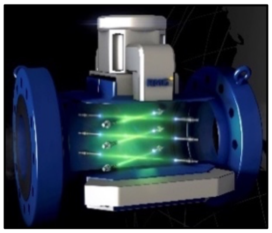
DNV Sustainable Gases Test Results for the RMG GT400 USM

Written by John Lansing

Introduction



The definition of natural gas is changing due to interest in using more renewable fuels. Of particular interest is the addition of Hydrogen (H_2) to natural gas and what issues that may develop from adding this non-hydrocarbon gas. Traditional natural gas has virtually no H_2 since it isn't generally found in wells. Adding H_2 to the natural gas has often been referred to as "non-conventional natural gas."

The measurement of natural gas, when significant percentages of H_2 have been added, raises questions and concerns about what effect this may have on metering equipment. Of particular interest is the impact significant levels of H_2 may have on various brands of high-pressure transmission gas ultrasonic (US) flow meters. In 2020 a Joint Industry Project (JIP) was formed in The Netherlands to test various levels of H_2 added to conventional natural gas. Participating European JIP users included Enagas, Fluxys, Gas Networks Ireland, Gasunie, Cascade, Gazsystem, Grtgaz, Ontras, Open Grid Europe and SNAM. Participating manufacturers, in alphabetic order, were Emerson, Endress+Hauser, Flexim, Honeywell, Krohne, Pietro Fiorentini, RMG, SICK and Tancy.

Testing was conducted at the DNV MPFLG facility in Groningen, Netherlands. Gases tested included conventional Groningen natural gas, pure Methane, pure Nitrogen, two high levels of CO_2 (outside of pipeline quality requirements) and five concentrations of H_2. All gases were tested at two pressures. **This Tech Note summarizes results for all gas compositions and test pressures for a 6-inch RMG GT400 6-path ANSI 300 Schedule 80 gas ultrasonic meter.**

Test Details

Two metering pressures, 16 and 32 Bar (232 & 464 PSIG), were used for all gas mixtures. Compositions included pipeline quality Groningen gas, pure Methane, pure Nitrogen, pipeline-quality natural gas with 5%, 10%, 15%, 20% and 30% H_2, and pipeline-quality natural gas with 10% and 20% CO_2. The RMG GT400 was not previously calibrated and had no calibration adjustments.

The flow meter working standards were an in-series combination of turbine and Coriolis meters. Two line sizes were used to cover the flow rate range. The low-flow measurements used a DN100 (4-inch) line for flow rates between 10-250 m^3/hr. (353-8,828 ACFH). For the higher flow rates, from 100-1000 m^3/hr. (3,531-35,314 ACFH), a DN150 (6-inch) was selected. The primary reference used to calibrate the working turbine/Coriolis standards was a sonic nozzle package with 5 different sizes. The flow rates for the primary sonic nozzle standard included 16, 40, 100, 250 and 500 m^3/hr.

For each of the given gas compositions and pressures, a single Flow Weighted Mean Error (FWME) was computed. The method for computing the FWME is defined in the ISO 17089-1 document, Section 6.3. This simplifies reporting what differences, if any, were observed for each of the test conditions relative to the Groningen (baseline) pipeline-quality natural gas.

Performance Results

The following Table 1 is from Section 1.3 of the DNV report ESNL.19899-RMG. It summarizes all test conditions (pressures and gas compositions) in column 1 along with the "Flow weighted mean (average) error (%)" in column 4 (highlighted in **red**).

Gas type	Average error (%)	Average repeatability (%)	Flow weighted mean average error (%)	FWME repeatability (%)	Number of data points
N2_32bar	-0.423%	0.132	-0.327%	0.085	12
N2_16bar	-0.233%	0.098	-0.338%	0.064	12
CH4_32bar	-0.223%	0.120	-0.326%	0.084	10
CH4_16bar	-0.341%	0.113	-0.347%	0.087	10
Ggas1_32bar	-0.397%	0.083	-0.380%	0.042	11
Ggas1_16bar	-0.494%	0.107	-0.424%	0.083	11
Ggas2_16bar	-0.378%	0.066	-0.385%	0.061	7
5H2_32bar	-0.427%	0.105	-0.398%	0.071	13
5H2_16bar	-0.429%	0.106	-0.348%	0.078	9
10H2_32bar	-0.308%	0.081	-0.294%	0.052	9
10H2_16bar	-0.296%	0.090	-0.318%	0.070	10
15H2_32bar	-0.354%	0.087	-0.313%	0.050	10
15H2_16bar	-0.383%	0.086	-0.356%	0.053	6
20H2_32bar	-0.376%	0.103	-0.347%	0.071	9
20H2_16bar	-0.329%	0.083	-0.331%	0.061	11
30H2_16bar	-0.381%	0.080	-0.385%	0.066	9
10CO2_32bar	-0.356%	0.090	-0.331%	0.081	9
10CO2_16bar	-0.421%	0.113	-0.366%	0.060	10
20CO2_32bar	-0.239%	0.093	-0.216%	0.071	11
20CO2_16bar	-0.323%	0.110	-0.308%	0.076	9

Table 1 Summarized Calibration Results

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The measurement effect on the GT400's performance for each of the test gases and pressures can be summarized by comparing the FWME of the baseline Groningen natural gas to each of the test conditions. Several gas flow rates were used to determine each FWME. The flow rates ranged from a low of around 17 m^3/hr. to a high of 1000 m^3/hr. which is the facility's maximum. The term "Drift" refers to the average deviation from the baseline Groningen natural gas vs. the specific test mixture.

The following graph (Figure 1) is from the DNV report which shows the FWME differences for pure Nitrogen and pure Methane relative to the Groningen natural gas. The "dots" (●) are the 32 Bar results and the "triangles" (▲) represent the 16 Bar results. Both graphs include a repeat of the Groningen gas several days later to verify the meter's performance hadn't changed.

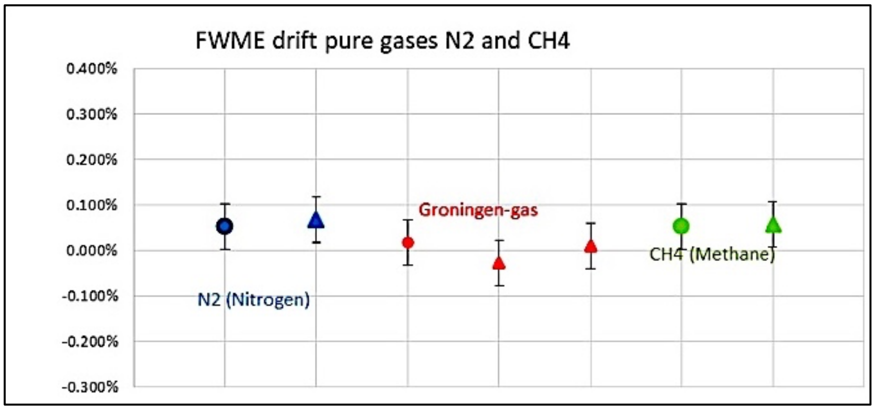

Figure 1 Meter FWME Drift with Pure Gases (dots are 32 bar; triangles 16 bar)

The following graph (Figure 2 in the DNV report) shows the FWME differences for the various mixtures of CO_2 and H_2.

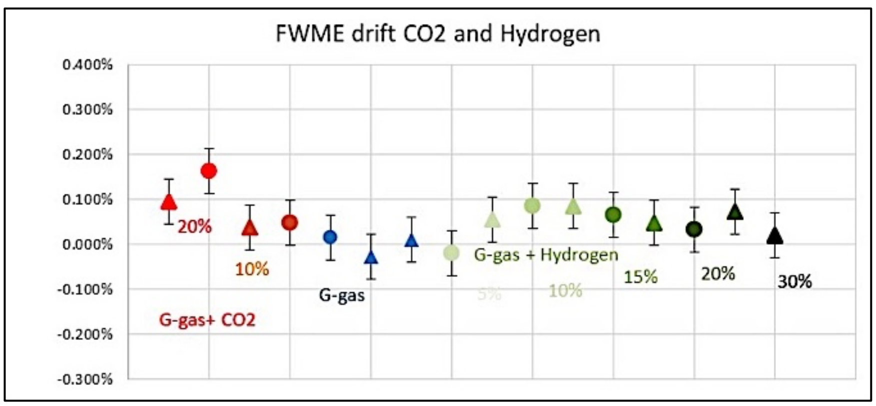

Figure 2 Meter FWME Drift with Gas Mixtures

Conclusions

The DNV Report number ESNL.198992-RMG, Section 1.6.4, page 4, states "Comment: Meter [RMG] is one of the few US meters, that shows no significant drift behavior when subject to other gases." In this same section it is stated "7 of the 9 US meters the drift is considered significant compared to the meter's transferability, mostly consistent drift patterns either positive (for 5) or negative (for 2) for lower density gases (e.g. when hydrogen is added to the natural gas)". The report further states "2 of the 9 US meters no significant systematic drift behavior has been assessed as compared to its transferability". **In other words, RMG was one of only two meters the various gas compositions were deemed to not have caused any significant performance changes**. Also, **no meter configuration parameters were changed** during the 11 days of testing.

RMG Tech Notes

This is the 12th Tech Note in our series. Previous Tech Notes are posted on the RMG website (www.RMG.com), or we can send them to you via email. Please contact us at salesUSA@rmg.com to obtain a PDF copy of any of our previous Tech Notes.

References

1. **JIP sustainable gases – Testing results for RMG Messtechnik GmbH,** Report No.: ESNL.198992-RMG, Dated 2021-10-01.