Analysis of Flow Meters at CT Transit, Hartford, CT

CDH was on site on August 23, 2012 and September 27, 2012 to check the water flow sensors at the site. Flow readings were compared against a strap-on ultrasonic flow meter. The specs for the instruments are given below:

Ultrasonic Flow Meter	Fuji PortaFlow-C Ultrasonic (transit-time) meter FSD22 sensing element
FL, FH	Onicon F-1211 Flow Meter, 4-20mA signal
FCH	Onicon F-1111 Flow Meter, 4-20mA signal
Pipe dimensions	
FL	3 in Schedule 40 steel
FH	3 in Schedule 40 steel
FCH	2 in Type L Copper

Flow Verification

The ultrasonic flow meter was used to verify the readings produced by the Onicon meters. The meter was strapped to the pipe in each loop and a set of readings was taken.

High grade flow was verified on August 23 by comparing the flows read by the Onicon flow meter to the flows read by the ultrasonic flow meter. Also on this visit, water damage was discovered in the cooling module flow meter, which was then removed, to be replaced at a later date. Low grade flow was not verified on this date due to the ultrasonic flow meter not being able to get a consistent signal when strapped to the low grade pipe.

During Testing and Balancing, the high and low grade flows were measured to be approximately 70 gpm using a Hydrodata flow meter, which measures the pressure differential before and after the pump.

On September 27, CDH installed a replacement flow meter for the cooling module and verified the flows produced with the new flow meter by comparing the flows read by the Onicon flow meter to the flows read by the ultrasonic flow meter.

Low grade flow was also verified with the ultrasonic flow meter. However, in order to verify the flows, it was necessary to repeatedly bleed air out of the low grade pipe by opening the ball valve slightly. This allowed the ultrasonic flow meter to get a consistent signal until more air built up in the pipe. At this point, more air was bled from the system. However, the low grade flow read by the Onicon flow meter verified within one percent when compared to the ultrasonic flow meter.

Table 1. Flow Verification

	Cooling Module		Low Grade		High Grade - Pump 1		High Grade - Pump 2	
	Ultrasonic	Onicon	Ultrasonic	Onicon	Ultrasonic	Onicon	Ultrasonic	Onicon
	33.8	31.2	45.1	46.9	72.1	71.71	73.8	72.84
	33.7	31.4	46.3	46.5	71.2	71.75	72.8	72.81
	34.0	31.5	46.0	46.9	72.4	72.01	72.3	72.34
	33.9	31.6	45.9	46.9	72.0	71.78	73.8	72.86
	33.9	31.3	46.6	46.6	72.0	71.74	73.5	72.84
	34.0	32.3	47.5	46.8	72.5	72.10	73.9	72.93
	34.4	31.9	47.7	46.6	72.4	71.94	74.4	72.92
	34.4	30.9	46.6	47.0	72.2	72.18	74.5	72.61
	34.1	31.8	46.2	46.9	71.9	72.00	73.5	72.36
	34.4	31.4	45.1	47.1	72.9	71.92	74.1	73.26
	34.7	31.5	47.8	46.7				
	34.8	31.9	46.5	46.7				
Average:	**34.2**	**31.6**	**46.4**	**46.8**	**72.2**	**71.9**	**73.7**	**72.8**
% Diff		*7.7%*		*-0.8%*		*0.3%*		*1.2%*

Appendix A — Historical Data Charts & Graphs

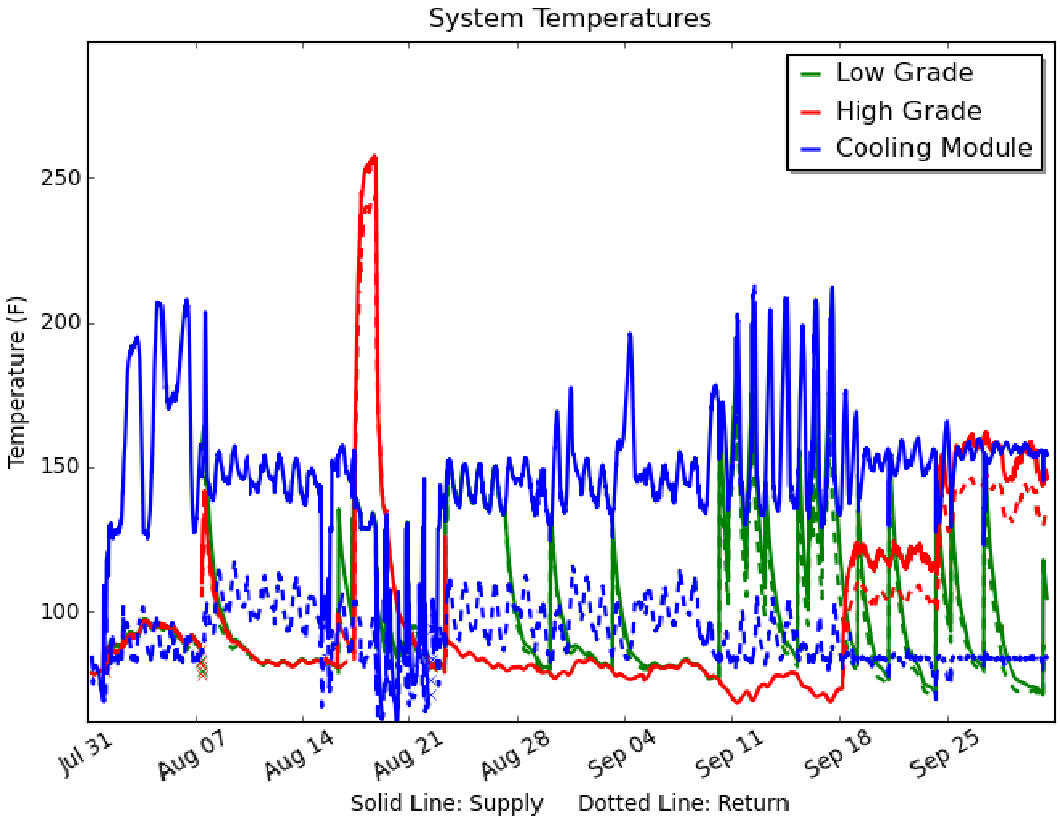


Figure 1. System Temperature Readings Over Life of Project

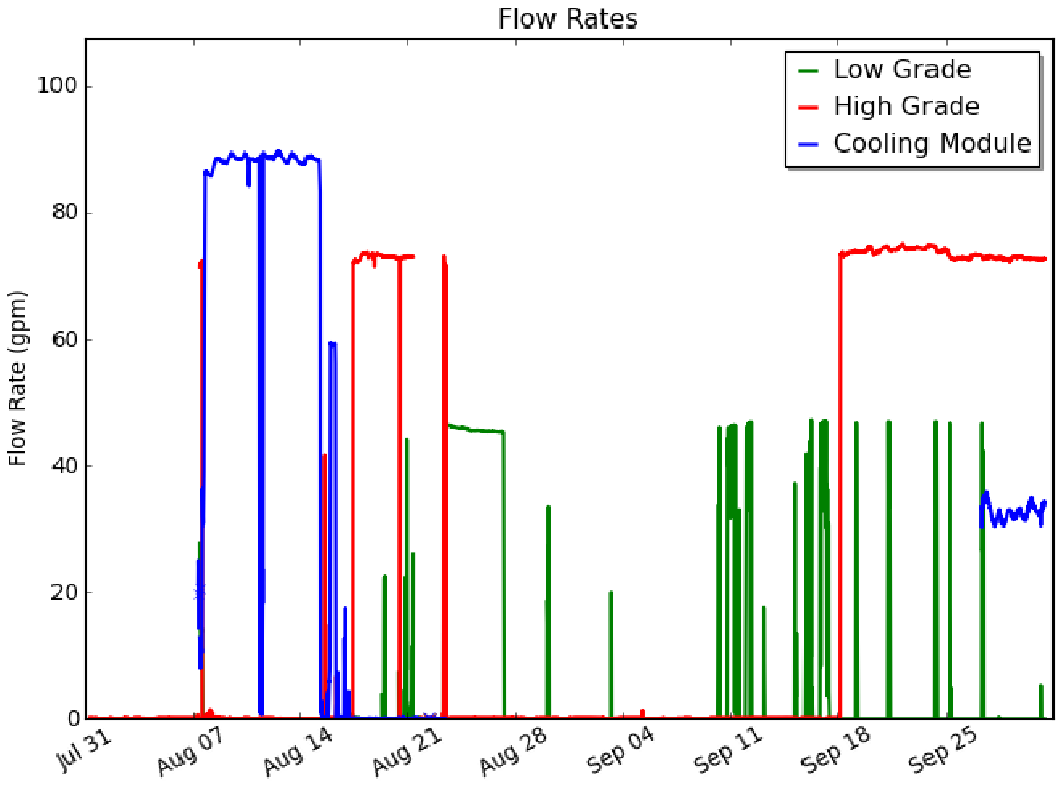


Figure 2. High Grade, Low Grade, and Cooling Module Flow Rates Over Life of Project

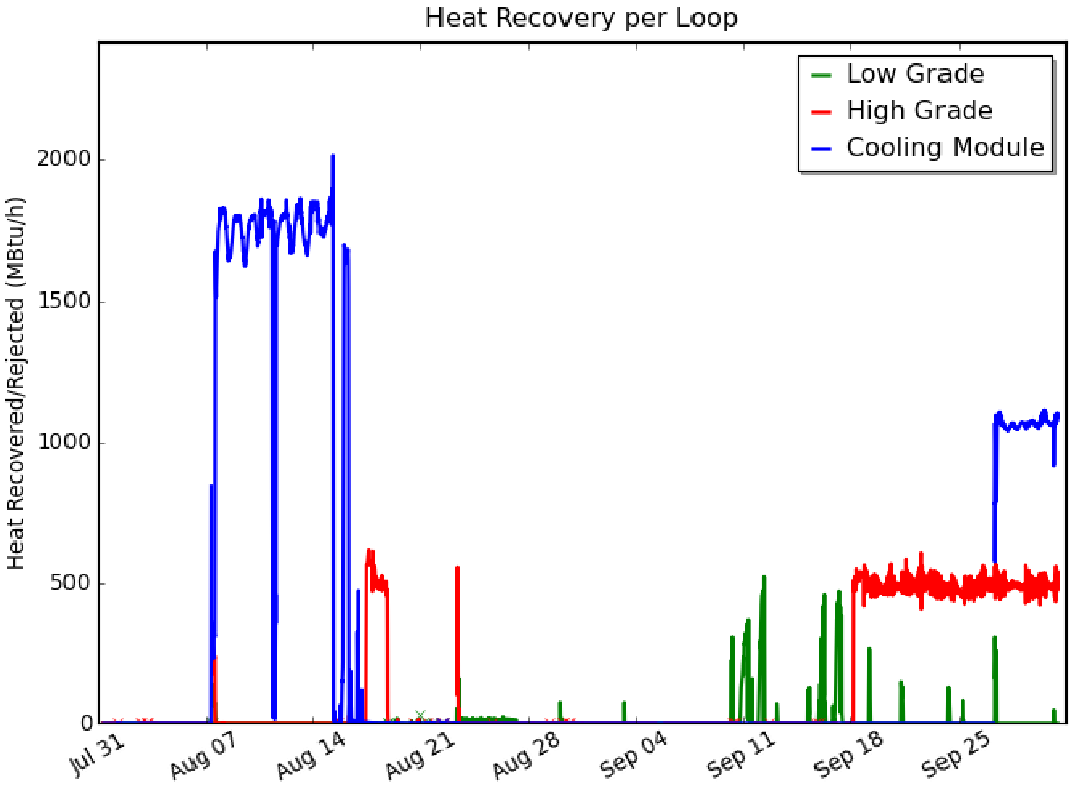
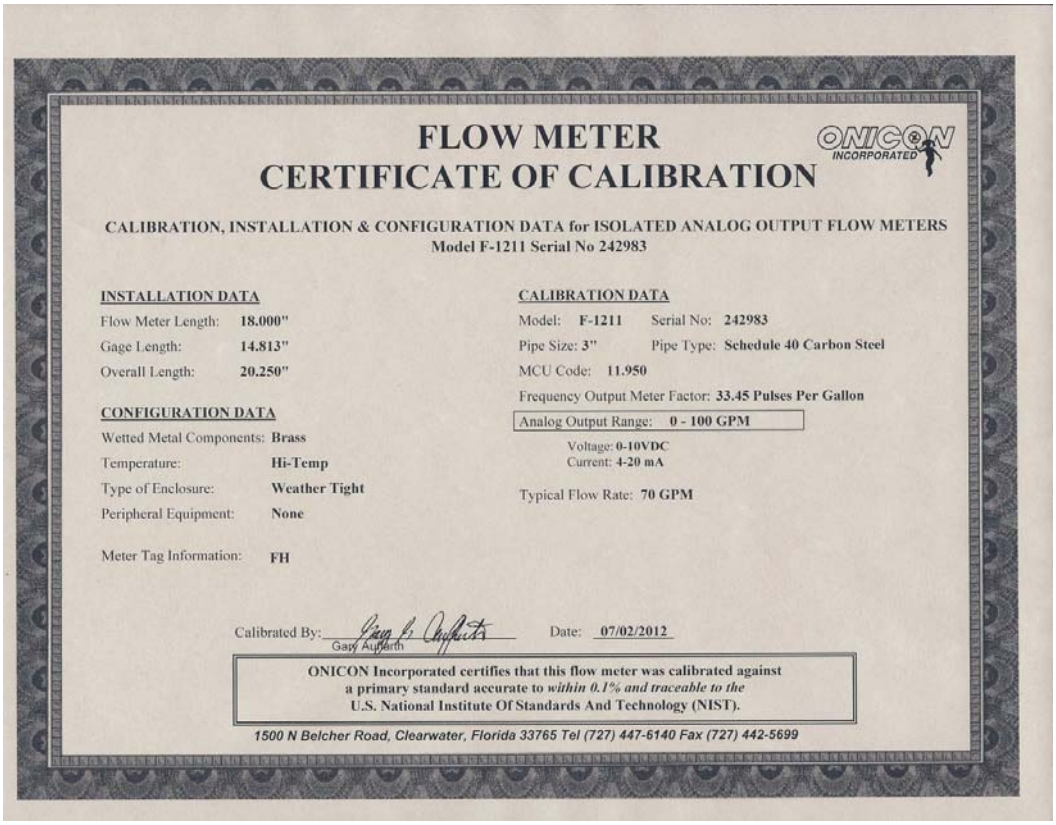


Figure 3. Heat Recovery in Each Loop Over the Life of the Project

Appendix B — Calibration Certificates for Onicon Flow Meters



FLOW METER CERTIFICATE OF CALIBRATION

ONICON INCORPORATED

CALIBRATION, INSTALLATION & CONFIGURATION DATA for ISOLATED ANALOG OUTPUT FLOW METERS
Model F-1211 Serial No 242983

INSTALLATION DATA

Flow Meter Length: **18.000"**
Gage Length: **14.813"**
Overall Length: **20.250"**

CONFIGURATION DATA

Wetted Metal Components: **Brass**
Temperature: **Hi-Temp**
Type of Enclosure: **Weather Tight**
Peripheral Equipment: **None**

Meter Tag Information: **FH**

CALIBRATION DATA

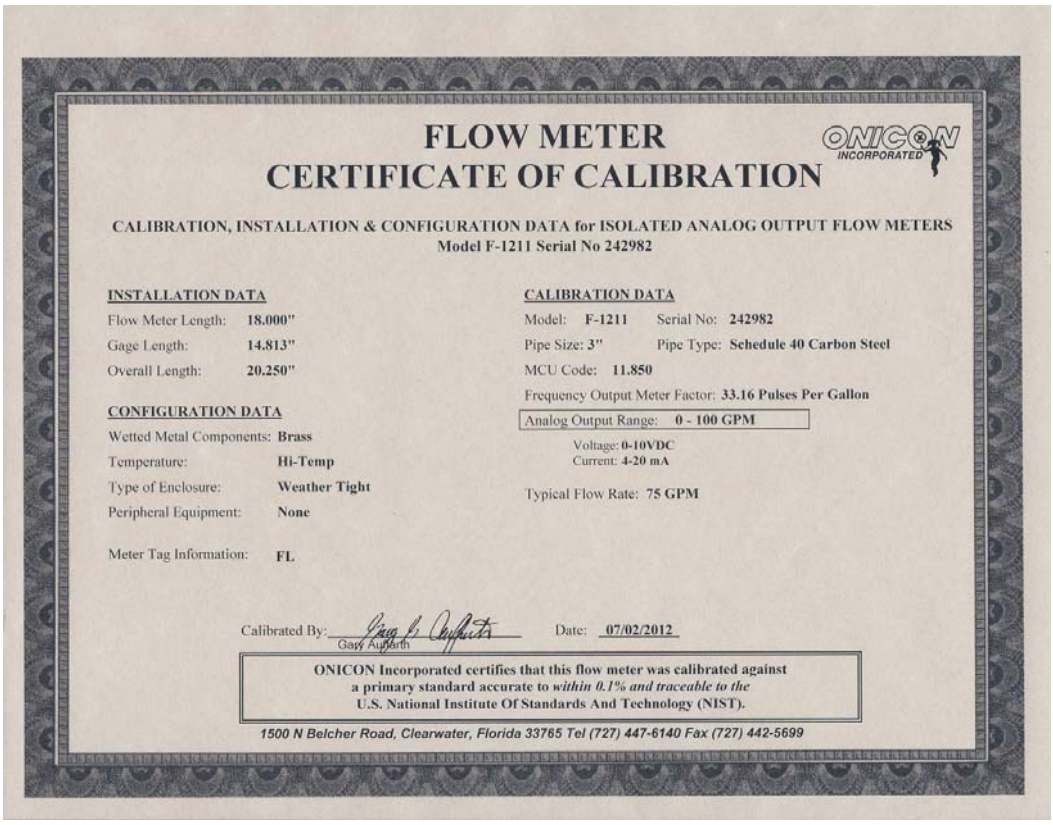
Model: **F-1211** Serial No: **242983**
Pipe Size: **3"** Pipe Type: **Schedule 40 Carbon Steel**
MCU Code: **11.950**
Frequency Output Meter Factor: **33.45 Pulses Per Gallon**
Analog Output Range: **0 - 100 GPM**
Voltage: **0-10VDC**
Current: **4-20 mA**

Typical Flow Rate: **70 GPM**

Calibrated By: Gary Auberth Date: **07/02/2012**

ONICON Incorporated certifies that this flow meter was calibrated against a primary standard accurate to *within 0.1% and traceable to the* U.S. National Institute Of Standards And Technology (NIST).

1500 N Belcher Road, Clearwater, Florida 33765 Tel (727) 447-6140 Fax (727) 442-5699



FLOW METER
CERTIFICATE OF CALIBRATION

ONICON INCORPORATED

CALIBRATION, INSTALLATION & CONFIGURATION DATA for ISOLATED ANALOG OUTPUT FLOW METERS
Model F-1211 Serial No 242982

INSTALLATION DATA

Flow Meter Length: **18.000"**
Gage Length: **14.813"**
Overall Length: **20.250"**

CONFIGURATION DATA

Wetted Metal Components: **Brass**
Temperature: **Hi-Temp**
Type of Enclosure: **Weather Tight**
Peripheral Equipment: **None**

Meter Tag Information: **FL**

CALIBRATION DATA

Model: **F-1211** Serial No: **242982**
Pipe Size: **3"** Pipe Type: **Schedule 40 Carbon Steel**
MCU Code: **11.850**
Frequency Output Meter Factor: **33.16 Pulses Per Gallon**
Analog Output Range: **0 - 100 GPM**
Voltage: **0-10VDC**
Current: **4-20 mA**

Typical Flow Rate: **75 GPM**

Calibrated By: Gary Aumarth Date: **07/02/2012**

ONICON Incorporated certifies that this flow meter was calibrated against a primary standard accurate to *within 0.1% and traceable to the* U.S. National Institute Of Standards And Technology (NIST).

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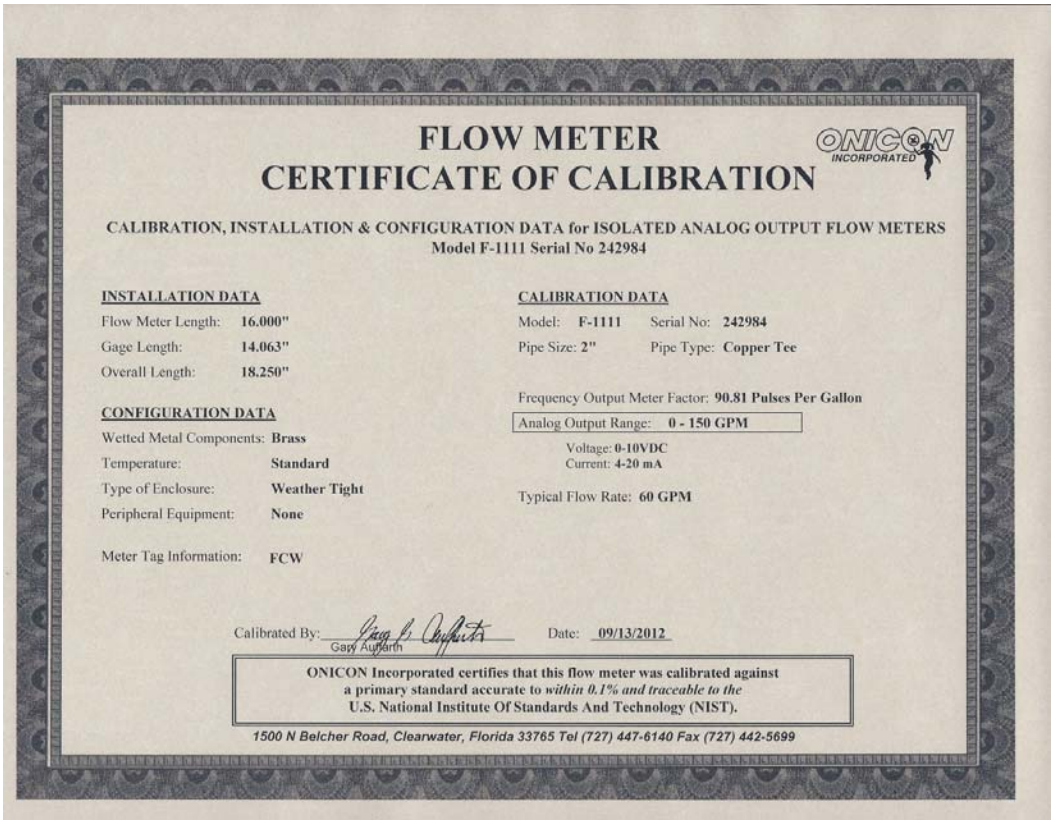

FLOW METER
CERTIFICATE OF CALIBRATION

ONICON INCORPORATED

CALIBRATION, INSTALLATION & CONFIGURATION DATA for ISOLATED ANALOG OUTPUT FLOW METERS
Model F-1111 Serial No 242984

INSTALLATION DATA

Flow Meter Length: **16.000"**
Gage Length: **14.063"**
Overall Length: **18.250"**

CONFIGURATION DATA

Wetted Metal Components: **Brass**
Temperature: **Standard**
Type of Enclosure: **Weather Tight**
Peripheral Equipment: **None**

Meter Tag Information: **FCW**

CALIBRATION DATA

Model: **F-1111** Serial No: **242984**
Pipe Size: **2"** Pipe Type: **Copper Tee**

Frequency Output Meter Factor: **90.81 Pulses Per Gallon**
Analog Output Range: **0 - 150 GPM**
Voltage: **0-10VDC**
Current: **4-20 mA**

Typical Flow Rate: **60 GPM**

Calibrated By: Gary Aumarth Date: **09/13/2012**

ONICON Incorporated certifies that this flow meter was calibrated against a primary standard accurate to *within 0.1% and traceable to the* U.S. National Institute Of Standards And Technology (NIST).

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