resolution of meter registration accuracy.
- Accuracy limits that meters must meet on the different rates to be acceptable.

As indicated in the bullet points above, water meter testing is based on three flow rates that are dictated based on meter size. These rates are known as Maximum, Intermediate & Minimum Rates and allow for verification of accuracy based on standard water consumption situations. Meters must test within the listed thresholds for each flow rate and accuracy percentage then

receive a total resulting score of +/- 1.5 percent to pass the testing and be returned into service. A table of testing parameters based on meter size has been provided for reference below.

**Electromagnetic and Ultrasonic Meters for Revenue Applications,
Type I (ANSI/AWWA C715)**

Size	Maximum Rate (All Meters)				Intermediate Rate (All Meters)				Minimum Rate (New and Rebuilt)				Minimum (Repaired)
	Flow Rate†		Test Quantity††		Flow Rate**		Test Quantity††		Flow Rate‡‡		Test Quantity††		Accuracy Limits
	in.	gpm	gal	ft³	percent	gpm	gal	ft³	percent	gpm	gal	ft³	percent
1/2	8	100	10	98.5–101.5	0.35	10	1	98.5–101.5	0.11 (0.18)	10	1	95–105 (98.5–101.5)	—
5/8	15	100	10	98.5–101.5	0.4	10	1	98.5–101.5	0.13 (0.20)	10	1	95–105 (98.5–101.5)	—
3/4	25	100	10	98.5–101.5	1	10	1	98.5–101.5	0.15 (0.5)	10	1	95–105 (98.5–101.5)	—
1	40	100	10	98.5–101.5	1.5	10	1	98.5–101.5	0.3 (0.75)	10	1	95–105 (98.5–101.5)	—
1½	60	100	10	98.5–101.5	4	100	10	98.5–101.5	0.6 (2)	100	10	95–105 (98.5–101.5)	—
2	100	100	10	98.5–101.5	5	100	10	98.5–101.5	1 (2.5)	100	10	95–105 (98.5–101.5)	—
3	200	500	50	98.5–101.5	15	100	10	98.5–101.5	2.5 (7.5)	100	10	95–105 (98.5–101.5)	—
4	400	1,000	100	98.5–101.5	20	500	50	98.5–101.5	3.5 (10)	300	40	95–105 (98.5–101.5)	—
6	800	2,000	200	98.5–101.5	40	1,000	100	98.5–101.5	9 (20)	300	40	95–105 (98.5–101.5)	—
8	1,000	5,000	500	98.5–101.5	80	3,000	400	98.5–101.5	18 (40)	2,000	300	95–105 (98.5–101.5)	—

Testing Frequency – The City's current testing protocol is to test large meters (3" – 8") on an annual basis as recommended by AWWA. Small water meters (5/8" - 2") are tested upon request of the customer or at any moment the City determines an issue may have arisen. At this time, the City has an informal testing process but doesn't have a formal meter testing policy. Staff utilize the outlined procedure to monitor the meter accuracies. However, with the installation of the new electronic meters, the City is in the process of developing a formal meter testing policy and establishing standards for meter testing for these types of meters. It is envisioned that this will include the annual testing of all large meters and expand meter testing to include an annual testing of a random sample of small meters. It should be noted that the State of Texas has not adopted a standard for water meter testing frequency and as such the City has historically provided testing via the frequency listed above.

Testing Process – To provide water meter testing, the City Council awarded a contract (R2019-75) with Southern Flow Meters to provide meter testing on an as needed basis. As mentioned, with exception to large water meters which are tested annually, meter testing is conducted based on the request of a customer or as directed by staff when a concern is realized in the field.

When meter testing is required for small meters (5/8" - 2"), a City staff member visits the meter location, pulls a profile and manually removes the meter from the ground/out of service. Immediately and to ensure uninterrupted services, a temporary meter is installed in the location and service remains in place for the customer. The meter to be tested is then provided to Southern Flow Meter (Third Party Contractor) who conducts testing services based on the requirements in the contract and the AWWA standard testing requirements. The tests are

conducted on a calibrated and certified test bench that uses a two-step testing method to measure the accuracy of the meter. The test is conducted by installing the meter onto a test bench and passing water through the meter before passing the same water through an in-line meter that has been calibrated and certified annually for accuracy. The readings from each meter are then compared to ensure they captured the same consumption based on the testing parameters. The second step or confirmation of results is based on a volumetric measuring process that occurs after the consumed water passes through both meters and discharges into a container. This container is mounted to a scale that is also calibrated and certified annually. The weight of water is then converted into volume and compared against the two water meters.

Meter Testing Results – Since February, the city has tested 38 new water meters, with 5 receiving initial test results below the allowable tolerances at the maximum flow rate. If a new meter tests outside the required accuracy limits, the meter is returned to the manufacturer under warranty and a new meter is installed. One of the five meters was tested in April of 2020 and replaced under warranty. The other four were tested within a short span in December 2020. Being new factory calibrated meters, staff questioned the validity of the results from the December batch, resulting in Southern Flow Meters recalibrating and certifying their equipment. When retested, the four meters were found to be within the required accuracy limits.

In summary 37 of 38 meters tested were within the required accuracy limits (+/- 1.5%) with a single meter testing at 97.8% being replaced under warranty.

A spreadsheet capturing all meter testing results has been attached to the end of this document. Additionally, because all identifying meter location and account information have been removed from the testing spreadsheet, a map of meter test locations has been provided to illustrate the community wide request for meter testing.