Precisive

Realtime. Online. All-the-time.

All-Optical Hydrocarbon Composition Analyzer

An alternative to gas chromatography

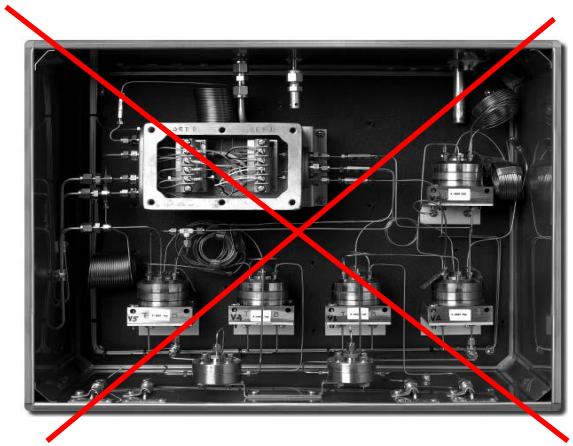
FROST & SULLIVAN

2012 BEST PRACTICES AWARD

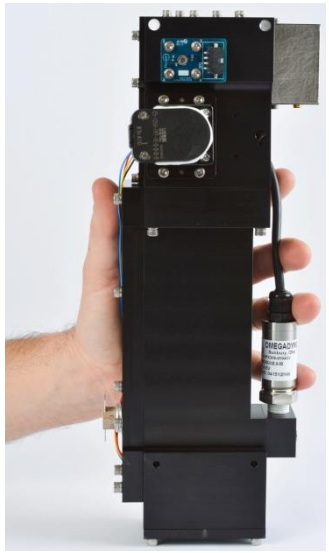
GLOBAL
SENSORS AND ANALYTICAL INSTRUMENTS
NEW PRODUCT INNOVATION AWARD

Tunable Filter Spectroscopy (TFS™) – Value Proposition

- Precisive's TFS™ technology is the only real-time all-optical hydrocarbon gas analyzer to-date with *chromatograph* (speciation) capabilities



Gas Chromatograph



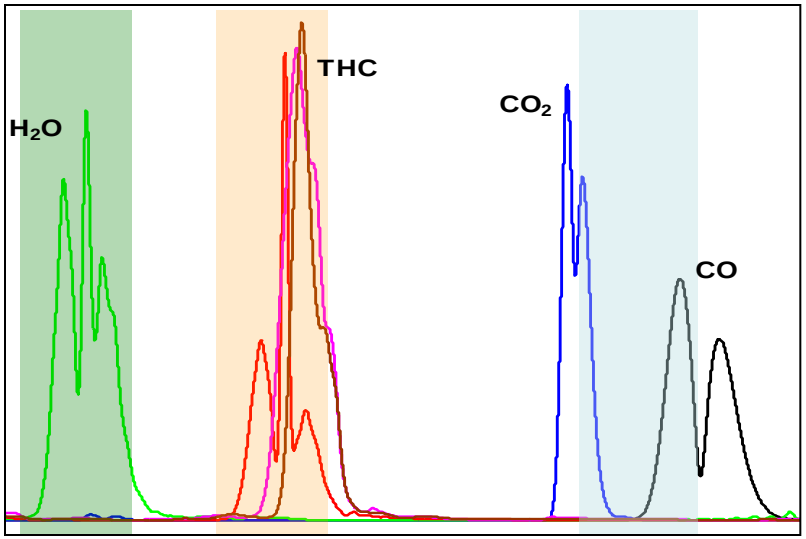
Precisive optical hydrocarbon composition sensor head

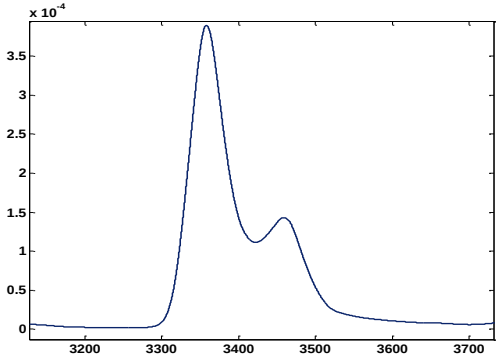
- Real-time measurement (1-sec update rate)
- Flow-through analysis without the need for carrier gas
- Permanent span calibration, minimizing or eliminating the need for field calibration gases
- Remote, unattended operation
- Extremely robust design with 1000+ units installed on drill rigs across North America

Fundamentals of TFS™ Sensor Technology

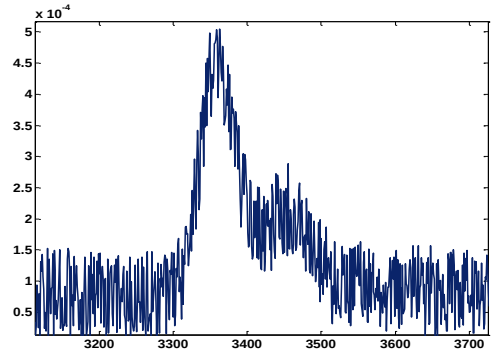
- Continuous high-resolution wavelength sweep within a narrow target band
- Multiple wavelength bands can be analyzed simultaneously
- Moderate spectroscopy coupled with advanced spectral decomposition algorithm
- Robust industrial-grade real-time sensor with GC-like speciation

PRECISIVE TFS™ HAS >20 TIMES HIGHER THROUGHPUT THAN GRATING/DIODE ARRAY BASED INSTRUMENTS



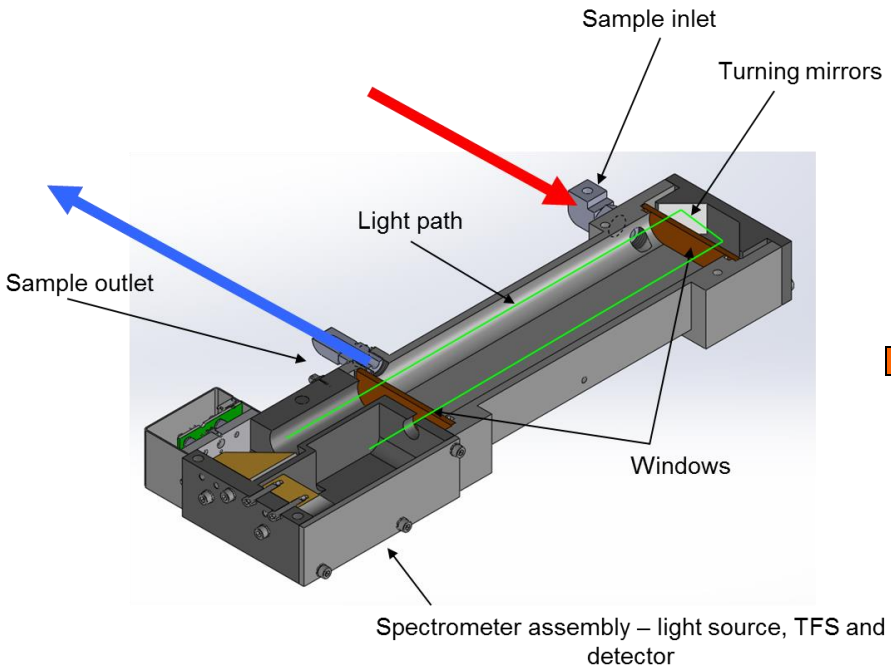


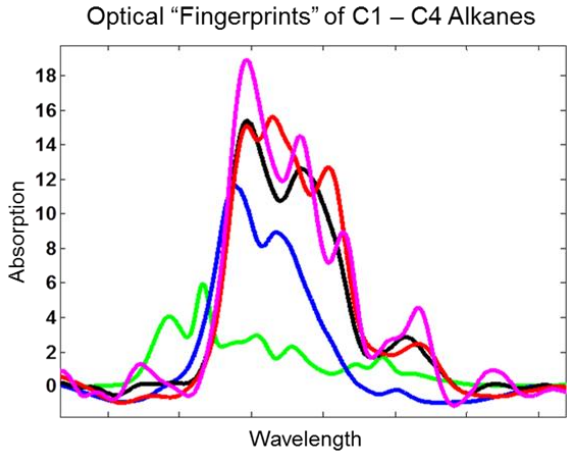
TFS



Grating / diode array

Light Absorption Spectroscopy with Advanced Spectral Decomposition Algorithm





Chemometrics

Methane	85.12
Ethane	6.53
Propane	2.35
n-Butane	1.05
iso-Butane	0.98

Speciated and Quantified Compounds

Example Configuration

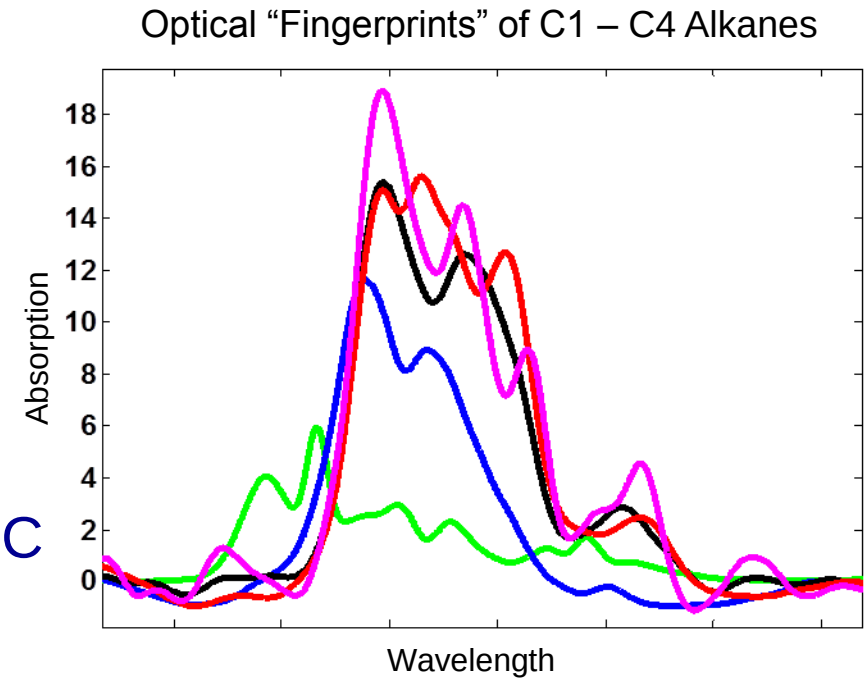
Ch. #	Compound	Range	Accuracy
1	Methane	0 - 100%	+/- 0.2%
2	Ethane	0 – 25%	+/- 0.2%
3	Propane	0 – 25%	+/- 0.2%
4	iso-Butane	0 – 10%	+/- 0.1%
5	n-Butane	0 – 10%	+/- 0.1%
6	Propylene	0 – 10%	+/- 0.2%
7	Ethylene	0 – 10%	+/- 0.2%

Hydrocarbon Composition Monitoring

	PRECISIVE (TFS)	GC-TCD	Calorimeter (residual oxygen)	NDIR
Compounds Speciation	Yes	Yes	No	No
Accuracy	High	High	High	Low
Sampling requirement	Flow through, no consumables	On-site support gases & infrastructure	On-site support gases & infrastructure	Flow through, no consumables
Response time	Seconds	2 – 5 minutes	Seconds	Seconds
Total cost of ownership	Low	High	High	Low
Other considerations	Flow-through Unattended No-calibration gases No-carrier gases	The incumbent and traditional choice for this application	High initial and operation cost, without compounds speciation	Poor choice for this application

Our Solution

- 1second updates (compared to 5 minutes with alternatives)
- Install with no maintenance
- Multi-components
- Sub ppm to % levels
  - sub ppm H2O, CO, CO2, THC
  - Low sulfur compounds
    - H2S, Mercaptan, etc.



- Gases & liquids (IPA in Water, Water in Methanol etc).

2012 Winner: Sensor & Analytical Instrument

2012 Global, Sensor & Analytical Instrument, New Product Innovation

The Frost & Sullivan New Product Innovation Award is a prestigious recognition of Precisive's accomplishments in the Sensors and Analytical Instruments Market. As an unbiased, third-party, Frost & Sullivan recognizes Precisive for delivering excellence and best practices in their respective endeavors. The New Product Innovation Award is backed by extensive analysis; companies identified, and the quality of their innovation, product benefits, customer ROI, and customer acquisition potential are monitored and evaluated through primary analyst research. This stringent methodology positions Precisive as a superior market participant.

The following criteria were used to benchmark Precisive's performance against key competitors for pipeline and process monitoring:

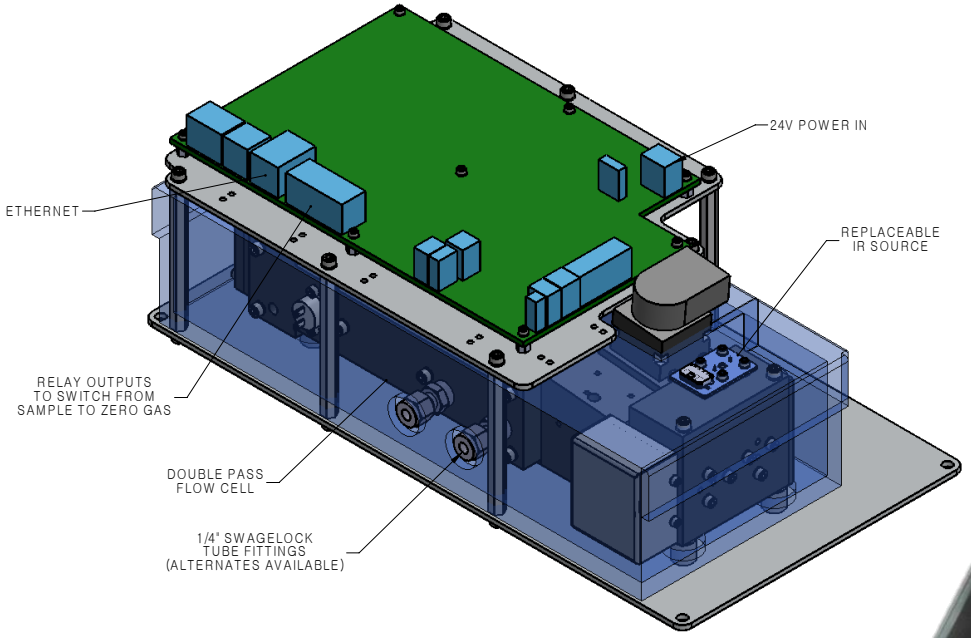
- Innovative Element of the Product
- Leverage of Leading-Edge Technologies in Product
- Value Added Features/Benefits
- Increased Customer ROI
- Customer Acquisition/Penetration Potential

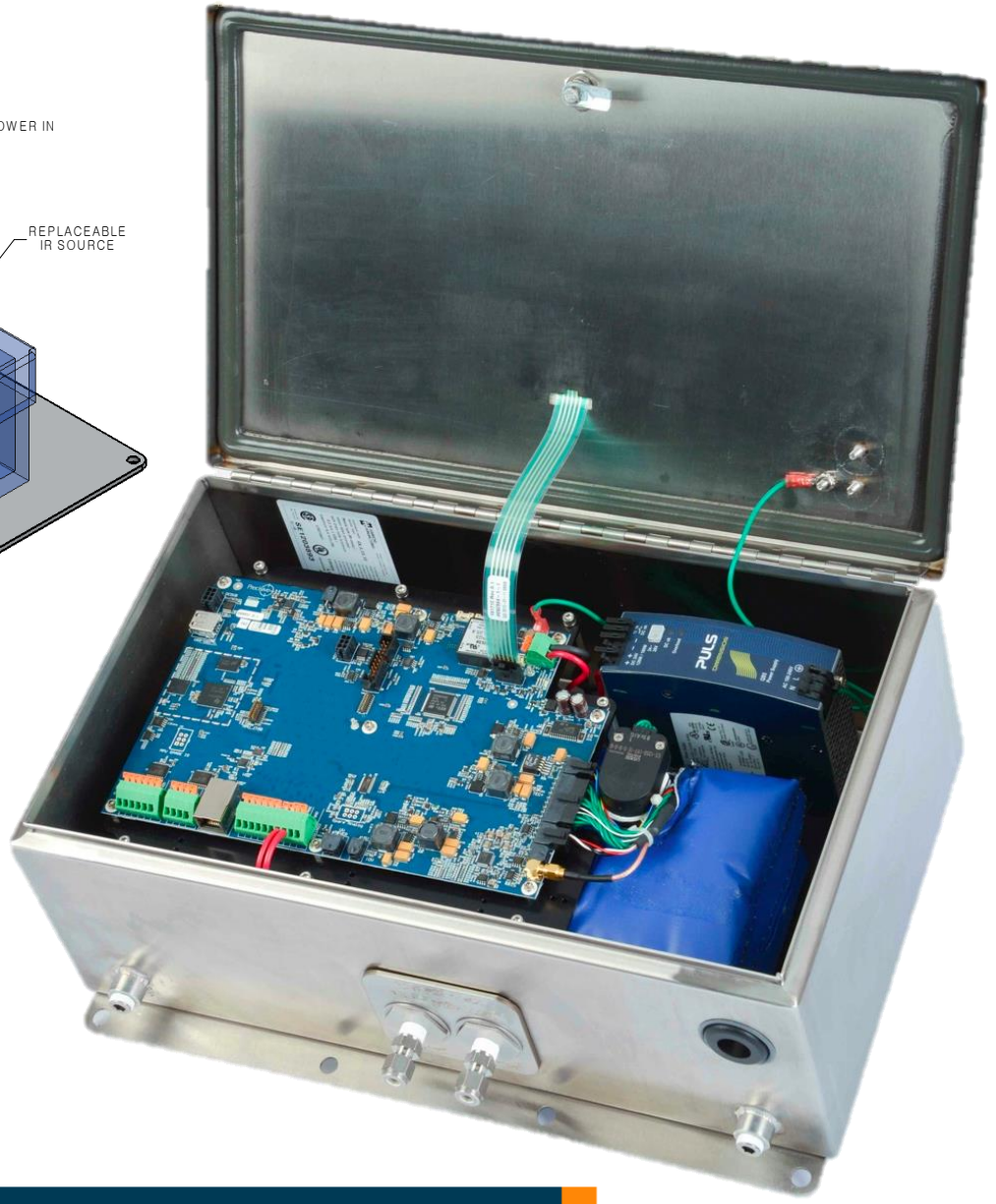
Precisive 5 (haza-area certified package)

All-optical, flow-through, on-line analyzer
Real-time response (1-5 seconds)
Multi-component analysis (12+) species
Unattended remote monitoring
Preferred alternative to GC

Compact design 17” x 11” x 6” (wall-mount)
Less than 25lb , wall-mountable
No carrier gas, no calibration gas
Low-zero drift, linear, accurate
24VDC (or external 110-260VAC)
CSA/ATEX/IECEx Class1Division2 certified
NEMA4X, CE, UL compliant package

Precisive 5





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Standard Alkane Gas Analyzer Specifications

- Measurement channels & ranges:
  - Methane (CH_4): 0-100%
  - Ethane (C_2H_6): 0 – 25%
  - Propane (C_3H_8): 0 – 25%
  - iso-Butane (C_4H_{10}): 0 – 10%
  - n-Butane (C_4H_{10}): 0 – 10%
  - iso-Pentane (C_5H_{12}): 0 – 5%
  - n-Pentane (C_5H_{12}): 0 – 5%
  - neo-Pentane (C_5H_{12}): 0 – 5%

  - Measurement ranges are configurable
  - Can be optimized to narrower ranges for better accuracy
  - Other hydrocarbon gases may be added
- Accuracy:
  - Methane: ±0.2% of full range or ± 0.05% (absolute), whichever is greater
  - Others: ±0.5% of full range or ± 0.05% (absolute), whichever is greater
- Resolution/Repeatability:
  - 0.01%/0.05% (5second averaging)
- Wetted parts:
  - Anodized aluminum (SS is optional), Viton O-rings, BK7 glass
- Sample pressure:
  - 0.1 – 30 psig
- Sample temperature:
  - 0 – 50 ^{0}C

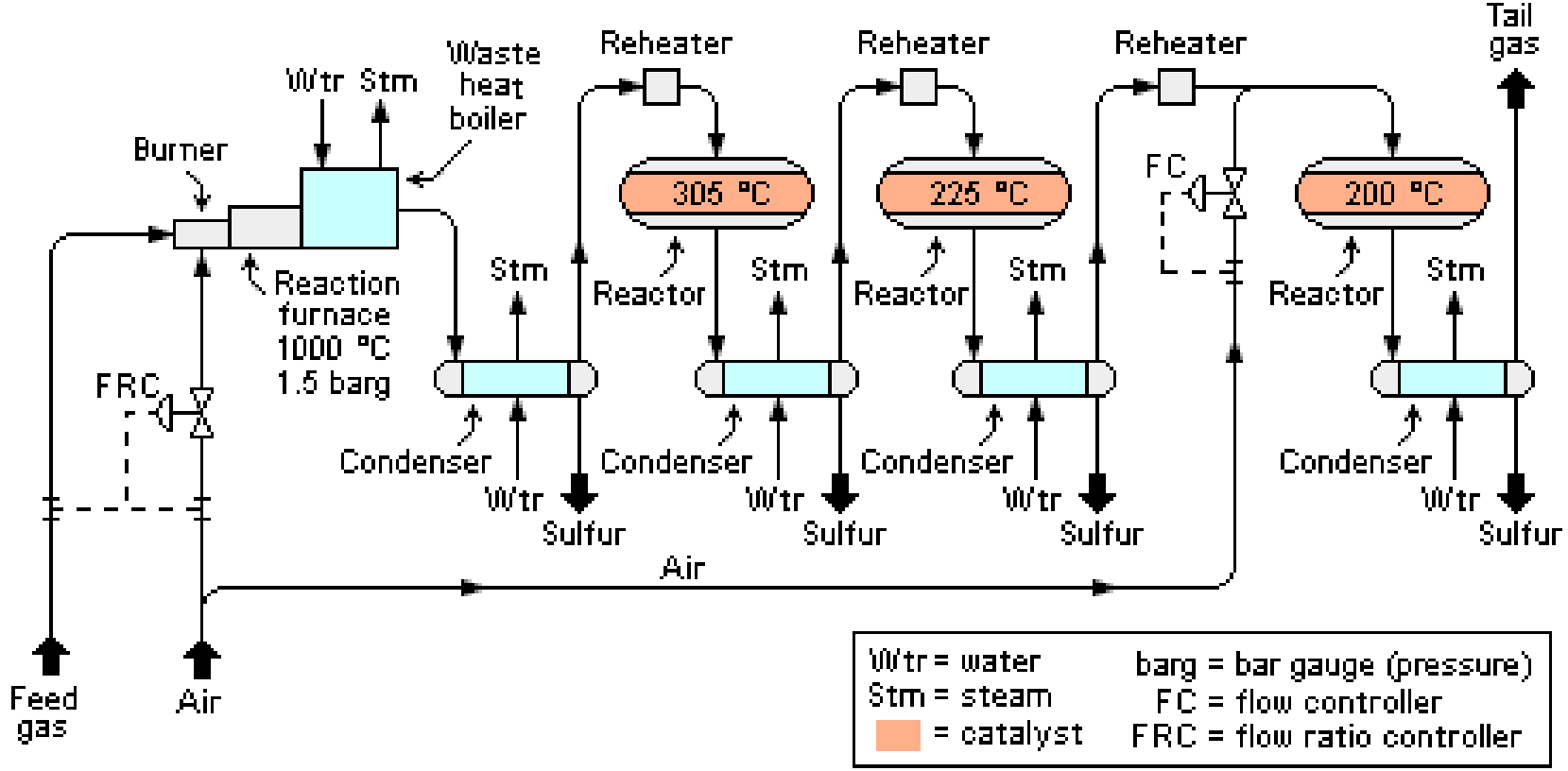
Applications for “install & forget” monitoring

- Hydrocarbon composition
  - BTU / Wobbe C1-C5 energy content measurement
  - Natural & Biogas pipeline quality
  - Fuel optimization/power generation
  - Custody transfer
- Petrochemical & process control
  - Chemical and gas blending (ie ethylene production)
  - Moisture / water / steam monitoring
  - Solvent purity monitoring
  - Sulfur recovery
  - Drying and end-point detection
  - Trace impurity detection
  - Bulk & specialty gas production (ie ASUs)
- Emissions
  - Combustion control
  - Continuous emissions monitoring

~1600 deployed units in 3years with the Precisive optical analyzer

Calibration 153: Sulfur Recovery

- calibration "153" with C1, C2, C3, nC4, iC4, 0-100% H2S and 0-100% CO2.



Source: Milton Beychok

Schematic diagram of a Claus sulfur recovery unit.

Other Calibrations: Natural Gas, LNG, LPG

Channel	Gas	-143	-147	-154
1	CH4	0 – 100%	0 – 100%	0 – 100%
2	C2H6	0 – 25%	0 – 25%	0 – 25%
3	C3H8	0 – 25%	0 – 25%	0 – 25%
4	Iso C4H10	0 – 10%	0 – 10%	0 – 10%
5	N C4H10	0 – 10%	0 – 10%	0 – 10%
6	C3H6	0 – 50%	0 – 50%	0 – 50%
7	C2H4	0 – 50%	0 – 50%	0 – 50%
8	CO2	0 – 100%	0 – 100%	0 – 100%
9	C2H2	n/a	0 – 30%	0 – 30%
10	Iso-C5H12	n/a	0 – 10%	0 – 10%
11	1-Butene	n/a	n/a	0 – 10%
12	Cis-2-Butene	n/a	n/a	0 – 10%
13	Trans-2-Butene	n/a	n/a	0 – 10%
14	Isobutylene	n/a	n/a	0 – 10%
15	1,3 Butadiene	n/a	n/a	0 – 10%