d•flux

Multiparameter Mass Flow Meter and Controller for Gases

PRECISE   **STABLE**   **FLEXIBLE**

DATASHEET

FIELD
PROVEN.

d·flux High Flow Delivers Revolutionary Performance

The demands on scientific and industrial flow measurement instruments have never been greater. Precise measurement of high flows and the ability to make fast and accurate changes between pure gas or gas mixes are crucial. Can you count on the consistent performance of your flow instrumentation in your factory or lab over time? And will your supplier be there for you if the unexpected happens?

With Sierra's d•flux, you're getting a reliable, high-performance package. Carefully milled from stainless steel or aluminum, d•flux is a multiparameter mass flow device that provides precise measurement outputs for five process variables: mass flow, volumetric flow, temperature, pressure, and density. It relies on true physical calculations from advanced 3D polynomial data tables to deliver the flow data you rely on. These diagnostics make switching gases faster and easier, with absolutely no loss in accuracy. And best of all, we're always here if you need us—Sierra's promise to customers for over 50 years.

Gas Flow Measurement and Control Applications

d•flux's field-proven capabilities make it an ideal choice for a wide range of applications, including:

- **Biopharmaceutical Production:** d•flux can be used to culture and grow microorganisms in bioreactors that are later used in medicines, vaccines, and genetic engineering
- **Hydrogen Production:** Applications include fuel cells, generation, storage and transportation, custody transfer, blending, and process monitoring and control
- **Carbon Capture and Storage:** Measure the CO2 produced from burning fossil fuels or biomass in chemical and bioenergy plants
- **Nuclear Energy:** Use d•flux to monitor Argon blanketing gas in a welding chamber
- **Gas Injection:** Measure the CO2 used to adjust pH in bioprocessing and wastewater

Specification Highlights

- **Multiparameter Measurement and Control**
  One device measures five process variables: mass flow, volumetric flow, temperature, pressure, and density

- **Multigas Capability**
  Pre-program up to 15 gases or gas mixtures

- **New Sierra Flow Connector App**
  Monitor and control meter functions conveniently from your mobile device with our free Android App (Bluetooth®)

- **Flow Rates**
  Up to 1508 slpm (Air)
  Other gases according to conversion (ex. Up to 3124 slpm for hydrogen)

- **Sensor Accuracy (5 options)**
  A1 Core: ± 0.5% of user full scale ± 1% of measured value (Air, N_2, Argon, and Oxygen gases only)
  B1 Prime: ± 0.3% of user full scale ± 0.7% of measured value
  B2 Prime high accuracy: ± 0.3% of user full scale ± 0.5% of measured value

  Hydrogen Applications
  B3 Prime H2: ± 0.3% of user full scale ± 0.7% of measured value
  B4 Prime H2 high accuracy: ± 0.3% of user full scale ± 0.5% of measured value
  User full scale = ~70...100% standard range

- **Sensor Stability**
  Less than 0.2% of measured value/year after tare

- **Repeatability**
  ± 0.2% of factory full scale

- **Pressure**
  1 to 200 psia (1 to 14 bar a)

- **Response time**
  Meter: 120 msec / Controller: 2000 msec
  Update time mass flow value: 10 msec
  Sensor sample rate: 1 msec. / 4 msec. with optimized filter settings

- **Turndown**
  1:100 for most gases
  1:1000 with Automated Dynamics: (meter only)

- **Warmup**
  Less than 2 sec for full accuracy

- **Temperature**
  -4°F to 140°F (-20°C to 60°C)

- **Digital Communications**
  Advanced Modbus and analog output. PROFINET or EtherCAT available as options

- **Warranty**
  3 Years, excluding cases of corrosion

Sierra Flow Connector App

d•flux's user-friendly software, Sierra Flow Connector, is available for free as a Bluetooth App from Google Play. It allows you to conveniently and securely connect to your d·flux instrument with an Android mobile device to create and edit profiles (a set of settings). While operating in the field, you can adjust flow range and dynamic range, filter settings, alarms and warnings, and an assortment of other critical parameters.

Sierra Flow Studio

Sierra's d•flux offers advanced Modbus communication and analog output. Optional digital communications include PROFINET or EtherCAT. Sierra Flow Studio is advanced PC-based software that lets you communicate with your d•flux device in a Microsoft Windows environment through Modbus. It is available for free download from Sierra's website.

The Differential Pressure Advantage

Sierra's d•flux uses a differential pressure measurement over a laminar flow element. The sensors measure the pressure differential, the absolute pressure, and the gas temperature.

With this information, the internal electronics calculate the mass flow going through the device. We generate a 3D polynomial curve based on the NIST (Refprop) data for each individual application. A unique advantage of the laminar flow meter is its linear relationship between flow rate and developed pressure drop. The meter becomes a mass flow controller by adding a control valve and a PID controller. You provide a setpoint to initiate a repeatable, stable mass flow. Changes to pressure and temperature do not influence the flow rate.

Stainless Steel or Aluminum Bodies

The d•flux meters are available in stainless steel or aluminum flow bodies. The aluminum body significantly reduces the weight and cost of the units while still maintaining excellent specifications and functionality. The anodized aluminum body is compatible with most gases and does not corrode.

d•flux controller SS -> 19.18 lbs / d•flux controller ALU -> 9.47 lbs

d•flux meter SS -> 8.15 lbs / d•flux meter ALU -> 3.52 lbs

Sierra Flow Connector App: Download on Google Play

Sensor Flexibility

d•flux offers a variety of sensor material choices for greater flexibility and economy for a wide range of gas flow applications.

1. The Core Sensor is a high-tech differential pressure sensor. The pressure differential and absolute pressure sensor are embedded in a single modular epoxy-based housing.

Note: The Core Sensor is only suitable for Air, Nitrogen, Argon, and Oxygen.

2. The Prime Sensor is constructed of all SS316L wetted materials, and all wetted parts are stainless. The pressure differential and absolute pressure sensor are integrated in a fully welded stainless housing. It's tough and highly corrosion resistant. It's also available as a high-performance sensor with optimized accuracy.

3. The Prime Hydrogen Sensor is the same as the Prime Sensor but has a gold coating on the membranes. This makes the sensor suitable for H_2 application (H_2 permeates through 316 membranes). It is also available as a high-performance sensor with optimized accuracy.

Measurably Different.™

Our primary goal at Sierra is to help make your operation smarter and more productive with the precision flow measurement tools we design and build to meet your application, budget, and delivery needs. And with 50+ years of expertise, we're always here for you.

Performance Specs

Flow Accuracy (5 sensor options)
A1 Core: ± 0.5% of user full scale ± 1% of measured value
B1 Prime: ± 0.3% of user full scale ± 0.7% of measured value
B2 Prime high accuracy: ± 0.3% of user full scale ± 0.5%
of measured value
For Hydrogen applications:
B3 Prime H2: ± 0.3% of user full scale ± 0.7% of measured value
B4 Prime H2 high accuracy: ± 0.3% of user full scale ± 0.5%
of measured value
User full scale = ~70...100% standard range

Sensor Options
Core sensor: suitable for air, nitrogen, oxygen and argon.
Only with FKM and EPDM.
Prime sensor: suitable for all gases excluding H2. Available with FKM,
EPDM and FFKM
Prime H2 sensor: suitable for all gases including H_2 (gold coated sensor)
Only with FKM and EPDM
Note: All sensors are available with both aluminum and stainless-steel bodies.
Prime sensors are also available with a high accuracy option

Repeatability
± 0.2% of factory full scale (according to SEMI standard E56-0309)

Operation Pressure
1 to 200 psia (1 to 14 bar a)

Temperature (environment/gas)
-4°F to 140°F (-20°C to 60°C)

Humidity Gas
0-95% Rh (non-condensing)

Long-term Stability
Typical < 0.2% of measured value / year after tare

Pressure Sensitivity
Prime and Prime H2 sensor: ± 0.05% factory full scale per bar (typical air)
Core sensor: ± 0.08% of factory full scale + 0.1% of measured value per
bar (typical air)

Temperature Sensitivity
<0.02% factory full scale (maximum flow range of the device) per 1°C of
inlet gas temperature at 100 psia (7 bara).

Accuracy Temperature
Typically ± 0.5 °C (not certified)

Accuracy Absolute Pressure
<0.5% MV (not certified)

Response Time
Meter: Typical 120 msec / Controller: 2000 msec (according to SEMI
standard SEMI E17-1011)[4]
Update time mass flow value: 10 msec / Sensor sample rate: 1 msec

Note: With optimized filter settings. All filter modes and values can be set through
the Sierra Flow Connecter App or the digital communication interface. [4]

Warm-up Time
<2 sec for full accuracy

Turndown (Dynamic Range)
Fixed dynamics: 1 : 100 for most gases[3]
Automated Dynamics: up to 1 : 1000 (available for meter only)
Automated or a fixed dynamic range can be selected during order process
This setting can be changed any time using the Sierra Flow Connector App

Note: The dynamic range is gas and pressure dependent, higher pressures means
lower dynamic range.[3]

Operation Specs

Flow Range

Measuring Ranges	LFE Type	Range (air)
Standard Ranges (Air/User Adjustable)[1]	1400	From 0-1078 ls/min to 0-1508 ls/min
	1000	From 0-755 ls/min to 0-1077 ls/min
	700	From 0-539 ls/min to 0-754 ls/min
	500	From 0-378 ls/min to 0-538 ls/min

See the Gases table below to view other gas options.

Gases

Gases	Min Range LFE 500 slpm	Max Range LFE 1400 slpm	Core	Prime	Prime H2
Air	378	1508	✓	✓	✓
N2	378	1508	✓	✓	✓
Ar	334	1336	✓	✓	✓
O2[3]	378	1508	✓	✓	✓
He	378	1508		✓	✓
CO2	200	797		✓	✓
CO	374	1497		✓	✓
H2	782	3124			✓
C3H8	108	430		✓	✓
CH4	407	1627		✓	✓

Note: Above are the default gases pre-programed for each sensor.
More gases can be added as optons.

1. Unless clearly stated, the specified flow ranges are for an equivalent flow of air at 1013.25
    mbar a (760 mmHg) and 70°F (21°C). Other common flow, temperature and pressure units
    can be selected through the Sierra Flow Connecter App or the digital communication
    interface. More information available in the d•flux instruction instructions.

2. Additional gases or gas mixtures can be added to the above standard list. Maximum
    you can store up to 15 gases per unit. Stored gases can be replaced by another gas or
    gas mixture (except for air). Programmed gases/mixtures can be selected through the
    Sierra Flow Connecter App or the digital communication interface. For other gases, gas
    mixtures and reference conditions please contact the factory. Only suitable for dry
    and clean gases.

3. Optional O2 cleaning possible upon request. For other gases and ranges please
    see our gas list.

Gas Profiles
Up to 15 user programmable profiles.
Profiles are preset configurations where the customer can set the gas,
range, dynamics, totalizers, engineering units and reference conditions for
up to 15 different applications. PID settings for controller only

Media
All gases and gas mixtures that are compatible with the selected materials
and for which data is available in the NIST refprop database. Contact the
factory for more information.

Power Supply
Meter: 15-36 VDC, (200 mA@24VDC, regulated) / Controller: 24 VDC ±10%,
(2000 mA@24VDC, regulated). Power in through M8-4P connection or
optionally through D-sub connection (ripple should not exceed 100 mV
peak-to-peak).

Note: We recommend that the body of this unit is properly connected to ground.

Operation Specs (continued)

Wetted Materials
Seals: FKM, EPDM, or FFKM (valve seat). Full FFKM version upon request
Body: Aluminum or Stainless-steel 316L (1.4404)
Valve (controller): 316 (1.4401), 416 (1.4005), 430F (1.4104).
Inlet filter: Stainless-steel 316 (1.4401), fastening stainless-steel (1.4122) or equivalent
A1 core sensor: Stainless-steel 316Ti (1.4571), silicon, gold, glass, silicone encapsulation, PBT. 30GF, ceramics
B1 + B2 Prime sensor: Stainless-steel 316L (1.4404)
B3 + B4 Prime H2 sensor: Stainless-steel 316L (1.4404) with gold coating

Electronic Housing
Powder coated stainless steel

Integrated Inlet Filter
50 Micron Stainless-steel 316 (1.4401) filter
Fastener material Stainless-steel (1.4122) or equivalent

Wetted Part Surface Roughness
1.6 Ra µm or better (contact factory for lower Ra values)

Integration & Installation

Output Signals Analog
Linear 4–20 mA or customer defined (max 20 mA), user selectable.
Linear 0–5 VDC or 0-10 VDC or customer defined (max. 10 VDC), user selectable mA output: 740 ohms maximum load resistance
Volt output: 1000 ohms minimum load resistance
All analog outputs are galvanically separated and protected

Note: If used with analog signals add ± 0.2% of factory full scale
to the uncertainty.

Setpoint Signals Analog
Linear 4–20 mA or customer defined (max 20 mA), user selectable.
Linear 0–5 VDC or 0-10 VDC or customer defined (max 10 VDC),
user selectable

Output Signals Digital
RS-485 (Modbus RTU 2-wire).
The Modbus address can be set with two rotary switches on the outside of the housing. All Modbus settings can be set through the Sierra Flow Connecter App

Output Digital Communications
Dual port RJ45 with integrated switch (easy to daisy chain)
RJ45 LEDs indicating link and activity on the network
Ethernet speed: maximum 100 Mbit.
PROFINET: PROFINET IO specification v2.33 / PROFINET IO devices conformance class B (RT) / Endianness: conform Siemens S7 (big.
EtherCAT: IEC standard IEC61158 / Endianness: little

Configuration Interface
Bluetooth 4.0 (d•flux Sierra Flow Connecter App available
from Google Play store)

Output I/O Mosfet
On/Off for external shut-off valve or alarm available through
M8-4P connector (power + open drain/collector output)
Contact type: mosfet transistor (open drain/collector)
Maximum voltage: 36 VDC, Max current 500 mA (Polyfuse protected)

Electrical Connection
9-pin D-sub male (power and signals) and M8-4P connector (power + open drain/collector output). Optional 2 x RJ45 (EtherCAT / PROFINET).

Process Connection
1" BSPP female (G1")
Optional: ½" BSPP, 1" Compression or Tri-clamp 50.5mm flange size (ISO)
See d·flux Accessories Guide.

Inlet Section
None required if our standard inlet filter / conditioner is installed
Without filter / conditioner a 10xD straight inlet is recommended
The inlet filter can be deselected at time of order.

Pressure Drop
Meter: Standard 400 mbar at factory full scale air venting to atmosphere (with filter / conditioner)
Optional: 325 mbar at factory full scale air venting to atmosphere (without filter / conditioner)
Pressure drop is dependent on operating pressure (higher pressure = lower pressure drop)

Note: For more information, please contact Sierra.

Controller: Min. pressure difference required for 1400 ln/min (air) < 2 bar

Note: Contact Sierra for other pressure drop requirements

Mounting Orientation
All orientations are possible

Weight
Stainless-steel: 8.15 lbs (meter), 19.18 lbs (controller).
Aluminum: 3.52 lbs (meter), 9.47 lbs (controller).
All excluding Ethernet interface and fittings.

Safety

Test Pressure
304.58 psia (21 bar a)

Maximum overpressure sensor
Core sensor: 406.11 psia (28 bar a),
Prime and Prime H2 sensor: 1305.34 psia (90 bar a)

Burst Pressure
Meter: 1450.38 psia (100 bar a) / Controller: 1015.27 psia (70 bar a)

Leak Rate
$< 1 \times 10^{-6}$ mbar l/s He

Ingress Protection Class
IP54. If IP54-D-sub is used, see d•flux Accessories Guide.
For optional EtherCAT/PROFINET: IP40

Note: For additional safety information please consult the d•flux safety information sheet available on our website. [1]

Approvals

EMC: IEC/EN 61326-1, IEC/EN 61000-6-2/4
Material Certificates: Contact the factory
FDA Compliance: Contact the factory
PED: Fully compliant. Since the unit has 1" process connection, complies with the SEP, as defined in article 4, paragraph 3 of the Pressure Equipment Directive (PED) (2014/68/EU)
RoHS/REACH: All components comply with Directive 2002/95/EC (RoHS) and the REACH guidelines.

Warranty: 3 years, excluding cases of corrosion

Software

Sierra Flow Connecter App – Use app to easily access and configure device parameters with our free Android App (Bluetooth)
**Sierra Flow Studio** - Use software to get access advanced diagnostics, monitoring, and reporting of very aspect of your d•flux.

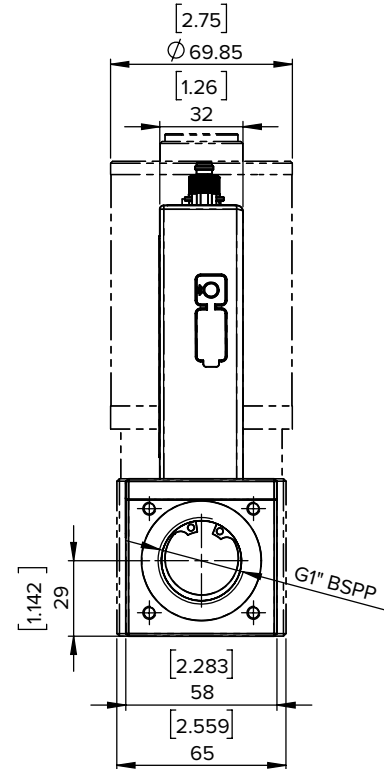Note: Technical specifications and dimensions are subject to change without notice.

d•flux Dimensional Drawings

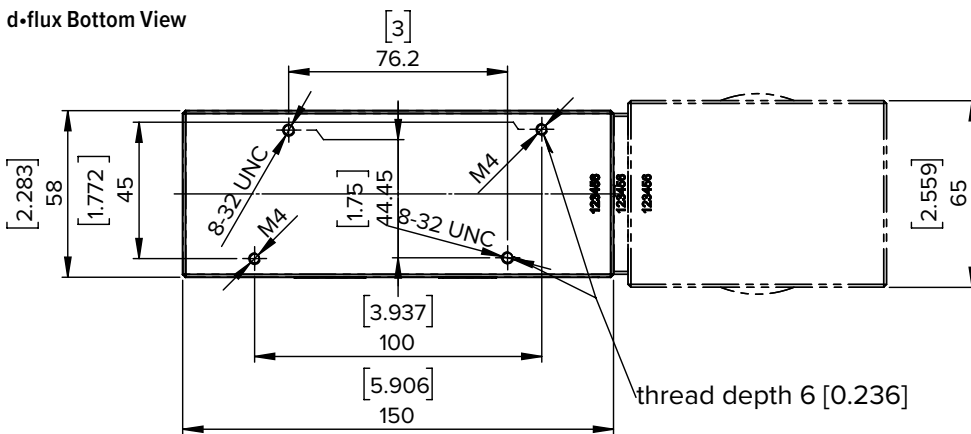| Dimensions with Fittings (Face-to-Face)	Meter	Controller
50.5 Tri-clamp	196 (7.717)	291 (11.457)
1" Compression fittings (Face-to-Face)	234 (9.213)	329 (12.953)
1" Compression fittings (Tube-to-Tube)	172 (6.772)	267 (10.512)
1" to ½" Reducer	172 (6.772)	267 (10.512)

d•flux Front View
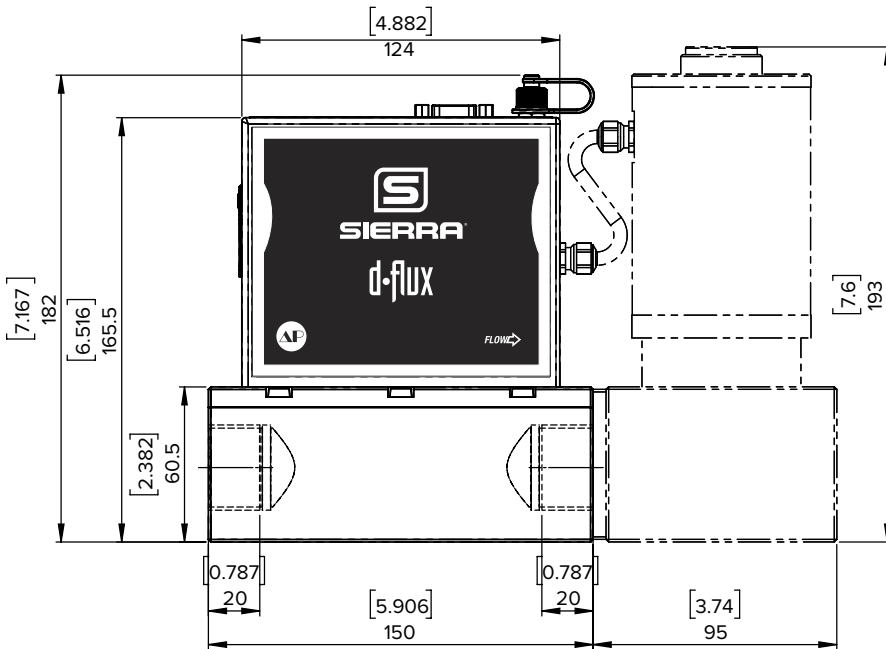
d•flux Side View

d•flux Bottom View

thread depth 6 [0.236]

Note: Dimensions in mm [values in brackets are inch sizes] / Depending on the configurator, the value can be mounted on the inlet or the outlet.

Note: Technical specifications and dimensions are subject to change without notice.

Ordering the d·flux

Instructions: To order a d·flux, please fill in each block and check the box from the corresponding features below and on the following page.

Parent	
☐ **DFM**	d·flux Multiparameter Flow Meter
☐ **DFC**	d··flux Multiparameter Flow Controller

Gases

See page five (5) for pre-programmed default gases for each sensor type (Core, Prime, and Prime H2). More gases can be added as options.

Temperature of the Gas (range from/to)

Pressure (please state absolute or gauge)	
P1 = Pressure inlet	
P2 = pressure outlet	

Note: Please state absolute or gauge

Flow Range / Flow Unit (f.i. ln/min)		
Measuring Ranges	**LFE Type**	**Range (air)**
	☐ 1400	From 0-1078 ls/min to 0-1508 ls/min
Standard Ranges	☐ 1000	From 0-755 ls/min to 0-1077 ls/min
(Air/User Adjustable)[1]	☐ 700	From 0-539 ls/min to 0-754 ls/min
	☐ 500	From 0-378 ls/min to 0-538 ls/min

Sensor Accuracy (after tare at calibration conditions)	
☐ **A1 Core**	± 0.5% of user full scale ± 1% of measured value (only for FKM or EPDM and for gases Air, N2, O2 and Argon only)
☐ **B1 Prime**	± 0.3% of user full scale ± 0.7% of measured value (can be combined w. Alu or SS/FKM or EPDM + FFKM valve seat)
☐ **B2 Prime**	High Accuracy: ± 0.3% of user full scale ± 0.5% of measured value (combinations same as B1)
☐ **B3 Prime H2**	± 0.3% of user full scale ± 0.7% of measured value (no FFKM available)
☐ **B4 Prime H2**	High Accuracy: ± 0.3% of user full scale ± 0.5% of measured value (no FFKM available)

Note: User full scale = ~70...100% standard range. All sensors are available with both aluminum and stainless-steel bodies.

Dynamnic Range	
☐	Fixed dynamics* (default 1 : 100). See configurator to determine dynamics for process conditions
☐	Automated Dynamics (max. 1 : 1000) customer adjustable (available for meter only)

Body Material
☐ Stainless steel 316L (1.4404)
☐ Aluminium

Elastomers O-rings	
☐ **FKM**	Suitable for all configurations
☐ **EPDM**	Only in combination with the Prime sensor (required for FDA/USP Class VI)
☐ **FFKM**	Only in combination with Prime sensor and 316L body

Valve Seat	
☐ **FKM**	Suitable for all configurations
☐ **EPDM**	Only in combination with the Prime sensor (required for FDA/USP Class VI)
☐ **FFKM**	Only in combination with Prime sensor and 316L body

Analog signals	Output Signals	Setpoint Signal (controller only)
For the output there is one VDC and one separate mA signal. For the setpoint, there is only one analog input signal. These signals can be adapted through the Sierra Flow Connector App.	☐ 4-20 mA + 0-5V*	☐ 4-20 mA*
	☐ 4-20 mA + 1-5V	☐ 0-20 mA
	☐ 4-20 mA + 0-10V	☐ 0-5 VDC
	☐ 4-20 mA + 2-10V	☐ 1-5 VDC
	☐ 0-20 mA + 0-5V	☐ 0-10 VDC
	☐ 0-20 mA + 1-5V	☐ 2-10 VDC
	☐ 0-20 mA + 0-10V	
	☐ 0-20 mA + 2-10V	

Digital Communication

☐ Modbus + Bluetooth communication*

☐ Modbus & EtherCAT (unit becomes IP40)

☐ Modbus & PROFINET (unit becomes IP40)

Fittings

☐ None (1" BSPP female connection)*

☐ 1" Compression fitting stainless steel 316L (1.4404)

☐ Tri-clamp 50.5 mm flange (ISO) stainless steel 316L (1.4404)

☐ Reducer to ½" BSPP female stainless steel 316L (1.4571)

Calibration Certificate

☐ Factory calibration 5 points*

☐ Factory calibration protocol 20 points

Note: Contact the factory for available certifications and approvals
*Default

Measurably Different.™

d•flux A 01/25