+ Scanner flow computer calculations firmware
Features and applications

FLUIDS

Fluids	Industry Standards	Scope	Limitations		QRATE Scanner* 3000 Series	NUFLO Scanner* 2000 Series
Natural gas, detailed composition						
Mole fractions of 21 components	AGA 8 (2017) part 1; ISO 12213 (2009)	Natural gas	Gas phase only; limits on mole%		■	■
	Groupe Européen de Recherche sur les Normativités (GERG) AGA 8 (2017) part 2; GERG 2008 (2012)	Natural gas	Gas, liquid, dense phases; no mole% limits		■	
	Speed of sound	AGA 10 equivalent computed by AGA 8 (2017)			■	
	Live gas composition updates	QRATE Scanner 3000 series connects to chromatographs. All models can receive composition updates from the network. QRATE Scanner 3000 series can update NUFLO Scanner 2000 series.			■	
Natural gas, gross characterization			**Pressure, psi [MPa]**	**Temperature, degF [degC]**		
Gravity, carbon dioxide (CO_2), and nitrogen (N_2), (GCN) method II	Standard GERG (SGERG) 88 (1988) AGA-8 (1994); ISO 12213-3 (2006)	Natural gas	Up to 1750 [12]	17 to 143 [−8 to 62]	■	■
			CO_2: 28.8% max.; nitrogen: 53.6% max.; gravity 0.554 to 0.870			
Steam			**Pressure, psi [MPa]**	**Temperature, degF [degC]**		
Saturated steam	International Association for the Properties of Water and Steam (IAPWS) IF-97 (1997)	Steam (Regions 2 and 4); only a pressure input is required; temperature is calculated	Up to 14,500 [100]	32 to 662 [0 to 350]	■	■
Superheated steam, saturated steam, water	International Association for the Properties of Water and Steam (IAPWS) IF-97 (1997)	Regions 1,2,3,4	Up to 14,500 [100]	32 to 1472 [0 to 800]	■	
Hydrocarbon liquids			**Density, kg/m²**	**Temperature, degF [degC]**		
Crude oil, lubricating oils, fuels, and special products	API Manual of Petroleum Measurement Standards (MPMS) Chapter 11.1 (2004)	Pressure and temperature correction	610 to 1,163	−58 to 302 [−50 to 150]	■	■

APPLICATIONS

Applications	Industry Standards	Scope	Limitations	QRATE Scanner 3000 Series	NUFLO Scanner 2000 Series
Multiphase correction					
Oil shrinkage factor correction	None	Hydrocarbon liquids	User-entered value	■	
Water cut; BS&W	None	Inferred by density from Coriolis meter or densitomer	0-100% water in oil, Modbus or analog input	■	
		From analyzer	0-100% water in oil, Modbus or analog input	■	

Water or liquid hydrocarbon in natural gas	Chisholm-Steven	User-entered liquid content. Use with spool cones with limited beta selection.	Lockhart-Martinelli <0.3, (~8 % max. liquid); apply proprietary "WG" sizing program		▪
Water in steam vapor	Chisholm-Steven	User-entered value: steam quality. Use with spool type cone meters with specific beta ratios.	Lockhart-Martinelli <0.3, (~8 % max. liquid); apply proprietary sizing program		▪
Energy flow calculation					
Natural gas energy measurement	AGA-5 (2009)	Hydrocarbon fuel gas, natural gas	29 components including trace gases	▪	
	ISO 6976 (2016); AGA-8(1994) Appendix C4; GPA 2172 (1996)	Hydrocarbon fuel gas, natural gas	21 components	▪	
	AGA-3 (1992) Part 3 Appendix F; AGA-5 (1963)	Hydrocarbon fuel gas, natural gas	21 components	▪	▪
	ASTM D3588 (2017)	Hydrocarbon gas	Water excluded	▪	
Natural gas properties ($Mr, Pc, Tc, W, Mu, k, hc, HN_25$)					
Natural gas, detailed characterization	GPA-2145 - 16 (2008)	Hydrocarbon fuel gas, natural gas; coefficients frequently amended		▪	▪

† Wireless devices excluded.

METERS

Meters	Industry Standards	Scope	Limitations	QRATE Scanner 3000 Series	NUFLO Scanner 2000 Series
Concentric sharp-edged orifice					
American Gas Association (AGA) standard orifice	AGA-3 Part 1 (1992)	Liquid, gas	Nominal 2-in pipe and larger Beta 0.1 to 0.75	▪	▪
	AGA-3 Part 1 (2012); API MPMS Ch 14.3.1 (2012)				
ISO and American Society of Mechanical Engineers (ASME) standard orifice	ISO-5167 (2003) Part 2				
Concentric small-bore orifice					
ASME precision small-bore orifice	ASME Measurement of Fluid Flow in Closed Conduits (MFC) 14M (2003)	Liquid, gas	1/2- to 1 1/2-in pipe Beta 0.1 to 0.75	▪	▪
Averaging pitot tubes					
Annubar® pitot tube	None; see Miller 3rd Ed.	Liquid, gas	High velocity required		▪
Generic pitot tube	None; see Miller 3rd Ed.	Liquid, gas	High velocity required		▪
Cone meters					
Wafer type	Miller 3rd Ed.	Liquid, gas, steam		▪	▪
Spool type	ISO 5167 part 5 2016	Liquid, gas, steam	NUFLO Scanner series 2000 uses Miller		▪
Venturi meters					
Classic venturi	ISO-5167 (2003) Part 4; ASME MFC-3M (2004)	Liquid, gas, steam		▪	
Linear meters					
Gas volume accumulation	AGA-7 (2006)	Gas turbine, vortex shedder, or ultrasonic	Any gas	▪	▪
Liquid volume accumulation	None	Liquid turbine, vortex shedder, or ultrasonic	Low-viscosity liquid	▪	▪
Mass accumulation	AGA-11 (2013)	Gas or liquid Coriolis mass meter	Single phase	▪	

SCANNER FIRMWARE FEATURES

The following is a summary of the functions that NUFLO Scanner 2000 and QRATE Scanner 3000 flow computers perform. All functions listed are provided in the firmware released mid-year 2020. Additional information can be found in the technical data sheets, installation and operation manuals, and other documents under the respective series at sensiaglobal.com/Measurement/Types/Flow-Computing-and-Automation.

Sensia periodically publishes firmware and software upgrades on its website to add new capabilities. There is no charge for the additional capabilities. However, the function may require additional or alternate circuit boards that are available at extra charge.

The QRATE Scanner 3000 series includes models 3100 and 3300.

The NUFLO Scanner 2000 series includes models 2000, 2100, 2105, and 2200.

Except as noted, the features in the table below apply with or without deploying a distributed measurement system in which NUFLO Scanner 2000 series and QRATE Scanner 3000 series models function together.

FUNCTIONS

Feature	Description	QRATE Scanner 3000 Series	NUFLO Scanner 2000 Series
General			
Access security	Four classes of users (download and read only, calibrate only, configuration editor, and administrator)	▪	
	Number of unique user names	20	9
Maintenance mode	Maintenance mode is automatically activated or deactivated after user warnings when any of the following activities commence or bkiISO 5167-2 (2003), are completed. While in maintenance mode, the last input or output values are retained (frozen). Activities that trigger the maintenance mode are manual gas composition changes, orifice plate changes, calibration changes, and PID controller tuning.	▪	▪
Partial records	If actvated when a user performs a change that will influence the computed flow results, the the current archive record will be closed at the time the change occurred and a new additional record inserted that will log the values for the time that remains in the interval. Scanner 3000 series models allow either or both interval records and daily records to have partial records.	▪	▪
View history without download	View daily records for a specified month or view interval (typically hourly) records for a specified day	▪	
Triggered log	An addition to interval (including hourly) logs and daily logs, the triggered log can be configured to; + Start and stop by multiple methods + capture minimum, maximum, or instantaneous values. Averages can also be captured as time or flow weighted. + Intervals from seconds to once a year Ideal for well testing and troubleshooting process conditions	▪	
Alarm summary QRATE Scanner 3000 series	Dedicated alarm status page displays 32 user-configurable alarms originating from any measured or calculated source, including from Modbus master or distributed multimeasurement and control network Features include alarm history acknowledgement, and ability to link to status outputs with or without latched alarms. 	▪	
Alarm summary NUFLO Scanner 2000 series	Dedicated alarm status page displays 16 user configurable alarms originating from any measured source. 		▪
Sensing and data management			
22-stream capacity	2 internal, 20 more possible using NUFLO Scanner 2000 series models connected as subordinates to a QRATE Scanner 3000 model.	▪	
Stacked DP or pressure sensors	Menu configurable to implement up to three DP sensors on a primary element. Improves the accuracy and rangability of a metering point.	▪	

Feature	Description	QRATE Scanner 3000 Series	NUFLO Scanner 2000 Series
Bidirectional - DP	Standard integral MVT are fully bidirectional and can be applied to the orifice. DP switch points are configurable. Each direction is allocated its own flow run. Net quantities are computed by the calculator feature.	▪	
	1 internal, 10 more possible using NUFLO Scanner 2000 series pairs as subordinates		
Turbine health monitoring	Assesses turbine wave form irregularities to detect electrical noise, bearing, or rotor problems.	▪	
Turbine flow direction	Two pulse inputs from one meter can be used for phase discrimination / quadrature decoding to detect flow direction.	▪	
	A status input can used to indicate flow direction.		
Pulse fidelity	Two pulse inputs from one meter can be used for compliance to MPMS Ch. 5.5 level B pulse fidelity.	▪	
20 turbine or pulse meter capacity	20 additional compensated flow runs using NUFLO Scanner 2000 Series as subordinates	▪	
	20 additional uncompensated flow runs using NUFLO MC III* flow totalizer as subordinates	▪	
	Can be also used in pairs for bidirectional flow. Utilizes a status input to define the direction of flow and then allocates each direction to separate flow runs. Net quantities are computed by the calculator feature.		
Gas composition	a. Can be communicated to the scanner by Modbus registers (SCADA host)	▪	▪
	b. Can be manually entered by user interface	▪	▪
	c. Collect from a chromatograph emulating a Daniel 2251 and apply the composition to itself or to subordinate NUFLO Scanner 2000 models. Where there are multiple gas sources, the QRATE Scanner 3000 series scanner can sequentially collect up to 8 compositions and allocate them appropriately to subordinate NUFLO Scanner 2000 series scanners.	▪	
	d. Gas composition is logged with archives	▪	
	e. Gas composition is logged in change log	▪	
Densitometer input	Accepts input from a liquid densitometer for determination of the API gravity of hydrocarbons to support pressure and temperature correction. Can also be used to determine the water cut based on density	▪	
Modbus master	Reads and writes data to or from other Modbus devices by selectable Modbus protocols over TCP or serial connections	▪	
End device power	1 to 5-volt input circuit power is provided by dedicated terminals.	▪	2105
End device battery power	Internal batteries power two 1 to 5-volt inputs to support uninterrupted operation	3100	2105
Port passthrough	Any combination of two digital communication ports can be directed to connect to each other. A typical application is to temporally repurpose the remote SCADA communication connection to talk directly to a smart field device that is connected to the scanner for the normal purpose of communicating process information. With the passthrough activated, the user at the SCADA host location can communicate to the field device regardless of the protocols or port formats. As an example, while remaining remote from the scanner location, a technician could communicate to a mass meter connected to the scanner and by using the software supplied by the mass meter manufacturer assess the heath or adjust the mass meter.	▪	
Calculators	The calculators are similar to a handheld calculator in capability and simplicity. The user can apply mathematical operations to any combination of values within one or more scanner.	▪	
	Typical applications are calculating rates, totals, and ratios from a combination of flow runs. The calculator can also be used for very simple logic applications.		
Ethernet automation port	Two Ethernet ports are standard. An optional network/security card provides DHCP client or server capability so the QRATE Scanner 3000 scanner can be the hub of an automation network.	▪	
Wi-Fi automation	The Wi-Fi option allows the scanner to manage 10 simultaneous wireless connections. The scanner can be the hub of a Wi-Fi automation network in addition to providing wireless connection to the browser-based user interface.	▪	
Control			
Programmability	User programable for special computations, production optimization, and control strategies	▪	
PID controllers	Two 4-20 mA plus one pulse/digital controller	▪	
	One 4-20 mA		▪
	Eight more possible using programmable capability	▪	▪
Miscellaneous			

Feature	Description	QRATE Scanner 3000 Series	NUFLO Scanner 2000 Series
Units of measure	Controlled in five functions. Mixed units in each function		
	1. Local display	■	■
	2. Calculation and log	■	■
	3. Modbus master	■	
	4. Modbus slave responses (ScanMap)	■	
	5. Programmable logic	■	
Browser interface	Full configuration and interaction from any smart device with a browser Use with or without internet connection	■	
Operational power source for the scanner	+ 9 to 28 VDC (consult technical data sheet for exact values by model)	■	■
	+ Direct solar panel input with integral battery and charge control (models 2105 and 2200).		■
	+ Long life nonrechargable nominal 1 year (models 2000, 2100, and 2200)		■
	+ 4-20mA output loop powered (model 2105 only)		■
Distributed measurement and control network multidrop serial or SmartMesh wireless network			
Auto-integration	QRATE Scanner 3000 series and NUFLO Scanner 2000 series configure each other automatically based on application of the NUFLO Scanner 2000 series model	■	■
Auto data recovery	All history files generated in a NUFLO Scanner 2000 series model are copied to a host 3000 series model connected by either the wired or wireless network. Continuous synchronization restores data that are missing in the 3000 series master or the subordinate NUFLO Scanner 2000 series model.	■	■
Gas composition	1. Can be communicated to scanner by Modbus registers (SCADA host)	■	■
	2. Can be manually entered by user interface	■	■
	3. A QRATE Scanner 3000 series model 3000 can collect from a chromatograph emulating a Daniel 2251 and apply the composition to itself or to subordinate NUFLO Scanner 2000 series models. Where there are multiple gas sources, the QRATE Scanner 3000 series scanner can sequentially collect up to eight compositions and allocate them appropriately to subordinate NUFLO Scanner 2000 series scanners.	■	
	4. Gas composition is logged with archives	■	■
	5. Gas composition is logged in change logged	■	■

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