

## AUDIT REPORT TRACKING SYSTEM (ARTS)

SECTION I: SUMMARY INFORMATION			
<b>Audit Title:</b>	Improvements in Water Meter Testing Needed	<b>Audit Release Date:</b>	05/20/2019
		<a href="#">Full Report / Highlights</a>	
<b>Department:</b>	Water Services	<b>Last Report Date:</b>	First ARTS Report
<b>Department Director:</b>	Terry Leeds	<b>This Report Date:</b>	05/18/2020
<b>Contact Person/Phone:</b>	John Clarkson	<b>Expected Presentation Date:</b>	TBD
SECTION II: PRIOR ARTS REPORTS			
None, this is the first ARTS report.			
SECTION III: RECORD OF IMPLEMENTED RECOMMENDATIONS			
1. Implemented 05/01/2019.		5. Implemented 06/01/2019	
2. Implemented 06/01/2019		6. Implemented 06/01/2019	
3. Implemented 06/01/2019		7. In Progress	
4. Implemented 06/01/2019			
SECTION IV: SUMMARY OF IMPLEMENTATION EFFORTS			
<b>Recommendation 1: The director of water services should not install new water meters that fail their accuracy testing.</b>			
<i>Status of Recommendation: Implemented</i>			
May 1, 2019. Meter Management Policy updated.			
<b>Recommendation 2: The director of water services should update water meter testing policies and procedures to require random sampling of new meters and a sample size that provides adequate confidence that the sample represents the accuracy of the entire batch.</b>			
<i>Status of Recommendation: Implemented</i>			
June 1, 2019. Currently testing approximately 6% of new meters. Percentage testing will increase or decrease depending on testing results, e.g. high rate of failures, increase percentage tested; low failure rate, decrease percentage tested.			
<b>Recommendation 3: The director of water services should ensure that a sample of each new water meter batch is tested.</b>			
<i>Status of Recommendation: Implemented</i>			
June 1, 2019. Updated in the Meter Management Policy.			
<b>Recommendation 4: The director water services should ensure pulled water meters are tested with a low, medium, high flow order.</b>			
<i>Status of Recommendation: Implemented</i>			
June 1, 2019. Policy updated. Changed the flow order in the MARS test bench to low, medium, high for customer requested meter tests.			
<b>Recommendation 5: The director of water services should ensure pulled water meters are tested only once.</b>			
<i>Status of Recommendation: Implemented</i>			
June 1, 2019. Some meter tests may need to be aborted for a variety of reasons, e.g. improper meter set on the test bench causing a bad seal, loss of power, error in entering starting and/or ending reads, etc. In those cases, the failed test will be documented with notes explaining why the test was aborted. Policy updated.			
<b>Recommendation 6: The director of water services should reimburse customers charged for pull tests that failed but were reported as passed.</b>			
<i>Status of Recommendation: Implemented</i>			
April 17, 2019 & May 29, 2019. Reimbursed the two customers charged the pull and test fee.			

**Recommendation 7: The director of water services should develop a comprehensive water meter replacement strategy that includes:**

- **Water meter replacement criteria based on ongoing testing of in-service meters; and**
- **A comprehensive water meter database that includes active and inactive meters with basic meter descriptive characteristics such as size, make, model, serial number, date of purchase, date of installation, meter locations, and accuracy test data.**

*Status of Recommendation: In Progress*

We are working to determine database needs and methodology for meter replacement strategy. Many utilities with an AMI system are moving to a meter replacement program based on usage data analysis.

**SECTION V: ADDITIONAL OUTCOMES**



## Meter Management Policy

<b>Title:</b> Meter Management Policy	
<b>Division:</b> Customer Service	<b>Policy Owner/Title:</b> Bill White, Meter Field Services Utility Manager
<b>Contributor(s):</b> James Binkley Magdalena Rea Willie Triplett William Harris	<b>Approved By (including date):</b> John Clarkson

### Purpose

The purpose of this document is to set forth the policy for the Meter Field Services (MFS) meter management program. The policy covers new meter testing, random testing of in-service meters used for future metering analysis, customer requested meter testing (pull and test), large meter testing and general testing procedures.

### Overview

The Meter Field Service team is responsible for maintaining approximately 180,000 utility meters of which, 162,000 accounts are classified as 1-inch meter or smaller. Customers who fit this criterion are predominately in the residential metering program. Large meters are generally used for commercial applications classified as 1.5" and larger.

Currently, Neptune Manufacturing accounts for 80% of the installed residential meters within the city while Sensus has 9%, Amco or Schlemberger manufactures about 10% and 1% are from other manufacturers.

### Sample testing of new residential meter

All new meters purchased by KC Water are tested and certified as accurate by the manufacturer using AWWA guidelines. Each meter comes with a tag documenting the test results for that specific meter. The manufacturer provides an Excel spreadsheet with all relevant meter information including the test results for each batch of meters purchased and received. Despite the fact new meters are tested and certified by the manufacturer, KC Water will test a random sample of each batch of new meters received to ensure the new meters purchased meet AWWA specified accuracy requirements. This process will help build an assurance of trust in the manufactures data and ensure damage did not occur during shipping.

KC Water currently purchases the Neptune model T-10 5/8" Pro Coder meter for all new installation of water meters. These meters measure usage in cubic feet and come with a ten-year

factory warranty. The T-10 meter is certified to NSF-61, satisfies AWWA Standard Specifications and each meter is accompanied by a factory test tag certification of accuracy at flows required by AWWA C700.

KC Water will test new meters random sampling approximately 6% of each batch of new meters purchased, using the MARS test bench. The sample size for testing will increase or decrease depending on testing results, e.g. high failures rate, increase percentage tested; low failure rate, decrease percentage tested. Percentage of new meter testing will never drop below 3%.

#### **MARS small test bench**



The Meter Shop Supervisor is responsible for recording purchased meters by entering the following data into the Hansen inventory system:

- Part number
- Storeroom location code
- Class (size and type)
- Quantity



The Preventive Maintenance Manager will be responsible for entering the following meter data in KWIC:

- Make and type
- Purchase order number
- Cost
- Meter serial number

MFS staff will random sample test new meters on the MARS test bench. The test bench will allow a maximum placement up to 10 meters in a series for each test run. The Preventive Maintenance Manager will ensure the selection of new meters. To ensure a random sample, no more than one meter will be pulled from a box of ten; at least two meters will be pulled from each skid row. No consecutive meter serial numbers will be pulled for testing.

KC Water uses American Water Works Association (AWWA) guidelines for accuracy tolerances. The meter is installed on the test bench and the line will then be purged which allows air to be removed. The purging process consists of running water through the bench for a few minutes from a low to high flow rate. The three flow tests will be performed on the meter in this order: a high flow test (10 CF of water), a medium flow test (5 CF of water) and low flow test (1 CF of water) which will determine if the meter(s) has passed or failed.

New meters purchased will be subject to the following fail / pass testing parameters (Table 1). If the meter test falls within all three accuracy tolerance parameters, the meter is considered passed. If any of the three flow tests fall outside of the accuracy tolerance parameters, the test is considered failed. No meter that fails testing according to AWWA standards will be placed in service.

**Table 1 - Testing flows and parameters of small meter testing**

Hi (maximum) test 10 CF	Tolerance level plus or minus 1.5 (98.5% – 101.5%)
**Med (intermediate) 5 CF	Tolerance level plus or minus 1.5 (98.5% – 101.5%)
Low (Medium) 1 CF	Tolerance level plus 1 minus 5 (95%-101%)

\*\*During testing, MFS intermediate range tests from 1 cu. ft. to 5 cu. ft. While the 2018 version of the AWWA M6 manual shows the test requirement volume for 5/8" intermediate test 1 cu. ft.; these volumes are minimum values.

All new meters that do not meet the minimum specified accuracy requirements, will be returned to the manufacturer and another meter will be randomly pulled and tested. If two or more meters fail from a sample batch, the failed meters will be tested in the presence of a manufacturer's



representative and the KC Water Preventive Management Manager to determine if the entire order needs to be returned.

**Testing of in-service meters**

Periodic testing of in-service meters: Meters will be exchanged and tested with a goal to accumulate test results for in-service meters at various age ranges. Once enough test data has been accumulated, KC Water will be able to use this data to develop a consumption / time limit for recommended useful life of residential meters. The guideline for the replacement of meters is shown below in Table 2 and will be used until an analysis of in-service meters can be completed. An analysis of in-service meter performance should be conducted every five years including updating the meter replacement guidelines and plan.

**Table 2 - Meter Replacement Guidelines**

Meter Size/Type	Target Time Between Exchanges (years)	Target Consumption Between Exchanges (CCF)
5/8" - 1" PD	15 to 20	5,000
1.5" - 2" PD	4 to 5	20,000
3" Compound /Turbo	3	150,000
4" Compound /Turbo	2	300,000
6" - 10" Turbo	1	500,000

Changes in consumption patterns / zero consumption: Meters may also be tested when there is a change in the consumption pattern, suggesting that the meter may not be working properly. These meters will take priority over regular periodic tests. Examples can include; Two-register compound meters (large meter) tested when consumption data indicates one side is not working properly and single register meters will be tested when there is an unusual sustained change in consumption that cannot be explained by seasonal or other factors.

**Customer requested meter testing (pull and test)**

The following procedures will be followed when a 5/8" to 1" meter is being pulled for testing at the customer's request. The pulled meter is bench tested within 24 hours and accuracy results vetted through the Meter Shop Supervisor and the Special Projects Coordinator before feedback is provided to customer. The following guidelines will be used at time of meter exchange in the field:



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- Leave residual water in the meter
- Place end caps on each end of the meter
- Keep the meter upright in transit
- Do not jar or shake the meter
- Keep the meter upright in storage
- Return meter to supervisor

Once the meter has reached the meter test bench, the following parameters are to be used for testing:

The pulled meter is installed on the test bench, the line is filled with water and air is removed from the test line, this purging process consists of running water through the bench for a few minutes at a low to high flow rate, this purge allows air to be removed from the test bench

The test shall start per AWWA guidelines beginning with low flow test (1 CF), medium flow test (5 CF) and high flow test (10 CF). Typically, the low test runs 40 minutes, medium test runs about 30 minutes and high test takes 10 minutes to get the results.

If, during the test, operator error or software malfunction occurs, the test is to be aborted and start a new test. The aborted test will be noted for reasoning of why 2<sup>nd</sup> test is needed.

**Table 3 – Consumer Requested Test Meters**

Low (Medium) 1CF	Tolerance level plus 1 or minus 5 (95% - 101%)
**Med (intermediate) 5 CF	Tolerance level plus or minus 1.5 (98.5% - 101.5%)
Hi (maximum) test 10 CF	Tolerance level plus or minus 1.5 (98.5%-101.5%)

\*\*During testing, MFS intermediate range tests from 1 cu. ft. to 5 cu. ft. While the 2018 version of the AWWA M6 manual shows the test requirement volume for 5/8" intermediate test 1 cu. ft.; these volumes are minimum values. As test volumes increase, the test result uncertainty decreases.

If the meter tests outside of the accuracy tolerances set by the AWWA on any of the flow tests, the meter has failed. All pull and test meters will be stored and kept for one year from the day of testing.

After the test is performed, a record of the test is recorded and sent to the Preventive Maintenance Manager who will verify the results and send them to the Special Projects Coordinator. The Special Projects Coordinator will communicate the results to the customer.

Below is an example of a customer requested passed test result document:



## Test Details

Kansas City MARS Meter Management Standard Test Report

<b>Test</b>	4/29/2020 9:33:52 AM	<b>Test</b>	5/8 Meters Pulled From Field		
<b>Date: Job</b>	13120307	<b>Name:</b>	2005 E 73 <sup>rd</sup> Terr Street Pull and Test		
<b>Number:</b>	Small 5-1000	<b>Remarks:</b>	John Doe	<b>Units:</b>	Cu.Ft.
<b>Bench:</b>					

## SubTest Details

Name	Tank	Line	Temp(F)	Exp	Act Rate	Exp Vol	Act Vol	Low Tol	High Tol
0.25 GPM LOW TEST	10 Gal	1/2" Line		.25	.27	1.00	.986	5.00%	1.00%
2 GPM MEDIUM TEST	10 Gal	1" Line		2.00	1.97	5.00	4.996	1.50%	1.50%
15 GPM HIGH TEST	100 Gal	2" Line		15.00	15.03	10.00	9.924	1.50%	1.50%

## Meter Details

Meter	Sub Test	Comp.	Start	End	Volume	Accurac	Pass
#1 - 68116862 Passed Neptune/Tri dent T-10	0.25 GPM LOW TEST	No	17391.027	17391.989	.962	97.56	Yes
	2 GPM MEDIUM TEST	No	17391.989	17397.003	5.014	100.36	Yes
	15 GPM HIGH TEST	No	17397.003	17406.865	9.862	99.37	Yes

### New large meter, repair and re-testing guidelines

All large new meters purchased by KC Water are tested and certified as accurate by the manufacturer using AWWA guidelines. Each large meter comes with a tag documenting the test results for that specific meter. The manufacturer provides an Excel spreadsheet with all relevant meter information including the test results for each batch of meters purchased and received. Despite the fact that new meters are typically tested and certified by the manufacturer, KC Water will test a sample of each batch of new meters received to ensure the new meters purchased meet KC WATER has specified accuracy requirements. This process will help build an assurance of trust in the manufactures data and ensure damage did not occur during shipping

### MARS large test bench





All large meters exchanged in the field are tested if applicable (unless damaged or freeze burst), rebuilt, and leaked checked for future installment

Compound meters and turbine meters shall be tested within the parameters listed in Table - 4

**Table 4 – 2” rebuilt displacement meter testing parameters**

Hi (maximum) test 10 CF	Tolerance level plus or minus 1.5 (98.5% – 101.5%)
Med (intermediate) 10 CF	Tolerance level plus or minus 1.5 (98.5% – 101.5%)
*Low (Medium) 2 CF	Tolerance level plus 1 minus 5 (95%-101%)

\*During testing, MFS low range tests from 10 cu. ft. to 2 cu. ft. While the 2018 version of the AWWA M6 manual shows the test requirement volume for 2” low test 10 cu. ft.; these volumes are minimum due to time constraints in testing meters. A consumer requested test would revert to 10 CF on the low test per AWWA guidelines.

Compound meters are tested per the manufacture’s specifications, per AWWA; the side arm meter is to be test in accordance with the appropriate test requirements for the type of meter used.

In order to reduce the amount of work involved in changing a meter, the meter’s UME (unitized measuring element) will be exchanged in the field whenever possible. The UME will be returned



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to the meter shop to be tested in a clean case of the same type. When a UME is not available or not appropriate for a particular location, the entire meter will be pulled and replaced. Special care must be taken when transporting meters or UMEs so as not to change their accuracy.

Any other type of meter testing parameters refer to the AWWA guidelines.

### General Meter Testing Procedures

Test as many meters at one time as possible to get the most productivity out of the time it takes to perform the test.

Responsibilities – One-meter testing technician will have primary responsibility for each of the two test benches. Each technician will be fully cross-trained on the operation of both test benches. In addition, at least one other person will be fully trained on the operation of both test benches and will assist with meter testing when requested by the meter shop manager. The meter shop manager may also require a meter-testing technician to assist with fieldwork as required. Meter tests may need to be aborted for a variety of reasons, e.g. improper meter set on the test bench causing a bad seal, loss of power, error in entering starting and/or ending reads, etc. In those cases, the failed test will be documented with notes explaining why the test was aborted and a new test will be performed.

Meters are manually counted by the Stock-keeper daily and quantities are reconciled in Hansen. The Preventive Meter Manager also takes daily spot checks of the storeroom to confirm adequate quantities on frequently used items. Stock levels recorded within Hansen do not prompt reorder points. The meter reorder process is triggered by manual oversight.

Any field conditions that are determined to be unsafe or do not meet KC Water standards will be reported to the Preventive Maintenance Manager. Additionally, any signs of meter tampering or other damage to the piping or meter pit will be reported to the meter shop manager. If a meter has been tampered with, or if a customer fails to comply with a Customer Service Notice, the Preventive Maintenance Manager will notify the Manager of Reading and Service.

The MARS test bench will be maintained according to the manufacturers written recommendations. A company who specializes in load cell calibration and uses National Institute of Standards and Technology (NIST) traceable weights will calibrate load cells at least once per year. MARS staff will visit on site annually via an annual maintenance agreement of the MARS testing equipment to visual inspector, repair any issues, adjustments, provide maintenance and provide training on the MARS Meter Test Equipment. Mars will provide software upgrades performed during the year to the MARS test system are included in this Agreement at no additional cost

