Field Service Trip Report

Customer:	Lockheed Martin	**Bill To:**	Order
	Cabot Road		
	Woburn, MA	**Order #80-8562**	
		PO#	
		Trip Date: 1-5-2016	

REASON FOR TRIP: Install Flexim Meter and Transducers on 2 pipes flowing electrolytes.

General

Quantity	Unit	A	B
Transducer serial no.		CDQ2N5251704	CDQ2N5270972

Parameters

Quantity	Unit	A	B
Function		n/a	n/a
Measuring point		-	-
Outer Diameter	inch	4.500	4.500
Wall thickness	inch	0.337	0.337
Wall material		PVC	PVC
Wall roughness	inch	0.000	0.000
Lining 1		No	No
Coating		No	No
Fluid		Other Medium 1	Other Medium 1
Fluid temperature	°F	75.0	75.0
Fluid pressure	bar(a)	1.000	1.000
Fluid c operating point	m/s	1700.0	1700.0
Fluid c range		Auto	Auto
Fluid viscosity	cSt	3.20	3.20
Fluid density	lb/ft3	74.91	74.91
Fluid concentration	g/l	1.00	1.00
Cable length	foot	0	0

Procedure of Demonstration or Service

Flexim's meter was installed in 2 Channel Mode on 2 different Electrolyte Supply Lines. The meter will measure the flow of the 2 lines separately and report.

The basic procedure for installation of the Flexim flow meter is as follows:

1. Determine a good location for the installation of the Transducers based on upstream piping, layout, other piping elements, and metering requirements
2. Verify Pipe and Liquid Parameters
3. Install Transducers as per Specifications and best practices
4. Verify Signal Strength to obtain reliable measurement
5. Verify Sound Speed to prove accuracy of the meter
6. Store measured data
7. If necessary, make recommendations or comments based on measured data

Installation

The Flexim meter was installed successfully.

Results

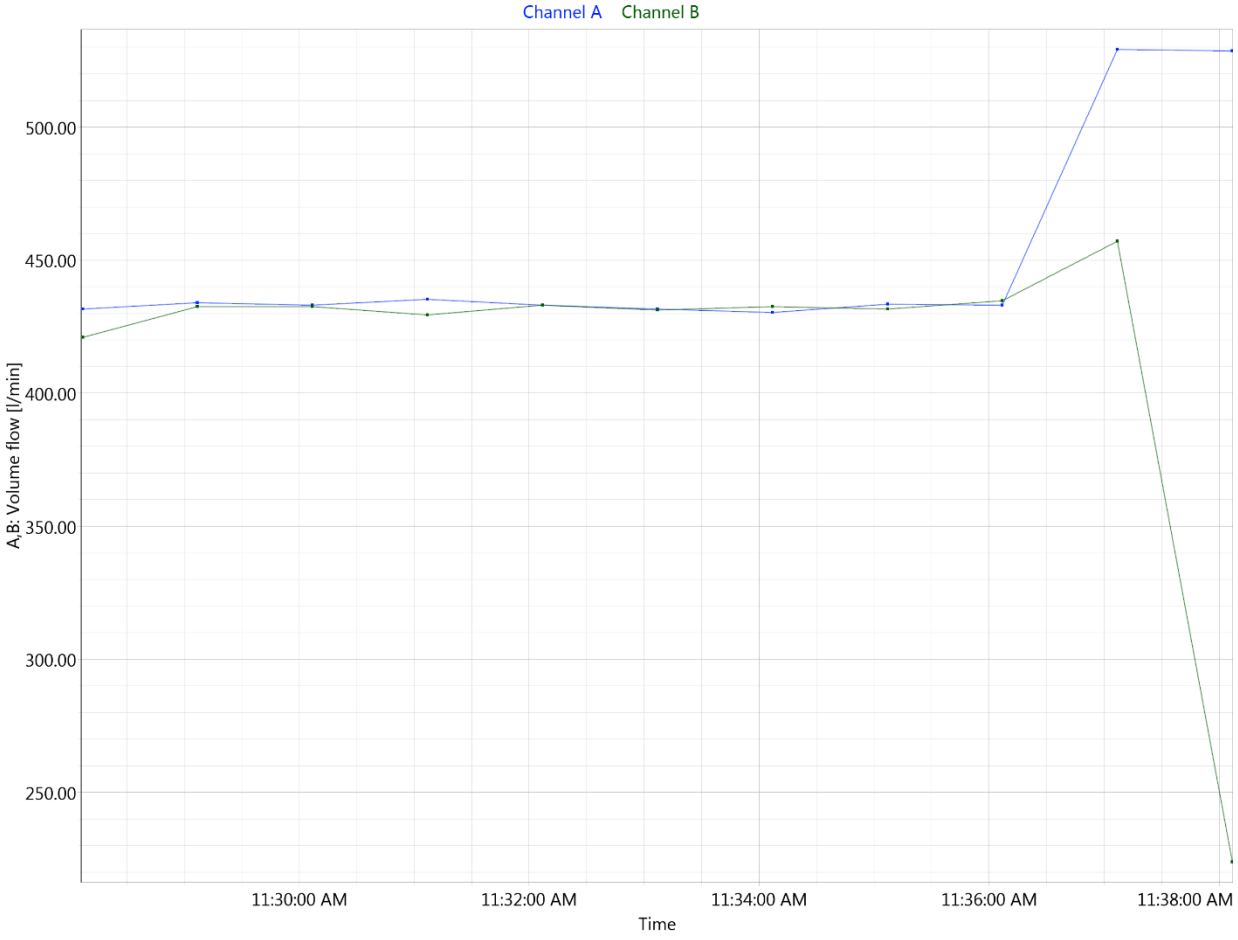
After installation, the meter was verified to pick up the flow of liquid through the pipes. The pumps were turned individually on the pipes connecting to Channel A and Channel B, and the flow rates corresponded to the adjustments. The pipe that appears higher in the picture is Channel A, the lower is Channel B.

Picture of portable meter installation

Flexim has the FluxData diagnostic software that is used to extract, view, and analyze the data from the meter. The parameters, data, and statistics can be viewed in graphs and tables. The FluxData file can also be imported into excel for further analysis.
The meter will publish volume flow in GPM and total flow in Gallons. The internal data logger was activated to record data. The meter stored the following values:

- Volume Flow Measurement in gallons/minute, GPM
- Volume Total, Gallons
- Flow Velocity in feet/second, fps
- Sound Speed in meters/second, m/s

Graph of test from FluxDiag software



Statistics from FluxDiag

The FluxDiag allows the user to view Statistics of values.

Channel	Quantity	Quality	Mean	Std.Dev	Unit	Points	Valid	Min	Max	Max-Min	Min@	Max@
A	Flow velocity		3.32	0.27	fps	11	11	3.17	3.90	0.73	1/5/2017 11:34:07 AM	1/5/2017 11:37:07 AM
A	Volume flow		450.30	37.09	l/min	11	11	430.35	529.15	98.80	1/5/2017 11:34:07 AM	1/5/2017 11:37:07 AM
A	Sound speed		1487.5	0.0	m/s	11	11	1487.4	1487.5	0.1	1/5/2017 11:30:07 AM	1/5/2017 11:28:07 AM
A	Amplitude		45.73	0.45	%	11	11	45.00	46.00	1.00	1/5/2017 11:28:07 AM	1/5/2017 11:29:07 AM
A	Quality		94.45	1.08	%	11	11	93.00	96.00	3.00	1/5/2017 11:33:07 AM	1/5/2017 11:31:07 AM
A	SCNR		0.00	0.00	dB	11	11	0.00	0.00	0.00	1/5/2017 11:28:07 AM	1/5/2017 11:28:07 AM

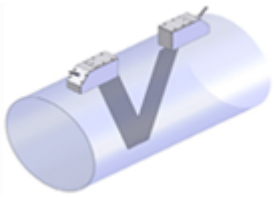
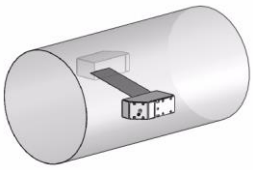
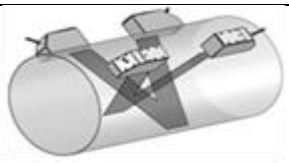
*Note: Sound speed will be incorrect in this graph as this test was with water.

Explanation of Meter Performance and Diagnostics

Sound Speed: The sound speed of an ultrasonic signal is the velocity at which the sound travels through a certain medium. All liquids have kown sound speeds that vary according to process conditions. Water has a sound speed between 1400 - 1555 m/s based on temperature range of 0F – 490F The sound speed measured by the meter after installation was 1487.5 m/s. If the meter is installed correclty, the sound speed will match the expected value within 25 m/s. The expected value for water at 70F is 1485 m/s. Flexim has a library of sound speeds for different liquids.

Signal Strength: The signal strength of an ultrasonic signal defines how well the signal is transmitted and received through the pipe wall and medium. Flexim displays signal strength as a percentage between 0 and 100% or 0-10bars. In order to be considered acceptable, the signal strength number must be at least 40% (4 bars). Average signal strength will fall between 50% or 5 Bars and 70% or 7 Bars. The signal strength measured for this application was [45].

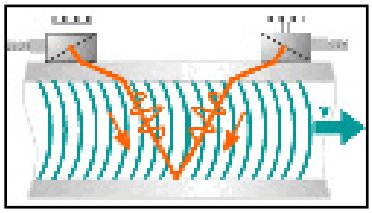
Configurations used to mitigate effects of distorted flow profile.

Configuration	Example	Typical Uses
2 Sound path		90% of Installations for Liquids, preferred configuration for Easy Applications Note: Transducers should not be installed at top or bottom of horizontal pipes
1 Sound path		Applications where 2 SP produced low signal. Must obtain 10 D of Upstream Straight Run
Dual Beam Direct X		Tough Applications; Dual Beam Wave Injectors; Limited Straight Run; Redundancy Required
Dual Beam Direct Offset V		Tough Applications; Dual Beam Wave Injectors with overlapping spacing; Limited Straight Run; Redundancy Required
Dual Beam V		Tough Applications; Limited Straight Run; Redundancy Required

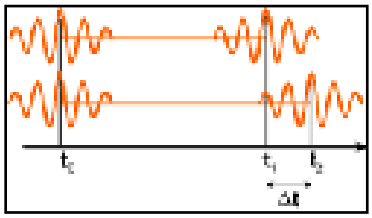
I. Transit Time Theory

The Transit Time Difference Method

- The transmission speed of an ultrasonic signal depends on the flow velocity of the carrier medium; similar to a swimmer swimming against the current, an ultrasonic signal moves slower against the flow direction of the medium than when in flow direction.



- For the measurement, two ultrasonic pulses are sent through the medium, one in flow direction, and a second one against it. The transducers are alternatively working as emitter and receiver.



- The transit time of the ultrasonic signal propagating in flow direction is shorter than the transit time of the signal propagating against flow direction.

- The transit-time difference Δt is measured and allows the determination of the average flow velocity on the propagation path of the ultrasonic signals. A profile correction is performed to obtain the average flow velocity on the cross-section of the pipe, which is proportional to the volume flow.

- Since ultrasounds propagate in solids, the transducers can be mounted onto the pipe. Measurement is Non-Invasive and there is no need to cut the pipe or interrupt any process.