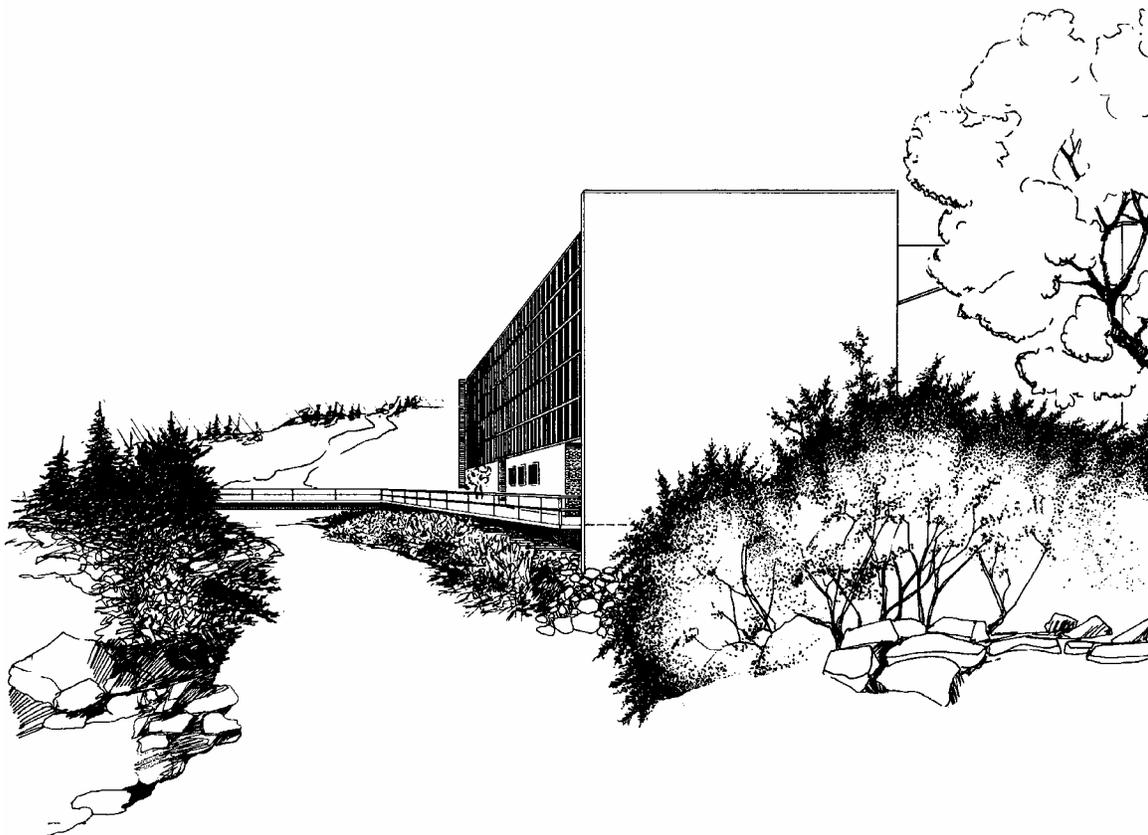


5/8-Inch and 3/4-Inch Flow Meter Endurance Testing

Prepared for

Master Meter

October 2005



UTAH WATER RESEARCH LABORATORY

**Utah State University
Logan, Utah**

Report No. 1602

5/8-inch and 3/4-inch Flow Meter Endurance Testing

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October 2005

Hydraulics Report No. 1602

INTRODUCTION

Utah State University was contracted by Master Meter to perform flow calibrations at the Utah Water Research Laboratory (UWRL) in Logan, Utah on a multitude of 5/8-inch and 3/4-inch flow meters. The testing required that the new meters in each size be base line tested in cold water (water less than 80 degrees Fahrenheit) and then operated at a set flow rate, 10 gallons per minute for 5/8-inch meters and 15 gallons per minute for 3/4-inch meters until incremental volumes of 500,000 gallons and 750,000 gallons had passed through the 5/8-inch and 3/4-inch meters respectively. Upon reaching the volumes indicated, the meters were then tested to evaluate any shifts in performance. This process was completed until the 5/8-inch meters reached 2,000,000 gallons and the 3/4-inch meters reached 3,000,000 gallons.

Upon reviewing the performance data of the meters, the testing was extended. The same testing process was repeated for both the 5/8-inch meters and the 3/4-inch meters until they had reached 4,000,000 gallons and 6,000,000 gallons respectively. One set of 5/8-inch production PD meters was started after the initial tests and lags the other 5/8-inch meters by 1,500,000 gallons in the endurance testing. This report summarizes the testing performed and the results of the testing.

TEST SETUP

The meters provided by master meter consisted of the following:

String 1 – Serial numbers: 4684552 and 4684553 (3/4-inch BLMJ)

String 2 – Serial numbers: 4684550, 4684551 (3/4-inch BLMJ)

String 2 – Serial numbers: 4684554, 4684555, and 4684556 (Dialog 3G, 3/4-inch BLMJ)

String 3 – Serial numbers: 4684540, 4684541 (5/8-inch BLMJ)

String 4 - Serial numbers: 4684542, 4684543 (5/8-inch BLMJ)

String 5 - Serial numbers: 4853524, 4853525, and 4853527 (Dialog 3G, 5/8-inch MMPD)



Figure 1. Endurance loop setup.

Each 5/8-inch meter was installed in series and each 3/4-inch meter was installed in series. The connections for each meter were provided by Master Meter and provided approximately 7 inches between each meter. Potable water from the City of Logan was used for the testing with it being continually refreshed to maintain temperatures less than 80 degrees. Upstream from the meters were filters to prevent any debris from getting into the meters. The water was pumped using a 2 horsepower pump connected to a small reservoir and the flow rate was regulated using throttling valves downstream from the meters. Figure 1 shows the endurance test loop.

ACCURACY TESTING

Upon receipt of the flow meters from Master Meter, the meters were baseline tested. Table 1 shows the conditions under which each of the meter sizes were tested. The typical draft size for each meter at each flow rate is shown in Table 2.

Table 1. Flow conditions tested.

Meter Size	Min Flow (gpm)	Low Flow (gpm)	Intermediate flow (gpm)	High Flow (gpm)
5/8-inch	0.25	2	12	20
3/4-inch	0.5	3	15	30

Table 2. Draft sizes collected at indicated flow rate.

Meter Size	Min Flow (gallons)	Low Flow (gallons)	Intermediate flow (gallons)	High Flow (gallons)
5/8-inch	20	20	80	120
3/4-inch	20	40	80	120

Rather than make adjustments to each meter at the baseline to represent the best possible accuracy over the range, it was determined by personnel from Master Meter and the Utah Water Research laboratory to simply let the as new condition represent the baseline. This was done simply because the endurance test is to identify changes in accuracy resulting from extended use. Therefore, changes in accuracy will be reported relative to the conditions established prior to endurance testing the meters.

The meters were tested using a gravimetric bench that was certified using NIST traceable weights. The weight of each draft and the temperature were measured for each run.

RESULTS

Tables 3 through 22 show the results of the testing in terms of actual meter registry. Note that the lower portion of the tables (titled “Average Shift in Registry from Initial”) shows the shift from the initial testing in percent. Meters 4853524, 4853525, and 4853527 (Dialog 3G, 5/8-inch MMPD) were placed into the endurance loop after the other 5/8-inch meters had passed the 1,500,000 gallon mark.

Table 23 shows a one page summary of all of the meters tested for the lowest and the highest rates of flow. Each meter has been identified by the last two digits of its serial number and its model. The data collected for this study show that the meters perform well within the accuracy specified by AWWA Manual M6 “Water Meters – Selection, Installation, Testing and Maintenance.” Furthermore, it is evident that the 5/8-inch and 3/4-inch multi-jet meters exceed statements made in Master Meter’s Utility Products Performance Warranty with regard to volume throughput.

SEE PAGES 15-17 FOR SPECIFIC RESULTS.

Table 3. Test results for meter 4684552 (3/4-inch BLMJ).

Meter Serial Number 4684552							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
Flow (gpm)	Percent Registered						
30	99.62%	99.80%	99.56%	99.77%	100.23%	100.09%	100.52%
30	99.63%	99.94%	99.58%	99.99%	100.19%	100.22%	100.45%
15	99.35%	100.20%	99.97%	99.86%	100.56%	100.38%	100.74%
15	99.45%	100.29%	100.07%	100.14%	100.17%	100.30%	100.69%
3	99.71%	100.52%	100.59%	100.50%	100.09%	100.46%	100.90%
3	99.94%	100.20%	100.70%	100.62%	100.90%	100.45%	101.11%
0.5	98.87%	97.51%	98.58%	97.11%	96.72%	96.37%	97.54%
0.5	98.95%	98.22%	98.24%	96.29%	95.65%	96.34%	97.32%
0.5	98.41%	96.93%	-	-	97.96%	96.41%	97.63%

Averages and Standard Deviations							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
Avg 30	99.63%	99.87%	99.57%	99.88%	100.21%	100.15%	100.48%
Std 30	0.007%	0.098%	0.016%	0.157%	0.027%	0.094%	0.055%
Avg 15	99.40%	100.24%	100.02%	100.00%	100.36%	100.34%	100.71%
Std 15	0.070%	0.066%	0.068%	0.202%	0.277%	0.055%	0.035%
Avg 3	99.83%	100.36%	100.65%	100.56%	100.49%	100.46%	101.01%
Std 3	0.162%	0.227%	0.082%	0.085%	0.577%	0.006%	0.151%
Avg 0.5	98.74%	97.55%	98.41%	96.70%	96.78%	96.37%	97.50%
Std 0.5	0.292%	0.645%	0.242%	0.577%	1.159%	0.034%	0.160%

Average Shift in Registry from Initial							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
30	-	0.24%	-0.06%	0.25%	0.59%	0.53%	0.86%
15	-	0.85%	0.63%	0.60%	0.97%	0.95%	1.32%
3	-	0.54%	0.82%	0.73%	0.67%	0.63%	1.18%
0.5	-	-1.19%	-0.34%	-2.04%	-1.97%	-2.37%	-1.25%

Table 4. Test results for meter 4684553 (3/4-inch BLMJ).

Meter Serial Number 4684553							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
Flow (gpm)	Percent Registered						
30	99.70%	99.92%	100.77%	100.45%	100.91%	100.60%	100.95%
30	99.71%	100.14%	100.71%	100.63%	100.79%	100.82%	100.84%
15	100.03%	100.20%	100.59%	100.26%	100.09%	100.50%	100.93%
15	100.01%	100.29%	100.50%	100.55%	100.74%	100.55%	100.75%
3	100.73%	100.14%	100.33%	100.25%	100.09%	100.58%	101.40%
3	100.70%	99.82%	100.32%	100.24%	100.78%	100.71%	101.48%
0.5	98.18%	97.27%	96.13%	94.93%	95.01%	90.46%	95.16%
0.5	100.44%	97.86%	96.03%	94.86%	93.72%	92.19%	95.19%
0.5	98.41%	96.69%	-	-	95.37%	91.32%	95.26%

Averages and Standard Deviations							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
Avg 30	99.71%	100.03%	100.74%	100.54%	100.85%	100.71%	100.89%
Std 30	0.007%	0.155%	0.042%	0.126%	0.086%	0.153%	0.083%
Avg 15	100.02%	100.24%	100.54%	100.41%	100.42%	100.53%	100.84%
Std 15	0.017%	0.066%	0.064%	0.200%	0.463%	0.035%	0.124%
Avg 3	100.72%	99.98%	100.33%	100.24%	100.43%	100.65%	101.44%
Std 3	0.018%	0.226%	0.008%	0.006%	0.488%	0.085%	0.058%
Avg 0.5	99.01%	97.27%	96.08%	94.89%	94.70%	91.32%	95.20%
Std 0.5	1.244%	0.587%	0.067%	0.047%	0.866%	0.863%	0.050%

Average Shift in Registry from Initial							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
30	-	0.32%	1.04%	0.83%	1.14%	1.01%	1.19%
15	-	0.22%	0.52%	0.39%	0.39%	0.51%	0.82%
3	-	-0.74%	-0.39%	-0.47%	-0.28%	-0.07%	0.72%
0.5	-	-1.74%	-2.93%	-4.12%	-4.31%	-7.69%	-3.81%

Table 5. Test results for meter 4684550 (3/4-inch BLMJ).

Meter Serial Number 4684550							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
Flow (gpm)	Percent Registered						
30	101.25%	101.45%	101.74%	101.18%	100.59%	101.68%	100.91%
30	101.10%	101.51%	101.41%	100.99%	100.67%	101.58%	100.94%
15	100.55%	101.35%	101.66%	101.49%	101.15%	101.44%	100.80%
15	100.61%	101.78%	101.50%	101.13%	100.68%	101.37%	100.82%
3	100.36%	102.10%	101.60%	101.14%	101.87%	102.34%	101.65%
3	100.40%	101.82%	101.85%	101.39%	101.53%	102.36%	101.48%
0.5	97.91%	97.44%	96.71%	98.32%	98.18%	97.12%	98.49%
0.5	98.61%	98.35%	98.33%	98.13%	96.85%	97.32%	98.74%
0.5	-	-	98.42%	-	98.67%	95.90%	98.58%

Averages and Standard Deviations							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
Avg 30	101.17%	101.48%	101.58%	101.08%	100.63%	101.63%	100.93%
Std 30	0.104%	0.043%	0.233%	0.132%	0.056%	0.068%	0.019%
Avg 15	100.58%	101.57%	101.58%	101.31%	100.92%	101.41%	100.81%
Std 15	0.047%	0.301%	0.111%	0.257%	0.327%	0.047%	0.009%
Avg 3	100.38%	101.96%	101.73%	101.26%	101.70%	102.35%	101.57%
Std 3	0.029%	0.198%	0.177%	0.175%	0.244%	0.014%	0.119%
Avg 0.5	98.26%	97.90%	97.52%	98.23%	97.90%	96.78%	98.60%
Std 0.5	0.496%	0.641%	0.966%	0.132%	0.940%	0.768%	0.124%

Average Shift in Registry from Initial							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
30	-	0.31%	0.40%	-0.09%	-0.54%	0.45%	-0.25%
15	-	0.98%	1.00%	0.73%	0.34%	0.82%	0.23%
3	-	1.58%	1.34%	0.88%	1.32%	1.96%	1.18%
0.5	-	-0.36%	-0.74%	-0.03%	-0.36%	-1.48%	0.34%

Table 6. Test results for meter 4684551 (3/4-inch BLMJ).

Meter Serial Number 4684551							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
Flow (gpm)	Percent Registered						
30	99.37%	100.02%	99.55%	99.53%	100.03%	100.29%	100.33%
30	100.06%	99.88%	99.84%	99.63%	100.55%	100.66%	100.31%
15	99.03%	99.79%	99.62%	99.31%	99.15%	99.32%	99.98%
15	98.72%	99.24%	99.49%	99.36%	99.71%	99.55%	100.06%
3	100.11%	101.08%	100.71%	100.43%	100.60%	101.71%	101.90%
3	100.28%	100.69%	100.96%	100.62%	100.65%	101.72%	101.48%
0.5	97.41%	96.71%	95.98%	97.38%	96.96%	96.62%	96.83%
0.5	98.61%	97.61%	98.09%	97.92%	95.41%	96.34%	97.32%
0.5	-	-	98.42%	97.71%	97.96%	95.65%	97.39%

Averages and Standard Deviations							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
Avg 30	99.72%	99.95%	99.69%	99.58%	100.29%	100.47%	100.32%
Std 30	0.490%	0.098%	0.205%	0.071%	0.367%	0.264%	0.010%
Avg 15	98.88%	99.52%	99.55%	99.34%	99.43%	99.43%	100.02%
Std 15	0.217%	0.388%	0.094%	0.034%	0.396%	0.160%	0.057%
Avg 3	100.19%	100.88%	100.83%	100.53%	100.62%	101.72%	101.69%
Std 3	0.120%	0.272%	0.177%	0.138%	0.038%	0.007%	0.296%
Avg 0.5	98.01%	97.16%	97.03%	97.65%	96.78%	96.20%	97.18%
Std 0.5	0.845%	0.638%	1.324%	0.274%	1.287%	0.500%	0.307%

Average Shift in Registry from Initial							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
30	-	0.24%	-0.02%	-0.13%	0.58%	0.76%	0.61%
15	-	0.64%	0.68%	0.46%	0.55%	0.56%	1.14%
3	-	0.69%	0.64%	0.33%	0.43%	1.53%	1.50%
0.5	-	-0.85%	-0.98%	-0.36%	-1.23%	-1.81%	-0.83%

Table 7. Test results for meter 4684554 (Dialog 3G, 3/4-inch BLMJ).

Meter Serial Number 4684554							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
Flow (gpm)	Percent Registered						
30	100.65%	101.24%	101.42%	101.33%	101.27%	101.40%	101.70%
30	100.54%	101.43%	101.37%	101.42%	101.58%	101.50%	101.72%
15	100.17%	100.67%	101.17%	101.16%	101.03%	101.25%	101.62%
15	100.11%	100.73%	101.32%	101.32%	101.38%	101.31%	101.63%
3	100.62%	101.46%	101.35%	101.71%	100.72%	101.71%	102.78%
3	100.92%	101.70%	101.60%	101.64%	101.53%	101.98%	102.22%
0.5	98.40%	97.69%	97.19%	97.62%	98.43%	98.12%	98.97%
0.5	99.60%	98.10%	99.07%	98.42%	97.09%	97.81%	98.26%
0.5	-	-	98.91%	98.20%	98.90%	96.92%	99.05%

Averages and Standard Deviations							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
Avg 30	100.59%	101.34%	101.39%	101.38%	101.43%	101.45%	101.71%
Std 30	0.075%	0.130%	0.032%	0.065%	0.221%	0.072%	0.020%
Avg 15	100.14%	100.70%	101.24%	101.24%	101.20%	101.28%	101.63%
Std 15	0.041%	0.043%	0.109%	0.115%	0.244%	0.041%	0.006%
Avg 3	100.77%	101.58%	101.47%	101.67%	101.13%	101.84%	102.50%
Std 3	0.211%	0.166%	0.177%	0.045%	0.569%	0.187%	0.393%
Avg 0.5	99.00%	97.90%	98.13%	98.02%	98.14%	97.62%	98.76%
Std 0.5	0.847%	0.296%	1.043%	0.410%	0.939%	0.623%	0.433%

Average Shift in Registry from Initial							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
30	-	0.74%	0.80%	0.78%	0.83%	0.85%	1.12%
15	-	0.56%	1.10%	1.10%	1.06%	1.14%	1.49%
3	-	0.81%	0.70%	0.90%	0.36%	1.08%	1.73%
0.5	-	-1.11%	-0.87%	-0.98%	-0.86%	-1.38%	-0.24%

Table 8. Test results for meter 4684555 (Dialog 3G, 3/4-inch BLMJ).

Meter Serial Number 4684555							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
Flow (gpm)	Percent Registered						
30	98.81%	98.92%	99.51%	99.37%	99.15%	99.09%	99.63%
30	98.87%	99.11%	99.47%	99.47%	99.28%	99.26%	99.45%
15	98.78%	99.23%	99.43%	99.31%	98.91%	99.07%	99.35%
15	98.72%	98.93%	99.55%	99.24%	99.36%	98.92%	99.62%
3	100.62%	100.95%	101.09%	101.19%	100.60%	101.09%	101.78%
3	100.66%	100.82%	100.96%	101.13%	100.78%	101.09%	101.48%
0.5	97.17%	96.47%	95.98%	96.89%	97.21%	95.37%	98.25%
0.5	98.36%	96.88%	97.60%	97.43%	95.89%	95.85%	97.56%
0.5	-	-	97.93%	97.47%	97.49%	94.88%	97.87%

Averages and Standard Deviations							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
Avg 30	98.84%	99.01%	99.49%	99.42%	99.22%	99.18%	99.54%
Std 30	0.039%	0.134%	0.023%	0.072%	0.090%	0.118%	0.121%
Avg 15	98.75%	99.08%	99.49%	99.28%	99.14%	99.00%	99.49%
Std 15	0.038%	0.209%	0.081%	0.052%	0.318%	0.109%	0.193%
Avg 3	100.64%	100.88%	101.03%	101.16%	100.69%	101.09%	101.63%
Std 3	0.030%	0.092%	0.094%	0.044%	0.127%	0.001%	0.208%
Avg 0.5	97.76%	96.67%	96.79%	97.16%	96.86%	95.37%	97.89%
Std 0.5	0.845%	0.290%	1.043%	0.322%	0.854%	0.485%	0.350%

Average Shift in Registry from Initial							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
30	-	0.18%	0.65%	0.58%	0.38%	0.34%	0.70%
15	-	0.33%	0.74%	0.53%	0.39%	0.24%	0.74%
3	-	0.24%	0.38%	0.52%	0.05%	0.45%	0.99%
0.5	-	-1.09%	-0.98%	-0.60%	-0.90%	-2.40%	0.13%

Table 9. Test results for meter 4684556 (Dialog 3G, 3/4-inch BLMJ).

Meter Serial Number 4684556							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
Flow (gpm)	Percent Registered						
30	99.53%	100.47%	99.99%	100.47%	100.63%	101.40%	101.66%
30	99.50%	100.29%	100.08%	100.53%	100.83%	101.54%	101.72%
15	99.66%	100.16%	100.18%	100.42%	100.21%	101.31%	101.56%
15	99.61%	99.92%	100.34%	100.34%	100.57%	101.31%	101.57%
3	101.29%	101.72%	100.96%	102.47%	101.36%	101.84%	102.53%
3	101.53%	101.95%	101.09%	102.41%	101.65%	102.10%	102.10%
0.5	97.91%	98.17%	97.68%	98.84%	99.16%	98.62%	99.68%
0.5	99.35%	98.10%	99.32%	99.40%	99.02%	98.54%	99.45%
0.5	-	-	99.40%	98.93%	99.14%	98.19%	99.76%

Averages and Standard Deviations							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
Avg 30	99.52%	100.38%	100.04%	100.50%	100.73%	101.47%	101.69%
Std 30	0.018%	0.128%	0.060%	0.039%	0.139%	0.100%	0.048%
Avg 15	99.63%	100.04%	100.26%	100.38%	100.39%	101.31%	101.56%
Std 15	0.040%	0.172%	0.118%	0.056%	0.257%	0.003%	0.006%
Avg 3	101.41%	101.83%	101.03%	102.44%	101.51%	101.97%	102.31%
Std 3	0.177%	0.162%	0.086%	0.047%	0.206%	0.189%	0.303%
Avg 0.5	98.63%	98.14%	98.50%	99.12%	99.11%	98.45%	99.63%
Std 0.5	1.021%	0.049%	0.974%	0.301%	0.076%	0.229%	0.165%

Average Shift in Registry from Initial							
Test Cond.	INITIAL	750,000	1,500,000	2,250,000	3,000,000	4,500,000	6,000,000
30	-	0.86%	0.52%	0.98%	1.21%	1.95%	2.17%
15	-	0.41%	0.63%	0.75%	0.75%	1.68%	1.93%
3	-	0.42%	-0.38%	1.03%	0.10%	0.56%	0.90%
0.5	-	-0.49%	-0.13%	0.49%	0.48%	-0.18%	1.00%

Table 10. Test results for meter 4684540 (5/8-inch BLMJ).

Meter Serial Number 4684540							
Test Cond.	INITIAL	500,000	1,000,000	1,500,000	2,000,000	3,000,000	4,000,000
Flow (gpm)	Percent Registered						
20	99.91%	100.31%	100.17%	100.44%	100.47%	100.59%	100.65%
20	99.89%	100.49%	100.99%	100.08%	100.56%	100.25%	100.96%
12	99.81%	100.18%	100.21%	100.34%	100.30%	100.92%	100.70%
12	99.50%	100.19%	100.26%	100.49%	100.85%	100.19%	100.61%
2	103.10%	101.39%	100.93%	101.02%	100.88%	101.16%	102.04%
2	102.78%	101.66%	100.96%	101.23%	101.30%	101.47%	101.51%
0.25	96.85%	96.69%	97.20%	98.14%	95.36%	97.72%	93.82%
0.25	99.45%	98.73%	93.07%	97.11%	96.92%	97.16%	97.32%
0.25	99.13%	97.21%	-	-	95.32%	97.73%	95.49%

Averages and Standard Deviations							
Test Cond.	INITIAL	500,000	1,000,000	1,500,000	2,000,000	3,000,000	4,000,000
Avg 20	99.90%	100.40%	100.58%	100.26%	100.51%	100.42%	100.80%
Std 20	0.017%	0.126%	0.578%	0.258%	0.068%	0.238%	0.220%
Avg 12	99.65%	100.18%	100.23%	100.41%	100.58%	100.56%	100.65%
Std 12	0.224%	0.004%	0.036%	0.106%	0.385%	0.516%	0.061%
Avg 20	102.94%	101.53%	100.94%	101.12%	101.09%	101.32%	101.77%
Std 20	0.223%	0.190%	0.020%	0.149%	0.301%	0.215%	0.369%
Avg 0.25	98.48%	97.55%	95.13%	97.62%	95.87%	97.53%	95.55%
Std 0.25	1.420%	1.061%	2.919%	0.730%	0.912%	0.326%	1.748%

Average Shift in Registry from Initial							
Test Cond.	INITIAL	500,000	1,000,000	1,500,000	2,000,000	3,000,000	4,000,000
20	-	0.49%	0.68%	0.36%	0.61%	0.52%	0.40%
12	-	0.53%	0.58%	0.76%	0.92%	0.90%	0.47%
2	-	-1.41%	-2.00%	-1.82%	-1.85%	-1.62%	0.25%
0.25	-	-0.93%	-3.34%	-0.85%	-2.61%	-0.94%	-2.00%

Table 11. Test results for meter 4684541 (5/8-inch BLMJ).

Meter Serial Number 4684541							
Test Cond.	INITIAL	500,000	1,000,000	1,500,000	2,000,000	3,000,000	4,000,000
Flow (gpm)	Percent Registered						
20	99.67%	100.31%	100.34%	99.80%	100.22%	100.26%	100.69%
20	100.18%	100.36%	100.99%	100.04%	99.97%	99.93%	100.44%
12	99.87%	100.42%	100.39%	99.79%	100.42%	100.45%	100.80%
12	99.80%	100.13%	100.32%	99.83%	100.08%	99.84%	100.56%
2	101.83%	100.89%	100.43%	101.02%	99.89%	100.89%	100.18%
2	101.26%	100.66%	100.46%	100.98%	100.81%	101.20%	101.46%
0.25	95.89%	94.82%	95.99%	94.75%	94.90%	95.29%	92.42%
0.25	98.97%	98.73%	91.39%	93.45%	96.00%	94.95%	96.37%
0.25	99.13%	96.24%	-	-	93.70%	95.30%	94.52%

Averages and Standard Deviations							
Test Cond.	INITIAL	500,000	1,000,000	1,500,000	2,000,000	3,000,000	4,000,000
Avg 20	99.92%	100.34%	100.66%	99.92%	100.09%	100.10%	100.56%
Std 20	0.359%	0.038%	0.462%	0.171%	0.180%	0.235%	0.172%
Avg 12	99.84%	100.28%	100.35%	99.81%	100.25%	100.14%	100.68%
Std 12	0.051%	0.210%	0.049%	0.022%	0.245%	0.432%	0.168%
Avg 2	101.55%	100.78%	100.45%	101.00%	100.35%	101.04%	100.82%
Std 2	0.400%	0.163%	0.022%	0.022%	0.650%	0.223%	0.910%
Avg 0.25	97.99%	96.60%	93.69%	94.10%	94.87%	95.18%	94.43%
Std 0.25	1.827%	1.980%	3.254%	0.919%	1.150%	0.198%	1.976%

Average Shift in Registry from Initial							
Test Cond.	INITIAL	500,000	1,000,000	1,500,000	2,000,000	3,000,000	4,000,000
20	-	0.41%	0.74%	-0.01%	0.17%	0.17%	0.23%
12	-	0.44%	0.51%	-0.03%	0.41%	0.30%	0.41%
2	-	-0.77%	-1.10%	-0.55%	-1.20%	-0.50%	0.04%
0.25	-	-1.40%	-4.30%	-3.90%	-3.13%	-2.82%	-2.16%

Table 15. Test results for meter 4684542 (5/8-inch BLMJ).

Meter Serial Number 4684542							
Test Cond.	INITIAL	500,000	1,000,000	1,500,000	2,000,000	3,000,000	4,000,000
Flow (gpm)	Percent Registered						
20	99.68%	99.87%	99.70%	99.88%	100.06%	100.10%	100.53%
20	99.57%	99.75%	99.69%	99.96%	100.24%	100.41%	100.25%
12	99.50%	99.56%	99.89%	99.86%	99.77%	100.04%	100.52%
12	99.30%	99.87%	99.36%	100.13%	100.43%	100.31%	100.61%
2	99.93%	100.63%	100.10%	100.04%	100.38%	102.00%	99.85%
2	100.17%	100.00%	100.31%	99.54%	100.57%	100.93%	101.51%
0.25	97.46%	95.64%	99.01%	97.90%	95.13%	96.02%	95.89%
0.25	98.27%	97.17%	96.43%	96.37%	96.69%	95.93%	98.27%
0.25	99.55%	92.95%	-	-	93.93%	96.76%	96.38%

Averages and Standard Deviations							
Test Cond.	INITIAL	500,000	1,000,000	1,500,000	2,000,000	3,000,000	4,000,000
Avg 20	99.62%	99.81%	99.70%	99.92%	100.15%	100.26%	100.39%
Std 20	0.076%	0.085%	0.013%	0.057%	0.132%	0.219%	0.198%
Avg 12	99.40%	99.71%	99.63%	99.99%	100.10%	100.17%	100.57%
Std 12	0.143%	0.220%	0.375%	0.192%	0.469%	0.193%	0.063%
Avg 20	100.05%	100.31%	100.21%	99.79%	100.47%	101.47%	100.68%
Std 20	0.171%	0.446%	0.151%	0.360%	0.129%	0.752%	1.179%
Avg 0.25	98.42%	95.25%	97.72%	97.14%	95.25%	96.23%	96.85%
Std 0.25	1.054%	2.135%	1.819%	1.076%	1.384%	0.454%	1.257%

Average Shift in Registry from Initial							
Test Cond.	INITIAL	500,000	1,000,000	1,500,000	2,000,000	3,000,000	4,000,000
20	-	0.19%	0.07%	0.30%	0.53%	0.63%	0.76%
12	-	0.31%	0.23%	0.59%	0.70%	0.77%	1.17%
2	-	0.27%	0.16%	-0.26%	0.43%	1.42%	0.63%
0.25	-	-3.17%	-0.70%	-1.29%	-3.17%	-2.19%	-1.58%

Table 16. Test results for meter 4684543 (5/8-inch BLMJ).

Meter Serial Number 4684543							
Test Cond.	INITIAL	500,000	1,000,000	1,500,000	2,000,000	3,000,000	4,000,000
Flow (gpm)	Percent Registered						
20	99.64%	100.16%	100.24%	99.84%	100.26%	99.94%	100.49%
20	99.57%	99.99%	100.18%	99.76%	99.81%	100.33%	100.36%
12	99.13%	99.62%	99.42%	99.86%	100.42%	100.04%	100.35%
12	98.99%	99.81%	99.89%	100.01%	99.72%	100.37%	100.18%
2	99.43%	99.89%	99.85%	99.56%	99.89%	100.61%	102.69%
2	99.43%	99.51%	99.81%	99.54%	100.07%	100.13%	101.00%
0.25	98.92%	95.64%	96.53%	95.96%	93.98%	96.50%	92.80%
0.25	100.24%	98.15%	95.47%	94.91%	94.15%	95.93%	94.70%
0.25	100.96%	95.30%	-	-	91.61%	96.51%	92.43%
0.25*	-	97.85%	-	-	-	-	-
0.25*	-	97.90%	-	-	-	-	-

Averages and Standard Deviations							
Test Cond.	INITIAL	500,000	1,000,000	1,500,000	2,000,000	3,000,000	4,000,000
Avg 20	99.60%	100.07%	100.21%	99.80%	100.03%	100.14%	100.43%
Std 20	0.048%	0.115%	0.043%	0.055%	0.322%	0.277%	0.086%
Avg 12	99.06%	99.71%	99.66%	99.93%	100.07%	100.20%	100.26%
Std 12	0.099%	0.137%	0.331%	0.107%	0.497%	0.235%	0.119%
Avg 2	99.43%	99.70%	99.83%	99.55%	99.98%	100.37%	101.85%
Std 2	0.002%	0.272%	0.025%	0.016%	0.130%	0.336%	1.194%
Avg 0.25	100.04%	96.36%	96.00%	95.43%	93.25%	96.31%	93.31%
Std 0.25	1.031%	1.558%	0.751%	0.740%	1.421%	0.333%	1.220%

Average Shift in Registry from Initial							
Test Cond.	INITIAL	500,000	1,000,000	1,500,000	2,000,000	3,000,000	4,000,000
20	-	0.47%	0.61%	0.20%	0.43%	0.53%	0.82%
12	-	0.66%	0.60%	0.87%	1.01%	1.14%	1.21%
2	-	0.27%	0.40%	0.12%	0.55%	0.94%	2.42%
0.25	-	-3.68%	-4.04%	-4.61%	-6.79%	-3.73%	-6.73%

Table 21. Test results for meter 4853525 (Dialog 3G, 5/8-inch MMPD).

Meter Serial Number 4853525					
Test Cond.	INITIAL	500,000	1,500,000	2,500,000	-
Flow (gpm)	Percent Registered				
20	99.91%	99.65%	99.54%	99.61%	-
20	99.89%	99.73%	99.65%	99.57%	-
12	100.10%	99.83%	99.92%	99.73%	-
12	100.11%	99.84%	99.54%	99.58%	-
2	101.01%	100.38%	100.89%	100.18%	-
2	101.20%	100.57%	100.67%	100.24%	-
0.25	95.95%	97.89%	97.23%	97.80%	-
0.25	97.88%	98.54%	97.16%	97.07%	-
0.25	98.39%	97.87%	97.48%	97.65%	-

Averages and Standard Deviations					
Test Cond.	INITIAL	500,000	1,500,000	2,500,000	-
Avg 20	99.90%	99.69%	99.59%	99.59%	-
Std 20	0.013%	0.055%	0.082%	0.022%	-
Avg 12	100.10%	99.83%	99.73%	99.66%	-
Std 12	0.007%	0.008%	0.264%	0.102%	-
Avg 20	101.11%	100.47%	100.78%	100.21%	-
Std 20	0.132%	0.129%	0.155%	0.045%	-
Avg 0.25	97.41%	98.10%	97.29%	97.51%	-
Std 0.25	1.287%	0.378%	0.172%	0.382%	-

Average Shift in Registry from Initial					
Test Cond.	INITIAL	500,000	1,500,000	2,500,000	-
20	-	-0.21%	-0.31%	-0.31%	-
12	-	-0.27%	-0.37%	-0.45%	-
2	-	-0.63%	-0.33%	-0.90%	-
0.25	-	0.69%	-0.11%	0.10%	-

Table 22. Test results for meter 4853527 (Dialog 3G, 5/8-inch MMPD).

Meter Serial Number 4853527					
Test Cond.	INITIAL	500,000	1,500,000	2,500,000	-
Flow (gpm)	Percent Registered				
20	100.11%	99.81%	99.66%	99.65%	-
20	100.05%	99.85%	99.77%	99.65%	-
12	100.41%	99.95%	99.92%	99.82%	-
12	100.35%	100.02%	99.72%	99.62%	-
2	101.26%	100.63%	100.61%	100.39%	-
2	101.20%	100.57%	100.93%	100.29%	-
0.25	98.11%	98.35%	98.45%	98.27%	-
0.25	99.43%	98.77%	98.38%	97.54%	-
0.25	99.60%	98.34%	98.70%	97.65%	-

Averages and Standard Deviations					
Test Cond.	INITIAL	500,000	1,500,000	2,500,000	-
Avg 20	100.08%	99.83%	99.71%	99.65%	-
Std 20	0.043%	0.024%	0.081%	0.006%	-
Avg 12	100.38%	99.98%	99.82%	99.72%	-
Std 12	0.036%	0.049%	0.139%	0.143%	-
Avg 20	101.23%	100.60%	100.77%	100.34%	-
Std 20	0.043%	0.045%	0.230%	0.074%	-
Avg 0.25	99.05%	98.49%	98.51%	97.82%	-
Std 0.25	0.818%	0.244%	0.168%	0.395%	-

Average Shift in Registry from Initial					
Test Cond.	INITIAL	500,000	1,500,000	2,500,000	-
20	-	-0.25%	-0.37%	-0.43%	-
12	-	-0.40%	-0.56%	-0.66%	-
2	-	-0.63%	-0.46%	-0.89%	-
0.25	-	-0.56%	-0.54%	-1.23%	-

Table 23. Summary of high and low flow rate data for meters tested.

5/8-inch MMPD Production PD data								
#	High Flow Rate				Low Flow Rate			
	0 MG	0.5 MG	1.5 MG	2.5 MG	0 MG	0.5 MG	1.5 MG	2.5 MG
24	100.2%	99.9%	99.9%	99.8%	98.5%	96.5%	97.2%	95.9%
25	99.9%	99.7%	99.6%	99.6%	97.4%	98.1%	97.3%	97.5%
27	100.1%	99.8%	99.7%	99.6%	99.0%	98.5%	98.5%	97.8%
Ave	100.1%	99.8%	99.7%	99.7%	98.3%	97.7%	97.7%	97.1%
S D	0.1%	0.1%	0.1%	0.1%	0.8%	1.1%	0.7%	1.0%

5/8-inch BLMJ data														
#	High Flow Rate							Low Flow Rate						
	0 MG	0.5 MG	1.0 MG	1.5 MG	2.0 MG	3.0 MG	4.0 MG	0 MG	0.5 MG	1.0 MG	1.5 MG	2.0 MG	3.0 MG	4.0 MG
40	99.9%	100.4%	100.6%	100.3%	100.5%	100.4%	100.8%	98.5%	97.5%	95.1%	97.6%	95.9%	97.5%	95.5%
41	99.9%	100.3%	100.7%	99.9%	100.1%	100.1%	100.6%	98.0%	96.6%	93.7%	94.1%	94.9%	95.2%	94.4%
42	99.6%	99.8%	99.7%	99.9%	100.2%	100.3%	100.4%	98.4%	95.3%	97.7%	97.1%	95.3%	96.2%	96.8%
43	99.6%	100.1%	100.2%	99.8%	100.0%	100.1%	100.4%	100.0%	96.4%	96.0%	95.4%	93.2%	96.3%	93.3%
Ave	99.8%	100.2%	100.3%	100.0%	100.2%	100.2%	100.5%	98.7%	96.4%	95.6%	96.1%	94.8%	96.3%	95.0%
S D	0.2%	0.3%	0.4%	0.2%	0.2%	0.1%	0.2%	0.9%	0.9%	1.7%	1.6%	1.1%	1.0%	1.5%

Data without Meters # 47, 48 & 49 that were coated and reassembled by coater *without* calibration.

3/4-inch BLMJ data														
#	High Flow Rate							Low Flow Rate						
	0 MG	0.75 MG	1.5 MG	2.25 MG	3.0 MG	4.5 MG	6.0 MG	0 MG	0.75 MG	1.5 MG	2.25 MG	3.0 MG	4.5 MG	6.0 MG
50	101.2%	101.5%	101.6%	101.1%	100.6%	101.6%	100.9%	98.3%	97.9%	97.5%	98.2%	97.9%	96.8%	98.6%
51	99.7%	100.0%	99.7%	99.6%	100.3%	100.5%	100.3%	98.0%	97.2%	97.0%	97.7%	96.8%	96.2%	97.2%
54	100.6%	100.6%	100.6%	100.6%	100.6%	100.6%	100.6%	99.0%	97.9%	98.1%	98.0%	98.1%	97.6%	98.8%
55	98.8%	99.0%	99.5%	99.4%	99.2%	99.2%	99.5%	97.8%	96.7%	96.8%	97.2%	96.9%	95.4%	97.9%
56	99.5%	100.4%	100.0%	100.5%	100.7%	101.5%	101.7%	98.6%	98.1%	98.5%	99.1%	99.1%	98.5%	99.6%
52	99.6%	99.9%	99.6%	99.9%	100.2%	100.2%	100.5%	98.7%	97.6%	98.4%	96.7%	96.8%	96.4%	97.5%
53	99.7%	100.0%	100.7%	100.5%	100.8%	100.7%	100.9%	99.0%	97.3%	96.1%	94.9%	94.7%	91.3%	95.2%
Ave	99.9%	100.2%	100.2%	100.2%	100.4%	100.6%	100.6%	98.5%	97.5%	97.5%	97.4%	97.2%	96.0%	97.8%
S D	0.8%	0.8%	0.8%	0.6%	0.6%	0.8%	0.7%	0.5%	0.5%	0.9%	1.3%	1.4%	2.3%	1.4%