

Technical Information

Raman Rxn4



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Function and system design

Analyzer technology

The Raman Rxn4 Raman analyzer is a for-purpose embedded system with built-in Raman RunTime control software. Raman spectroscopy provides the chemical specificity of mid-IR spectroscopy and the sampling simplicity of a near-IR analyzer. By operating in the visible spectral region, Raman spectroscopy allows vibrational spectra to be collected in situ, using fiber-coupled probeheads, without sample purging, and without the use of exotic sampling devices.

The Raman Rxn4 suite of analyzers are based on advanced and innovative technologies that provide distinct advantages over traditional instrumentation. The HoloPlex advantage, standard in all Raman Rxn4 analyzers, yields both full spectral coverage and high spectral resolution simultaneously for improved qualitative and quantitative analysis. Analysis is fast because the entire Raman spectrum is measured simultaneously, which translates into real-time data collection for reaction analysis and monitoring.

All Raman Rxn4 analyzers employ a unique self-monitoring system to ensure the validity of each analysis. The analyzer is capable of two-point self-calibration in extreme environments and utilizes self-diagnostics and spectral correction methods when system calibration is unnecessary. The analyzer's precision is essential for robust chemometric analyses and calibration transfer between instruments.

The Raman Rxn4 suite of analyzers allow for remote fiber-optic connections to probe sampling points for installation flexibility.

The Raman Rxn4 can be configured as a single channel, four channel, or Hybrid Raman analyzer. All are designed for use with the Endress+Hauser Raman fiber optic probe line.

Front panel

The front panel of the Raman Rxn4 analyzer is shown below:

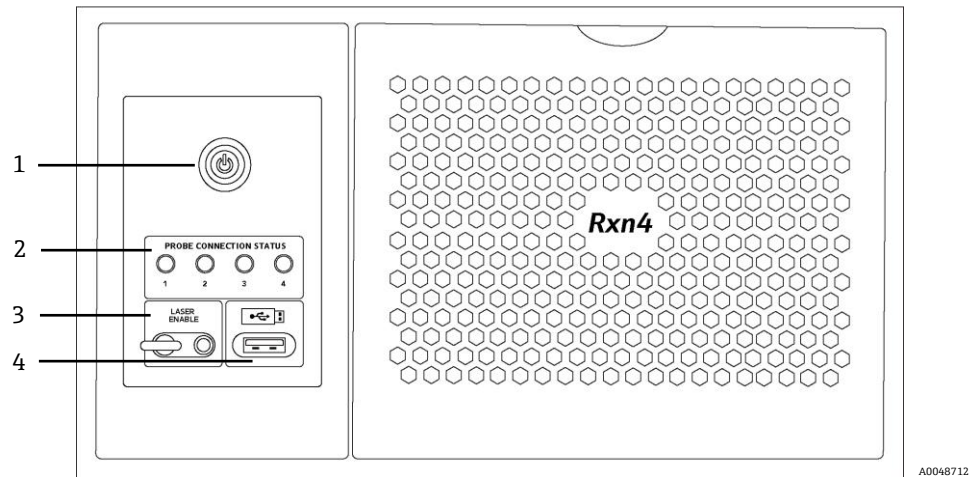


Figure 1. Front panel of a Raman Rxn4 four channel analyzer

#	Name	Description
1	Main Power Switch	The main power switch turns the instrument on and off, which includes the laser regardless of the position of the laser key switch. The Power push button incorporates a Blue LED in the shape of a power symbol, which indicates the system power status (all components are powered when lit). The Power push button will communicate error conditions using blink codes when embedded software is not able to communicate them. To turn the instrument on, press and release the Power button once. To turn a responsive instrument off, shut down using Raman RunTime. If the instrument is unresponsive, it may be powered down using a long 10 second press and hold of the Power button.
2	Probe Connection Status Indicators	The bank of Yellow LED indicators above the laser key and USB 3.0 port indicates the physical connection status of each probe. The LED is lit when the corresponding probe is properly connected. While the Raman Rxn4 four channel analyzer front panel has four LED indicators, the front panel of the Raman Rxn4 Hybrid analyzer has only two LED indicators, and the front panel of the Raman Rxn4 single channel analyzer has only one LED indicator.
3	Laser Key Switch	The laser key switch turns the laser on and off. The Red LED indicator adjacent to the laser key switch indicates the laser power status. To activate the laser, turn the laser key switch to the ON position. The Red LED indicator should remain lit whenever the laser is ON.
4	USB 3.0 Port	The USB 3.0 port is intended to obtain diagnostic exports from the instrument using a USB flash drive.

Table 1. Front panel of Raman Rxn4

Rear panel

The rear panel of the Raman Rxn4 analyzer is shown below:

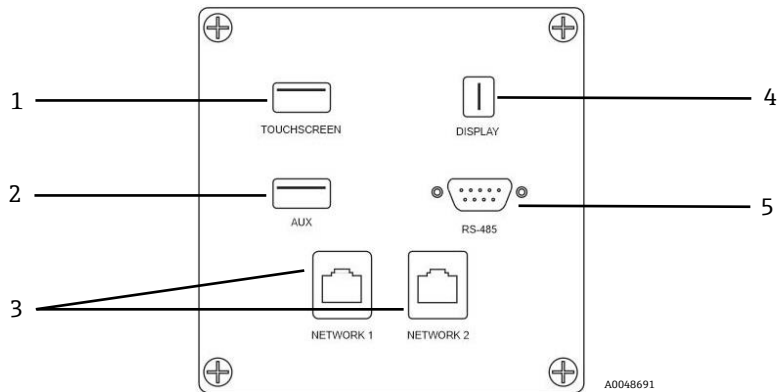


Figure 2. Rear external circuit input/output panel of a Raman Rxn embedded analyzer

#	Label	Interface Format	Description
1	TOUCHSCREEN	USB 2.0 Port	Input from touchscreen.
2	AUX	USB 2.0 Port	Reserved for future use.
3	NETWORK 1 and NETWORK 2	Two 1GB TCP/IP Ethernet Ports	Ethernet connection for OPC and Modbus communication and automation.
4	DISPLAY	Mini DisplayPort	Video connection for optional touchscreen.
5	RS-485	DB9 connector for 2-wire, half-duplex Modbus RTU interface. Pin 2 is Data+, Pin 3 is Data -, and Pin 5 is ground.	Modbus RTU interface connection.

Table 2. Raman Rxn4 ports

Interior of the Raman Rxn4

The interior of the Raman Rxn4 with the cover removed is shown below. The internal components are common among all configurations.

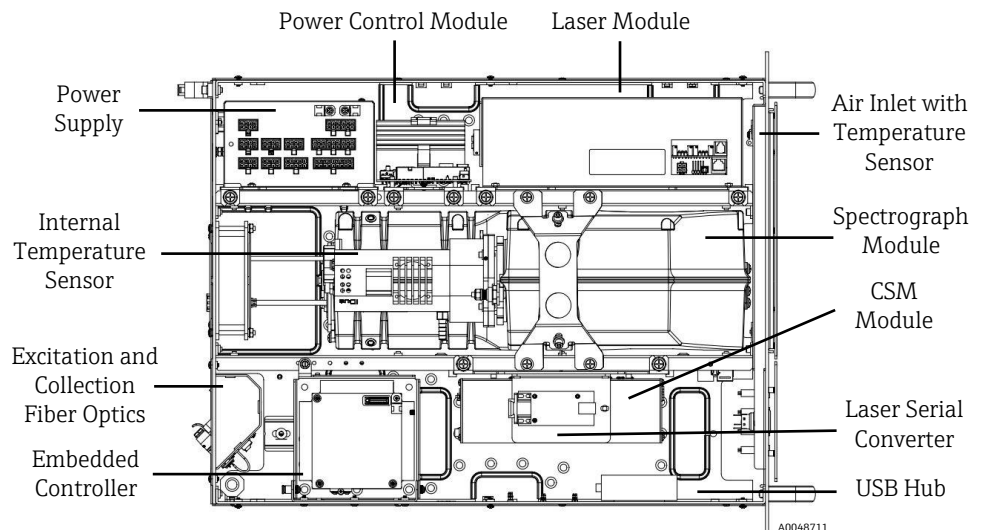


Figure 3. The interior of the Raman Rxn4 analyzer

Port connections

The port connections for the Raman Rxn4 analyzer are shown below:

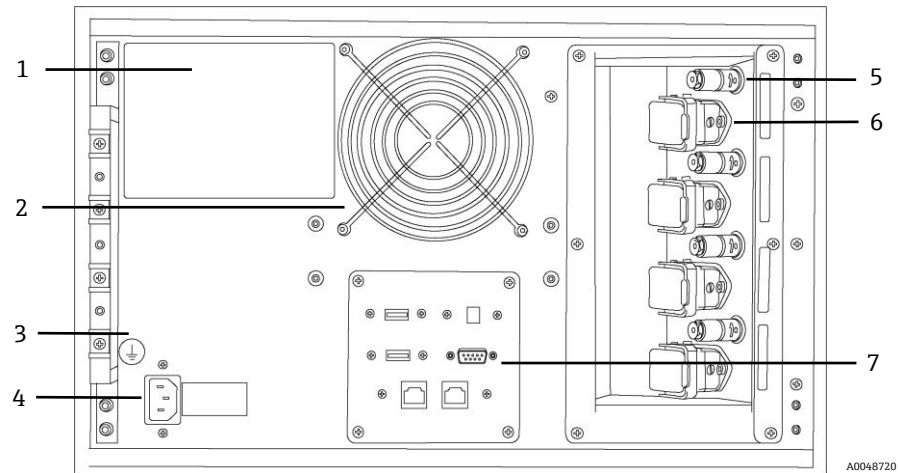


Figure 4. Rear panel of Raman Rxn4

#	Name	Description
1	CDRH Product Label	Product information about the Raman Rxn4 analyzer.
2	Air Exhaust	Air exhaust fan and outlet.
3	Strain Relief	EO fiber cable strain relief mounting location.
4	AC Inlet 100-240 VAC 50/60 Hz	Power socket outlet that AC power to the base unit. Ground pin on this connector serves as the Protective Conductor Terminal.
5	Remote Interlock Connectors	Safety feature. To interrupt the laser, remove the black plug.
6	EO Fiber Connector	Provides fiber optic laser radiation output, fiber optic Raman collection and electrical laser interlock loop for each instrument channel. The electrical laser interlock loop is intrinsically safe and is governed by Endress+Hauser drawing 4002396. Match 3 prongs on probe to 3 plugs on EO. Pull latch down to secure probe in place. Laser radiation may NOT exit a channel whose EO fiber connector is removed because removing the EO connector also interrupts the laser interlock loop for that channel.
7	Analyzer Ports	Touchscreen USB Port, USB Port, Ethernet Ports, RS-485 Serial Port, and Touchscreen Video Port.

Table 3. Port connection

Software

Raman RunTime

Raman RunTime embedded software is the control platform for its suite of Raman Rxn analyzers. Raman RunTime software is intended for easy integration with standard multivariate analysis and automation platforms to enable a real-time, in situ process monitoring and control solution. Raman RunTime presents an OPC and Modbus interface, which provides clients with analyzer data as well as analyzer control functions. Raman RunTime is fully embedded into Raman Rxn analyzers.

The main view of Raman RunTime displays four quadrants for four channel analyzers, one for each probe and a status bar (bottom) for a quick view of warnings and acquisition status. Single channel analyzers display only one main channel/probe window, while Hybrid analyzers display two channel/probe windows, one for the Rxn-20 probe channel and one for the non-Rxn-20 probe ALT. Batch details are accessed and edited from each corresponding quadrant/probe window. To switch back and forth between the main view and batch detail views, click the Title Bar for each probe/quadrant. Views of current spectrum vs. process values (model results) can also be easily swapped with by clicking on the Quadrant/Probe window display. Additional features, such as system settings, calibration, and diagnostics, are found under the Options section on the lower left corner of the screen.



Figure 5. Raman RunTime's main view in a Raman Rxn four channel analyzer

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User privilege levels

The Raman Runtime user levels are described below:

User Level	Action
User	<ul style="list-style-type: none"> ▪ Change subject (channel) display name ▪ View summary and detail of active batch acquisitions ▪ View calibration of information ▪ View diagnostics ▪ Perform exports (Basic, Diagnostic, Full)
Operator	User level actions plus: <ul style="list-style-type: none"> ▪ View active batch acquisitions ▪ Perform calibration and view calibrations information ▪ Perform verification and view verification results ▪ Start/stop batch acquisitions ▪ Focus ▪ Snapshot ▪ Ad hoc analysis ▪ Change system display name ▪ Configure date and time ▪ Restart
Admin	No Restrictions Operator level restrictions plus: <ul style="list-style-type: none"> ▪ Add/remove models ▪ Configure models (display name, enable/disable components & properties) ▪ Configure network ▪ Configure Open platform communications (OPC) ▪ Change security settings & manage users ▪ Apply embedded software updates

Table 4. User privileges

Software requirements

The client system software requirements are described below:

- Silverlight 5.0 or greater (for remote access)
- OPC UA client software (for OPC interface)
- OPC Classic client software (for OPC interface)
- Modbus client software (for Modbus interface)

Installation

Mounting location

It is recommended that the Raman Rxn4 analyzer be located in a standard 19-inch wide equipment rack with at least 30 inches of depth using the included slide rails, mounting brackets, and cable carriers. Alternately, the analyzer can be located on a level surface such as a laboratory benchtop or an equipment cart. In addition, the location selected should be:

- Free of moisture, dust, and corrosive vapors
- Isolated from excess vibrations

Ventilation

The location selected should allow for adequate ventilation to both the front and rear of the base unit. A space of not less than 6 inches (155 mm) must be provided in both the front and rear of the base unit for proper inlet and outlet air movement.

If the unit is to be mounted in a user-provided 19-inch wide equipment rack, the rack must allow for adequate airflow and temperature transfer. Rack depth must be at least 30 inches.

Air filter

The Raman Rxn4 incorporates a tacked polyester spun air filter element to reduce dust intake into the base unit. The air filter is accessed by a magnetically secured access panel on the front of the instrument (4). The air filter should be cleaned with compressed air once every month or if the embedded software is reporting an internal over-temperature error (if ambient temperature is within specification). In extremely dusty conditions, the air filter should be cleaned more often. The air filter has a **Blue** tacky side which should be oriented toward the outside of the base unit.

If a replacement air filter is needed, refer to our website (<https://endress.com/contact>) for the list of local sales channels in your area.

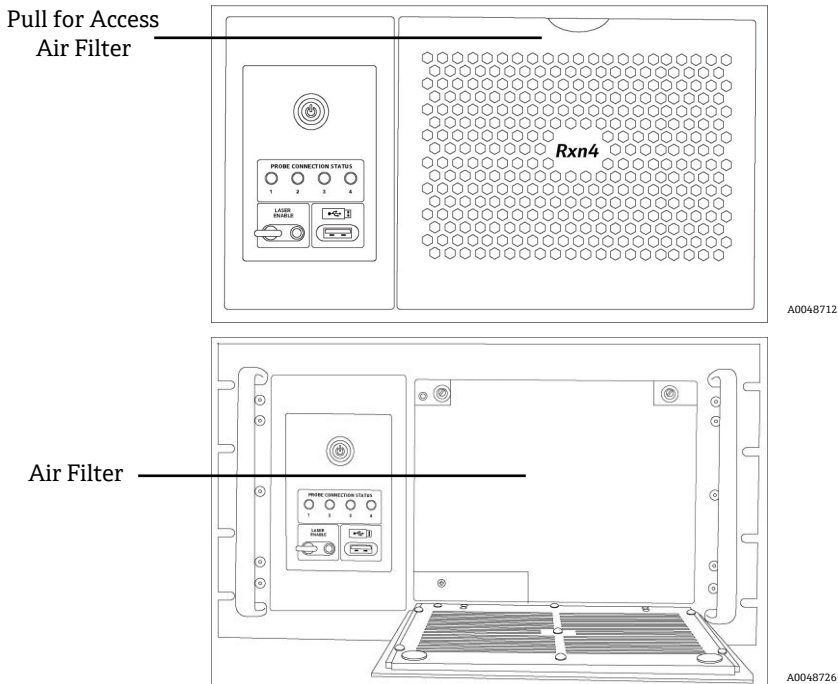


Figure 6. Filter access

Specifications

Dimensions

The height, width, and length of the Raman Rxn4 are shown below:

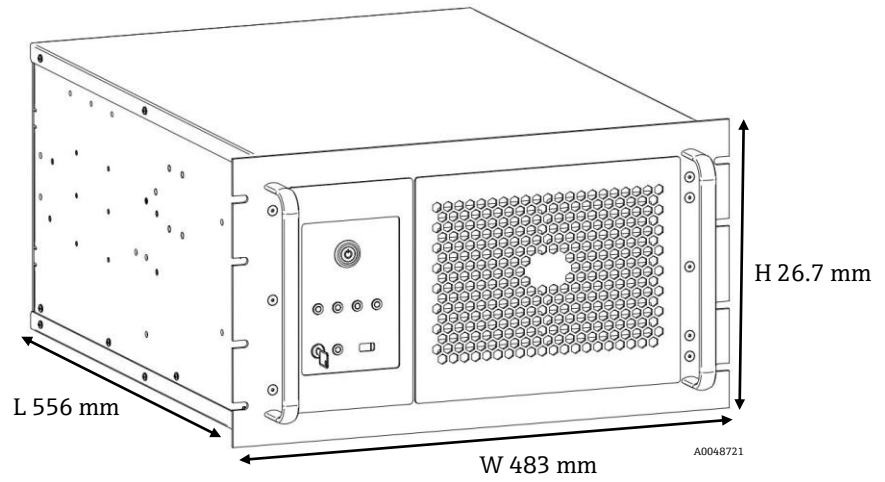


Figure 7. Raman Rxn4 dimensions

Name	Description
Height	267 mm (10.5 in.)
Width	483 mm (19 in.)
Length	556 mm (21.9 in.)

Table 5. Raman Rxn4 analyzer dimensions

Analyzers

The specifications for the three types of Raman Rxn4 analyzers are listed below:

Category	Raman Rxn4	Raman Rxn4 w/Enclosure	Raman Rxn4 Hybrid
Laser Wavelength	532 nm 785 nm 1000 nm	532 nm 785 nm 1000 nm	785 nm
Spectral Coverage	150-4350 cm ⁻¹ (532 nm) 150-3425 cm ⁻¹ (785 nm) 200-2400 cm ⁻¹ (1000 nm)	150-4350 cm ⁻¹ (532 nm) 150-3425 cm ⁻¹ (785 nm) 200-2400 cm ⁻¹ (1000 nm)	175-1890 cm ⁻¹ (785 nm)
Spectral Resolution	5 cm ⁻¹ (532 nm) 4 cm ⁻¹ (785 nm) 5 cm ⁻¹ (1000 nm) average	5 cm ⁻¹ (532 nm) 4 cm ⁻¹ (785 nm) 5 cm ⁻¹ (1000 nm) average	4 cm ⁻¹ (785 nm) average
Temperature / % Relativity Humidity	<i>Ops Temp:</i> 5 °C to 35 °C (41 °F to 95 °F) (532 nm, 785 nm); 5 °C to 30 °C (41 °F to 86 °F) (1000 nm) <i>Stg Temp:</i> -15 °C to 50 °C (5 °F to 122 °F) <i>Relative Humidity:</i> 20 % to 80 %, non-condensing	<i>Ops Temp:</i> 5 °C to 50 °C (41 °F to 122 °F) <i>Stg Temp:</i> -15 °C to 50 °C (5 °F to 122 °F) <i>Relative Humidity:</i> Up to 80 % for temperature range 5 °C to 31 °C (41 °F to 87.8 °F), decreasing linearly to 20 % at 50 °C (122 °F)	<i>Ops Temp:</i> 15 °C to 30 °C (59 °F to 86 °F) <i>Stg Temp:</i> -15 °C to 50 °C (5 °F to 122 °F) <i>Relative Humidity:</i> 20 % to 80 %, non-condensing
Input Voltage	100-240 V 50-60 Hz ±10 %	120 V ± 10% 60 Hz OR 230 V ± 10 % 50/60 Hz	100-240 V 50-60 Hz ±10 %
Power Consumption	400 W (max) 250 W (typical start-up) 120 W (typical running)	1560 W (max) 1560 W (typical start-up) 750 W (typical running)	400 W (max) 250 W (typical start-up) 120 W (typical running)
Warm-up Time	120 minutes	120 minutes	120 minutes
Unit Dimensions	483 x 267 x 556 mm	1175 x 1480 x 826 mm (with optional trolley)	483 x 267 x 556 mm
Weight	28.5 kg	185.5 kg (with optional trolley)	28.5 kg
Sampling Probe Compatibility	Rxn-10 (with optics), Rxn-30, Rxn-40, Rxn-41, Rxn-45, and Rxn-46	Rxn-10 (with optics), Rxn-30, Rxn-40, Rxn-41, Rxn-45, and Rxn-46	Rxn-20 (with optics) and one alternate non-Rxn-20 Endress+Hauser Raman probe
Hazardous Area Certifications	ATEX, North American, IECEx	Pending	ATEX, North American, IECEx
Connection Interface	OPC, Modbus (contact Endress & Hauser for other options)	OPC, Modbus (contact Endress & Hauser for other options)	OPC, Modbus (contact Endress & Hauser for other options)
Installation Options	19-inch rack package	NEMA 4X enclosure; wall-mountable, mobile trolley, or fixed stand	19-inch rack package

Table 6. Analyzer Specifications

Laser

The specifications for the laser are listed below:

Item	Description
532 nm Excitation wavelength Maximum power output Warranty	532 nm 120 mW unlimited hours for 1 year
785 nm Excitation wavelength Maximum power output Warranty	785 nm 400 mW unlimited hours for 1 year
1000 nm Excitation wavelength Maximum power output Warranty	993 nm 400 mW unlimited hours for 1 year

Table 7. Laser

Probes

The specifications for the probes are listed below:

Item	Description
Raman Rxn4 (single channel and four channel)	Compatible with: RamanRxn probehead equipped with immersion or non-contact optics Endress+Hauser gas and liquid phase Raman probe Endress+Hauser bioprocessing Raman probes
Raman Rxn4 Hybrid	Compatible with: Rxn-20 probe and One other ALT probe including: RamanRxn probehead equipped with immersion or non-contact optics Endress+Hauser gas and liquid phase Raman probe Endress+Hauser bioprocessing Raman probes

Table 8. Probes

Sound levels

The specifications for the sound levels are listed below:

Analyzer / Accessory	Sound Level from Operator's Position
Raman Rxn4	58.2 dB

Table 9. Sound levels

Network configuration

The table below summarizes the ports relevant to specific Raman Runtime features. Ports for OPC Classic are assigned dynamically in the indicated range; fixed-port behavior is only available for OPC UA. It's only necessary to open firewall ports for the features intended to use. Ports in bold should be regarded as mandatory for the associated protocol; other ports are recommended for full functionality (e.g. discovery services).

Protocol	Ports
OPC UA	TCP 4840, 4843, 52601, and 62886
OPC Classic	TCP 135 and 49152-65535
Modbus	TCP 502
File Sharing	TCP 139 and 445
Remote Access	TCP 943 , 3593 , 4525 , and 5674; User datagram protocol (UDP) 3702

Table 10. Raman RunTime network configuration

Certificates and approvals

Hazard area rating

The hazard area rating details are listed below:

Item	Description
Rxn-10 Probe	None
Rxn-20 series probes can be classified to:	<p>ATEX Ex II 2/1 G Ex ia op is IIA or IIB or IIB+H2 or IIC T4 or T3 or T6 Ga $-20\text{ }^{\circ}\text{C} (-4\text{ }^{\circ}\text{F}) \leq \text{TA} \leq 60\text{ }^{\circ}\text{C} (140\text{ }^{\circ}\text{F})$</p> <p>IECEX IECEX ITS 14.0015X</p> <p>North American Ex ia op is IIA or IIB or IIB + H2 or IIC T3 or T4 or T6 Ga Class I, Division 1, Groups A, B, C, D T3/T4/T6 Class I, Zone 0 AEx ia op is IIA or IIB or IIB + H2 or IIC T3 or T4 or T6 Ga</p>
Rxn-30 series probes can be classified to:	<p>ATEX Ex II 2/1 G Ex ia op is IIA or IIB or IIB+H2 or IIC T3 or T4 or T6 Ga $-20\text{ }^{\circ}\text{C} (-4\text{ }^{\circ}\text{F}) \leq \text{TA} \leq 60\text{ }^{\circ}\text{C} (140\text{ }^{\circ}\text{F})$</p> <p>IECEX IECEX ITS 14.0015X</p> <p>North American Ex ia IIB+H2 T4 Class I Zone 0 AEx ia IIB+H2 T4 Class I Division 1 Groups B, C, & D T4</p>
Rxn-40 and Rxn-41 series probes can be classified to:	<p>ATEX Ex II 2/1 G Ex ia op is IIA or IIB or IIB+H2 or IIC T3 or T4 or T6 Ga $-20\text{ }^{\circ}\text{C} (-4\text{ }^{\circ}\text{F}) \leq \text{TA} \leq 60\text{ }^{\circ}\text{C} (140\text{ }^{\circ}\text{F})$</p> <p>IECEX IECEX ITS 14.0015X</p> <p>North American Ex ia IIC T4 Class I Zone 0 AEx ia IIC T4 Class I Division 1 Groups A, B, C, & D T4</p>
Rxn-45 Probe	None

Table 11. Hazardous area rating

Hazard area certification

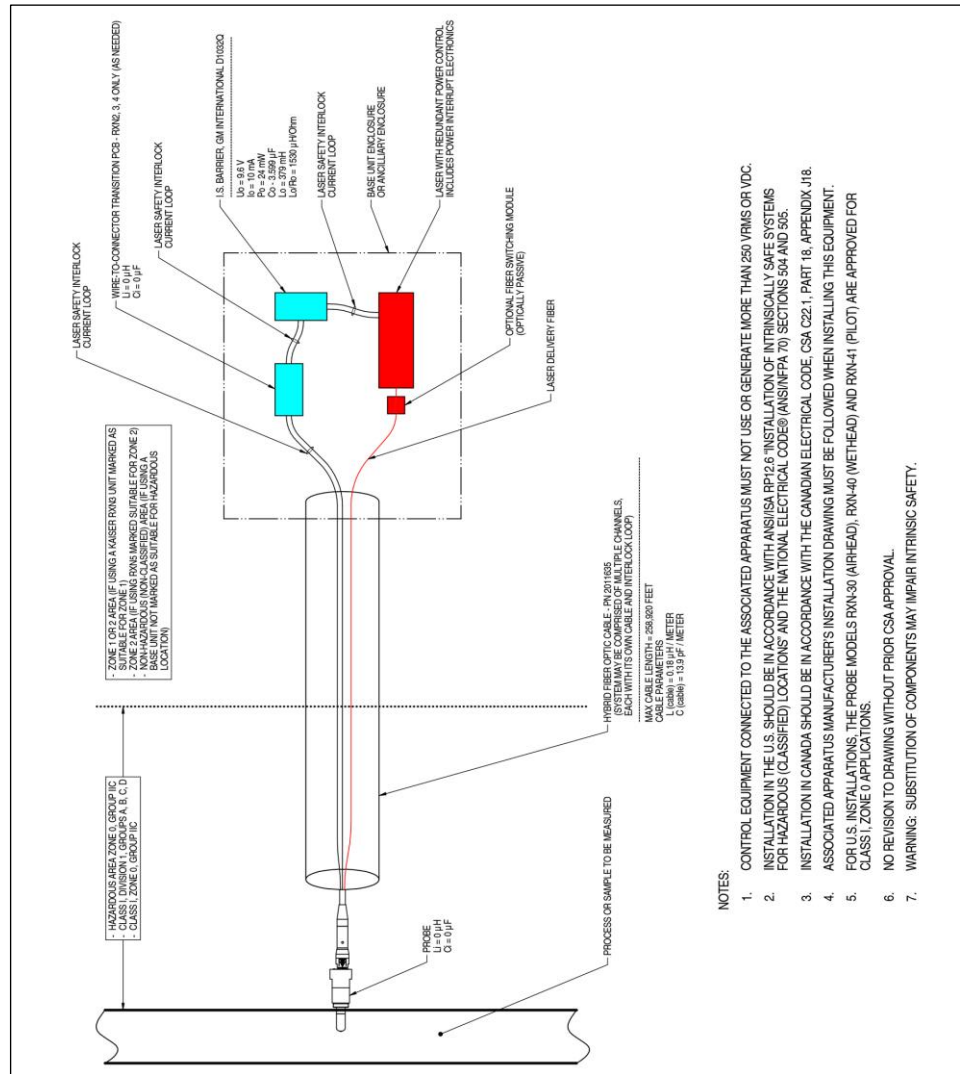
The hazard area certification details are listed below:

Item	Description
Certification – Base Unit (fiber optic and interlock outputs only)	<p>ATEX Ex II (2)(1) G Ex [ia Ga] [op sh Gb] IIC CE 0035 Ex II (2)(1) G</p> <p>IECEX Ex [ia Ga] [op sh Gb] IIC</p> <p>North American Intrinsically Safe output for probe and sensors used in Class I, Division 1, Groups A, B, C, and D. Ambient Temperature Range: $5\text{ }^{\circ}\text{C} (41\text{ }^{\circ}\text{F}) \leq \text{Tamb} \leq 35\text{ }^{\circ}\text{C} (95\text{ }^{\circ}\text{F})$</p>

Table 12. Hazardous area certification

Hazard area drawing

The hazard area installation drawing is shown below:



- NOTES:
1. CONTROL EQUIPMENT CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 VRMS OR VDC.
 2. INSTALLATION IN THE U.S. SHOULD BE IN ACCORDANCE WITH ANSI/ISA 812.6 (INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS) AND THE NATIONAL ELECTRICAL CODE® (ANSI/NFPA 70) SECTIONS 504 AND 505.
 3. INSTALLATION IN CANADA SHOULD BE IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE, CSA C22.1, PART 18, APPENDIX J18.
 4. ASSOCIATED APPARATUS MANUFACTURER'S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.
 5. FOR U.S. INSTALLATIONS, THE PROBE MODELS RN-30 (AIRHEAD), RN-40 (WETHEAD) AND RN-41 (PILOT) ARE APPROVED FOR CLASS I, ZONE 0 APPLICATIONS.
 6. NO REVISION TO DRAWING WITHOUT PRIOR CSA APPROVAL.
 7. WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.

Figure 8. Hazardous area certification

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