



*ZENNER – BANNING FACILITY*

*WATER METER TESTING*

*REPORT AND ANALYSIS*

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## EXECUTIVE SUMMARY

### INTRODUCTION

In early 2019, the customer service center for the Utilities Department began receiving an increased number of calls related to unusually high-water bills. This eventually developed into a significant issue for the City and several residents. Internal Audit decided to perform a water meter process review to attempt to determine the root cause of the issues which caused the widespread customer concerns. The review was divided into phases and a process review of meters at the Zenner facility in Banning, CA was conducted as a part of the review to attempt to understand the major aspects of meter functions and any relationship to the issues that customers experienced.

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### BACKGROUND

In 2017, after a competitive bidding process, the City of Fort Smith accepted a bid from Zenner to purchase approximately \$1,222,503 positive displacement type (PD) water meters in sizes 5/8, 3/4, 1", 1 1/2", 2", and turbines or Ultrasonic in 3" and 4" meters to replace the city's water meters.

The City of Fort Smith did not have a calibrated meter bench equipment that could be used on the new meters purchased from Zenner and the meter bench does not test all meter sizes. Therefore, Internal Audit made arrangements to test the meter calibration of a sample of Zenner meters at the City of Fayetteville water department. The testing indicated an unacceptable number of meters with inaccurate flow readings. After this was reported to the City Administration by Internal Audit the Utility Director and the City Administrator decided to send meters to a Mars facility to be tested independently. Mars is a company that test water meters and sells meter benches.

According to the discussions with the Utility Director, he was not satisfied with the handling and the testing of the meters by Mars. The Utility Director and the City Administrator then called and spoke with the Zenner management team and an agreement was made to send 1,028 meters to Zenner's Banning, California facility for testing. Zenner paid for the travel of the Utility Deputy Director and two of the Internal Audit (IA) team members to observe the Zenner testing process. The City sent 810 PD 5/8 meters, 55 PD 3/4 meters, 133 PD 1" meters, 6 PD 1 1/2" meters, and 24 PD 2" meters.

Internal Audit observed the first two tests and then physically performed with the meter testers all of the following testing. The meter testers set up a worksheet on the computer that allows for the bar code on the meter to read into the sheet so that there are no human errors. IA scanned in the serial numbers from the bar code on the meters and the meter tester entered the water temperature. Next the meter tester reads the register and enters the information into a hand held device. After each read and entry, the meter tester will verify that the number was entered correctly and no extra numbers or decimals were entered that would cause the reading to not calculate correctly. After the reads are entered, the meter tester will purge the system to ensure that all air bubbles are removed that could cause the meters to not register the flows correctly.

The high flow test is conducted first, next is the medium flow, and last is the low flow. Each time the flow is complete, the registers are read and the numbers are entered into the spreadsheet. If the meter passes the test set up in the testing equipment for minimum and maximum variance, the column with the meter percentage will turn white if the test fails the column stays gray. The Banning facility follows the AWWA standards and there is an AWWA allowable standard of deviation. (See the attached chart for the allowable AWWA allowable standard of deviation). If the meter fails, the meter will be tested on another testing bench. The spreadsheets are maintained by the meter tester by the serial numbers, date and their name.

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## ***AUDIT SCOPE AND OBJECTIVES***

The engagement scope considered activities and transactions related to the Water Meter Testing and the Zenner Facility meter process.

Our audit objective, as refined during research and the risk assessment process occurring throughout the course of our work, was focused on the following objectives.

1. To determine if the Utilities Department meter implementation was mapped out and proper procedures in place to provide guidance and steps of meter process.
2. To determine if the Utilities – Meter Department have proper procedures in place for returning inoperable meters and documentation of meter issues.
3. To determine if meters are properly calibrated prior to installation and maintained in the manner required to ensure the water flow measurements are accurately captured.
4. To understand the Zenner facility meter process and determine if they followed the bid specifications and AWWA standards.

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## ***PROCEDURES PERFORMED***

To obtain sufficient evidence to achieve audit objectives and support our conclusions, we performed the following:

### **Planning**

- Conducted kick-off meeting with Zenner Management, Utilities Management and Internal Audit;
- Conducted interviews and process walkthroughs with key individuals managing the Water Meter Testing.
- Identified potential areas for process improvements and control gaps;
- Refined work plan based on risks, standards, and processes, and developed test plans; and
- Requested the list of meters sent to Zenner, and results from Mars testing.

### **Fieldwork**

- Performed independent water meter testing on sampled meters to determine if meters were calibrated according to AWWA standards.
- Examined test results of sampled meters to determine if meters are periodically testing as part of the City's Water Meter Testing and Maintenance Program.
- Documented findings and confirmed with management.

### **Reporting**

- Prepared a draft report to include testing results and recommendations
- Discussed draft findings with management.

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## ***AUDIT METHODOLOGY***

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We conducted this performance audit in accordance with Generally Accepted Government Auditing Standards and in conformance with the International Standards for the Practice of Internal Auditing as promulgated by the Institute of Internal Auditors. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives.

The scope of our work did not constitute an evaluation of the overall internal control structure of the Utility Department. Management is responsible for establishing and maintaining a system of internal controls to ensure that City assets are safeguarded; financial activity is accurately reported and reliable; and management and employees are in compliance with laws, regulations, and policies and procedures. The objectives are to provide management with reasonable, but not absolute assurance that the controls are in place and effective.

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## **CONCLUSIONS AND SIGNIFICANT ISSUES**

We believe that we have obtained sufficient and appropriate evidence to adequately support the conclusions provided below as required by professional auditing standards.

The historical practice of the Utility Department has been to budget yearly for the purchase of water meters based upon needs.

The City had purchased multi-jet water meters from Zenner in prior years, but switched to positive displacement water meters when the City bid out the meters in 2017. Resolution 21-18 was approved and signed February 2018, accepting the bid with Zenner to provide water meters in the amount of \$1,222,503 for sizes 5/8" up to 2" and the funds were appropriated in the 2018 Budgeted Capital Outlay – Other Equipment account.

During the bidding process for the water meters, the City did call Zenner and discussed their metering technology. Additionally, the City had been installing Zenner meters for several years before Resolution 21-18, however the City did not visit the Zenner facility to understand and evaluate their meter testing and quality control process.

Meters received by the City under the Zenner purchase order were tested to determine compliance with AWWA standards only on a sample basis before they were installed. The inaccuracy issues identified in the original testing by Internal Audit (in Fayetteville) and in the sample sent to the Zenner facility would have been identified prior to installation if the meters had been subjected to more robust testing by the City of Fort Smith.

In addition to the incomplete testing process the City did not communicate with Zenner about meter issues identified with the new meters. As a result, it is Internal Audits understanding that a number of the new Zenner water meters were scrapped rather than being returned to Zenner as a warranty claim. Specifically, the City scrapped/junked (according to documentation provided by the Utility Department) approximately 570 meters and 40 of those had a purchase date as of 2017 and would likely have been subject to warranty replacement by Zenner. Relevant sections of the Zenner warranty are presented below.

### ***“MATERIALS AND WORKMANSHIP***

*When used in normal potable systems and installed with an appropriate strainer on the inlet side of the meter, Zenner USA warrants its Water Meters and Components thereto free from defects in materials and workmanship, occurring within the earlier of the following time periods:*

• **Non-Remote Register:** *Twenty-five (25) years from date of installation or twenty-five (25) years and six (6) months from date of shipment.*

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## **AWWA METER ACCURACY**

ZENNER USA warrants that in normal, potable water systems, its Water Meters will meet or exceed AWWA new meter accuracy standards for within the following timeframes:

- 5/8" Water Meters: Fifteen (15) years from date of sale or 1,500,000 gallons, whichever occurs first;
- 3/4" Water Meters: Fifteen (15) years from date of sale or 2,250,000 gallons, whichever occurs first;
- 1" Water Meters: Fifteen (15) years from date of sale or 3,000,000 gallons, whichever occurs first;
- 1-1/2" Water Meters: Ten (10) years from the date of sale or 6,000,000 gallons, whichever occurs first;
- 2" Water Meters: Ten (10) years from the date of sale or 8,000,000 gallons, whichever occurs first.

## **WATER METER OR COMPONENT RETURNS**

Zenner USA's liability hereunder is expressly limited to the repair or replacement of the Water Meter or Components thereto at Zenner USA's sole discretion, upon the Customer's return of the Water Meter or Components thereto. The Customer must ship the Water Meter or Components thereto prepaid F.O.B. to the service center designated by Zenner USA. The Customer is responsible for all direct and indirect costs associated with removing the Water Meter or Components thereto and reinstalling the repaired or replacement Water Meter or Components thereto. The replaced Water Meter or Components thereto become the property of Zenner USA. "

Currently, the Utilities Department does not have a Water Meter Testing and Maintenance Program. However, the operational practice of the department for testing water meters is that testing is done when customers have complaints about their meter readings or when meters are taken out of service to determine if the meters will be scrapped. Ideally meters should be tested to protect the customer against meter inaccuracy that could result in overcharges from over registration (and to protect the City from undercharges).

The meters are received by the Utilities - Meter Department and entered into inventory, however when they are installed, they do not remove the meter sticker which has flow information, and maintain the information for use as needed. Therefore, the Meter Department does not have information as to the meter's flow range history.

According to AWWA standards, **all** new meters should be tested for accuracy of registration at flow rates and test-flow quantities before they are placed in service. The City of Fort Smith testing bench equipment used for testing water meters can only test 5/8" and 3/4" size meters and only four meters at a time. The remaining larger meter sizes used by the City, which includes 1" and above, cannot be tested at all on this testing equipment. The Utility Department has in its 2021 CIP budget funds for the purchase of a new meter test bench which can test a range of meter sizes, including residential meters.

Water meters should also be tested under an on-going plan based on the guidelines outlined in the AWWA standards, which state that ninety-five percent (95%) of new meters should be tested for accuracy before installation. In addition to new meters being tested, AWWA standards state that at least ninety-five percent (95%) of the meters actually tested must register results within the accuracy limits shown for both normal and minimum/maximum test-flow rates. AWWA standards also state that for those meters already installed, a 5% minimum of meters should be tested yearly. IA previously obtained documentation of meter test results from 2017 – 2019 that reported 1,377 meters tested over the course of 27 months, which is 3% of the population of meters.

The following results reflect the failure percentage from the Zenner Meter facility testing:

Meter Size	1 <sup>st</sup> High Flow Test	1 <sup>st</sup> Med Flow Test	1 <sup>st</sup> Low Flow Test	Overall (Failed at least one Test)	2 <sup>nd</sup> Retested High Flow Test	2 <sup>nd</sup> Retested Med Flow Test	2 <sup>nd</sup> Retested Low Flow Test	Overall (Failed at least one Test)	Failed 2 Flow Test	Failed 3 Flow Test
5/8 <sup>th</sup>	10%	1%	3%	14%	17%	3%	17%	41%	.86%	.37%
5/8 <sup>th</sup> 300 Series (1)	20%	3%	14%	27%	N/A	N/A	N/A	N/A	N/A	N/A
5/8 <sup>th</sup> (2)	19%	56%	44%	100%	N/A	N/A	N/A	N/A	N/A	N/A
3/4 <sup>th</sup>	7%	5%	2%	9%	0%	13%	0%	13%	1.82%	1.82%
1 inch (3)	3%	1%	6%	8%	0%	0%	40%	40%	N/A	N/A
1.5 inch	0%	0%	17%	17%	0%	0%	0%	0%	N/A	N/A
2 inch	0%	4%	0%	4%	0%	100%	0%	100%	N/A	N/A

- (1) Meters from the Zenner facility that were tested to replace City meters that failed during the flow test and could not be retested due to time constraint.
- (2) Meters passed the first test, but were placed in the retested meters and failed.
- (3) Due to time constraints several of the 1 inch meters were not retested, however the meters that failed were to be replaced with 1 inch meters from the Banning Facility. Therefore, the failure percentage for meters retested are based upon the number of 1 inch meters that were retested.

Based on the results of the testing indicated above, Internal Audit recommends the purchased meters currently in the City warehouse be returned to Zenner for complete testing unless the City purchases a new testing bench and implements a meter testing plan within the year. If the City cannot perform this within the year, returning the meters to Zenner will allow for any faulty meters to be repaired or replaced under warranty. The test result sheet from Zenner should be included with each box to allow for the testing history to be maintained by the City. This will allow the City to have documentation of meter flow reads in case there are questions/complaints by the citizen of where the meter was installed. The retest by Zenner should be overseen by a City employee to ensure the same process is continued throughout the testing of the meters. IA also recommends that the invoices contain all meter serial numbers that are shipped to the City and the serial numbers listed are all received in the shipment.

Zenner personnel were very cooperative with Internal Audit throughout the testing process. IA would like to express their appreciation to Zenner for allowing us to document, ask questions, and observe the testing of the meters. This process was very time consuming and involved a number of Zenner employees to ensure we were able to complete all of the testing.

## OTHER OBSERVATION

- In January 2018, bids were solicited by the City Utilities Department to purchase new water meters. The lowest and acceptable bid was from Zenner Performance Meters of Addison in the amount of \$1,222,503. Based on testing procedures performed and interviews with experienced technicians, the quality and performance of other brands of meters should have been considered not only based

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on price, but the quality, accuracy rate, and useful life. There is no documentation that these additional attributes were considered by the Utilities Department in recommending which vendor meters should be purchased from.

- During testing, audit noted that calibration labels from Zenner were placed on the wrong meters. The labels identify the meter number and what the calibration number was for high, medium, and low flow. The calibration numbers would be reviewed and compared to the calibrated numbers when tested by the City. An analysis would not produce the right information if the City did not identify those meters labeled wrong by Zenner.
- During testing, audit noted that a 5/8" meter top was placed on a 2" meter. If the City was not able to identify those meters with the incorrect meter top before the meter was installed, then the City would lose revenue because the flow of water would not register correctly.

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***ACKNOWLEDGEMENT AND SIGNATURES***

The Audit Team would like to thank the Utility Department and Zenner Management/Employees at the Banning facility for their cooperation, time, and efforts throughout the course of the engagement.

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Tracey Shockley, CFE  
City of Fort Smith Internal Audit Director

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## ***WATER METER ACTION ITEMS – MANAGER'S RESPONSES***

While working with Internal Audit on the current water meter change out project audit, the current Utility Department Management recognized, alongside Internal Audit, that the proper procedures and safeguards were not in place to ensure industry standard were followed. The industry standards are used to ensure both the City of Fort Smith and its customers are protected from issues that may arise during a project of this type and magnitude. The current Utility Department Management cannot speak as to the previous decisions made by past management, but it is taking steps to ensure the proper documented procedures are put in place before proceeding with the completing the meter change out project.

**Meter Inventory:** All Zenner water meters come with an attached flow testing label. Staff will verify each label with the meter serial number to ensure the meter is properly labeled. The flow testing information on the label will be recorded in a spreadsheet or database for future comparison of the original, factory meter test and future meter tests as part of the meter maintenance program.

**Meter Change Out Records:** All Zenner meters that have been previously installed had a paper form associated with it. The Meter Service Order (MSO) form was generated in Munis for the installed meters. If the serial number sticker was not available to be attached to the MSO, the meter testing label was used instead and placed on the MSO. Staff will work to record the testing information on the label and will be recorded in a spreadsheet or database for future comparison of the original, factory meter test and future meter tests as part of the meter maintenance program.

**Meter Defects/Warranty:** All Zenner meters are currently under warranty and all defective meters will be returned to Zenner for repair or replacement. If the meter is damaged due to neglect or unforeseen actions by the City or citizens and is not covered under warranty, the meter will be scrapped. A written explanation and photo of the meter will be filed for future review. Parts from scrapped meters that are functional and may be used to repair other meters will be salvaged and documented as to which scrapped meter the part originated and which meter the part was used to repair.

Documentation will be maintained to ensure that the meters returned are replaced, the testing information sheets accompany the replacement meter, and the replacement meter is also tested upon receiving it.

**Current Meter Testing:** All Zenner meters currently in stock will be tested utilizing the current test bench to determine if the meter has a gross defect. Meters that fall outside the test parameters will be sent back to Zenner for retesting and repair under warranty. Once the new test bench is installed, calibrated, and staff are trained, the Zenner meters will be tested prior to installation. Documentation will be maintained to support the test of each meter for historical purposes.

**Meter Maintenance Program:** Once the new meters have been installed, meters will be pulled from the field and tested based on manufacture lot and date of in service. The test results will be compared to both new meter specifications and to the original factory or verified test results. If the meter fails, it will be sent back to Zenner for repair and a test verified meter will be installed. This program will follow the AWWA guidance for meter testing. Documentation will be maintained to support the test of each meter for historical purposes.

**Meter Test Bench:** Staff is visiting other cities to look at the water meter test bench they are using. Staff will write specifications for the bench and place it out to bid. The bench that best meets the specifications will be chosen. Staff is also looking for a location to install the test bench. Investigations are underway to purchase a facility or revamp the current facilities at 3900 Kelley Hwy to house the new test bench and meter department.

**The remainder of this report is a discussion of Zenner's operations, the testing process and various matters regarding the meters themselves.**

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Zenner USA is a German owned company and is part of the Zenner/ Minol group, a global company that has been in existence for more than 117 years and is focused solely on the consumption-based metering business. Globally the company operates in 100 countries and owns and operates 50 assembly and manufacturing plants. The Banning, California location is where the City currently receives its meters from. The Banning plant receives parts and some completed meters from the company's other manufacturing plants from around the world. Parts and meters are manufactured in Asia, primarily China, India, Viet Nam and Myanmar. The meters are assembled with a chamber, register, and then subjected to high, medium, and low flow tests. A sticker with the results from the test are attached to the meter. However, depending on the shipment cost, the register may be left on or removed from the meter body when delivered by other Zenner facilities. If the register is removed, the register from the Banning facility is attached at and tested to compare it to the sticker attached. All PD meters received at the Banning facility are tested. The Banning facility also receives and maintains inventory of all meter parts in order to provide replacement parts when a meter has failed testing. No meter goes out with a register higher than 20 ccf, and if the register is higher, it is replaced. The 1 1/2" and higher meters are assembled at the Banning facility according to the customer's request and specifications. The Banning facility handles PD meters, multi-jet meters, turbines and ultrasonic meters. The City only purchases PD meters currently although some multi Jets were purchased initially before the city switched to PDs as a requirement. A PD meter operates with a piston and a set volume of water to move the register and measures it by cubic feet, gallons, or cubic meters. The multi-jet has openings in the chamber and water jets through the openings and spins the impellor which signals the register to turn. The ultrasonic has no moving parts and moves with only sound and has batteries that last approximately ten (10) years and are field replaceable.

The Banning facility has two test benches for the 5/8, 3/4, and 1" meters, which depending on the size of the meter can hold up to 28 meters total (14 meters each side). The Gravimetric benches were made by Zenner for Zenner and the high, medium, and low flow water valves are assembled to the bench. The Gravimetric testing bench is calibrated once every five months and the scales are calibrated every three months. The scales and the water temperature gauge are observed during the process because of the flow test and the temperature which has to be entered into the calculation sheet. The temperature plays a part of the testing because of the density in the water changes based upon the temperature of the water. The flow test is based upon how many gallons/cubic feet go through each flow during testing. The 5/8 testing for high flow pushes through 15 gallons per minute and runs for 3 minutes. Medium flow pushes through 2 gallons per minutes and runs for 3.9 minutes. The low flow pushes through .25 gallons per minute and runs for 15 minutes. (See the chart attached for the gallons and time run length for the other meter sizes).

The Banning facility also has a testing bench that can test any size meter, but usually the bigger size meters are tested because it holds a limited number of meters. The two meter testers have seven and nine years of experience respectively, and the chief meter tester has over 30 years of experience. Zenner does have two engineers at the facility.

After the meter(s) have been tested, the Banning facility engraves the meters with the serial numbers and the meter caps. If there are any special request of meter numbers (i.e. a letter between numbers, etc...) those are sometimes engraved at the facility making the specific meter and before shipment to the Banning facility. The Banning facility also test the encoders in the meters with different cable attachments such as Itron Connectors, Barewire or Nicors in various lengths with meters (male and females) by comparing the read of the ID and the read from the inside of the encoder. The ID reader will let them know that the encoder is not working correctly by not showing a read or a different number. The ID Coder also tells the operator the serial number of the meters for verification.

When a meter fails, it is retested on the other testing bench. If it fails again, then depending on what is seen during testing (i.e. the register not turning, register running backwards, etc...) the register is replaced or the chamber of the meter is examined. The meter chambers are sensitive and could cause the meter to fail its flow test. For instance, when the piston turns the inside if a small foreign object is stuck behind the plastic mesh, it

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can cause water not to flow correctly and prevent the register from spinning. When the meter is tested the second time, the foreign object may have been pushed out, or when the chamber is removed the debris may be dislodged. Once the meter is reassembled with either a new register and/or chamber, the meter is tested again. If the meter fails again, then the meter is transferred to out of service. If the meter passes, then it will go to the bench to be processed with the serial number.

All meters that are not special requested will have the serial numbers engraved before it leaves the facility. The caps are also stamped with the serial number and placed on the meter register. Once the meter is ready for a customer, the encoders are placed on the meter, packaged and a shipping label are placed in the box. Each time the meter is handled through the different divisions (divisions or departments? Is this supposed to be quality control?), the meter is to be checked for the serial number, whether the register is on correctly, the cap agrees to the sticker and register number, and the sticker identifies the high, medium, and low flow numbers from the testing phase.