Rosemount™ 470XA

Natural Gas Chromatograph

The Rosemount 470XA Natural Gas Chromatograph (GC), part of the XA series of Emerson gas chromatographs, is designed to provide greater ease of use and increased measurement performance for your C6+ BTU/CV analysis.

A unique feature of the Rosemount 470XA is its Maintainable Module based on Rosemount XA-series oven technology, which allows easy field replacement and service, greatly reducing downtime and overall operating costs.

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Overview

Incorporating an operating method similar to previous gas chromatographs, the Rosemount 470XA gives you the option of choosing a hydrogen or helium carrier gas and helium, nitrogen, or instrument air actuation gas.

The local operator interface (LOI), a standard feature in the Rosemount 470XA, is a full color VGA display with an alpha-numeric keypad that allows you to perform common tasks without having to connect to a computer. The LOI has built-in tutorials to guide even the most inexperienced operator through step-by-step instructions on how to safely operate and maintain the GC, therefore reducing the need for specialized technicians.

Features

Designed for custody metering of natural gas

- Four-minute C6+ standard analysis

- ±0.0125 percent repeatability of heating value (±0.125 BTU/1000 BTU) in controlled environments

- ±0.025 percent repeatability of heating value (±0.25 BTU/1000 BTU) over extended temperature range of -4 °F to +140 °F (-20 to +60 °C)

- Latest Gas Processors Association (GPA) 2145, GPA 2172, American Gas Association (AGA) 8, and International Organization for Standardization (ISO) 6976 calculations

- Analysis results storage in excess of the latest American Petroleum Institute (API) 21.1 requirements

Simplified functionality and ease of use

Full color local operator interface (LOI) with built-in software assistants to guide the operator through common tasks, such as:

- Module replacement

- Changing calibration gas

- Auto-valve timing

- Device start-up

Reduced installation costs

- 24 Vdc power with less than 55 Watts startup and less than 25 Watts (steady state) nominal power

- Pole and wall mount options

- No shelter required for most environments; optional enclosure available for extreme environments

Contents

Lower operational costs

- Low carrier gas usage

- Automatic validation routine reduces calibration gas usage

- Maintainable Module replacement or service is quick and easy

- Optional utility gases: H_2, He, and N_2

The Rosemount 470XA is designed for the continuous online analysis of natural gas. The analysis uses a configuration of three 6-port valves with four separation columns to measure the common components found in natural gas.

NOTICE

The hydrogen sulfide and water limit in a sample is 0.02 mole percent.

Table 1: C6+ standard measurement ranges

Component	Measurement range
Methane	60 to 100 mole %
Ethane	0 to 20 mole %
Propane	0 to 10 mole %
N-Butane	0 to 5 mole %
Iso-Butane	0 to 5 mole %
N-Pentane	0 to 1 mole %
Iso-Pentane	0 to 1 mole %
Neo-Pentane	0 to 1 mole %
Nitrogen	0 to 20 mole %
Carbon dioxide	0 to 20 mole %
C6+	0 to 0.7 mole %

Maintainable Module

A key advantage of the Rosemount 470XA is the compact Maintainable Module that includes the columns, thermal conductivity detectors (TCDs), analytical valves, and solenoids, all within a single enclosure. Providing the technician with easy access to these key components inside a single enclosure is a cost-effective way to service or repair the module compared to other gas chromatographs (GCs) that have no serviceable components.

The Rosemount 470XA Maintainable Module uses valves and column sets identical to the robust and industry proven Rosemount 700XA and 770XA Gas Chromatographs.

If the Maintainable Module needs repair, a technician can quickly and easily replace it in the field without causing major interruptions or delays. Once the replacement module has been properly installed and is back online, the GC will self validate and calibrate before automatically switching to Analysis mode.

Figure 1: Rosemount 470XA Maintainable Module

Local operator interface (LOI)

A challenging concern in the industry today is the declining experience of operators in the field and the lack of available time to provide routine maintenance service calls. The Rosemount 470XA has a full-color LOI designed to simplify gas chromatograph (GC) operations in the field. The LOI uses a full VGA LCD display interface combined with a 19-key tactile feedback keypad that is rated for Class 1, Division 1 hazardous areas.

Figure 2: Rosemount 470XA LOI
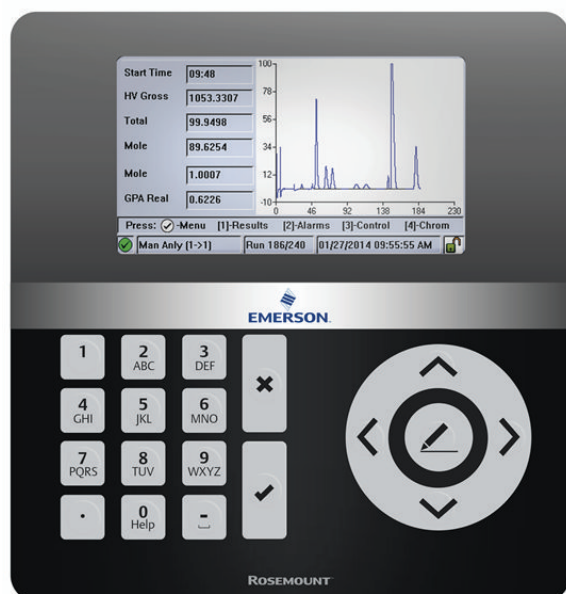
You can perform most GC routine maintenance functions directly from the LOI. In most cases, you can install, configure, and place the GC online without using a computer.

Routine maintenance functions

- Changing calibration gas: When replacing the standard calibration gas, built in software assistants in the local operator interface (LOI) walk you through these basic steps:
  — Validate the existing calibration according to the thermal conductivity of each of the components.

  — Change the calibration bottle.

  — Enter new values.

  — Purge the calibration gas.

  — Analyze the calibration gas to validate the new concentration values.

  — Calibrate to the new standard.

  — Return to automatic analysis of the stream.

- Auto-valve timing: Over time, restrictions can build up inside the analytical flow-paths of a gas chromatograph (GC) oven. The auto-valve timing adjusts the analytical valve timings and integration events to optimize the analysis to account for these changes. This reduces the need for fully trained GC experts in the field and ensures that the analyzer is maintaining the tight tolerances required to reduce measurement errors.

- Module replacement: When a module is replaced in the field, the LOI initiates the purge, validation, and calibration sequence. The status and progress of the module initiation sequence can be monitored from the LOI and will confirm when the analyzer is back online.

Additionally, many of the functions historically performed with a computer can now be done with the LOI, including:

- Viewing, accepting, and clearing alarms.

- Stopping and starting the analysis cycle.

- Viewing chromatograms.

- Viewing calibration and validation reports.

- Viewing archive data and trends.

- Viewing and configuring communication settings.

Flexible communication with inputs and outputs (I/O)

You can connect the Rosemount 470XA to supervisory systems, such as flow computers, remote terminal units (RTUs), or supervisory control and data acquisition (SCADA) systems using two RS-232/485 serial ports or two Ethernet ports.

You can configure each serial or Ethernet port with unique Modbus® maps that provide individual read/write access control. You can use the industry standard SIM_2251 Modbus map or a fully customized map based on either the Enron™ (one register per floating point) or Modicon™ (two registers per floating point) data formats.

Additionally, two analog outputs, one analog input, one digital input, and one digital output are available on the gas chromatograph (GC).

One of the Ethernet ports has an RJ-45 connector that you can use to connect to a local computer for maintenance and diagnostic access. The Ethernet port has a switchable DHCP server that can assign an Internet protocol (IP) address to the connected computer.

Data archiving and reports

Every analysis is time and date stamped and archived for retrieval by the Rosemount MON2020 software. With this software, you can display, print, or store pre-configured reports. You can also directly trend results or easily export them to several common formats, such as ASCII text, HTML, or Microsoft® Excel™.

Available data storage types

Archiving	Assuming a four-minute analysis time, the GC archives up to 85 days of analysis records and up to 370 days of calibration records (one calibration per day) automatically by time and date.
Chromatograms	The GC permanently stores over four days worth of analysis chromatograms, 370 final calibration chromatograms (depending on the analysis time), and user-selected protected chromatograms.
Drawings and documents	The GC stores manuals and drawings in several file formats; you can retrieve these with Rosemount MON2020. This eliminates the risk of manuals and drawings being misplaced. You can also upload user-generated documents, such as maintenance checklists or installation drawings, to the GC for later retrieval.

Standard logs and reports

Audit logs	Data and event logs that fully conform to API report 21.1 for metering audit purposes and backup to primary systems (flow computer, SCADA, DCS)
Event logs	A continuous record of all operator changes with time, date, and user-identified records
Maintenance logs	Track maintenance or testing performed on the gas chromatograph
Average reports	- Hourly 24-hour - Weekly - Monthly - Variable
Analysis reports	Physical property calculations for component and group analysis and alarms
Raw data reports	Retention times, peak areas, detector number, method, integrations start/stop, and peak width for analysis
Calibration reports	Raw component data, new response factors, retention times, and deviation from last calibration

Final calibration reports Results from the calibration response factors and retention time adjustments

Rosemount MON2020

Emerson has designed the Rosemount 470XA Gas Chromatograph (GC) to operate unattended. If adjustments are needed, Emerson's proprietary desktop software, Rosemount MON2020, allows complete control of the GC either locally or remotely.

From the software, you can:

- Start or stop analysis, calibration, or validation cycles.

- Generate and save current and historical analysis and calibration reports.

- Review and modify analytical settings.

- Upload and display multiple chromatograms for comparison.

- Upload and trend any of the measured results.

- Export data to text, HTML, or Microsoft® Excel™ for use in third party applications.

- Check on original calibration against the last calibration.

- Perform GC operation checks and modifications simultaneously.

- Upload and view manuals and drawings stored in the GC.

Rosemount MON2020 is a Microsoft Windows®-based software program that makes it easy to use analyzer configuration, maintenance, and data collection. With intuitive drop-down menus and fill-in-the-blank tables, even new users can quickly navigate through the software.

Figure 3: Rosemount MON2020 interface
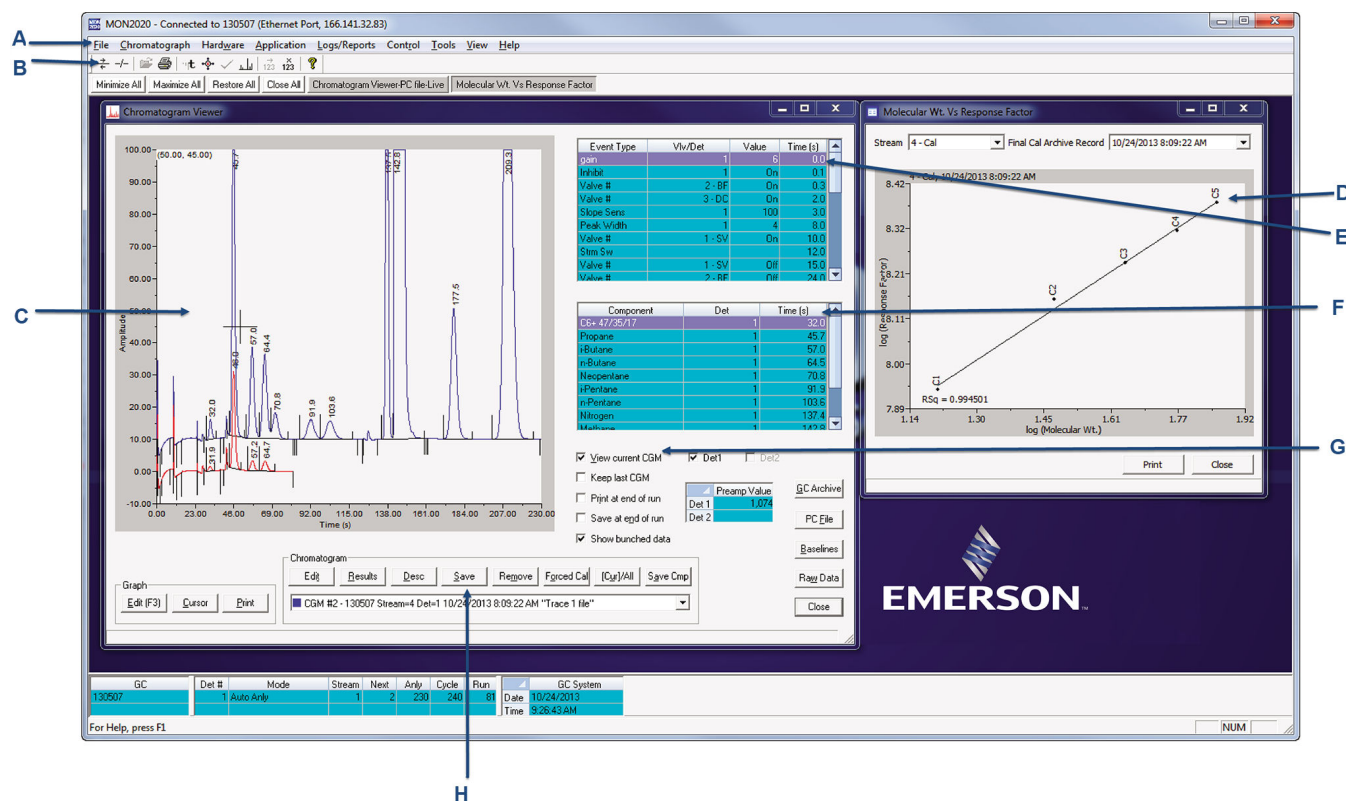
A. Simple drop-down menus
B. Connect to any GC with a mouse click
C. Full featured chromatogram display
D. Response Factor fidelity chart
E. Fully detailed Timed Events table
F. Automatic listing of measured components
G. Quickly add chromatograms to overlay; GC archive
H. Save chromatograms to hard drive

With its abilities to communicate with your enterprise network and export to numerous file types, Rosemount MON2020 is a powerful tool that ensures that operators, engineers, maintenance personnel, and management have access to critical data, such as current and archived chromatograms, alarm history, event logs, and maintenance logs.

The software's chromatogram viewer allows you to view and compare both live and archived chromatograms simultaneously. Despite its small size, the chromatogram file includes analysis and calculation results, integration and valve time settings, retention time settings, and raw peak data.

The trend viewer makes it easy to trend multiple variables on a single chart. To help diagnose process or analysis issues, you can select single or multiple points on the trend viewer; the chromatograms associated with these points will open in the chromatogram viewer. You can save the trend files or export them as text, CSV, or Excel files.

Rosemount MON2020 can connect to a Rosemount GC via Ethernet directly or over your local or wide area network. The software is equipped with multi-level username and password security settings to limit and control access to the GC and provide levels of access authority ranging from read-only access to full control of the GC and its data.

Applications

Natural gas custody transfer

Rosemount gas chromatographs (GCs) are synonymous with natural gas custody transfer and known for improving gas measurement analysis and reducing lost-and-unaccounted-for (LAUF) gas.

The Rosemount 470XA can perform International Organization for Standardization (ISO), Gas Processors Association (GPA), or American Gas Association (AGA) physical property calculations and store the analysis results in non-volatile memory for up to 85 days. Operators can easily retrieve the stored data using Rosemount MON2020™ software or Modbus® communication. The GC uses industry standard SIM_2251 Modbus maps as the default serial communication protocol. You can customize the GC to accommodate other requirements as needed.

Designed to replace aging C6+ gas chromatographs currently installed in the network, this GC does not require configuration changes to the supervisory control and data acquisition (SCADA) system or flow computer.

Production gas measurement

Analyzing production gas in the gathering network has traditionally been done with manual or automatic samplers. However, the ongoing costs of collecting and analyzing these samples and the time delay between collecting the sample and receiving the results is leading many producers to look at installing on-line gas chromatographs (GCs) closer to the wellhead.

The infrastructure and field knowledge that a traditional GC requires for installation and ongoing maintenance often does not exist in the production and gathering network environment. The Rosemount 470XA addresses these concerns by decreasing the infrastructure and utility requirements for installation and operation and using the local operator interface (LOI) to guide operators through the most common maintenance functions.

The GC can be installed outdoors using a 4-in. (102 mm) diameter pole mount with a sun shield. For other areas where snow or inclement weather is more prevalent, a small cabinet enclosure is available, eliminating the high cost of a full shelter. In addition, low power requirements make solar or natural gas power generators feasible at locations off the power grid.

Power generation and furnace gas control

Tighter emissions regulations and the need for maximum burner efficiency require the air/fuel ratio to be optimized based on the energy content and quality of the incoming gas. The composition and energy content of the natural gas supplied can vary significantly with little or no notice from the gas provider.

Feed gases with Wobbe Index values outside of the burner's design parameters can result in damage to the burner tip or inefficient combustion leading to flame-outs. Monitoring the feed gas can provide a check on the natural gas supply and help avoid burner damage or unexpected flame-outs.

The Rosemount 470XA can measure the quality of the incoming gas and calculate its Wobbe Index to provide feed-forward control to the fuel/air ratio. This can lead to significant improvements in burner efficiency and lower emissions when compared to flue gas measurements that provide feedback control. Using the Wobbe Index value from the gas chromatograph (GC), the burner management system can adjust to changes in gas quality before the oxygen, nitrogen, or carbon monoxide levels in the flue gas streams increase.

Specifications

Table 2: Electronics specifications

Specification	Description
Power supply	24 Vdc (standard) at the unit 21-30 Vdc (operating range) at the unit Class 2 and SELV as specified by CEC, C22.1, and NEC, National Fire Protection Association (NFPA) **NOTICE** Provide the gas chromatograph (GC) with one 5-amp circuit breaker for protection.
Power consumption at 72 °F (22 °C)	50 Watts (start-up) 20 Watts (steady state)

Table 3: Construction specifications

Specification	Description
Environmental temperature	-4 to +140 °F (-20 to +60 °C)
Enclosure protection rating	IP65 and Type 4X
Dimensions (without sample system or mounts)	18 in. (height) x 15.6 in. (width) x 11 in. (depth) 460 mm (height) x 396 mm (width) x 280 mm (depth)
Mounting options	Pipe, wall, or bench
Weight (without sample system or mounts)	50 lb. (23 kg)

Table 4: Performance specifications

Specification	Description
Applications	4 minute C6+ standard analysis[1]
Repeatability	**Controlled environment** ■ ±0.0125% calorific value ■ ±0.125 BTU/scf per 1,000 BTU/scf **Uncontrolled environment: -4 to +140 °F (-20 to +60 °C)** ■ ± 0.025% calorific value ■ ± 0.25 BTU/scf per 1,000 BTU/scf
Calculations	International Organization for Standardization (ISO) 6976, American Gas Association (AGA) 8, Gas Processors Association (GPA) 2172 (using the GPA 2145 physical properties table)
Recommended carrier gas ■ Purity ■ Moisture content ■ Hydrocarbon content ■ Supply pressure ■ Carrier gas flow	Zero-grade helium at 90 psig (6.2 barg) or hydrogen at 30 psig (2.1 barg) ■ 99.995% (zero-grade) ■ Less than 10 ppm ■ Less than 0.5 ppm ■ 90 psig (6.2 barg) for helium; 60 psig (4.1 barg) for hydrogen ■ 20 cc/min for helium, 10 cc/min for hydrogen

Table 4: Performance specifications *(continued)*

Specification	Description
Recommended actuation gas ■ Moisture content ■ Particulate ■ Supply pressure	Helium, nitrogen, or clean dry air at 90 psig (6.2 barg) ■ Less than 10 ppm ■ Less than 2 microns ■ 90 psig (6.2 barg)
Recommended sample (calibration) gas input pressure range	20 psig (1.4 barg)
Valves	Three 6-port diaphragm analytical valves
Oven	Airless iso-thermal
Detector	Thermal conductivity detector (TCD)
Streams	Up to 3 sample streams and 1 calibration stream
Vibration	Meets ASTM-4169 specifications

(1)   *Custom light process applications available upon request.*

Table 5: Standard communications

Specification	Description
Ethernet	Two available connections: one RJ-45 plug-in port and one 4-wire termination. Both with 10/100 mbps.
Analog input	One standard input filtered with transient protection, 4–20 mA that is user scalable and assignable.
Analog outputs	Two isolated outputs, 4–20 mA.
Digital inputs	One input that is user assignable, optically isolated, and rated to 30 Vdc at 0.5 A.
Digital output	One user-assignable output, Form C and electro-mechanically isolated, 24 Vdc.
Serial ports	Two termination blocks, configurable as RS-232 or RS-485.

Table 6: Archived data storage capabilities

Type[1]	Maximum number of records	Remarks
Analysis results	86464	240 days with 4 minute cycle time
Final calibration results	370	1 year of final calibration results
Calibration results	100	
Final validation results	370	1 year of final validation results
Validation results	100	
Analysis chromatogram	3406	Approximately 9.4 days assuming 4 minute cycle time
Final calibration chromatograms	370	1 year of final calibration chromatograms[2]
Final validation chromatograms	370	1 year of final validation chromatograms[2]
Protected chromatograms	100	User-selectable
Hourly averages (up to 250 variables)[3]	250	10.4 days
Daily averages (up to 250 variables)[3]	365	1 year
Weekly averages (up to 250 variables)[3]	58	1 year
Monthly averages (up to 250 variables)[3]	12	1 year

Table 6: Archived data storage capabilities *(continued)*

Type[1]	Maximum number of records	Remarks
Variable averages (up to 250 variables)[3]	250	
Every run (up to 250 variables)[3]	250	
Alarm logs	1000	
Event logs	1000	

(1)   *Based on four-minute BTU with daily calibration application.*
(2)   *The gas chromatograph (GC) can store final calibration or final validation chromatograms for up to a year, provided that no more than one calibration or validation is run per day, and the cycle time is less than 15 minutes. If the cycle time exceeds 15 minutes, the oldest final calibration or validation chromatograms are deleted to make room for newer ones.*
(3)   *You can have a total of up to 250 averages of all types, including hourly, 24 hour, weekly, monthly, variable, and every run averages.*

Table 7: Maximum approved gas pressure

Gas stream	Maximum approved pressure
Sample/calibration	30 psig (2.1 barg)
Carrier	90 psig (6.2 barg)
Actuation	110 psig (7.6 barg)

Vent specifications

The flows of the vents are:

- Sample vent: 10 to 50 cc/min of sample gas for approximately 3.5 minutes of the four minute cycle.

- Measure vent: Continuous flow of less than 20 cc/min of carrier gas and 20 cc of sample gas per analysis cycle.

- Sample bypass: Continuous flow of 150 to 200 cc/min of sample gas.

Product certifications

For product certifications, see the *Rosemount 470XA Gas Chromatograph Quick Start Guide*.

Recommended installation

The drawings in Figure 4 represent the minimum recommended installation guidelines for Rosemount 470XA Gas Chromatographs. Please consult Emerson for detailed installation recommendations for your specific application.

Figure 4: Mounting dimensions
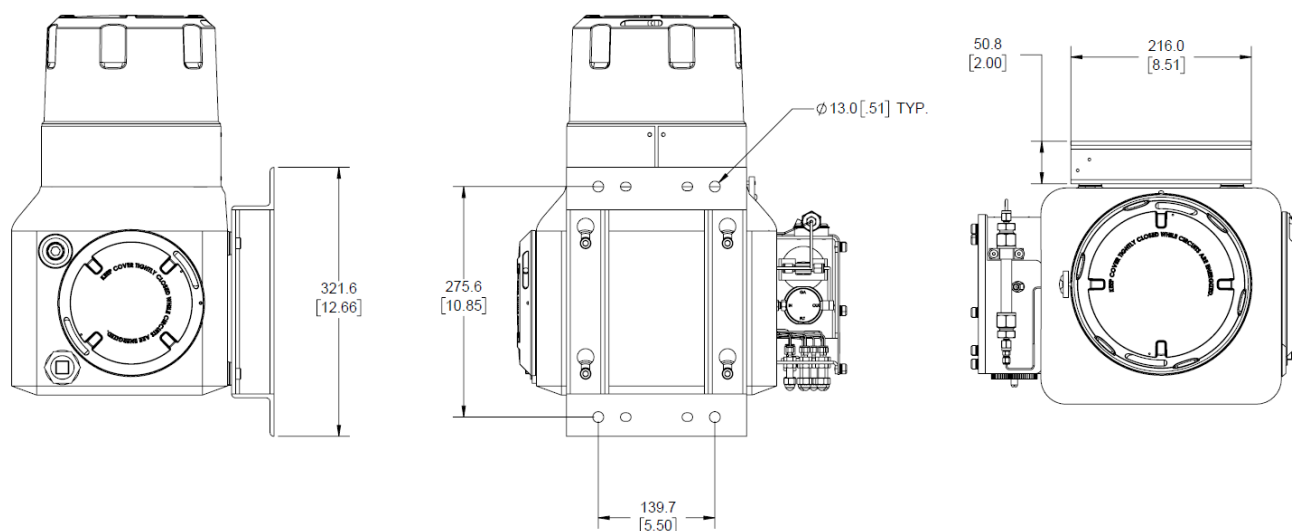
Dimensions are in millimeters with inches in brackets.

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