

LNG: baseload custody transfer

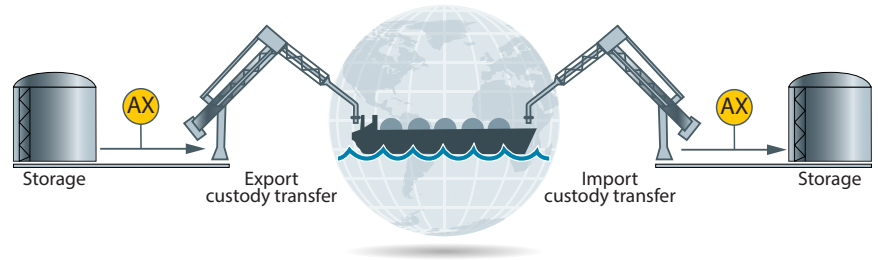


Figure. 1: Custody transfer during transport of LNG

Benefits at a glance

- Measures LNG in the cryogenic liquid phase
- Faster update times
- No analysis delays due to sample transport or vaporization
- Up to 10 times less uncertainty in Btu transferred when compared to Vaporizer/GC systems
- Virtually immune to LNG flow variations for accurate energy measurement of more of the transferred cargo
- Does not shut down during flow interruptions; starts accurate analysis immediately upon flow resumption
- Lower OPEX

Once LNG has been liquefied and stored in tanks, it is ready for transport to other markets, usually via an LNG carrier. These custody transfers from the storage tank to the ship, or from the ship at a receiving terminal, often involve millions of dollars of product in a single shipment. As such, it is essential that both the deliverer and recipient of the LNG know exactly how much energy has been transacted, and an uncertainty of as little as 1% in energy transferred can cost the buyer or seller several hundred thousand dollars.

Measurement of Btu

According to the GIIGNL¹, a key factor in determining proper energy transfer is the measurement of gross calorific value (GCV), which is calculated from LNG composition. A unique feature of the Raman Rxn4 analyzer is that it measures the composition of LNG in the cryogenic liquid state, resulting in faster update times because it does not require any vaporization, sample conditioning, or sample transport. Figure 2 shows results from a Raman Rxn4 analyzer for monitoring the CV of several different shiploads of LNG of varying quality during offloading at a major import terminal over a several week period, collected simultaneously

with a GC-vaporizer combination. These results demonstrate that the Raman Rxn4 analyzer provides over 10 times lower uncertainty in the GCV when compared with legacy GC-vaporizer systems.

Issues with traditional measurements

For traditional GC-vaporizer systems, it is essential to eliminate partial and pre-vaporization for all LNG flow rates of the LNG sample, which requires careful installation and proper maintenance to ensure good insulation and no hot spots in the sample vaporization and transport paths. In addition, the GIIGNL LNG Custody Transfer Handbook states that LNG must be sampled during stable flow of LNG. Data collected during flow variations and interruptions is not used in the calculation of the energy transferred, and can result in a significant amount of LNG being transferred without known GCV. The Raman Rxn4 analyzer is essentially immune to LNG flow variations, so can provide a more complete measurement of the GCV of the entire shipload. Maintenance is significantly lower with the Raman Rxn4 analyzer, since there are no moving parts and no insulation to degrade.

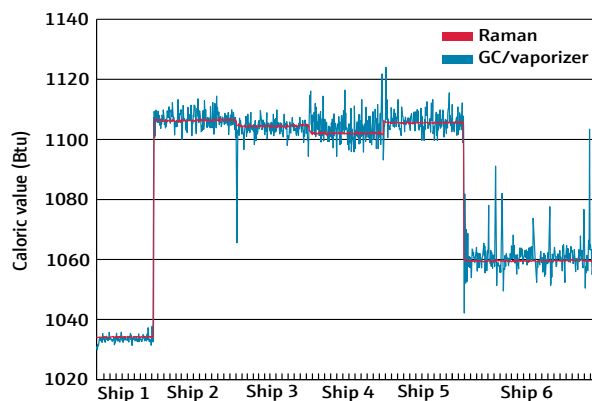


Figure 2: Comparison of LNG Btu uncertainty of Vaporizer/GC combinations and the Raman analysis for six ship loads

Raman Rxn4 analyzer for LNG custody transfer

The Raman Rxn4 analyzer for LNG coupled with the Rxn-41 probe for cryogenic service provides accurate measurement of the Wobbe index (WI), gross heating value (GHV), and full composition of LNG with up to a 10 times lower uncertainty than legacy GC vaporizer systems currently in use. Accuracy when compared to reference LNG is ± 3 Btu/scf. Samples are measured directly in the liquid phase, eliminating the need for costly vaporization, conditioning and transport of LNG for composition measurement. The wide range of WI and Btu handled by the Raman Rxn4 analyzer LNG software method is suitable for LNG transactions worldwide, ensuring that both buyer and seller have an accurate and precise measure of the energy of the LNG cargo during all custody transfer transactions.

The Raman Rxn4 Raman solution for LNG custody transfer consists of the following:

- Raman Rxn4 analyzer base unit with laser and internal calibration
- Rxn-41 fiber optic probe for cryogenic service
- Fiber optic cable (length from 15 to 500 meters, customized to your plant requirements)
- Dedicated LNG custody transfer method valid over LNG temperature range of 93K to 117 K*

*Requires manual entry for fixed temperature, or temperature input (± 1 K) via Modbus for varying temperature.

**Performance may vary for different cable lengths and analysis time.

LNG component ranges and performance*

Component	Concentration (Mol %)		Uncertainty (k=2)
	Min	Max	
Methane (CH_4)	87.000	98.170	< 0.46
Ethane (C_2H_6)	1.300	10.500	< 0.38
Propane (C_3H_8)	0.160	3.000	< 0.11
i-Butane (iC_4H_{10})	0.060	0.400	< 0.023
n-Butane (nC_4H_{10})	0.078	0.600	< 0.028
i-Pentane (iC_5H_{12})	0.005	0.120	< 0.031
n-Pentane (nC_5H_{12})	0.005	0.120	< 0.015
Nitrogen (N_2)	0.040	1.050	< 0.056

Table 1: Range of validated LNG with worst case uncertainty for fiber lengths < 500 m and measurement time of 300 seconds**

Component	Range	Uncertainty (k=2)
	Min – Max	
Gross heating value (MJ/m^3)	38.4 - 42.2	< 0.16
Gross heating value (MJ/kg)	53.8 - 55.3	< 0.072

Table 2: LNG heating value ranges for the LNG custody transfer method

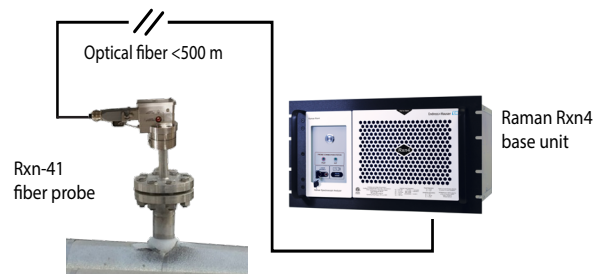


Figure 3: Recommended direct flange mounted installation

References

1. G.I.I.G.N.L. (Groupe International des Importateurs de Gaz Naturel Liquéfié), *LNG Custody Transfer Handbook, version 5.00 (2017)*.