Raman analyzer application guide for the Oil & Gas, Power & Energy, and Chemical industries

Composition analysis of gas streams and LNG

Endress+Hauser

People for Process Automation

Raman application guide - Oil & Gas, Power & Energy, and Chemical industries

Listed below are applications in the Oil & Gas, Power & Energy, and Chemical industries where Endress+Hauser Raman analyzers are used to measure gas and liquid composition. Measured gases include CO (carbon monoxide), CO_2 (carbon dioxide), H_2 (hydrogen), N_2 (nitrogen), O_2 (oxygen), H_2S (hydrogen sulfide), NH_3 (ammonia), CH_3OH (methanol), CH_4 (methane), C_2H_6 (ethane), C_3H_8 (propane), and more. Measured liquids are currently focused on the Oil & Gas industry and include liquefied natural gas and mixed refrigerant composition.

The Raman Rxn4 analyzer, Raman Rxn5 analyzer, Rxn-30 probe, and Rxn-41 probe were developed by and are manufactured by Endress+Hauser, and are powered by patented Kaiser Raman holographic technology. The Raman Rxn5 analyzer has been specifically designed with the high sensitivity required for gas-phase. The Raman Rxn4 analyzer provides the accuracy requirements for LNG custody transfer applications.

Gas-phase applications

Industry	Process plant	Measurement parameter	Application note title/process measurement point
Oil & Gas, Chemical	Ammonia plant		**Ammonia: production analytics overview**
		Carbon number	Ammonia: natural gas feed to primary reformer
		Composition/CH_4	Ammonia: raw syngas - primary reformer outlet
		Composition/CO	Ammonia: raw syngas - secondary reformer outlet
		Composition/CO	Ammonia: high temperature shift converter outlet
		Composition/CO_2	Ammonia: low temperature shift converter outlet
		Composition/CO_2	Ammonia: CO_2 absorber outlet - methanator inlet
		Composition/H_2/N_2	Ammonia: methanator outlet - purified syngas
		H_2/N_2 ratio	Ammonia: converter feed stream
		Composition/impurities	Ammonia: converter exit stream
		CH_4 impurities	Ammonia: synthesis loop purge gas
Oil & Gas, Power & Energy, Chemical	HyCO plant, H_2 plant		**Merchant/Captive hydrogen: production analytics overview**
		Carbon number	Merchant/Captive hydrogen: natural gas feed to primary reformer
		Composition/CH_4	Merchant/Captive hydrogen: raw syngas - primary reformer outlet
		Composition/CO	Merchant/Captive hydrogen: raw syngas - secondary reformer outlet
		Composition/CO	Merchant/Captive hydrogen: high temperature shift converter outlet
		Composition/CO_2	Merchant/Captive hydrogen: low temperature shift converter outlet
		Composition/CO_2	Merchant/Captive hydrogen: CO_2 absorber outlet – feed to PSA
		Composition/H_2/N_2	Merchant/Captive hydrogen: PSA unit H_2 stream
		CH_4 leakage	Merchant/Captive hydrogen: CO_2 absorber recovery stream
Oil & Gas, Chemical	Syngas plant		**IGCC plant SNG production analytics overview**
		Composition/CH_4	SNG: raw syngas from gasifier effluent
		Composition/H_2/CO/CO_2	SNG: syngas after scrubber
		Composition/H_2/CO/CO_2	SNG: raw syngas from other trains
		Composition/H_2/CO/CO_2	SNG: common syngas header after scrubbers
		Composition/H_2/CO/CO_2	SNG: shift converter outlet
		Composition/H_2/CO/CO_2	SNG: CO_2 absorber outlet
		Composition/H_2/CO/CO_2	SNG: at methanator outlet
		Composition/CH_4/H_2/CO/CO_2	SNG: to pipeline

Gas-phase applications

Industry	Process plant	Measurement parameter	Application note title/process measurement point
Oil & Gas, Chemical	Methanol plant		Methanol: production analytics overview
		Carbon number	Methanol: natural gas feed to primary reformer
		Composition/CH_4	Methanol: raw syngas - primary reformer outlet
		Composition/H_2/CO/CO_2	Methanol: raw syngas - secondary reformer outlet
		Composition/CH_4	Methanol: raw syngas from gasifier effluent
		Composition/H_2/CO/CO_2	Methanol: syngas after scrubber
		Composition/H_2/CO/CO_2	Methanol: make-up syngas
		Composition/H_2/CO/CO_2	Methanol: syngas to methanol reactor
Power & Energy	Gas turbine		Gas turbine: production analytics overview
		Composition/H_2/C_1-C_5/N_2/CO_2	Gas turbine: natural gas and hydrogen fuel feed

Liquid-phase applications

Industry	Process plant	Measurement parameter	Application note title/process	Analyzer platform
Oil & Gas	LNG	Composition/Btu	LNG: baseload custody transfer	Raman Rxn4
		Composition/Wobbe Index	LNG: natural gas quality	Raman Rxn4
		Composition	LNG: rundown to storage	Raman Rxn4
		Composition/Btu	LNG: truck loading	Raman Rxn4
		Composition/Btu	LNG: bunkering	Raman Rxn4

Raman analyzers and probes

Using the Rxn-30 probe, the Raman Rxn5 analyzer is ideally suited for the measurement of gas-phase samples. The Rxn-30 probe can be operated in a Class 1/Div 1, Zone 0 environment, and can be integrated into sample conditioning systems to handle more challenging process stream conditions. Using the Rxn-41 probe, the Raman Rxn4 analyzer is able to analyze LNG in the cryogenic liquid phase, avoiding the need for a vaporizer.

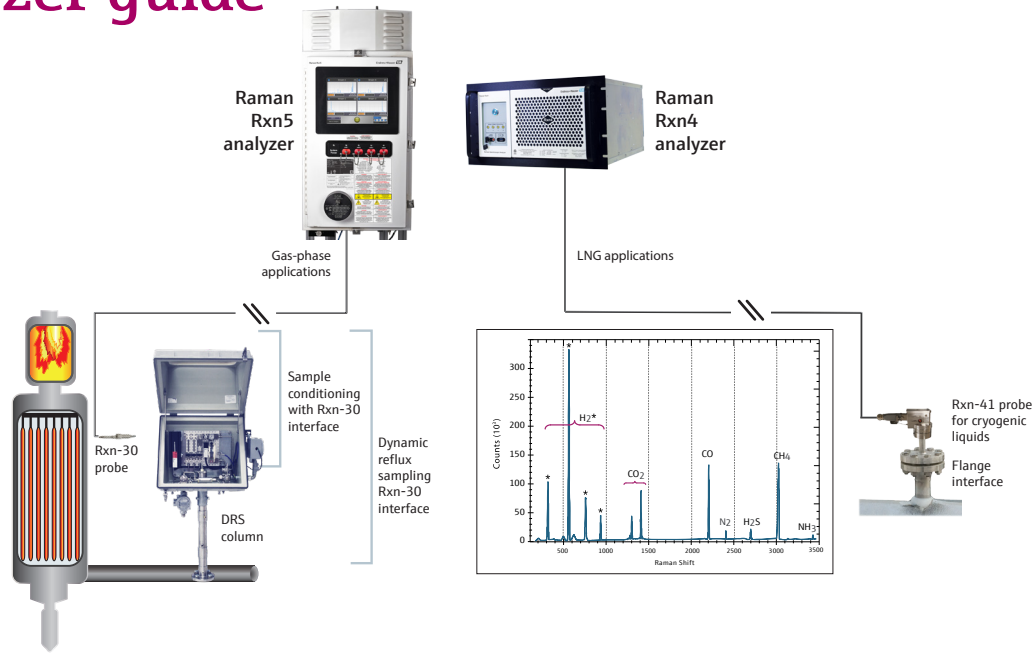**Raman Rxn5 analyzer**

Raman Rxn4 analyzer

Rxn-30 probe
Fiber optic probe

Rxn-41 probe
Fiber optic probe

Analyzer guide

Raman Rxn5 analyzer

Raman Rxn4 analyzer

Gas-phase applications

LNG applications

Rxn-30 probe

Sample conditioning with Rxn-30 interface

Dynamic reflux sampling Rxn-30 interface

DRS column

Rxn-41 probe for cryogenic liquids

Flange interface

Raman Shift / Counts (10^3) — spectrum labels: H2*, CO$_2$, CO, CH$_4$, N$_2$, H$_2$S, NH$_3$

Sample streams

- Installed at the sample tap
- Syngas sample streams
  - Reformers
  - Gasifiers
  - Shift converters
  - PSA
  - Methanators
- Synthesis loops
  - Ammonia
  - Methanol
- LNG sample streams
  - Baseload custody transfer
  - Bunkering
  - Truck loading
  - Mixed refrigerant liquids
  - Mixed refrigerant gases
  - LNG quality adjustment
  - LPG

Sample interface

- Non-extractive optical probe
- Multiple options for syngas
  - For dry streams at moderate temps
    - Union cross
    - Rxn-30 sample panel*
  - For particle-laden, high temps, high moisture
    - Dynamic reflux sampler*
- Rxn-41 probe for cryogenic liquids
  - Direct-coupled/fast loop
- Rxn-30 probe for gas streams
- No flare
- Works at process P and T
- Class I/Div I; Zone 1

*Provided by Endress+Hauser Solutions groups

Analysis result

- Full stream composition
- Peak areas proportional to concentration
- Simple method-based analysis (no complex models)
- Btu/Wobbe index output

Base unit

- Laser-based analyzer
- No vaporizer for LNG
- No columns or carrier gas
- No stream switching
- No sample transport
- Analyze four independent streams sequentially (Raman Rxn4 analyzer) or simultaneously (Raman Rxn5 analyzer)
- Raman Rxn4: general purpose (GP) area
- Raman Rxn5: Class I/Div 2; Zone 2

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