App Note - Oil & Gas Industry

Flow measurement for natural gas distribution

Problem

A municipal gas distribution network company needed to measure the flow of natural gas at multiple locations on various pipes. Accurate measurements need to be taken for two reasons. First, to evaluate whether the company will be able to meet gas demands over the winter months and secondly, for the company to plan for future expansion.

Knowing the flow rate of gas at various locations helps the company prevent costly outages and provides valuable information when planning to lay new pipe for expansion.

Currently, flow is monitored throughout the network at a small number of the pressure reducing stations (mostly main stations and where large demands are required) by turbine and differential pressure meters.

Besides the obvious draw-backs of these types of meters (pressure drop, costly maintenance and intrusive installation), the customer needed to take measurements in other locations throughout the pipe network.

Solution

Digital Flow CTF878 clamp-on ultrasonic flow meter with C-RL transducers installed on various pipe using a CFT clamping fixture. See each location for transducer details.

Location 1: Reducing station

Pipe OD: 3 in (80 mm)
Pipe wall: 0.2 in (5 mm)
Pipe material: Carbon steel
Pressure: 116 psig (9 bar)
Temperature: Ambient ~ 50ºF (10ºC)
Transducers: C-RL-304 (500 kHz) with no dampening material

Location 2: Underground carbon steel pipe with PE coating

Pipe OD: 4 in (100 mm)
Pipe wall: 0.16 in (4 mm) steel, 0.08 in (2 mm) PE
Pipe material: Carbon steel with 2 mm polyethylene (PE) coating on the outside of the pipe
Pressure: 116 psig (9 bar)
Temperature: Ambient ~ 50ºF (10ºC)
Transducers: C-RL-304 (500 kHz) with no dampening material

Location 3: Underground cast iron pipe

Pipe OD: 6 in (150 mm)
Pipe wall: 0.27 in (6.8 mm)
Pipe material: Cast iron
Pressure: 116 psig (9 bar)
Temperature: Ambient ~ 50ºF (10ºC)
Transducers: C-RL-304 (500 kHz) with no dampening material

Location 4: Flow to and from reducing station

A. Pipe to Station
Pipe OD: 8 in (200 mm)
Pipe wall: 0.34 in (8.6 mm)
Pipe material: Cast iron
Pressure: 14.5 psig (2 bar)
Temperature: Ambient 28ºF (-2ºC)
Transducers: C-RL-304 (500 kHz) with no dampening material

B. Pipe from station
Pipe OD: 12 in (300 mm)
Pipe wall: 0.43 in (11 mm)
Pipe material: Cast iron
Pressure: 1.45 psig (1113 mbar)
Temperature: Ambient 28ºF (-2ºC)
Transducers: C-RL-306 (200 kHz) with DMP-1 applied

Location 5: PVC pipe from reducing station

Pipe OD: 12 in (300 mm)
Pipe wall: 0.30 in (7.7 mm)
Pipe material: PVC
Pressure: 1.45 psig (1113 mbar)
Temperature: Ambient 36°F (2°C)
Transducers: C-RL-304 (500 kHz) with no dampening material

Location 6: Cement pipe from reducing station

Pipe OD: 12 in (300 mm)
Pipe wall: 0.94 in (24 mm)
Pipe material: Asbestos Cement
Pressure: 1.45 psig (1113 mbar)
Temperature: Ambient 36°F (2°C)
Transducers: C-RL-304 (500 kHz) with no dampening material

Installation

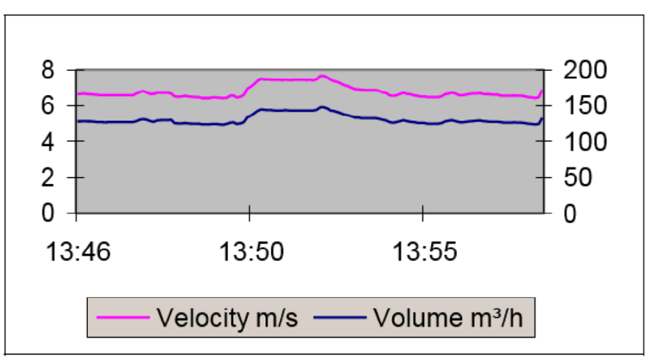
The CTF878 flow meter and transducer was installed temporarily in three locations (see specifications of more details on each site).

Location 1: Reducing station

The equipment was installed in a reducing station on a carbon steel pipe upstream of a reducing valve with pressure ranging from 116 to 14 psig (9 to 2 bar).

Flow profile was good despite the disturbances upstream. The noise from the reducing value was not present in this location. Good flow profile was attributed to the 3 to 4 in (80 to 100 mm) reducing pipe section.

C-RL transducers installed on a 3 in (80 mm) pipe in a reducing station



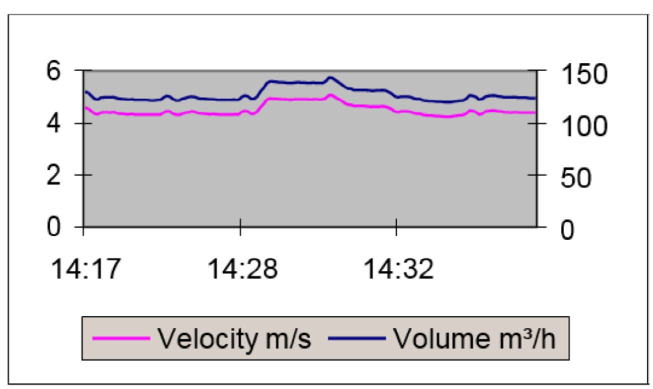
Flow rate measurement at Location 1

Location 2: Underground carbon steel pipe with polyethylene (PE) coating

Flow readings and diagnostics at this location were excellent. Typically, polyethylene (PE) has interfered with integrity of the transducer signal; however, it did not present a problem here. It is assumed the PE coating had no effect on the quality of the transducer signal.

If you compare the flow rate graphs from location 1 and 2 you will see similar data. Flow rate was similar because the measurements were taken on the same pipeline. Location 2 was located 82 ft (25 m) upstream of location 1. The similarity in flow measurement further proved the accuracy of the meter.

C-RL transducers installed on a 4 in (100 mm) carbon steel pipe with a 0.08 in (2mm) PE coating (outside)

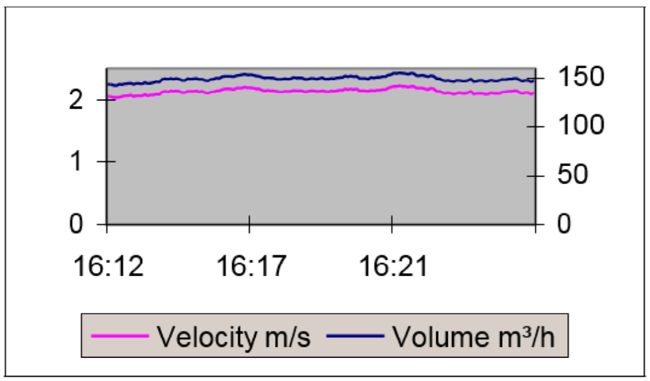


Flow rate measurement at Location 2

Location 3: Underground cast iron pipe

Despite the poor pipe wall conditions, flow readings and diagnostics were excellent at this location as well.

C-RL transducers installed on a 6 in (150 mm) cast iron pipe

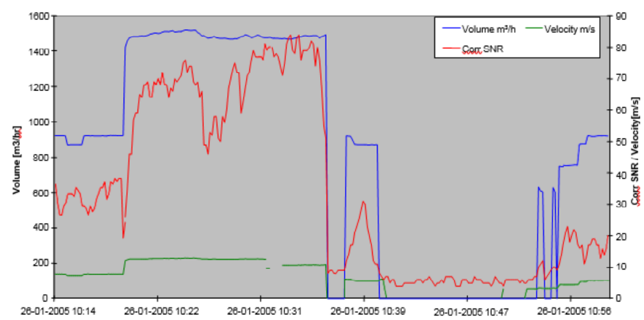


Flow rate measurement at Location 3

Location 4: Flow to and from reducing station

Transducers were installed on two cast iron pipes approximately 33 ft (10 m) away from the reducing station. Measurements were good despite the valve noise present. DMP-1 was applied to location B.

C-RL-304 (A) and 306 (B) transducers installed on pipe leading to and from the reducing station

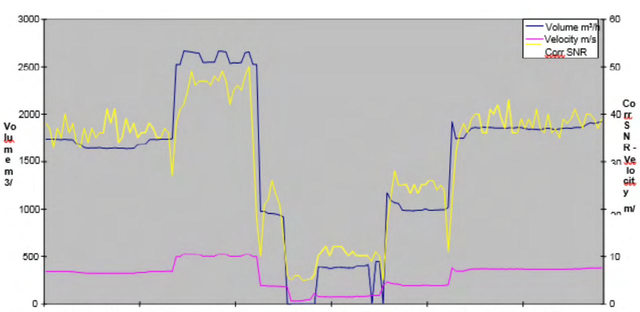


Flow rate measurement at Location 4
(Flow fluctuations shown above were caused by customer controlling the pressure downstream of the reducing valve.)

Location 5: PVC pipe from reducing station

Flow measurements were good at this location despite valve noise. Minimum velocity was approximately 3 to 5 ft/s (1 to 1.5 m/s) with good straight run.

C-RL-304 Transducers installed on a 12 in. (300 mm) PVC pipe downstream of reducing station



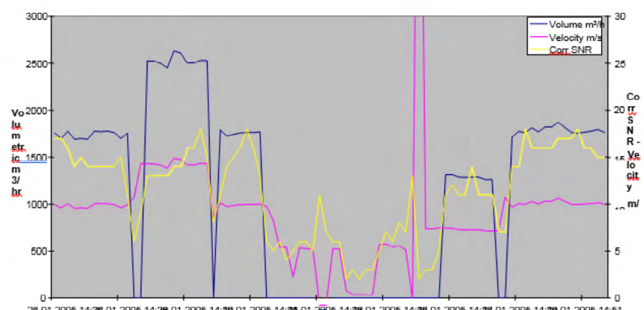
Flow rate measurement at Location 5

Location 6: Cement pipe from reducing station

This measurement location was initially thought to be a bad location for two reasons. First, the pipe was very old and secondly, it had a 0.94 in (24 mm) wall thickness of pure asbestos cement.

Despite the pipe condition, the C-RL-304 transducers were installed and the CTF878 returned good flow readings.

C-RL-304 transducers installed on a 12 in (300 mm) asbestos cement pipe downstream of reducing station



Flow rate measurement at Location 6
(Flow fluctuations shown above were caused by customer controlling the pressure downstream of the reducing valve.)

Benefit

The CTF878 provided the portability the customer needed. More importantly, the CTF878 was able to demonstrate reliable, accurate measurements over a complete range of pipe sizes, materials (including pipes with polyethylene coating) and pressure ranges with only one set of transducers.

Additionally, the customer preferred our technology because of the easy transducer mounting and alignment with the CTF clamping fixture.

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