

Technical data

# molbox2 Flow Terminal

## ± 0.125 % of reading—lowest uncertainty for gas flow calibration



The molbox2 flow terminal from Fluke Calibration represents a significant update to the molbloc/molbox gas flow calibration system. molbox2 combined with molbloc flow elements enables you to achieve the lowest uncertainty available for gas flow meter and controller calibrations. A special configuration, molbox2-S, allows you to use molbox-S sonic nozzle flow elements at higher pressures than were previously possible, greatly extending their usable flow range.

A molbloc/molbox2 gas flow calibration system is the ideal solution for calibrating flow meters, thermal mass flow controllers (MFCs), rotameters, turbine meters, bubble meters, and other flow measurement devices. With real-time measurements, no moving parts and supported by traceable calibration in several different gases and operating pressures, molbloc/molbox can handle virtually any calibration application without compromise. molbloc/molbox systems are widely used in many industries, including pharmaceuticals, semiconductors, aerospace, environmental monitoring, energy production, reference gas blending, and research and standards laboratories.

### Unparalleled uncertainty specifications

molbox2 innovations enable the molbloc/molbox2 system to achieve the lowest gas flow measurement uncertainties in the industry. The lower uncertainty is made possible by several key improvements, including:

- Use of Fluke Calibration's exclusive quartz reference pressure transducer (Q-RPT) technology to precisely measure both absolute and differential pressure. molbox2 Q-RPTs are specially characterized sensors benefitting from the same technology used in Fluke Calibration's pressure transfer standards.

### Features

- ± 0.125 % of reading uncertainty on mass flow measurements with molbloc-L and molbloc-S elements with premium calibrations
- Now get accredited and traceable uncertainty specification of +/- 0.5% of reading for 9 select gases for molbloc-L, without calibrations in actual gases - based upon gas properties in NIST REFPROP10 and the default N2 gas calibration
- Get traceable uncertainty specifications for 18 additional gases for molbloc-L without calibrations in actual gases - based upon gas properties in NIST REFPROP10 and the default N2 gas calibration
- Three times faster flow response speed compared to previous molbox versions
- Full suite of software automation products and hardware accessories to create a complete gas flow calibration system—including COMPASS® for Flow calibration assistance software

- “Premium” molbloc calibrations linearize molbloc flow output to better capitalize on existing precision and repeatability.
- Expanded molbloc modelization enables improved performance of molbloc-L laminar flow elements across their range of operating pressures.
- Reduced uncertainty on gas properties utilizing data from NIST Reference Fluid Thermodynamic and Transport Properties Database (REFPROP10).
- Continued improvements in Fluke Calibration’s molbloc calibration chain, based on fundamental mass- and time-based mass flow measurements using Fluke Calibration’s own dynamic Gravimetric Flow Standard.
- Get accredited and traceable uncertainty specification of 0.5 % of reading for 9 select gases, without calibrations in actual gases, based upon gas properties of NIST REFPROP10 and N<sub>2</sub> gas calibration.
- Get traceable uncertainty specifications for 18 additional gases based upon gas properties of NIST REFPROP10 and N<sub>2</sub> gas calibration.
- Three time faster flow response speed compared to previous molbox versions.

Four levels of molbloc-L flow element calibration are now available to let you balance uncertainty, accreditation, traceability and costs:

- **Premium:**  $\pm 0.125$  % reading or 0.0125 % full scale of reading flow measurement uncertainty
- **Standard:**  $\pm 0.2$  % reading or 0.02% full scale flow measurement uncertainty
- **Accredited and traceable:**  $\pm 0.5\%$  of reading or 0.05% full scale flow measurement uncertainty for 9 select gases
- **Traceable but not accredited:**  $\pm$  greater of 0.5% reading, 0.05% full scale, or root sum square\*[0.2% reading, gas property uncertainties] for 18 additional gases

New molbloc-Ls are eligible for either calibration type. Existing molblobs are compatible with molbox2 at  $\pm 0.2$  % of reading uncertainty (standard) and  $\pm 0.125\%$  of reading uncertainty (premium) with actual gas calibrations. See below for details on upgrade service to existing molblobs to allow  $\geq 0.5\%$  uncertainty with expanded gas library and use of NIST REFPROP10 model without actual gas calibrations (N<sub>2</sub> gas calibration still required).

The molbloc/molbox system has stood the test of time since the early 1990’s, used in many demanding calibration laboratories, intercomparisons and government organizations worldwide. Fluke Calibration’s uncertainty specifications are conservative and backed by a thorough uncertainty analysis and metrology support.

Fluke Calibration’s innovation and design is continually aimed at making sure our products deliver specifications that can be realized by the user, not under best case conditions but in your real-world application.

### molbox2-S expands rangeability—without vacuum pumps

molbox2-S is a special configuration of molbox2 that enables you to cover a wide range (10:1 range turndown) with molbloc-S sonic nozzle flow elements, without requiring costly vacuum pumps. molbox2-S is available with upstream Q-RPT pressure range up to 2 MPa (300 psia) to allow molbloc-S elements to be conveniently used over a wide flow range upstream of flow meters being tested at atmospheric pressure, a common application. This extra rangeability makes it simple to configure a calibration system using fewer molbloc elements and minimal accessories. It also greatly extends the range of your existing molbloc-S elements when a high pressure molbloc calibration is added.

### molbloc-S range example with device under test at atmospheric pressure

| molbloc-S element | Usable range with SP calibration and molbox2 A700K | Usable range with HP calibration and molbox2-S -A2M |
|-------------------|----------------------------------------------------|-----------------------------------------------------|
| 1E2-S             | 15 to 60 slm*                                      | 20 to 300 slm                                       |
| 5E2-S             | 67 to 250 slm*                                     | 100 to 1000 slm                                     |

\*Minimum usable flow of molbloc-S elements with SP calibrations are limited by back pressure requirements for sonic flow when used upstream of a device at atmospheric pressure. Flow values are in standard liters per minute referenced to 0 °C.

molbox2-S is designed for use with molbloc-S elements and therefore is configured for absolute pressure measurement only, reducing its cost. It also reduces flow system complexity and overall cost, as well as ongoing recalibration costs.

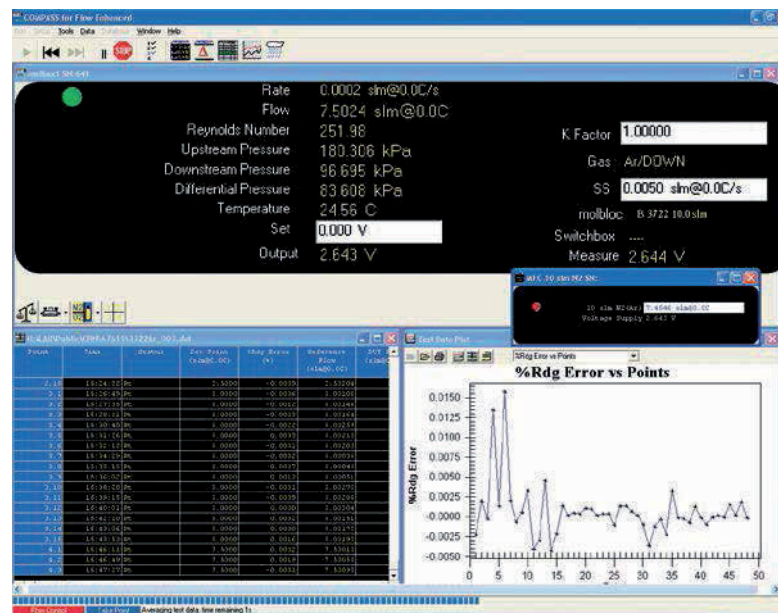
### Use the same molbloc in multiple applications

Multiple molbloc calibrations are now supported for each gas. This means that you can now have

a molbloc calibrated separately for use both at high pressure (upstream of the device under test) and low pressure (downstream of the device under test) to support different applications instead of requiring two molblobs or manually loading separate molblob calibration files. All calibrations are stored on the molblob EEPROM and the user simply selects the calibration type from the molbox1+ front panel or via molbox2 remote interface.

## COMPASS® for Flow software adds automation and more

COMPASS calibration assistance software takes molblob/molbox to the next step in automating calibrations. COMPASS and a personal computer work with molblob/molbox to create a modern, full function, turnkey system for calibrating and testing flow devices.



COMPASS sets up device under test (DUT) records (also known as unit under test), defines and associates test procedures with DUTs, runs tests, acquires reference and test data, produces standard and custom calibration reports. Mass flow device gas correction factors and gas density corrections for volumetric devices like rotameters are easily supported, with options to dynamically calculate the corrected flow using automatic input of pressure and temperature measurements. All reference, DUT and test data are collected and stored in standard delimited files that can be easily downloaded to other applications.

A new version of the software, COMPASS for Flow, brings features to flow calibration that are also only available in Fluke Calibrations COMPASS for Pressure software. These include:

- Enhanced support for devices under test requiring custom calculations on output indications, special communications support and calibration of multiple devices at once.
- Macro support to handle almost unlimited test system automation.
- More complete and flexible support for accessory devices like MFC-CB (Fluke Calibration mass flow controller control box).

## Specifications

| General                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Power requirements                                                                                                            | 85 V ac to 264 V ac, 47 Hz to 440 Hz, 18 VA max consumption                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Normal operating temperature range                                                                                            | 15 °C to 30 °C (59 °F to 86 °F)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Storage temperature range                                                                                                     | -20 °C to 70 °C (-4 °F to 158 °F)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Vibration                                                                                                                     | Meets MIL-T-28800D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Weight                                                                                                                        | 6.8 kg (15 lb) max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Dimensions (WxHxD)                                                                                                            | 32 cm x 12 cm x 30 cm (12.6 in x 4.7 in x 11.8 in) approx.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Communication ports                                                                                                           | RS-232 (COM1), RS-232 (COM2), IEEE-488.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Pressure connections (molbox2 and molbloc)                                                                                    | Quick connectors equivalent to Swagelok® QM Series (SS-QM2-B200)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Flow ranges                                                                                                                   | <1 sccm to >5000 slm. See separate molbloc-L and molbloc-S range tables                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Flow measurement rate                                                                                                         | 340 milliseconds                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Gases supported<br>(Consult your sales representative for a current list of gases available for factory molbloc calibration.) | Nitrogen (N <sub>2</sub> ), Air, Argon (Ar), Carbon Monoxide (CO), Helium (He), Oxygen (O <sub>2</sub> ), Carbon Dioxide (CO <sub>2</sub> ), Carbon Tetrafluoride (CF <sub>4</sub> ), Ethane (C <sub>2</sub> H <sub>6</sub> ), Ethylene (C <sub>2</sub> H <sub>4</sub> ), Fluoroform (CHF <sub>3</sub> ), Hexafluoroethane (C <sub>2</sub> F <sub>6</sub> ), Hydrogen (H <sub>2</sub> ), Methane (CH <sub>4</sub> ), Nitrous Oxide (N <sub>2</sub> O), Propane (C <sub>3</sub> H <sub>8</sub> ), Sulfur Hexafluoride (SF <sub>6</sub> ), Butane (C <sub>4</sub> H <sub>10</sub> ), Octafluorocyclobutane (C <sub>4</sub> F <sub>8</sub> ), Xenon (Xe), Propylene (C <sub>3</sub> H <sub>6</sub> ), Acetylene (C <sub>2</sub> H <sub>2</sub> ), Neon (Ne), Krypton (Kr), isoButane (iBtN), Deuterium (D <sub>2</sub> ), Natural Gas (NG)<br><br>*Availability to add custom gases and mixtures not currently on the molbox2 |
| Valve driver option                                                                                                           | (8) 12 V outputs. Each output can sink 500 mA at 12 V, max 1 Amp total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| MFC control option<br>(analog input/output)                                                                                   | Nominal voltage range: 0 V dc to 6 V dc input, 0 V dc to 5 V dc output<br>Nominal current range: 4 mA to 20 mA input, 4.01 mA to 20 mA output<br>Accuracy: ± 0.1 % FS (set), ± 0.05 % FS (measure)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

## Pressure Measurement

|                                         |                                                                                                                |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------|
| Type                                    | Q-RPT Characterized Quartz Reference Pressure Transducers – Oscillating quartz crystal with mechanical bellows |
| Calibrated pressure range (full scale)  |                                                                                                                |
| A700K                                   | 0 to 600 kPa absolute (0 to 87 psia)                                                                           |
| A350K                                   | 0 to 300 kPa absolute (0 to 44 psia)                                                                           |
| S A1.4M (molbloc-S only)                | 0 to 1.2 MPa absolute (0 to 174 psia)                                                                          |
| S A2M (molbloc-S only)                  | 0 to 2 MPa absolute (0 to 290 psia)                                                                            |
| Measurement uncertainty (one-year)      |                                                                                                                |
| Absolute pressure <sup>4</sup>          | ± (0.01 % of reading or 0.003 % Q-RPT span, whichever is greater)                                              |
| Differential pressure (A700K with Tare) | ± (8.4 Pa (0.0012 psi) or 0.032 % ΔP, whichever is greater)                                                    |
| Differential pressure (A350K with Tare) | ± (4.2 Pa (0.0006 psi) or 0.026 % ΔP, whichever is greater)                                                    |

## Temperature Measurement

|                        |                                                    |
|------------------------|----------------------------------------------------|
| Type                   | molbloc PRTs with molbox2 Ohmic Measurement System |
| Range (FS)             | 0 to 40 °C                                         |
| Resolution             | 0.01 °C                                            |
| molbloc PRT precision  | ± 0.02 °C (15 to 30 °C)                            |
| S A2M (molbloc-S only) | 0 to 2 MPa absolute (0 to 290 psia)                |
| On-board               |                                                    |
| Reference resistor     | 100 and 110 W ± 0.01 %, stability < 25 ppm/year    |
| Ohmic measurement      | ± 0.02 % of reading (15 °C to 30 °C)               |



## Flow measurement

| with molbloc-L laminar flow elements                                                                                                                     |                                                                                                                  |                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                          | Standard molbloc calibration                                                                                     | Premium molbloc calibration                                                                                      |
| Range                                                                                                                                                    | 0 to 100 % molbloc full scale                                                                                    | 0 to 100 % molbloc full scale                                                                                    |
| Resolution                                                                                                                                               | 0.0015 % FS                                                                                                      | 0.0015 % FS                                                                                                      |
| Precision <sup>1</sup>                                                                                                                                   | ± 0.07 % of reading,<br>± 0.007 % FS under 10 % FS                                                               | ± 0.07 % of reading,<br>± 0.007 % FS under 10 % FS                                                               |
| Stability (one-year) <sup>2</sup>                                                                                                                        | ± 0.09 % of reading,<br>± 0.009 % FS under 10 % FS                                                               | ± 0.03 % of reading,<br>± 0.003 % FS under 10 % FS                                                               |
| Measurement uncertainty <sup>3</sup> (For any gas for which the molbloc in use is calibrated)                                                            | ± 0.2 % of reading,<br>± 0.02 % FS under 10 % FS                                                                 | ± 0.125 % of reading,<br>± 0.0125 % FS under 10 % FS                                                             |
| Measurement uncertainty <sup>5</sup> (For any molbox2 supported gas that Fluke is accredited and the molbloc in use is NOT calibrated in actual gas)     | ±0.5 % of reading from 10 % to 100 % FS,<br>±0.05 % FS under 10 % FS                                             | ±0.5 % of reading from 10 % to 100 % FS,<br>±0.05 % FS under 10 % FS                                             |
| Measurement uncertainty <sup>6</sup> (For any molbox2 supported gas that Fluke is not accredited and the molbloc in use is NOT calibrated in actual gas) | ± greater of 0.5% reading, 0.05% full scale, or<br>root sum square*[0.2% reading, gas property<br>uncertainties] | ± greater of 0.5% reading, 0.05% full scale, or<br>root sum square*[0.2% reading, gas property<br>uncertainties] |
| with molbloc-S sonic nozzle flow elements                                                                                                                |                                                                                                                  |                                                                                                                  |
|                                                                                                                                                          | Standard molbloc calibration                                                                                     | Premium molbloc calibration                                                                                      |
| Range                                                                                                                                                    | 10 to 100 % molbloc full scale                                                                                   | 10 to 100 % molbloc full scale                                                                                   |
| Resolution                                                                                                                                               | 0.0015 % FS                                                                                                      | 0.0015 % FS                                                                                                      |
| Precision <sup>1</sup>                                                                                                                                   | ± 0.06 % of reading                                                                                              | ± 0.06 % of reading                                                                                              |
| Stability (one-year) <sup>2</sup>                                                                                                                        | ± 0.05 % of reading                                                                                              | ± 0.03 % of reading                                                                                              |
| Measurement uncertainty <sup>3</sup> (For any gas for which the molbloc in use is calibrated)                                                            | ± 0.2 % of reading                                                                                               | ± 0.125 % of reading                                                                                             |

1. Precision: Combined linearity, hysteresis, repeatability.

2. Stability: Maximum change in zero and span over specified time period for typical molbox and molbloc used under typical conditions. As stability can only be predicted, stability for a specific molbox and molbloc should be established from experience.

3. Measurement uncertainty: Maximum deviation of the molbox2 flow indication from the true value of the flow through the molbloc including precision, stability and Fluke calibration.

4. With regular use of Autozero. Add 0.005 % of Q-RPT span for one year without use of AutoZero, (translates to 0.005 % FS for molbloc-S, does not significantly affect molbloc-S standard calibration or molbloc-L uncertainty.)

5. Measurement uncertainty of a gas other than N<sub>2</sub> that Fluke has experience with but the molbloc does not have an actual gas calibration.

6. Measurement uncertainty of a gas other than N<sub>2</sub> that Fluke does not have experience with and the molbloc does not have an actual gas calibration.

### Upgrading is easy

Upgrading from molbox1 and molbox1+ to molbox2 is economical and easy. A hardware and software upgrade can be performed at a Fluke Calibration factory. To upgrade and achieve the new specifications and features offered by molbox2 the following steps are performed on your system at Fluke Calibration.

#### 1. molbox2 hardware/software changes.

Any required parts are changed to make your molbox materially identical to a factory produced molbox2. The molbox is flashed to v6.0 embedded software. Two options are available: **Upgrade** your existing molbox1 and molbox1+ to meet molbox2 specifications, or **Trade up** to a new molbox2, capturing savings by reusing a few key parts.

#### 2. Q-RPT characterization of molbox1 and molbox1+ internal pressure transducers.

Both existing internal pressure transducers are used in the new molbox2. Extensive characterization of the transducers enhances

their precision and ensures they meet molbox2 specifications.

**3. molbloc updates.** Any molbloc that has a +2 in its SN (upgraded previous molbloc) or is above SN 10,000 for molbloc-L or 6000 for molbloc-S can be used with molbox2 to support the NIST REFPROP10 model and get stated uncertainties without calibrations in actual gases. Majority of other molbloc-L and -S SNs can be used with molbox2, but will require a hardware and/or firmware upgrade to support the NIST REFPROP10 model to get stated uncertainties without actual gas calibrations.

**4. New molbloc gas calibrations.** molblobs are fully modeled and calibrated following hardware updates to realize the benefits of the enhanced gas property data used in molbox2, Fluke Calibration's improved calibration chain and new molbloc linearization and modeling techniques. The entire system will be upgraded and returned to you with new specifications and calibration certificates at a fraction of the cost of a new system.

## Options and accessories

### MFC Control Option

Set and read analog voltage and current MFCs. Optional board is built-into molbox2 and connector is on rear panel. Delivered with MFC cable and connection kit

### New molbloc calibration options

Each molbloc calibration option can now be ordered as low, standard and high pressure in standard or premium. Premium molbloc calibrations result in an improved uncertainty specification when the molbloc is used with a molbox2 terminal. molbloc pressuredependent calibration options are listed below. molbloc flow ranges are dependent on the calibration pressure option and gas chosen. See the molbloc-L range sheet and molbloc-S data sheet for available molbloc ranges. All uncertainties  $\geq 0.5\%$  offered in molbox2 using NIST REFPROP10 requires only an accredited N<sub>2</sub> calibration.

| molbloc-L Calibration Options <sup>4,5</sup> |                                                                |                                                                                                                                                                               |                                                                                                                                                       |                                                      |
|----------------------------------------------|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| Calibration Type                             | Operating Pressure                                             | Accuracy                                                                                                                                                                      | A2LA Accredited Gas Coverage <sup>1,3</sup>                                                                                                           | NIST REFPROP10 Traceable Gas Coverage <sup>2,3</sup> |
| Downstream Standard                          | Atmospheric Pressure downstream of the molbloc                 | $\pm 0.2\%$ rdg for Accredited Calibration Gas with Actual Gas Calibration<br>$\pm 0.5\%$ rdg All Accredited Gases with NIST REFPROP10, Traceable gases with NIST REFPROP10   | Air, He, H <sub>2</sub> , Ar, SF <sub>6</sub> *, CH <sub>4</sub> , C <sub>3</sub> H <sub>8</sub> , CO <sub>2</sub> , N <sub>2</sub> O, N <sub>2</sub> | 18 additional gases <sup>6</sup>                     |
| Low Pressure Standard                        | 200 to 325 kPa (29 to 47 psi) absolute upstream of the molbloc | $\pm 0.2\%$ rdg for Accredited Calibration Gas with Actual Gas Calibration<br>$\pm 0.5\%$ rdg All Accredited Gases with NIST REFPROP10, Traceable gases with NIST REFPROP10   | Air, He, H <sub>2</sub> , Ar, SF <sub>6</sub> *, CH <sub>4</sub> , C <sub>3</sub> H <sub>8</sub> , CO <sub>2</sub> , N <sub>2</sub> O, N <sub>2</sub> | 18 additional gases <sup>6</sup>                     |
| High Pressure Standard                       | 325 to 525 kPa (47 to 76 psi) absolute upstream of the molbloc | $\pm 0.2\%$ rdg for Accredited Calibration Gas with Actual Gas Calibration<br>$\pm 0.5\%$ rdg All Accredited Gases with NIST REFPROP10, Traceable gases with NIST REFPROP10   | Air, He, H <sub>2</sub> , Ar, SF <sub>6</sub> *, CH <sub>4</sub> , C <sub>3</sub> H <sub>8</sub> , CO <sub>2</sub> , N <sub>2</sub> O, N <sub>2</sub> | 18 additional gases <sup>6</sup>                     |
| Downstream Premium                           | Atmospheric Pressure downstream of the molbloc                 | $\pm 0.125\%$ rdg for Accredited Calibration Gas with Actual Gas Calibration<br>$\pm 0.5\%$ rdg All Accredited Gases with NIST REFPROP10, Traceable gases with NIST REFPROP10 | Air, He, H <sub>2</sub> , Ar, SF <sub>6</sub> *, CH <sub>4</sub> , C <sub>3</sub> H <sub>8</sub> , CO <sub>2</sub> , N <sub>2</sub> O, N <sub>2</sub> | 18 additional gases <sup>6</sup>                     |
| Low Pressure Premium                         | 200 to 325 kPa (29 to 47 psi) absolute upstream of the molbloc | $\pm 0.125\%$ rdg for Accredited Calibration Gas with Actual Gas Calibration<br>$\pm 0.5\%$ rdg All Accredited Gases with NIST REFPROP10, Traceable gases with NIST REFPROP10 | Air, He, H <sub>2</sub> , Ar, SF <sub>6</sub> *, CH <sub>4</sub> , C <sub>3</sub> H <sub>8</sub> , CO <sub>2</sub> , N <sub>2</sub> O, N <sub>2</sub> | 18 additional gases <sup>6</sup>                     |
| High Pressure Premium                        | 325 to 525 kPa (47 to 76 psi) absolute upstream of the molbloc | $\pm 0.125\%$ rdg for Accredited Calibration Gas with Actual Gas Calibration<br>$\pm 0.5\%$ rdg All Accredited Gases with NIST REFPROP10, Traceable gases with NIST REFPROP10 | Air, He, H <sub>2</sub> , Ar, SF <sub>6</sub> *, CH <sub>4</sub> , C <sub>3</sub> H <sub>8</sub> , CO <sub>2</sub> , N <sub>2</sub> O, N <sub>2</sub> | 18 additional gases <sup>6</sup>                     |

| molbloc-S (specify Premium or Standard) |                                                                    |
|-----------------------------------------|--------------------------------------------------------------------|
| Calibration Type                        | Operating Pressure (absolute)                                      |
| Low Pressure Standard                   | 20 to 200 kPa (3 to 30 psia) absolute upstream of the molbloc      |
| Standard pressure                       | 50 to 500 kPa (7 to 70 psia) absolute upstream of the molbloc      |
| High Pressure (New calibration option)  | 200 kPa to 2 MPa (29 to 300 psia) absolute upstream of the molbloc |

\*SF<sub>6</sub> not available as Actual Calibration Gas

<sup>1</sup>The molbloc parameters have been established by an accredited N<sub>2</sub> calibration (Standard or Premium), all known uncertainties are defined, Fluke is accredited for the gas, but did NOT do an actual gas calibration OR flow the gas on this molbloc. Gases have been validated by Fluke and gas properties have been corrected per the method.

<sup>2</sup>The molbloc parameters have been established by an accredited N<sub>2</sub> calibration, all known uncertainties are defined including gas properties either from RefProp10 or valid customer path (e.g. ROR, GFS, other flow Primary reference), but Fluke has no direct experience with or validation of the gas

<sup>3</sup>NIST REFPROP10 Table with Accredited and Traceable gas uncertainties with 0.2 or 0.125% rdg N<sub>2</sub> actual gas calibration uncertain

<sup>4</sup>molbox upgrades available to molbox2 and will have "+2" added to existing S/N

<sup>5</sup>molbloc-L compatible with molbox2 will have serial number >10000 or upgrades will have "+2" added to existing S/N for molbox2 compatibility

<sup>6</sup>See the molbloc-L range sheet for specific gases and uncertainties offered for molbloc-L compatible with molbox2



## molbloc-L ranges with low pressure and downstream calibrations

|                |                                    |                                                        | molbloc size and full scale flow (sccm @ 0 °C) |                       |                         |                         |                          |                            |                              |                               |                               |                                 |
|----------------|------------------------------------|--------------------------------------------------------|------------------------------------------------|-----------------------|-------------------------|-------------------------|--------------------------|----------------------------|------------------------------|-------------------------------|-------------------------------|---------------------------------|
|                |                                    |                                                        | Size                                           |                       |                         |                         |                          |                            |                              |                               |                               |                                 |
|                | Gasses                             |                                                        | 1E1                                            | 5E1                   | 1E2                     | 2E2                     | 5E2                      | 1E3                        | 5E3                          | 1E4                           | 3E4                           | 1E5 <sup>3</sup>                |
| Inert          | Nitrogen                           | N <sub>2</sub>                                         | 10                                             | 50                    | 100                     | 200                     | 500                      | 1 000                      | 5 000                        | 10 000                        | 30 000                        | 100 000                         |
|                | Argon                              | Ar                                                     | 10                                             | 50                    | 100                     | 200                     | 500                      | 1 000                      | 5 000                        | 10 000                        | 30 000                        | 80 000                          |
|                | Helium                             | He                                                     | 10                                             | 50                    | 100                     | 200                     | 500                      | 1 000                      | 5 000                        | 10 000                        | 30 000                        | 100 000                         |
|                | Sulfur hexafluoride                | SF <sub>6</sub>                                        | 10                                             | 50                    | 100                     | 200                     | 500                      | 1 000                      | <b>2 000</b><br><b>500</b>   | <b>6 000</b><br><b>1 000</b>  | <b>6 000</b><br><b>4 000</b>  | -                               |
|                | Xenon                              | Xe                                                     | 10                                             | 40                    | 80                      | 150                     | 400                      | 800                        | <b>3 000</b><br><b>500</b>   | 8 000                         | <b>11 000</b><br><b>3 000</b> | <b>30 000</b><br><b>20 000</b>  |
|                | Neon                               | Ne                                                     | 10                                             | 50                    | 100                     | 100                     | 500                      | 1 000                      | 5 000                        | 10 000                        | 20 000                        | 60 000<br>6 000                 |
|                | Krypton                            | Kr                                                     | 10                                             | 50                    | 100                     | 200                     | 500                      | 1 000                      | 5 000                        | 10 000                        | 20 000                        | 70 000<br>8 000                 |
| Flammable      | Butane                             | C <sub>4</sub> H <sub>10</sub>                         | 20                                             | 100                   | <b>130</b><br><b>30</b> | <b>270</b><br><b>50</b> | <b>670</b><br><b>140</b> | 2 300                      | <b>2 200</b><br><b>1 400</b> | <b>7 000</b><br><b>3 000</b>  | -                             | -                               |
|                | Ethane                             | C <sub>4</sub> H <sub>6</sub>                          | 20                                             | 100                   | 200                     | 400                     | 1000                     | 2 000                      | <b>6 000</b><br><b>1 000</b> | <b>18 000</b><br><b>2 000</b> | <b>18 000</b><br><b>6 000</b> | <b>60 000</b><br><b>50 000</b>  |
|                | Ethylene                           | C <sub>4</sub> H <sub>4</sub>                          | 16                                             | 80                    | 160                     | 320                     | 800                      | 1 600                      | <b>7 000</b><br><b>1 000</b> | 16 000                        | <b>20 000</b><br><b>5 000</b> | <b>70 000</b><br><b>40 000</b>  |
|                | Hydrogen                           | H <sub>2</sub>                                         | 20                                             | 100                   | 200                     | 400                     | 1 000                    | 2 000                      | 10 000                       | 20 000                        | 60 000                        | 200 000                         |
|                | Methane                            | CH <sub>4</sub>                                        | 16                                             | 80                    | 160                     | 320                     | 800                      | 1 600                      | 8 000                        | 16 000                        | <b>40 000</b><br><b>5 000</b> | <b>120 000</b><br><b>40 000</b> |
|                | Propane                            | C <sub>3</sub> H <sub>8</sub>                          | 20                                             | 100                   | 200                     | 400                     | 1 000                    | 2 000                      | <b>3 000</b><br><b>1 000</b> | <b>10 000</b><br><b>2 000</b> | <b>10 000</b><br><b>7 000</b> | -                               |
|                | Propylene                          | C <sub>3</sub> H <sub>6</sub>                          | 20                                             | 100                   | 200                     | 400                     | 1 000                    | 2 000                      | 5 000                        | 10 000<br>3 000               | 15 000<br>8 000               | -                               |
|                | Acetylene                          | C <sub>2</sub> H <sub>2</sub>                          | 20                                             | 100                   | 200                     | 400                     | 1 000                    | 2 000                      | 10 000                       | 20 000                        | 25 000<br>7 000               | 80 000<br>20 000                |
|                | IsoButane                          | iC <sub>4</sub> H <sub>10</sub><br>(iBt <sub>n</sub> ) | 20                                             | 100                   | 200                     | 300                     | 700                      | 2 000                      | 3 000<br>1 000               | 10 000<br>3 000               | 10 000<br>9 000               | -                               |
|                | Deuterium                          | D <sub>2</sub>                                         | 20                                             | 100                   | 200                     | 300                     | 800                      | 2 000                      | 10 000                       | 20 000                        | 50 000                        | 160 000<br>16 000               |
|                | Natural Gas                        | NG                                                     | 20                                             | 100                   | 200                     | 400                     | 900                      | 2 000                      | 10 000                       | 20 000                        | 50 000                        | 120 000<br>18 000               |
| Fluoro-carbons | Carbon tetrafluoride               | CF <sub>4</sub>                                        | 10                                             | 50                    | 100                     | 200                     | 500                      | 1 000                      | <b>4 000</b><br><b>600</b>   | 10 000                        | <b>12 000</b><br><b>3 000</b> | <b>36 000</b><br><b>25 000</b>  |
|                | Hexafluoroethene                   | C <sub>2</sub> F <sub>6</sub>                          | 10                                             | 50                    | 100                     | 200                     | 500                      | 1 000                      | <b>2 000</b><br><b>600</b>   | <b>6 000</b><br><b>1 200</b>  | <b>6 000</b><br><b>4 000</b>  | -                               |
|                | Trifluoromethane                   | CHF <sub>3</sub>                                       | 10                                             | 50                    | 100                     | 200                     | 500                      | 1 000                      | 4 000<br>600                 | 10 000                        | <b>12 000</b><br><b>4 000</b> | <b>38 000</b><br><b>30 000</b>  |
| Other          | Air                                | Air                                                    | 10                                             | 50                    | 100                     | 200                     | 500                      | 1 000                      | 5000                         | 10 000                        | 30 000                        | 100 000                         |
|                | Carbon dioxide                     | CO <sub>2</sub>                                        | 10                                             | 50                    | 100                     | 200                     | 500                      | 1 000                      | 5000                         | 10 000                        | <b>20 000</b><br><b>4 000</b> | <b>60 000</b><br><b>30 000</b>  |
|                | Carbon monoxide                    | CO                                                     | 10                                             | 50                    | 100                     | 200                     | 500                      | 1 000                      | 5000                         | 10 000                        | 30 000                        | 100 000                         |
|                | Nitrous oxide                      | N <sub>2</sub> O                                       | 10                                             | 50                    | 100                     | 200                     | 500                      | 1 000                      | 5000                         | 10 000                        | <b>20 000</b><br><b>4 000</b> | <b>60 000</b><br><b>30 000</b>  |
|                | Octafluorocyclobutane <sup>1</sup> | C <sub>4</sub> F <sub>8</sub>                          | 15                                             | <b>60</b><br><b>9</b> | <b>67</b><br><b>17</b>  | <b>130</b><br><b>34</b> | <b>330</b><br><b>84</b>  | <b>1 100</b><br><b>175</b> | <b>1 050</b><br><b>840</b>   | <b>3 400</b><br><b>1 700</b>  | -                             | -                               |
|                | Oxygen                             | O <sub>2</sub>                                         | 10                                             | 50                    | 100                     | 200                     | 500                      | 1 000                      | 5000                         | 10 000                        | 30 000                        | 80 000                          |

<sup>3</sup> See page 9 for footnotes

## molbloc-L ranges with high pressure calibrations

|                |                                    |                                                        | molbloc size and full scale flow (sccm @ 0 °C) |                         |                         |                          |                            |                            |                               |                               |                                |                                 |
|----------------|------------------------------------|--------------------------------------------------------|------------------------------------------------|-------------------------|-------------------------|--------------------------|----------------------------|----------------------------|-------------------------------|-------------------------------|--------------------------------|---------------------------------|
|                |                                    |                                                        | Size                                           |                         |                         |                          |                            |                            |                               |                               |                                |                                 |
|                | Gasses                             |                                                        | 1E1                                            | 5E1                     | 1E2                     | 2E2                      | 5E2                        | 1E3                        | 5E3                           | 1E4                           | 3E4                            | 1E5                             |
| Inert          | Nitrogen                           | N <sub>2</sub>                                         | 20                                             | 100                     | 200                     | 400                      | 1 000                      | 2 000                      | 10 000                        | 20 000                        | <b>50 000</b><br><b>7 500</b>  | N/A                             |
|                | Argon                              | Ar                                                     | 20                                             | 100                     | 200                     | 400                      | 1 000                      | 2 000                      | 10 000                        | 17 000                        | <b>45 000</b><br><b>6 000</b>  | N/A                             |
|                | Helium                             | He                                                     | 20                                             | 100                     | 200                     | 400                      | 1 000                      | 2 000                      | 10 000                        | 20 000                        | 65 000                         | N/A                             |
|                | Sulfur hexafluoride                | SF <sub>6</sub>                                        | 25                                             | <b>100</b><br><b>15</b> | <b>120</b><br><b>30</b> | <b>250</b><br><b>50</b>  | <b>600</b><br><b>150</b>   | <b>2 000</b><br><b>300</b> | <b>2 000</b><br><b>1 400</b>  | <b>6 200</b><br><b>2 800</b>  | -<br>-                         | N/A                             |
|                | Xenon                              | Xe                                                     | 20                                             | 100                     | 150                     | 150                      | 650                        | 1 700                      | <b>3 350</b><br><b>950</b>    | <b>11 000</b><br><b>1 900</b> | <b>11 000</b><br><b>5 700</b>  | N/A                             |
|                | Neon                               | Ne                                                     | 10                                             | 100                     | 100                     | 100                      | 1 000                      | 1 000                      | 10 000                        | 10 000                        | 40 000                         | N/A                             |
|                | Krypton                            | Kr                                                     | 20                                             | 100                     | 200                     | 200                      | 1 000                      | 2000                       | <b>6 000</b><br><b>1 000</b>  | 20 000                        | <b>20 000</b><br><b>5 000</b>  | N/A                             |
| Flammable      | Butane                             | C <sub>4</sub> H <sub>10</sub>                         | N/A                                            | N/A                     | N/A                     | N/A                      | N/A                        | N/A                        | N/A                           | N/A                           | N/A                            | N/A                             |
|                | Ethane                             | C <sub>2</sub> H <sub>6</sub>                          | 40                                             | 200                     | <b>350</b><br><b>50</b> | <b>750</b><br><b>100</b> | <b>1 800</b><br><b>200</b> | 4 000                      | <b>6 000</b><br><b>2 300</b>  | <b>20 000</b><br><b>4 500</b> | <b>20 000</b><br><b>13 000</b> | N/A                             |
|                | Ethylene                           | C <sub>2</sub> H <sub>4</sub>                          | 40                                             | 200                     | 350                     | 700                      | 2 000                      | 4 000                      | <b>7 000</b><br><b>1 000</b>  | <b>2 000</b><br><b>4 000</b>  | <b>22 000</b><br><b>12 700</b> | N/A                             |
|                | Hydrogen                           | H <sub>2</sub>                                         | 40                                             | 200                     | 400                     | 900                      | 2 000                      | 4 500                      | 22 000                        | 45 000                        | 130 000                        | N/A                             |
|                | Methane                            | CH <sub>4</sub>                                        | 35                                             | 175                     | 350                     | 700                      | 1 700                      | 3 500                      | <b>13 000</b><br><b>2 000</b> | 33 000                        | <b>42 000</b><br><b>12 000</b> | N/A                             |
|                | Propane                            | C <sub>3</sub> H <sub>8</sub>                          | 50                                             | <b>200</b><br><b>25</b> | <b>200</b><br><b>50</b> | <b>400</b><br><b>100</b> | <b>1 000</b><br><b>250</b> | <b>3 500</b><br><b>500</b> | <b>3 500</b><br><b>2 600</b>  | <b>11 000</b><br><b>5 400</b> | -<br>-                         | N/A                             |
|                | Propylene                          | C <sub>3</sub> H <sub>6</sub>                          |                                                | 100                     | 200                     | 400                      | 1 000                      | 2 000                      | 5 000                         | <b>10 000</b><br><b>3 000</b> | <b>15 000</b><br><b>8 000</b>  | -<br>-                          |
|                | Acetylene                          | C <sub>2</sub> H <sub>2</sub>                          |                                                | 100                     | 200                     | 400                      | 1 000                      | 2 000                      | 10 000                        | 20 000                        | <b>25 000</b><br><b>7 000</b>  | <b>80 000</b><br><b>20 000</b>  |
|                | IsoButane                          | iC <sub>4</sub> H <sub>10</sub><br>(iBt <sub>n</sub> ) | N/A                                            | N/A                     | N/A                     | N/A                      | N/A                        | N/A                        | N/A                           | N/A                           | N/A                            | N/A                             |
|                | Deuterium                          | D <sub>2</sub>                                         | 30                                             | 200                     | 300                     | 600                      | 2 000                      | 3 000                      | 20 000                        | 20 000                        | 50 000                         | <b>160 000</b><br><b>16 000</b> |
|                | Natural Gas                        | NG                                                     | 20                                             | 200                     | 300                     | 700                      | 2 000                      | 3 000                      | <b>13 000</b><br><b>2 000</b> | 40 000                        | <b>40 000</b><br><b>10 000</b> | <b>120 000</b><br><b>18 000</b> |
| Fluoro-carbons | Carbon tetrafluoride               | CF <sub>4</sub>                                        | 30                                             | 100                     | 200                     | 400                      | 1 000                      | 2 000                      | <b>3 700</b><br><b>1 200</b>  | <b>12 000</b><br><b>2 400</b> | <b>12 000</b><br><b>7 300</b>  | N/A                             |
|                | Hexafluoroethene                   | C <sub>2</sub> F <sub>6</sub>                          | 25                                             | <b>100</b><br><b>15</b> | <b>120</b><br><b>30</b> | <b>250</b><br><b>50</b>  | <b>600</b><br><b>150</b>   | <b>2 000</b><br><b>300</b> | <b>1 800</b><br><b>1 500</b>  | <b>6 000</b><br><b>3 000</b>  | -<br>-                         | N/A                             |
|                | Trifluoromethane                   | CHF <sub>3</sub>                                       | 25                                             | 125                     | <b>240</b><br><b>30</b> | <b>450</b><br><b>60</b>  | <b>1 200</b><br><b>150</b> | 2 500                      | <b>4 000</b><br><b>1 500</b>  | <b>12 000</b><br><b>3 000</b> | <b>12 000</b><br><b>8 800</b>  | N/A                             |
| Other          | Air                                | Air                                                    | 20                                             | 100                     | 200                     | 400                      | 1 000                      | 2 000                      | 10 000                        | 20 000                        | <b>50 000</b><br><b>7 200</b>  | N/A                             |
|                | Carbon dioxide                     | CO <sub>2</sub>                                        | 25                                             | 125                     | 250                     | 500                      | 1 250                      | 2 500                      | <b>6 600</b><br><b>1 400</b>  | <b>20 000</b><br><b>2 500</b> | <b>20 000</b><br><b>8 800</b>  | N/A                             |
|                | Carbon monoxide                    | CO                                                     | 20                                             | 100                     | 200                     | 400                      | 1 000                      | 2 000                      | 10 000                        | 20 000                        | 40 000<br>7 500                | N/A                             |
|                | Nitrous oxide                      | N <sub>2</sub> O                                       | 25                                             | 125                     | 250                     | 500                      | 1 250                      | 2 500                      | <b>11 000</b><br><b>1 500</b> | <b>20 000</b><br><b>3 000</b> | <b>20 000</b><br><b>9 000</b>  | N/A                             |
|                | Octafluorocyclobutane <sup>1</sup> | C <sub>4</sub> F <sub>8</sub>                          | N/A                                            | N/A                     | N/A                     | N/A                      | N/A                        | N/A                        | N/A                           | N/A                           | N/A                            | N/A                             |
|                | Oxygen                             | O <sub>2</sub>                                         | 20                                             | 100                     | 200                     | 400                      | 1 000                      | 2 000                      | 10 000                        | 20 000                        | <b>40 000</b><br><b>6 500</b>  | 80 000                          |

A **bold value** indicates that the maximum flow is limited by the maximum Reynolds number value of 1200 (1550 for 3E4-L), which is reached before the normal differential pressure range is reached. In that case, the second value gives the minimum flow for which measurement uncertainty (accuracy) is equal to the nominal uncertainty specification.

Where there is no value in the field (--), this indicates that the maximum Reynolds number is reached before the differential pressure reaches 5 kPa (1 kPa in the case of the 1E5 molbloc), therefore, calibration with that gas is not useful.

[1] Due to low vapor pressure, only downstream calibration is available.

[2] The operating pressure range is greater than the vapor pressure value for this gas.



A bold value indicates that the maximum flow is limited by the maximum Reynolds number value of 1 200 which is reached before the normal differential pressure range is reached. In that case, the second value gives the minimum flow for which measurement uncertainty (accuracy) is equal to the nominal uncertainty specification. Divide the second value by 10 when using molbox RFM microrange option. Where there is no value in the field (-), this indicates that the maximum Reynolds number is reached before the differential pressure reaches 5 kPa (1 kPa in the case of the 1E5 molbloc), therefore calibration with that gas is not useful.

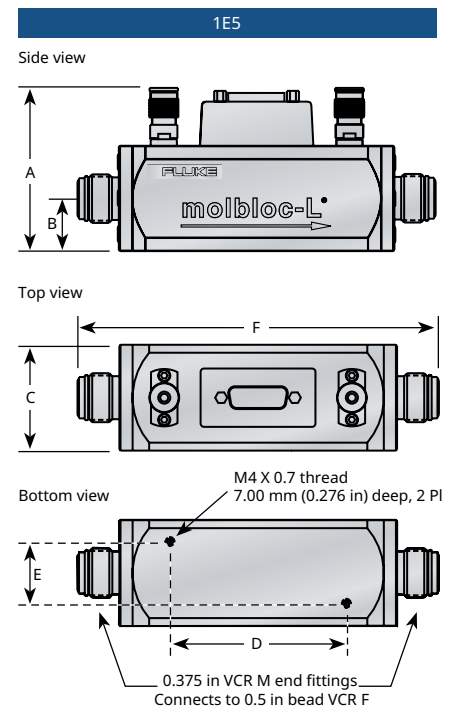
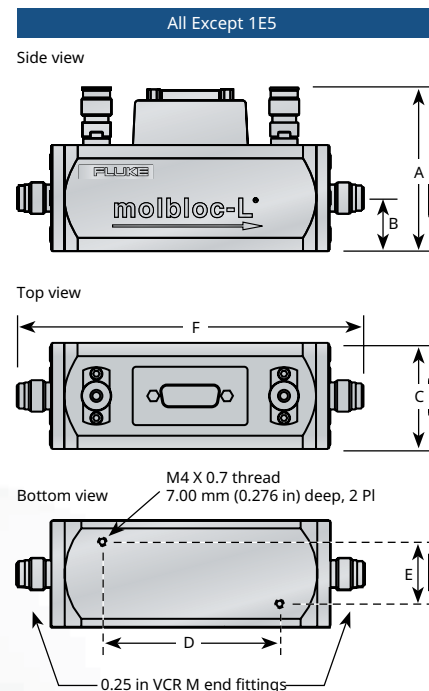
1 Due to low vapor pressure, only downstream calibration type is available.

2 The operating pressure range is greater than the vapor pressure value for this gas.

3 uncertainty of 1E5 for molbloc-L is +/- 0.5% of reading or +/- 0.125% FS whichever is greater. Premium calibrations and upstream high-pressure calibrations are not available on the 1E5 for molbloc-L

## molbloc-L dimensions

|   | 5E3 and lower             | 1E4,3E4                   | 1E5                       |
|---|---------------------------|---------------------------|---------------------------|
| A | 58.50 mm<br>(2.303 in)    | 74.50 mm<br>(2.933 in)    | 74.50 mm<br>(2.933 in)    |
| B | 16.00 mm<br>(0.630 in)    | 24.00 mm<br>(0.945 in)    | 24.00 mm<br>(0.945 in)    |
| C | 32.00 mm<br>(1.260 in) sq | 48.00 mm<br>(1.890 in) sq | 48.00 mm<br>(1.890 in) sq |
| D | 68.84 mm<br>(2.750 in)    | 80.00 mm<br>(3.150 in)    | 80.00 mm<br>(3.150 in)    |
| E | 19.06 mm<br>(0.750 in)    | 28.00 mm<br>(1.102 in)    | 28.00 mm<br>(1.102 in)    |
| F | 124.00 mm<br>(4.881 in)   | 157.00 mm<br>(6.181 in)   | 164.00 mm<br>(6.458 in)   |



| Calibration type | Operating pressure (absolute)                                  |
|------------------|----------------------------------------------------------------|
| Downstream       | Atmospheric pressure downstream of the molbloc                 |
| Low Pressure     | 200 to 325 kPa (29 to 47 psi absolute) upstream of the molbloc |
| High Pressure    | 325 to 525 kPa (47 to 76 psi absolute) upstream of the molbloc |

## Uncertainty with NIST REFPROP10 + Actual N<sub>2</sub> gas calibration

| Gas library                 |                                 | % Uncertainty using NIST REFPROP10 + actual N <sub>2</sub> gas calibration | A2LA Accredited + Traceable | Traceable |
|-----------------------------|---------------------------------|----------------------------------------------------------------------------|-----------------------------|-----------|
| nitrogen*                   | N <sub>2</sub>                  | 0.2 or 0.125                                                               | X                           |           |
| helium*                     | He                              | 0.5                                                                        | X                           |           |
| argon*                      | Ar                              | 0.5                                                                        | X                           |           |
| hydrogen*                   | H <sub>2</sub>                  | 0.5                                                                        | X                           |           |
| oxygen                      | O <sub>2</sub>                  | 2                                                                          |                             | X         |
| methane*                    | CH <sub>4</sub>                 | 0.5                                                                        | X                           |           |
| ethylene                    | C <sub>2</sub> H <sub>4</sub>   | 5                                                                          |                             | X         |
| air*                        | Air                             | 0.5                                                                        | X                           |           |
| R116 Hexafluoroethane       | C <sub>2</sub> F <sub>6</sub>   | 5                                                                          |                             | X         |
| nitrous oxide*              | N <sub>2</sub> O                | 0.5                                                                        | X                           |           |
| R14 Carbon Tetrafluoride    | CF <sub>4</sub>                 | 1.3                                                                        |                             | X         |
| sulfur hexafluoride         | SF <sub>6</sub>                 | 0.5                                                                        | X                           |           |
| R143a Trifluoromethane      | CHF <sub>3</sub>                | 10                                                                         |                             | X         |
| carbon dioxide*             | CO <sub>2</sub>                 | 0.5                                                                        | X                           |           |
| propylene                   | C <sub>3</sub> H <sub>6</sub>   | 3.7                                                                        |                             | X         |
| propane*                    | C <sub>3</sub> H <sub>8</sub>   | 0.5                                                                        | X                           |           |
| ethane                      | C <sub>2</sub> H <sub>6</sub>   | 0.5                                                                        |                             | X         |
| carbon monoxide             | CO                              | 1.1                                                                        |                             | X         |
| butane                      | C <sub>4</sub> H <sub>10</sub>  | 1.5                                                                        |                             | X         |
| xenon                       | Xe                              | 1                                                                          |                             | X         |
| acetylene                   | C <sub>2</sub> H <sub>2</sub>   | 20                                                                         |                             | X         |
| RC318 Octofluorocyclobutane | C <sub>4</sub> F <sub>8</sub>   | 1.9                                                                        |                             | X         |
| neon                        | Ne                              | 3                                                                          |                             | X         |
| krypton                     | Kr                              | 3                                                                          |                             | X         |
| isoButane                   | iC <sub>4</sub> H <sub>10</sub> | 0.5                                                                        |                             | X         |
| deuterium                   | D <sub>2</sub>                  | 5                                                                          |                             | X         |
| NG                          | Natural Gas                     | 0.5                                                                        |                             | X         |
| HeOx                        | He/Ox 79/21                     | 2                                                                          |                             | X         |

\*Actual gas calibrations available at ±0.2% rdg uncertainty (standard) or ±0.125% rdg uncertainty (premium)

# molbloc-S ranges with high pressure, standard pressure and low pressure calibrations



molbloc-S size, KF (sccm/kPa), and full scale flow (slm @ 0 °C)

|           |                     |                               |       | Size            | 1E1-S | 2E1-S  | 5E1-S | 1E2-S | 2E2-S  | 5E2-S  | 1E3-S | 2E3-S | 5E3-S | 1E4-S |
|-----------|---------------------|-------------------------------|-------|-----------------|-------|--------|-------|-------|--------|--------|-------|-------|-------|-------|
|           |                     |                               |       | KF (sccm/kPa)   | 10    | 20     | 50    | 100   | 200    | 500    | 1000  | 2000  | 5000  | 10000 |
| Gases     |                     |                               |       | Ratio           |       |        |       |       |        |        |       |       |       |       |
|           |                     |                               |       | Cal type        |       |        |       |       |        |        |       |       |       |       |
| Inert     | Nitrogen            | N <sub>2</sub>                | 1.000 | HP              | 20.00 | 40.00  | 100.0 | 200.0 | 400.0  | 1000.0 | 2000  | 4000  | 10000 | 20000 |
|           |                     |                               |       | SP              | 6.00  | 12.00  | 30.0  | 60.0  | 120.0  | 300.0  | 600   | 1200  | 3000  | 6000  |
|           |                     |                               |       | LP              | 2.00  | 4.00   | 10.0  | 20.0  | 40.0   | 100.0  | 200   | 400   | 1000  | 2000  |
|           |                     |                               |       | minimum w/o vac | 2.00  | 3.50   | 7.7   | 15.0  | 28.0   | 67.0   | 129   | 248   | 596   | 1173  |
|           | Argon               | Ar                            | 0.837 | HP              | 16.74 | 33.49  | 83.7  | 167.4 | 334.9  | 837.2  | 1674  | 3349  | 8372  | 16744 |
|           |                     |                               |       | SP              | 5.03  | 10.0   | 25.1  | 50.3  | 100    | 251    | 503   | 1004  | 2512  | 5023  |
|           |                     |                               |       | LP              | 1.67  | 3.35   | 8.4   | 16.7  | 33.5   | 83.7   | 167   | 335   | 837   | 1674  |
|           |                     |                               |       | minimum w/o vac | 1.70  | 3.00   | 6.5   | 12.9  | 23.3   | 57.1   | 108   | 208   | 498   | 996   |
|           | Helium              | He                            | 2.647 | HP              | 52.94 | 105.87 | 264.7 | 529.4 | 1058.7 | 2646.8 | 5294  | 10587 | 26468 | 52936 |
|           |                     |                               |       | SP              | 15.9  | 31.8   | 79.4  | 159   | 318    | 794    | 1588  | 3176  | 7940  | 15881 |
|           |                     |                               |       | LP              | 5.29  | 10.59  | 26.5  | 52.9  | 105.9  | 264.7  | 529   | 1059  | 2647  | 5294  |
|           |                     |                               |       | minimum w/o vac | 9.40  | 13.10  | 25.7  | 51.4  | 91.5   | 199.4  | 399   | 695   | 1738  | 3281  |
|           | Sulfur hexafluoride | SF <sub>6</sub>               | 0.435 | HP              | 8.70  | 17.39  | 43.5  | 87.0  | 173.9  | 434.8  | 870   | 1739  | 4348  | 8695  |
|           |                     |                               |       | SP              | 2.6   | 5.2    | 13.1  | 26    | 52     | 130    | 260   | 522   | 1304  | 2609  |
|           |                     |                               |       | LP              | 0.87  | 1.74   | 4.3   | 8.7   | 17.4   | 43.5   | 87    | 174   | 435   | 870   |
|           |                     |                               |       | minimum w/o vac | 0.80  | 1.40   | 3.1   | 5.9   | 11.4   | 26.9   | 54    | 100   | 250   | 500   |
|           | Xenon               | Xe                            | 0.460 | HP              | 9.21  | 18.42  | 46.0  | 92.1  | 184.2  | 460.4  | 921   | 1842  | 4604  | 9209  |
|           |                     |                               |       | SP              | 2.8   | 5.5    | 13.8  | 28    | 55     | 138    | 276   | 552   | 1381  | 2762  |
|           |                     |                               |       | LP              | 0.92  | 1.84   | 4.6   | 9.2   | 18.4   | 46.0   | 92    | 184   | 460   | 921   |
|           |                     |                               |       | minimum w/o vac | 0.80  | 1.40   | 3.6   | 6.5   | 12.9   | 29.7   | 59    | 110   | 267   | 529   |
|           | Ethane              | C <sub>2</sub> H <sub>6</sub> | 0.960 | HP              | 19.21 | 38.42  | 96.0  | 192.1 | 384.2  | 960.4  | 1921  | 3842  | 9604  | 19208 |
|           |                     |                               |       | SP              | 5.8   | 11.5   | 28.8  | 58    | 115    | 288    | 576   | 1152  | 2881  | 5762  |
|           |                     |                               |       | LP              | 1.92  | 3.84   | 9.6   | 19.2  | 38.4   | 96.0   | 192   | 384   | 960   | 1921  |
|           |                     |                               |       | minimum w/o vac | 1.50  | 3.00   | 6.7   | 13.4  | 25.2   | 61.9   | 119   | 229   | 552   | 1104  |
|           | Ethylene            | C <sub>2</sub> H <sub>4</sub> | 0.996 | HP              | 19.92 | 39.83  | 99.6  | 199.2 | 398.3  | 995.8  | 1992  | 3983  | 9958  | 19916 |
|           |                     |                               |       | SP              | 6.0   | 12.0   | 29.9  | 60    | 120    | 299    | 598   | 1195  | 2987  | 5975  |
|           |                     |                               |       | LP              | 1.99  | 3.98   | 10.0  | 19.9  | 39.8   | 99.6   | 199   | 398   | 996   | 1992  |
|           |                     |                               |       | minimum w/o vac | 1.70  | 3.10   | 7.5   | 13.9  | 27.7   | 64.2   | 128   | 237   | 572   | 1144  |
|           | Hydrogen            | H <sub>2</sub>                | 3.730 | HP              | 74.60 | 149.19 | 373.0 | 746.0 | 1491.9 | 3729.8 | 7460  | 14919 | 37298 | 74596 |
|           |                     |                               |       | SP              | 22.4  | 44.8   | 112   | 224   | 448    | 1119   | 2238  | 4476  | 11189 | 22379 |
|           |                     |                               |       | LP              | 7.46  | 14.92  | 37.3  | 74.6  | 149.2  | 373.0  | 746   | 1492  | 3730  | 7460  |
|           |                     |                               |       | minimum w/o vac | 8.30  | 14.50  | 36.2  | 62.5  | 114.5  | 280.9  | 509   | 980   | 2312  | 4623  |
|           | Methane             | CH <sub>4</sub>               | 1.320 | HP              | 26.40 | 52.81  | 132.0 | 264.0 | 528.1  | 1320.2 | 2640  | 5281  | 13202 | 26403 |
|           |                     |                               |       | SP              | 7.92  | 15.8   | 39.6  | 79.2  | 158    | 396    | 792   | 1584  | 3960  | 7921  |
|           |                     |                               |       | LP              | 2.64  | 5.28   | 13.2  | 26.4  | 52.8   | 132.0  | 264   | 528   | 1320  | 2640  |
|           |                     |                               |       | minimum w/o vac | 2.60  | 4.40   | 10.2  | 20.1  | 36.7   | 88.2   | 170   | 327   | 786   | 1517  |
| Flammable | Propane             | C <sub>3</sub> H <sub>8</sub> | 0.789 | HP              | 15.77 | 31.55  | 78.9  | 157.7 | 315.5  | 788.7  | 1577  | 3155  | 7887  | 15774 |
|           |                     |                               |       | SP              | 4.73  | 9.47   | 23.6  | 47.3  | 95     | 237    | 473   | 947   | 2366  | 4733  |
|           |                     |                               |       | LP              | 1.58  | 3.15   | 7.9   | 15.8  | 31.5   | 78.9   | 158   | 315   | 789   | 1577  |
|           |                     |                               |       | minimum w/o vac | 1.30  | 2.30   | 5.5   | 10.5  | 20.8   | 48.8   | 98    | 181   | 453   | 907   |

|                |                                    |                               |       |                 |       |       |       |       |       |        |      |      |       |       |
|----------------|------------------------------------|-------------------------------|-------|-----------------|-------|-------|-------|-------|-------|--------|------|------|-------|-------|
| Fluoro-carbons | Carbon tetrafluoride               | CF <sub>4</sub>               | 0.563 | HP              | 11.26 | 22.51 | 56.3  | 112.6 | 225.1 | 562.9  | 1126 | 2251 | 5629  | 11257 |
|                |                                    |                               |       | SP              | 3.37  | 6.76  | 16.9  | 33.7  | 67.7  | 169    | 337  | 676  | 1688  | 3377  |
|                |                                    |                               |       | LP              | 1.13  | 2.25  | 5.6   | 11.3  | 22.5  | 56.3   | 113  | 225  | 563   | 1126  |
|                |                                    |                               |       | minimum w/o vac | 0.90  | 1.80  | 4.1   | 7.9   | 15.7  | 36.3   | 70   | 134  | 323   | 647   |
|                | Hexafluoro-ethene                  | C <sub>2</sub> F <sub>6</sub> | 0.447 | HP              | 8.95  | 17.89 | 44.7  | 89.5  | 178.9 | 447.3  | 895  | 1789 | 4473  | 8947  |
|                |                                    |                               |       | SP              | 2.69  | 5.36  | 13.4  | 26.9  | 53.6  | 134    | 269  | 536  | 1342  | 2684  |
|                |                                    |                               |       | LP              | 0.89  | 1.79  | 4.5   | 8.9   | 17.9  | 44.7   | 89   | 179  | 447   | 895   |
|                |                                    |                               |       | minimum w/o vac | 0.80  | 1.30  | 3.2   | 5.9   | 11.8  | 27.6   | 55   | 103  | 257   | 514   |
|                | Trifluoro methane                  | CHF <sub>3</sub>              | 0.629 | HP              | 12.59 | 25.18 | 62.9  | 125.9 | 251.8 | 629.4  | 1259 | 2518 | 6294  | 12588 |
|                |                                    |                               |       | SP              | 3.78  | 7.55  | 18.8  | 37.8  | 75.5  | 189    | 378  | 755  | 1888  | 3776  |
|                |                                    |                               |       | LP              | 1.26  | 2.52  | 6.3   | 12.6  | 25.2  | 62.9   | 126  | 252  | 629   | 1259  |
|                |                                    |                               |       | minimum w/o vac | 1.00  | 2.00  | 4.4   | 8.8   | 17.2  | 40.6   | 78   | 150  | 362   | 723   |
| Other          | Air                                | Air                           | 0.983 | HP              | 19.67 | 39.34 | 98.3  | 196.7 | 393.4 | 983.5  | 1967 | 3934 | 9835  | 19670 |
|                |                                    |                               |       | SP              | 5.90  | 11.8  | 29.5  | 59.0  | 118   | 295    | 590  | 1180 | 2951  | 5900  |
|                |                                    |                               |       | LP              | 1.97  | 3.93  | 9.8   | 19.7  | 39.3  | 98.3   | 197  | 393  | 983   | 1967  |
|                |                                    |                               |       | minimum w/o vac | 2.00  | 3.40  | 7.6   | 15.2  | 27.4  | 67.1   | 127  | 244  | 585   | 1170  |
|                | Carbon dioxide                     | CO <sub>2</sub>               | 0.795 | HP              | 15.91 | 31.81 | 79.5  | 159.1 | 318.1 | 795.3  | 1591 | 3181 | 7953  | 15906 |
|                |                                    |                               |       | SP              | 4.78  | 9.54  | 23.9  | 47.8  | 95.4  | 239    | 478  | 954  | 2386  | 4772  |
|                |                                    |                               |       | LP              | 1.59  | 3.18  | 8.0   | 15.9  | 31.8  | 79.5   | 159  | 318  | 795   | 1591  |
|                |                                    |                               |       | minimum w/o vac | 1.40  | 2.50  | 6.2   | 11.1  | 22.1  | 51.2   | 102  | 189  | 473   | 914   |
|                | Carbon monoxide                    | CO                            | 1.000 | HP              | 20.00 | 40.00 | 100.0 | 200.0 | 400.0 | 1000.0 | 2000 | 4000 | 10000 | 19999 |
|                |                                    |                               |       | SP              | 6.00  | 12.0  | 30.0  | 60.0  | 120   | 300    | 600  | 1200 | 3000  | 6000  |
|                |                                    |                               |       | LP              | 2.00  | 4.00  | 10.0  | 20.0  | 40.0  | 100.0  | 200  | 400  | 1000  | 2000  |
|                |                                    |                               |       | minimum w/o vac | 2.00  | 3.50  | 7.7   | 15.4  | 27.8  | 68.3   | 129  | 248  | 595   | 1190  |
|                | Nitrous oxide                      | N <sub>2</sub> O              | 0.795 | HP              | 15.90 | 31.80 | 79.5  | 159.0 | 318.0 | 795.1  | 1590 | 3180 | 7951  | 15902 |
|                |                                    |                               |       | SP              | 4.78  | 9.54  | 23.9  | 47.8  | 95.4  | 239    | 478  | 954  | 2386  | 4771  |
|                |                                    |                               |       | LP              | 1.59  | 3.18  | 8.0   | 15.9  | 31.8  | 79.5   | 159  | 318  | 795   | 1590  |
|                |                                    |                               |       | minimum w/o vac | 1.40  | 2.50  | 6.2   | 11.1  | 22.1  | 51.2   | 102  | 189  | 473   | 914   |
|                | Octafluorocyclobutane <sup>1</sup> | C <sub>4</sub> F <sub>8</sub> | 0.367 | LP              | 0.73  | 1.47  | 3.7   | 7.3   | 14.7  | 36.7   | 73   | 147  | 367   | 733   |
|                |                                    |                               |       | minimum w/o vac | 0.60  | 1.10  | 2.4   | 4.8   | 9.2   | 22.7   | 44   | 84   | 211   | 421   |
|                | Oxygen                             | O <sub>2</sub>                | 0.935 | HP              | 18.71 | 37.42 | 93.5  | 187.1 | 374.2 | 935.4  | 1871 | 3742 | 9354  | 18708 |
|                |                                    |                               |       | SP              | 5.62  | 11.2  | 28.1  | 56.2  | 112   | 281    | 562  | 1122 | 2807  | 5612  |
|                |                                    |                               |       | LP              | 1.87  | 3.74  | 9.4   | 18.7  | 37.4  | 93.5   | 187  | 374  | 935   | 1871  |
|                |                                    |                               |       | minimum w/o vac | 1.90  | 3.40  | 7.3   | 14.4  | 26.4  | 63.8   | 120  | 232  | 557   | 1113  |

<sup>1</sup> The vapor pressure of Octafluorocyclobutane is 230 kPa absolute. Only LP operation is possible. Downstream vacuum is recommended.

Ratio = Inverse square root density ratio of the indicated gas to that of nitrogen. Also the ratio of mass flow rates in each gas for a given molbloc-S element.  
KF = Pressure to flow conversion ratio, sccm/kPa

To estimate a flow in a given gas at a given pressure: Flow(slm) = KF \* pressure in kPa absolute / 1000 \* gas ratio

All flows are approximate; in gases other than nitrogen and air, flows may vary up to 10% due to differences in nozzle characteristics and manufacturing

Cal Types: HP = High Pressure calibration 200 kPa to 2 Mpa absolute; table shows flow @ 2 Mpa, minimum flow is 10 % of value shown

SP = Standard Pressure calibration 50 kPa to 600 kPa absolute; minimum flow with vacuum is ~8.4 % of value shown (flow at ~50 kPa)

LP = Low Pressure calibration 20 kPa to 200 kPa absolute; table shows flow @ 200 kPa, minimum flow with vacuum is 10 % of value shown

minimum w/o vac = estimated minimum critical flow without vacuum when atmospheric pressure (100 kPa, 14.7 psia) is downstream of molbloc-S.

molbloc-S elements use critical (sonic) flow venturi nozzle technology to measure flows which overlap with the ranges of molbloc-L and cover the higher end of the Product system flow range. molbloc-S flow measurements are valid only when the ratio of pressure downstream to the pressure upstream of the nozzle is low enough to assure a critical (choked) flow. Measurement uncertainty (accuracy) specifications for molblocs are valid only for gases with which the molbloc has been calibrated. All molbloc-S elements are calibrated in one standard gas, either air or N<sub>2</sub>, and may be calibrated in other gases. Calibrations with other gases are optional. The list of gases which can be measured by molbloc-S is the same as molbloc-L.

molbloc-S flow ranges are defined by the molbloc Pressure to Flow Conversion Ratio (Kf), the gas ratio used, the absolute pressure that can be delivered upstream of molbloc-S, the downstream pressure and the acceptable back pressure ratio. Kf is expressed in units of sccm/kPa and defines the relationship between mass flow in nitrogen and the absolute upstream pressure delivered to the molbloc-S. molbloc-S sizes are defined by the nominal Kf of the molbloc-S nozzle, with scientific notation, for example a 1E3 molbloc-S has a Kf of 1000 sccm/kPa. To differentiate from molbloc-L size designations, this molbloc size is designated as 1E3-S.

To calculate the flow rates for gases, or at different pressures, use this formula:

**Flow (slm) = Kf × Pressure in kPa absolute/1000 × Gas Ratio**

Kf = Pressure to Flow Conversion Ratio, sccm/kPa

Gas Ratio = Inverse square root density ratio of the current gas to Nitrogen

Table below shows known ratios for various gases to help in these calculations

| Pressure calibration type            |                               |
|--------------------------------------|-------------------------------|
| Low Pressure (LP)                    | (with vacuum) <sup>[2]</sup>  |
|                                      | (no vacuum) <sup>[1][3]</sup> |
| Standard Pressure (SP)               | (with vacuum) <sup>[4]</sup>  |
|                                      | (no vacuum) <sup>[1][5]</sup> |
| High Pressure (HP) <sup>[6][7]</sup> |                               |

[1] Upstream pressure applied to achieve minimal critical flow rate with atmospheric pressure (approximately 100 kPaa) downstream of molbloc-S (no vacuum applied to the outlet).

[2] Low Pressure calibration (LP) (with vacuum) upstream minimum pressure=20 kPaa (3 PSia) and maximum pressure = 200 kPaa (30 PSia).

[3] Low Pressure calibration (LP) (no vacuum) upstream minimum pressure = atmospheric pressure on the outlet and maximum pressure = 200 kPaa (30 PSia).

[4] Standard Pressure (SP) (with vacuum) upstream minimum pressure = 50 kPaa (7 PSia) and maximum pressure = 600 kPaa (87 PSia).

[5] Standard Pressure (SP) (no vacuum) upstream minimum pressure = atmospheric pressure on the outlet and maximum pressure = 600k Paa (87 PSia).

[6] High Pressure (HP) upstream minimum pressure = 200 kPaa (30 PSia) and maximum pressure = 2 MPaa (290 PSia).

[7] Requires molbox2-S A2M range to reach maximum flow. molbox2-S A1.4 M will have reduced maximum flow.

| Gas                          | Gas ratio                       |       |
|------------------------------|---------------------------------|-------|
| Nitrogen                     | N <sub>2</sub>                  | 1.000 |
| Helium                       | He                              | 2.647 |
| Argon                        | Ar                              | 0.837 |
| Hydrogen                     | H <sub>2</sub>                  | 3.730 |
| Oxygen                       | O <sub>2</sub>                  | 0.935 |
| Methane                      | CH <sub>4</sub>                 | 1.320 |
| Ethylene                     | C <sub>2</sub> H <sub>4</sub>   | 0.996 |
| Air                          | Air                             | 0.983 |
| R116 Hexafluoroethane        | C <sub>2</sub> F <sub>6</sub>   | 0.447 |
| Nitrous Oxide                | N <sub>2</sub> O                | 0.795 |
| R14 Carbon Tetrafluoride     | CF <sub>4</sub>                 | 0.563 |
| Sulfur Hexafluoride          | SF <sub>6</sub>                 | 0.435 |
| R143a Trifluoromethane       | CHF <sub>3</sub>                | 0.629 |
| Carbon Dioxide               | CO <sub>2</sub>                 | 0.795 |
| Propylene                    | C <sub>3</sub> H <sub>6</sub>   | 0.808 |
| Propane                      | C <sub>3</sub> H <sub>8</sub>   | 0.789 |
| Ethane                       | C <sub>2</sub> H <sub>6</sub>   | 0.960 |
| Carbon Monoxide              | CO                              | 1.000 |
| Butane                       | C <sub>4</sub> H <sub>10</sub>  | 0.680 |
| Xenon                        | Xe                              | 0.460 |
| Acetylene                    | C <sub>2</sub> H <sub>2</sub>   | 1.033 |
| RC318 Octafluorocyclobutane1 | C <sub>4</sub> F <sub>8</sub>   | 0.367 |
| Neon                         | Ne                              | 1.179 |
| Krypton                      | Kr                              | 0.578 |
| IsoButane                    | iC <sub>4</sub> H <sub>10</sub> | 0.682 |
| Deuterium                    | D <sub>2</sub>                  | 2.639 |
| Natural Gas                  | NG                              | 1.276 |



## Nominal molbloc-S nitrogen N<sub>2</sub> flow rate at various upstream pressures

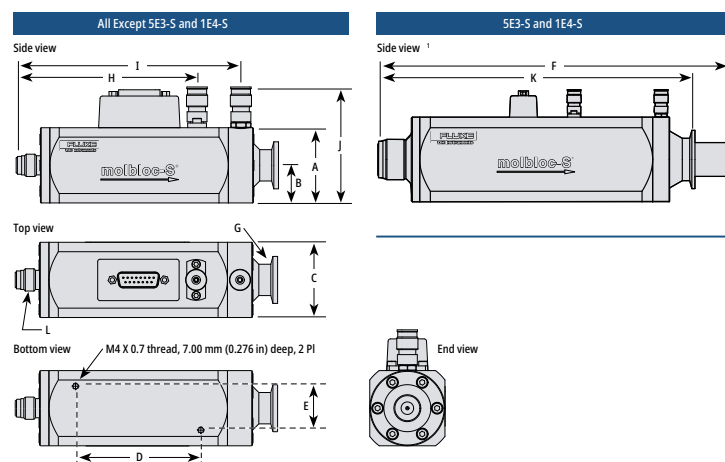
| molbloc-S mass flow rate (slm @ 0 °C) when molbloc-S upstream pressure is: <sup>1,2</sup> |                              |                    |                    |                      |                                           |                      |                      |                                            |                       |                     |
|-------------------------------------------------------------------------------------------|------------------------------|--------------------|--------------------|----------------------|-------------------------------------------|----------------------|----------------------|--------------------------------------------|-----------------------|---------------------|
| Designator                                                                                | K <sub>F</sub><br>(sccm/kPa) | 20 kPa<br>(3 psia) | 50 kPa<br>(7 psia) | 100 kPa<br>(15 psia) | Minimum<br>without<br>vacuum <sup>3</sup> | 200 kPa<br>(30 psia) | 600 kPa<br>(87 psia) | 800 kPa<br>(116 psia)<br>(typ. compressor) | 1.2 MPa<br>(174 psia) | 2 MPa<br>(290 psia) |
| 1E1-S                                                                                     | 10                           | 0.2                | 0.5                | 1                    | 1.8                                       | 2                    | 6                    | 8                                          | 12                    | 20                  |
| 2E1-S                                                                                     | 20                           | 0.4                | 1                  | 2                    | 3.2                                       | 4                    | 12                   | 16                                         | 24                    | 40                  |
| 5E1-S                                                                                     | 50                           | 1                  | 2.5                | 5                    | 7.7                                       | 10                   | 30                   | 40                                         | 60                    | 100                 |
| 1E2-S                                                                                     | 100                          | 2                  | 5                  | 10                   | 15                                        | 20                   | 60                   | 80                                         | 120                   | 200                 |
| 2E2-S                                                                                     | 200                          | 4                  | 10                 | 20                   | 28                                        | 40                   | 120                  | 160                                        | 240                   | 400                 |
| 5E2-S                                                                                     | 500                          | 10                 | 25                 | 50                   | 67                                        | 100                  | 300                  | 400                                        | 600                   | 1000                |
| 1E3-S                                                                                     | 1000                         | 20                 | 50                 | 100                  | 129                                       | 200                  | 600                  | 800                                        | 1200                  | 2000                |
| 2E3-S                                                                                     | 2000                         | 40                 | 100                | 200                  | 248                                       | 400                  | 1200                 | 1600                                       | 2400                  | 4000                |
| 5E3-S                                                                                     | 5000                         | 100                | 250                | 500                  | 596                                       | 1000                 | 3000                 | 4000                                       | 6000                  | 10000               |
| 1E4-S                                                                                     | 10000                        | 200                | 500                | 1000                 | 1173                                      | 2000                 | 6000                 | 8000                                       | 12000                 | 20000               |

## molbloc-S dimensions

|   | 1E1-S                         | 2E1-S                         | 5E1-S                         | 1E2-S                         | 2E2-S                      | 5E2-S                      | 1E3-S                      | 2E3-S                      | 5E3-S                               | 1E4-S                               |
|---|-------------------------------|-------------------------------|-------------------------------|-------------------------------|----------------------------|----------------------------|----------------------------|----------------------------|-------------------------------------|-------------------------------------|
| A | 48.0 mm<br>(1.89 in) sq       | 48.0<br>(1.89 in) sq          | 48.0<br>(1.89 in) sq          | 48.0 mm<br>(1.89 in) sq       | 48.0 mm<br>(1.89 in) sq    | 48.0 mm<br>(1.89 in) sq    | 48.0 mm<br>(1.89 in) sq    | 48.0 mm<br>(1.89 in) sq    | 80.0 mm<br>(3.15 in) sq             | 80.0 mm<br>(3.15 in) sq             |
| B | 24.0 mm<br>(0.94 in)          | 24.0 mm<br>(0.94 in)          | 24.0 mm<br>(0.94 in)          | 24.0 mm<br>(0.94 in)          | 24.0 mm<br>(0.94 in)       | 24.0 mm<br>(0.94 in)       | 24.0 mm<br>(0.94 in)       | 24.0 mm<br>(0.94 in)       | 40.0 mm<br>(1.57 in)                | 40.0 mm<br>(1.57 in)                |
| C | 48.0 mm<br>(1.89 in) sq       | 48.0 mm<br>(1.89 in) sq       | 48.0 mm<br>(1.89 in) sq       | 48.0 mm<br>(1.89 in) sq       | 48.0 mm<br>(1.89 in) sq    | 48.0 mm<br>(1.89 in) sq    | 48.0 mm<br>(1.89 in) sq    | 48.0 mm<br>(1.89 in) sq    | 80.0 mm<br>(3.15 in) sq             | 80.0 mm<br>(3.15 in) sq             |
| D | 80.0 mm<br>(3.15 in)          | 80.0 mm<br>(3.15 in)          | 80.0 mm<br>(3.15 in)          | 80.0 mm<br>(3.15 in)          | 80.0 mm<br>(3.15 in)       | 80.0 mm<br>(3.15 in)       | 80.0 mm<br>(3.15 in)       | 80.0 mm<br>(3.15 in)       | 176.0 mm<br>(6.93 in)               | 176.0 mm<br>(6.93 in)               |
| E | 28.0 mm<br>(1.10 in)          | 28.0 mm<br>(1.10 in)          | 28.0 mm<br>(1.10 in)          | 28.0 mm<br>(1.10 in)          | 28.0 mm<br>(1.10 in)       | 28.0 mm<br>(1.10 in)       | 28.0 mm<br>(1.10 in)       | 28.0 mm<br>(1.10 in)       | 44.0 mm<br>(1.73 in)                | 44.0 mm<br>(1.73 in)                |
| F | 167.5 mm<br>(6.59 in)         | 167.5 mm<br>(6.59 in)         | 167.5 mm<br>(6.59 in)         | 167.5 mm<br>(6.59 in)         | 171.0 mm<br>(6.73 in)      | 171.0 mm<br>(6.73 in)      | 171.0 mm<br>(6.73 in)      | 171.0 mm<br>(6.73 in)      | 299.7 mm<br>(11.80 in) <sup>1</sup> | 331.0 mm<br>(13.03 in) <sup>1</sup> |
| G | KF16 flange                   | KF16 flange                   | KF16 flange                   | KF16 flange                   | KF16 flange                | KF16 flange                | KF16 flange                | KF16 flange                | KF40 flange                         | KF40 flange                         |
| H | 100.0 mm<br>(3.94 in)         | 100.0 mm<br>(3.94 in)         | 100.0 mm<br>(3.94 in)         | 100.0 mm<br>(3.94 in)         | 84.0 mm<br>(3.31 in)       | 84.0 mm<br>(3.31 in)       | 84.0 mm<br>(3.31 in)       | 84.0 mm<br>(3.31 in)       | 154.0 mm<br>(6.06 in)               | 154.0 mm<br>(6.06 in)               |
| I | 128.0 mm<br>(5.04 in)         | 128.0 mm<br>(5.04 in)         | 128.0 mm<br>(5.04 in)         | 128.0 mm<br>(5.04 in)         | 128.0 mm<br>(5.35 in)      | 128.0 mm<br>(5.35 in)      | 128.0 mm<br>(5.35 in)      | 128.0 mm<br>(5.35 in)      | 236.0 mm<br>(9.29 in)               | 236.0 mm<br>(9.29 in)               |
| J | 73.0 mm<br>(2.87 in)          | 73.0 mm<br>(2.87 in)          | 73.0 mm<br>(2.87 in)          | 73.0 mm<br>(2.87 in)          | 73.0 mm<br>(2.87 in)       | 73.0 mm<br>(2.87 in)       | 73.0 mm<br>(2.87 in)       | 73.0 mm<br>(2.87 in)       | 106.0 mm<br>(4.17 in)               | 106.0 mm<br>(4.17 in)               |
| K | 167.5 mm<br>(6.59 in)         | 167.5 mm<br>(6.59 in)         | 167.5 mm<br>(6.59 in)         | 167.5 mm<br>(6.59 in)         | 171.0 mm<br>(6.73 in)      | 171.0 mm<br>(6.73 in)      | 171.0 mm<br>(6.73 in)      | 171.0 mm<br>(6.73 in)      | 290.0 mm<br>(11.42 in)              | 290.0 mm<br>(11.42 in)              |
| L | ¼ in VCR<br>Male <sup>2</sup> | ¼ in VCR<br>Male <sup>2</sup> | ¼ in VCR<br>Male <sup>2</sup> | ¼ in VCR<br>Male <sup>2</sup> | ½ in VCR<br>M <sup>2</sup> | ½ in VCR<br>M <sup>2</sup> | ½ in VCR<br>M <sup>2</sup> | ½ in VCR<br>M <sup>2</sup> | KF25 flange                         | KF25 flange                         |

1 On some molbloc-S elements, the venturi nozzle extends beyond the molbloc downstream flange, making the overall length dimension, F, longer than the fitting-to-fitting length dimension, K. A 40 mm diameter ISO-KF nipple is supplied with 5E3-S and 1E4-S molblobs because for these molbloc sizes the nozzle overhang may interfere with downstream connections or connection of a blank off cap for leak testing.

2 Default connector type is listed. Additional upstream connector options may be available. Contact your DHI Sales Representative for details.



## Ordering information

| molbox2 Models |                   |                                |                             |
|----------------|-------------------|--------------------------------|-----------------------------|
| Item No.       | Model             | Description                    | molbloc Compatibility       |
| 6074904        | MOLBOX2-A700K     | MASS FLOW TERM A700K STD       | For molbloc-L and molbloc-S |
| 6074970        | MOLBOX2-A700K-MFC | TERM A700K STD, MFC CTRL       | For molbloc-L and molbloc-S |
| 6074962        | MOLBOX2-A350K STD | MASS FLOW TERM A350K STD       | For molbloc-L and molbloc-S |
| 6074958        | MOLBOX2-A350K-MFC | TERM A350K STD, MFC CNTRL      | For molbloc-L and molbloc-S |
| 6074943        | MOLBOX2-A1.4M     | SONIC MASS FLOW TERM A1.4M STD | molbloc-S only terminal     |
| 6074894        | MOLBOX2-A1.4M-MFC | SONIC A1.4M STD MFC CTRL       | molbloc-S only terminal     |
| 6074873        | MOLBOX2-A2M       | SONIC MASS FLOW TERM A2M STD   | molbloc-S only terminal     |
| 6074887        | MOLBOX2-A2M-MFC   | SONIC TERM A2M STD, MFC CNTRL  | molbloc-S only terminal     |

| molbloc-L and molbloc-S models |         |                              |                                                                        |
|--------------------------------|---------|------------------------------|------------------------------------------------------------------------|
| Item No.                       | Model   | Description                  | molbox compatibility (Item No.)                                        |
| 6084512                        | 1E1-L-2 | LAMINAR MOLBLOC FLOW ELEMENT | 6074904, 6074970, 6074962, 6074958                                     |
| 6084596                        | 5E1-L-2 | LAMINAR MOLBLOC FLOW ELEMENT | 6074904, 6074970, 6074962, 6074958                                     |
| 6084583                        | 1E2-L-2 | LAMINAR MOLBLOC FLOW ELEMENT | 6074904, 6074970, 6074962, 6074958                                     |
| 6084577                        | 2E2-L-2 | LAMINAR MOLBLOC FLOW ELEMENT | 6074904, 6074970, 6074962, 6074958                                     |
| 6084565                        | 5E2-L-2 | LAMINAR MOLBLOC FLOW ELEMENT | 6074904, 6074970, 6074962, 6074958                                     |
| 6084633                        | 1E3-L-2 | LAMINAR MOLBLOC FLOW ELEMENT | 6074904, 6074970, 6074962, 6074958                                     |
| 6084622                        | 5E3-L-2 | LAMINAR MOLBLOC FLOW ELEMENT | 6074904, 6074970, 6074962, 6074958                                     |
| 6084614                        | 1E4-L-2 | LAMINAR MOLBLOC FLOW ELEMENT | 6074904, 6074970, 6074962, 6074958                                     |
| 6084605                        | 3E4-L-2 | LAMINAR MOLBLOC FLOW ELEMENT | 6074904, 6074970, 6074962, 6074958                                     |
| 6084554                        | 1E5-L-2 | LAMINAR MOLBLOC FLOW ELEMENT | 6074904, 6074970, 6074962, 6074958                                     |
| 6084520                        | 1E1-S-2 | SONIC MOLBLOC FLOW ELEMENT   | 6074904, 6074970, 6074962, 6074958, 6074943, 6074894, 6074873, 6074887 |
| 6084531                        | 2E1-S-2 | SONIC MOLBLOC FLOW ELEMENT   | 6074904, 6074970, 6074962, 6074958, 6074943, 6074894, 6074873, 6074887 |
| 6084499                        | 5E1-S-2 | SONIC MOLBLOC FLOW ELEMENT   | 6074904, 6074970, 6074962, 6074958, 6074943, 6074894, 6074873, 6074887 |
| 6084508                        | 1E2-S-2 | SONIC MOLBLOC FLOW ELEMENT   | 6074904, 6074970, 6074962, 6074958, 6074943, 6074894, 6074873, 6074887 |
| 6084475                        | 2E2-S-2 | SONIC MOLBLOC FLOW ELEMENT   | 6074904, 6074970, 6074962, 6074958, 6074943, 6074894, 6074873, 6074887 |
| 6084481                        | 5E2-S-2 | SONIC MOLBLOC FLOW ELEMENT   | 6074904, 6074970, 6074962, 6074958, 6074943, 6074894, 6074873, 6074887 |
| 6084452                        | 1E3-S-2 | SONIC MOLBLOC FLOW ELEMENT   | 6074904, 6074970, 6074962, 6074958, 6074943, 6074894, 6074873, 6074887 |
| 6084468                        | 2E3-S-2 | SONIC MOLBLOC FLOW ELEMENT   | 6074904, 6074970, 6074962, 6074958, 6074943, 6074894, 6074873, 6074887 |
| 6084447                        | 5E3-S-2 | SONIC MOLBLOC FLOW ELEMENT   | 6074904, 6074970, 6074962, 6074958, 6074943, 6074894, 6074873, 6074887 |
| 6084549                        | 1E4-S-2 | SONIC MOLBLOC FLOW ELEMENT   | 6074904, 6074970, 6074962, 6074958, 6074943, 6074894, 6074873, 6074887 |

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