

Aurora

New Light for Moisture Measurement in Hydrogen

GE's Aurora analyzer uses tunable diode laser absorption spectroscopy (TDLAS) to rapidly and accurately measure moisture in hydrogen. The analyzer is suitable for installation in hazardous areas and operates over a wide range of environmental conditions. Aurora's fast response allows continuous measurement for moisture level optimization, immediate alert if moisture concentrations are outside of process specification and the fastest return to service once process upsets are corrected. In order to meet hazardous area requirements, the standard Aurora may be installed in a purged enclosure.

Typically in the catalytic reforming process, moisture in hydrogen recycle and makeup is controlled at around 20 – 40 ppm. Too little moisture can prevent complete activation of the catalyst, while too much moisture can kill the catalyst and cause corrosion in the system. Aurora enables increased efficiency and prolonged catalyst life.

GE's experience in moisture measurement includes aluminum oxide, polymer capacitance and chilled mirror sensors. GE's heritage also includes the development of the first injection diode laser in 1962 by Dr. Robert Hall in Schenectady, NY. The compact and inexpensive diode laser made it possible for compact discs, laser printers and fiber optic telecommunications. The Aurora TDLAS hygrometer enables catalytic reforming facilities to monitor moisture content in real time with high precision and reliability.



Features and Benefits

- Optical response <2 seconds
- No cross sensitivity to glycols or other contaminants
- Direct readout in lbs/mmscf, mg/m³, dew point or ppmv
- Turnkey sampling system for measurement integrity
- Hot permit not required with through-the-glass programming
- Analog and digital communications available
- Aurora H₂O View software enable remote service, trend graphing and diagnostics
- Five years of continuous, reliable service before first factory service
- Patented calibration process to meet variety of composition applications

Theory of Operation

The Aurora TDLAS hygrometer fundamentally measures the partial pressure of water vapor (water in the gas state). With the simultaneous measurement of pressure and temperature, the Aurora provides all of the commonly used moisture units, including:

- Volume ratio in parts per million by volume (ppm_v)
- Absolute humidity in lbs per million standard cubic feet (lbs/mmscf) or milligrams per cubic meter (mg/m³)
- Dew point temperature in °C or °F
- Pressure dew point in °C or °F

The fundamental water vapor pressure measurement is based on the Beer-Lambert Law:

$$A = \ln \left(\frac{I_0}{I} \right) = SLN$$

A = Absorbance

I₀ = Incident light intensity

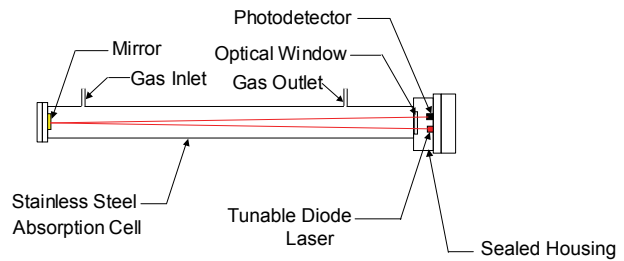
I = Light intensity transmitted through sample gas

S = Absorption coefficient*

L = Absorption path length (a constant)

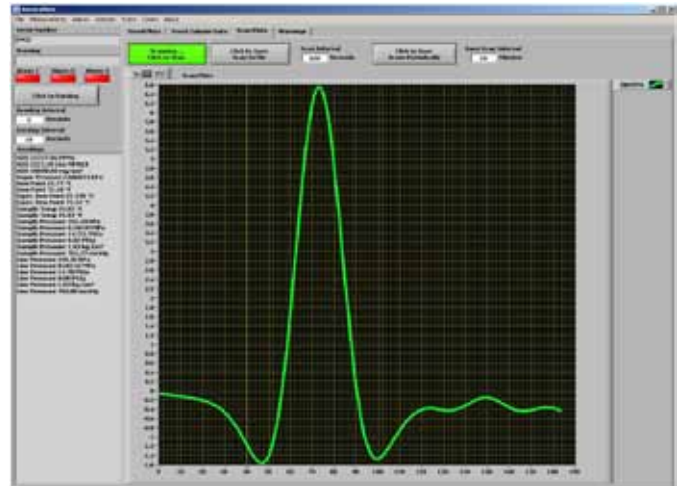
N = Concentration of water vapor (directly related to the ratio of the partial pressure of water and the total pressure)

*The absorption coefficient is a constant for a specific gas composition at a given pressure and temperature. At certain specific frequencies the water molecule will absorb light energy, while at other frequencies the gas is



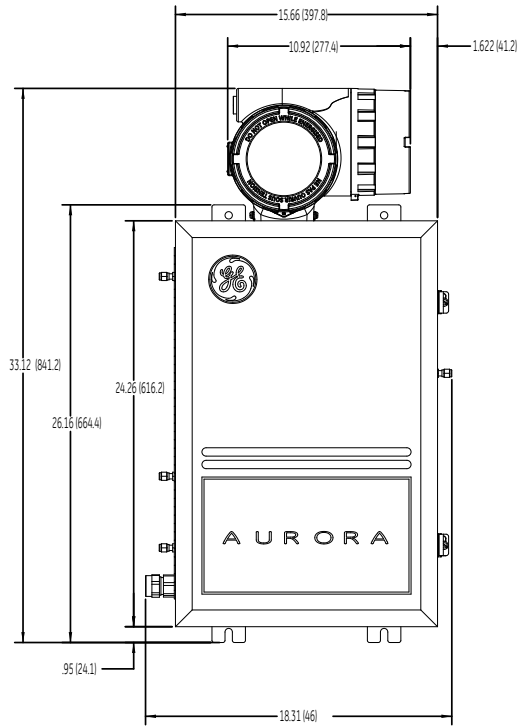
Cross-section of absorption cell

practically transparent. At a given absorbing frequency, as the concentration of water vapor increases, the absorption also increases. Aurora utilizes a diode laser that is swept through a narrow frequency band in the near infrared spectrum. The laser is also modulated at high frequency. By measuring the laser light intensity with a photodetector, the Aurora is able to provide direct measurement of the partial pressure of water by correlation of laser light lost to the incident light. The light loss or absorption signal is reduced by looking at the second harmonic signal known as the 2F signal. The magnitude of the 2F signal is related to the partial pressure of water, which is divided by the total pressure and multiplied by 10⁶ yields ppmv (parts per million by volume).

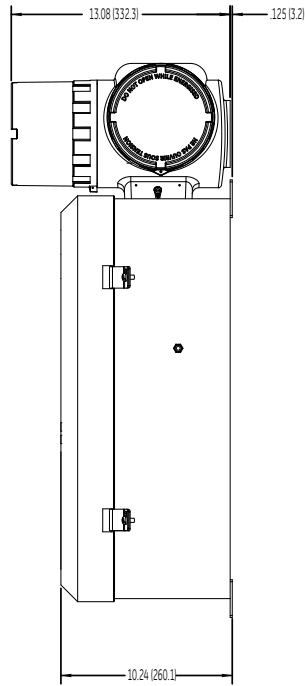


The location of the peak on the X-axis confirms the identity of water. The y-axis is related to the partial pressure of water and therefore the concentration. The system is equipped with AuroraView software, which enables users to capture the absorption spectrum and export it to other application programs such as Excel™.

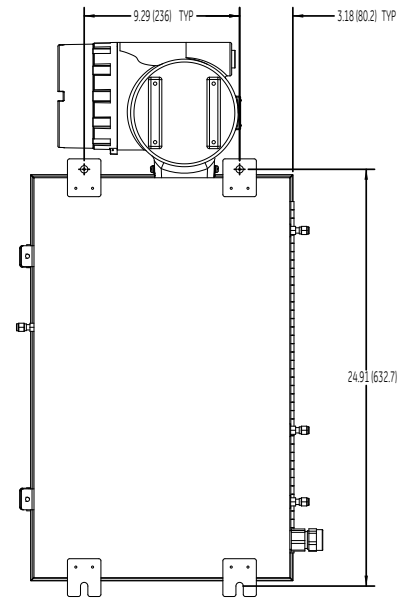
Dimensions



Front view



Side view



in (mm)

Specifications

Range

Parts Per Million by Volume

0 to 5000 ppm_v

Lower Detect Level

5 ppm_v

Dew/Frost Point¹

-65.5° to -2.6°C frost point

Dew/Frost Point¹

-85.9° to 27.3°F frost point

Process Dew/Frost Point¹

Process or equivalent dew point/frost point by calculation with process pressure signal (4-20 mA) or constant

Absolute Humidity

3.8 to 3,803 mg/m³

Absolute Humidity

0.24 to 237 lbs/MMSCF

¹ Readings below 0°C (32°F) are in "frost point," temperature and above 0°C (32°F) are in "dew point" temperature.

Accuracy

Parts Per Million by Volume

±2% of reading or 4 ppmv
(Accuracy of other parameters derived from ppmv.)

Response Time

Optical response

<2 seconds

System response

The system response is dependent on the length of sample tubing, sample system components, flow rate and pressure, as well as the change in moisture concentration.

Operating Pressure

Operating sample cell pressure

69 to 172 Kpa (10 to 25 psia)

Maximum Pressure

1380 KPa (200 psi)

Process Pressure

10,342 KPa (1500 psig) maximum²

² Higher pressure available with application of additional sampling system components.

Flowrate

Sample Cell Flowrate

10 to 60 SLH (0.4 to 2 SCFH); 30 SLH (1 SCFH) nominal

Coalescer By-pass Fast Loop

5 to 10X of flowrate through sample cell

Display

Backlit LCD. Three programable simultaneous parameters. Alphanumeric status and diagnostic display. LEDs for power, laser temperature stability, keypad lockout.

I/O

Analog Outputs

Three programmable 0/4-20 mA; 500 Ohm max load

Analog Input

Loop powered 4-20 mA input for remote pressure transmitter. Aurora supplies 24 VDC.

Digital Interface

Two programmable digital communications ports RS232, RS485 with multidrop capability and assignable address, MODBUS RTU protocol

User Interface

Programmable "through-the-glass" via magnetic stylus

Laser

Class 1 product. Conforms to IEC 60825-1. Edition 2.0
Safety of Laser Products



Warning! Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous laser exposure.

Enclosure

Ingress Protection

IP-66

Net Weight

37 Kg (100 lb)

Temperature

Operating

-20 to 65°C (-4 to 149°F)

Storage

-20 to 70°C (-4 to 158°F)

Optional Heater/Thermostat Set Point

20°C/68°F ±5°C/9°F for US/Canada

10°C/50°F ±5°C/9°F EU and Elsewhere

Hazardous Area Certification

USA/Canada



Explosion-proof for Class I, Division 1, Groups C&D

EU and Elsewhere



ATEX and IEC Ex:

Ex de IIB T6 -20°C to +65°C

Flameproof with increased safety compartment

European Certification

CE

Complies with EMC Directive 2004/108/EC, Low Voltage Directive 2006/95/EC and Pressure Directive 97/25/EC for DN/25

Calibration

Recommended Factory Verification/Service

Five years



www.ge-mcs.com

920-638B