Bios Gas Flow Bench
User Manual

PROVEN DryCal® TECHNOLOGY

NVLAP® NVLAP Lab Code 200661

Bios
Driving a Higher Standard in Flow Measurement℠

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Accuracy
Reliability
Convenience

About Bios Flow Bench

Bios Gas flow benches offer practical engineered solutions for calibration of gas flow measurement devices using proven DryCal® technology. Bios flow benches are configured to provide the stable flow critical to the calibration process. Our configurations use different components to connect the gas source, regulate pressure, control the flow, and direct the flow to a specific device being calibrated against a DryCal® standard

Configurations

The Bios Flow Benches are pre-configured for specific applications.
They are available in different configurations.

MFC Flow Bench Model (100-025): is a Gas flow delivery system used for calibrating Mass Flow Controllers where the exhaust of the MFC is at atmospheric pressure. It includes an on-off valve, a precision pressure regulator, a pressure gauge, and an MFC mounting stand. It requires connection to a gas source of approximately 100 psi.

Pic 1: MFC Flow Bench model (100-025)

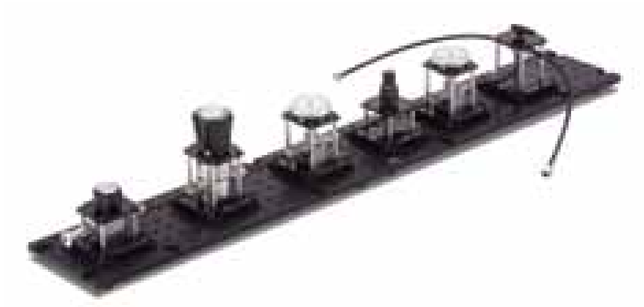
Features

- MFC mounting stand to hold the MFC
- Pressure regulator to obtain and maintain the required MFC inlet pressure
- ¼" Tubing connection compatible to most popular MFCs
- Quick-connect to secure an easy connection to the flow source
- Specially designed for MFC calibration

General Purpose Flow Bench Model (100-030 L/H): is a gas flow delivery system used for calibrating rotameters, bubble meters, and flow calibrators. It includes an on-off valve, a precision pressure regulator, a high side pressure gauge, a needle valve, a low side pressure gauge and an A/B valve. It requires connection to a gas source of approximately 100 psi.

The General Purpose Flow bench can be configured as low and high flow based on needle valve selected, either:

- BIOS part number 100-007, Low Flow Needle Valve for a flow rate 5-5000 cc/min
- Or BIOS part number 100-008, High Flow Needle Valve for a flow rate 500-50,000 cc/min

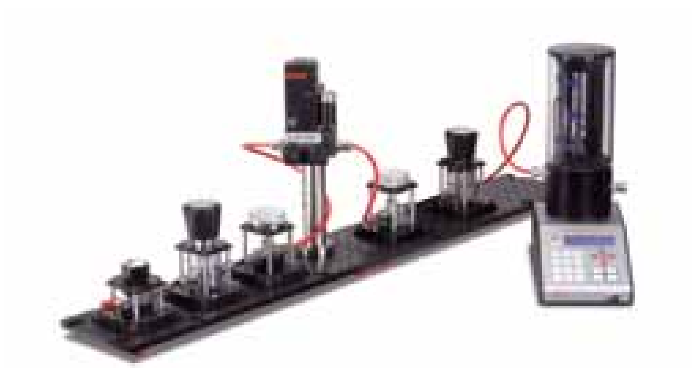


Pic 2: General Purpose Flow Bench Model (100-030 L/H)

Features

- Pressure regulator to obtain and maintain the desired pressure
- Needle valve to control the flow
- Quick-connect to secure an easy connection to the flow source
- Low side pressure gauge to measure the pressure drop across the flow meter
- Configured to calibrate any kind of flow measurement device
- Can be configured to calibrate mass flow meters

Back Pressure Module Model (100-028): is an add-on Module that allows calibration of a device under test (DUT) at back pressure of up to 60 PSI. It includes a Pressure gauge and a Back Pressure Regulator. The back pressure module is used in conjunction with flow bench 100-025 or 100-030 for calibrating flow meters at a specific pressure.



Pic 3: Back pressure module with 100-025

Features

- Back pressure regulator to create a specific pressure
- Specially designed for MFC and rotameter calibration at a specific pressure

The Bios General Purpose Flow Bench, 5 to 500 SLM (100-031): is pre-configured for most calibration applications. This includes Variable Area Flow Meters, Piston Provers, Bubble Meters, Mass Flow Controllers, and Mass Flow Meters where the exhaust is at atmospheric pressure. If your device being calibrated requires backpressure, contact Bios for the additional required backpressure module.

General Purpose Flow Bench, 5 to 500 SLM Features

- Pressure regulator to obtain and maintain the required inlet pressure
- Pressure gauge to set inlet pressure
- Valves to direct flow to various flow control devices
- Needle valve to set flow rates from 5 - 50 SLm
- 0.063" and 0.125" sonic nozzles to set flow rates from 50 - 500 SLm
- A/B valves to divert flow between the DryCal standard and DUT
- 1/2" port to connect a MFC to the pressure regulated gas source

Leak Test

MFC Flow Bench Leak Test Procedure

Equipment:

Flow Source
¼" leak test plug

Procedure:

Step 1
Connect flow bench to flow source using 1/4" rigid tubing.

Step 2
Ensure all fittings and components are wrench tight.

Step 3
Ensure inlet valve is closed and open flow source.

Step 4
Turn flow bench regulator counter clockwise to zero flow.

Step 5
Put leak test plug on end of flow bench and tighten

Step 6
Open the inlet valve to supply gas to flow bench.

Step 7
Open the flow bench regulator to increase pressure to 80psi or equal to inlet pressure.

Step 8
Close inlet valve and observe the pressure gauge on flow bench. Any drop in pressure represents a leak. Retighten fittings if needed and repeat.

Step 9
Ensure no leakage after 5 minutes.

Step 10
Remove leak test plug to release pressure.

Step 11
Disconnect flow bench from flow source.

Step 12
Decrease flow bench regulator.

General Purpose Flow Bench (models 100-030L/H) Leak Test Procedure

Equipment:

Flow Source
¼" leak test plug
¼" Swage union

Procedure:

Step 1
Connect flow bench to flow source using 1/4" rigid tubing.

Step 2
Ensure all fittings and components are wrench tight.

Step 3
Ensure inlet valve is closed and open flow source.

Step 4
Turn flow bench regulator counter clockwise to zero flow.

Step 5
Turn needle valve clockwise to zero flow.

Step 6
Open the inlet valve to supply gas to flow bench.

Step 7
Open the flow bench regulator to increase pressure to 80psi or equal to inlet pressure.

Step 8
Close inlet valve and observe first pressure gauge on flow bench. Any drop in pressure represents a leak between the outlet of the inlet valve and the inlet of the needle valve. Retighten fittings if needed and repeat.

Step 9
Ensure no leakage after 5 minutes and continue.

Step 10
Open needle valve to bleed off pressure.

Step 11
Close flow bench regulator.

Step 12
Put unions and leak test plugs on A/B valve tubing and tighten.

Step 13
Open inlet valve.

Step 14
Open flow bench regulator to 25psi.

Step 15
Open needle valve and bring low pressure gauge to 25psi.

Step 16
Toggle A/B valve to equalize pressure on either side of valve.

Step 17
Close needle valve and observe low pressure gauge. Any pressure drop represents a leak between the outlet of the needle valve and the ends of the A/B valve tubing. Retighten fittings if needed and repeat.

Step 18
Ensure no leakage after 5 minutes then turn A/B valve to other position.

Step 19
Ensure no leakage after 5 minutes.

Step 20
Remove leak test plugs to release pressure and toggle A/B valve.

Step 21
Disconnect flow bench from flow source.

Step 22
Decrease flow bench regulator and close needle valve.

General Purpose Flow Bench, 5 to 500 SLM Leak Test Procedure

Equipment:

Flow Source

¼" leak test plug

¾" leak test cap

Procedure:

Step 1

Connect flow bench to flow source.

Step 2

Ensure all fittings and components are wrench tight.

Step 3

Turn flow bench regulator counter clockwise to zero flow.

Step 4

Close both ½" valves and open ¼" valve.

Step 5

Turn needle valve clockwise to zero flow.

Step 6

Open the flow bench regulator to increase pressure to 80psi or equal to inlet pressure.

Step 7

Decrease flow bench regulator completely.

Step 8

Observe the pressure gauge on flow bench. Any drop in pressure represents a leak upstream of any closed valve. Retighten fittings if needed and repeat.

Step 9

Ensure no leakage after 5 minutes and continue.

Step 10

Open needle valve to bleed off pressure.

Step 11

Close flow bench regulator.

Step 12

Put unions and leak test plugs on A/B valve tubing and tighten.

Step 13

Center ¼" A/B valve selector to open both ports to pressure.

Step 14

Open the flow bench regulator to increase pressure to 80psi or equal to inlet pressure, then decrease flow bench regulator completely.

Step 15

Observe the pressure gauge. Any pressure drop represents a leak between the outlet of the needle valve and the ends of the ¼" A/B valve tubing. Retighten fittings if needed and repeat.

Step 16

Close ¼" valve and open both ½" valves.

Step 17

Install leak test caps on ¾" A/B valve and tighten.

Step 18

Center ¾" A/B valve selector to open both ports to pressure.

Step 19

Open the flow bench regulator to increase pressure to 80psi or equal to inlet pressure, then decrease flow bench regulator completely.

Step 20

Observe the pressure gauge. Any pressure drop represents a leak between the outlet of the ½" valve an A/B valve. Re-tighten fittings if needed and repeat.

Step 21

Remove leak test plugs to release pressure. Leak test complete.

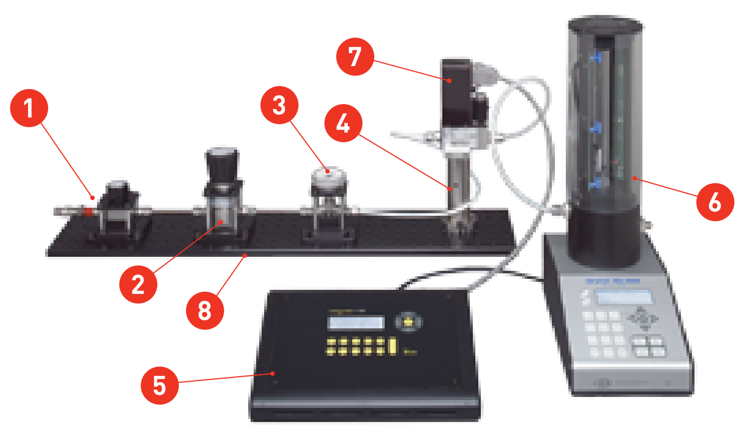
Application

MFC Calibration Procedure Using Bios Met Lab® Series Primary Piston Prover

Introduction:

The flow measurement professional is responsible for calibrating and/or verifying the accuracy of various flow devices, such as mass flow controllers (MFCs). This costly, time-consuming process involves sending MFCs out for calibration or verifying them in-house.

As the leader in primary gas flow measurement, Bios has developed an on-site calibration solution that combines the precision and speed of our Met Lab® Series of primary piston provers, MFC control system and carefully-selected instruments and gauges to enable fast, precise verifications of MFCs, while removing much of the guesswork and interpretation from the process. This MFC calibration procedure is designed to help the flow measurement professional apply our MFC calibration solution and Met Lab piston prover for optimum, defensible results.



Equipment required:

1. **On/Off Valve**
2. **Pressure Regulator**
3. **Pressure Gauge**
4. **MFC Mounting Stand**
5. **Bios Integrator™ 110 MFC Command, Control and Readout Device**
6. **Bios Met Lab** (shown with model ML-800)
7. **Mass Flow Controller (MFC)**
8. **Breadboard**

For your convenience, Bios offers the MFC Ambient Gas Flow Delivery System (part number 100-025, pictured above) as a pre-packaged MFC calibration solution; please contact Bios or an authorized Bios sales representative for details (Note: Met Lab and Integrator 110 not included).

Installation using the Bios MFC Ambient Gas Flow Delivery System:

Step 1
Verify all device connections. The Bios MFC Ambient Gas Flow Delivery System comes with in-series, ¼" tubing connection of the on/off valve, pressure regulator and pressure gauge, as well as a "quick connect" with male/female connectors for connection of the on/off valve to the gas cylinder/compressed air

Step 2
Place the MFC under test on the mounting stand. First check the flow direction before mounting the MFC and then firmly tighten the base plate screws

Step 3
Place your Met Lab in the most downstream position of the series. Connect ¼" tubing from the pressure gauge to the MFC's input, and from the MFC's outlet to the Met Lab's inlet

Step 4
Connect both the MFC's cable and the Met Lab's serial cable to the designated ports on the back of the Integrator 110 (refer to Integrator 110 manual as necessary)

MFC Calibration continued

Procedure:

Step 1

Turn on your Met Lab primary piston prover and either your Integrator 110 or alternate MFC control box, as applicable

Step 2

Set your Met Lab's measurement type to 'Std' (for standardizing) and set its standardizing temperature to match that of the MFC's standardizing temperature, typically 0.0C or 21.10C (refer to your Met Lab manual as necessary)

Step 3

If the MFC requires a sensor factor for the gas under test (if that gas is a surrogate or proxy gas), make sure to change the Met Lab's sensor factor to match that of the MFC (the sensor factor is obtained by the MFC manufacturer)

Step 4

Open the on/off valve. Using the pressure regulator, adjust the gas flow's pressure to match that of the MFC's rated inlet pressure. If the indicated gauge pressure is more than the MFC's rated pressure, loosen the connection to the MFC and simultaneously adjust the pressure regulator until the desired pressure is achieved

Step 5

Set the flow to the MFC (as applicable, this is done using either your Integrator 110 or the alternate MFC control box)

Step 6

Begin taking flow measurements with your Met Lab. Your Met Lab's flow measurements are reflected on your Integrator 110's display, along with the deviation percentage between the MFC and your Met Lab.

Application Notes:

- Allow the MFC to warm up before beginning a calibration by connecting the MFC to the power supply (or to the Integrator 110; see Integrator 110 manual) before inputting a setpoint
- Allow a specified valve change time before recording the results of consecutive setpoints
- Allow the Met Lab to stabilize before beginning a calibration for optimum measurement results
- The following formula represents the MFC's accuracy in comparison to your Met Lab: **% Accuracy (full scale) = (Met Lab measurement - MFC reading)*100/MFC full scale %**

Variable Area Gas Flow Meter Calibration Procedure Using Bios Met Lab® Series Primary Piston Prover

Introduction:

The flow measurement professional is responsible for calibrating and/or verifying the accuracy of various flow measurement devices, such as variable area gas flow meters (variable area flow meters). This costly, time-consuming process typically involves sending variable area meters out for calibration or verifying them in-house. As the leader in primary gas flow measurement, Bios has developed a simple calibration procedure that combines the precision and high-speed of our Met Lab® Series of primary piston provers with carefully-selected instruments and gauges to enable accurate calibration of variable area flow meters.

Flow Corrections:

Each variable area flow meter is designed to operate under a certain set of conditions which include the temperature, pressure and the type of gas. Usually, these conditions are documented directly on the tube enclosure of the variable area flow meter, with the flow rate scales referenced in mm (millimeter). A reference table is provided to enable you to match the millimeter readings against the equivalent flow rates at the specified standard temperature and pressure. Otherwise, direct scale variable area flow meters indicate the flow rates directly on the tube enclosure.

When calibrating variable area flow meters using a Bios Met Lab primary piston prover, correction must be applied to the Met Lab's indicated flow measurements in order to take into account the difference between the *actual* temperature, pressure and gas used versus the variable area flow meter's *specified* temperature, pressure, and gas requirements.

To properly calibrate variable area flow meters, refer to the following formula:

Variable Area Flow Meter's Corrected Flow = Variable Area Flow Meter's Indicated Flow X Correction Factor

Where:

Correction Factor = $\sqrt{(A \times B \times C)}$

Where:

A = The Specific Gravity of the calibration gas as specified by the variable area flow meter / The Specific Gravity of the calibration gas

B = The operating Pressure in PSIA during calibration / Pressure in PSIA as specified by the variable area flow meter

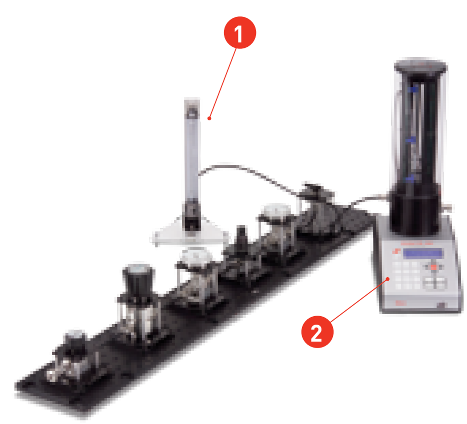
C= Temperature in ^{o}K as specified by the variable area flow meter / Temperature in ^{o}K during calibration

Equipment required:

1. Bios Gas Flow Delivery System (part number 100-030)

2. Bios Met Lab Series primary piston prover (models ML-800, ML-500 or Definer 220)

The Bios Gas Flow Delivery System features an on/off valve, precision pressure regulator, high-side and low-side pressure gauges, needle valve, A-B switch (three-way valve), "quick connect" with male and female connectors, and breadboard.



Variable Area Gas Flow Meter Calibration

Installation:

Step 1
Connect and/or verify all device connections. The Bios Gas Flow Delivery System comes with in-series, ¼" tubing connection of the on/off valve, pressure regulator, high-range pressure gauges, needle valve and A-B switch, as well as a "quick connect" with male/female connectors for connection of the on/off valve to the gas cylinder/ compressed air

Step 2
Connect one end of the A-B switch to the inlet fitting of the variable area flow meter and the other end to the inlet fitting of your Met Lab

Step 3
Using the quick connect, connect the on/off valve to the gas cylinder/compressed air. Gas inlet pressure should be approximately 80 to100 psi

Procedure:

Step 1
Close the needle valve, open the on/off valve and set the gas pressure by adjusting the pressure regulator to above 30 psi

Step 2
If the variable area flow meter contains a built-in needle valve, open its needle valve fully for unrestricted gas flow

Step 3
Turn on your Met Lab primary piston prover. Through its Setup menu, set your Met Lab's pressure unit to 'psi' and its flow readings to 'Vol' (Volumetric). For other flow measurement options (such as Continuous readings or the number of readings in the average), consult your Met Lab product manual

Step 4
Press your Met Lab's **Read** button in order to record the ambient pressure and temperature

Step 5
Flip the A-B switch to the variable area flow meter and gradually begin to open the needle valve on your flow bench.

Step 6
Set the variable area flow meter's flow at the desired level using the needle valve. The flow rate is indicated by the point on the printed scale where the float's center stabilizes

Step 7
Wait one to two minutes for the float to stabilize. To ensure a particular flow point, flip the A-B switch back and forth a few times to check if the float returns to the previous scale point. If it needs adjustment, adjust the flow using the needle valve

Step 8
Record the low range pressure gauge's pressure reading (in psia)

Step 9
If you are not using a direct scale variable area flow meter, record the reflected flow rate reading from the reference flow table against the floating point

Step 10
Refer to "Flow Corrections" in order to correct the variable area flow meter's indicated flow for the operating temperature, pressure and the type of gas

Step 11
Flip the A-B switch to your Met Lab. Begin taking flow measurements with your Met Lab.

Step 12
Determine the full scale accuracy of the variable area flow meter using the following formula:

% Accuracy = (Met Lab's Flow Measurement - Variable Area Flow Meter's corrected flow reading)*100 / Variable Area Flow Meter Full Scale %

Application Notes:

- We recommend taking a minimum of ten flow measurements in an average. The more measurements in the average, the better the calibration results
- Allow the Met Lab to stabilize before beginning a calibration
- When calibrating a variable area flow meter, it's best to use its specified calibration gas (calibrating with a surrogate gas can add greater uncertainty). If a surrogate must be used, we recommend using one with specific gravity similar to the gas the variable area flow meter is designed for

An Alternative Method of Calibrating Variable Area Flow Meter at Rated Temperature and Pressure Using MetLab Series Primary Piston Prover

Introduction:

The previous Bios method recommends calibration of a variable area flow meter (rotameter) by applying a correction factor to the Met Lab's indicated flow reading for temperature and pressure, without subjecting the rotameter to the pressure specified for the variable area flow meter. This procedure is recommended as an alternative method for rotameter calibration where it will be subjected to its rated pressure using the Bios back pressure module. The back pressure module consists of a back pressure regulator and a pressure gauge

Flow Corrections:

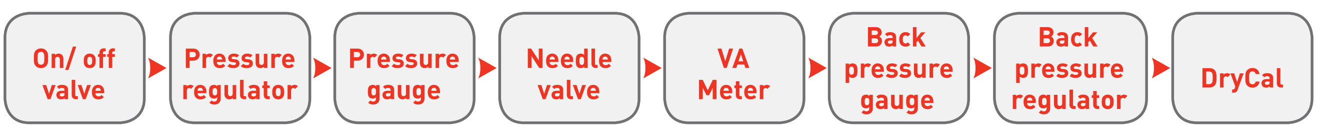
Each variable area flow meter is designed to operate under a certain set of conditions which include the temperature, pressure and the type of gas. Usually, these conditions are documented on the tube enclosure of the rotameter. A reference table is provided to match the millimeter readings against the equivalent flow rates at the specified temperature and pressure. Otherwise, direct scale variable area flow meter indicates the flow rates directly on the tube enclosure.

When calibrating a rotameter using a Bios MetLab piston prover, a flow correction factor (FCF) must be applied to the Met Lab's indicated flow measurement in order to take into account the difference between the actual temperature versus the rotameter's rated temperature.

In this procedure, no correction is applied for the pressure as the equipment set up is designed to calibrate the rotameter at rated pressure. Correction is applied to the MetLab's indicated flow measurement only when the actual gas temperature differs to its rated temperature.

Flow correction factor, FCF = $1/\sqrt{\{(\text{calibration temp in Fahrenheit} + 460)/(\text{operating temp in Fahrenheit} + 460)\}}$

Set up diagram:



Equipment required:

1. Bios Gas Flow Delivery System, consists of on/off valve, pressure regulator, pressure gauge, needle valve

2. Back pressure regulator and pressure gauge

3. Bios Met Lab series Primary Piston Prover (Models ML-800, ML-500, or Definer 220)

Installation:

Step 1

Connect all the devices as per the set up diagram. Connect tubing from the back pressure regulator to the inlet of the DryCal and leave the outlet open to atmosphere

Step 2

The gas flow delivery system comes with a 'Quick-Connect' with male/female connector that connects the on/off valve to gas cylinder/compressed air. Connect the 'Quick-connect' to the gas flow source. Gas pressure should be approximately 80 to 100 psi

Procedure:

Step 1

Turn on the MetLab. Through its set up menu, set the flow reading type to 'STD' and Temp Correction Factor to rated temperature of the rotameter

Step 2

Through the set up menu, enter the calculated flow correction factor (FCF) as a Sensor Factor in your MetLab if the actual gas temperature differs to the rated temperature of rotameter. Otherwise, set its value to default 1.00

Step 3

Close the needle valve, open the on/off valve, and set the gas pressure by adjusting the pressure regulator to 30 psi above the rotameter's rated pressure

Step 4

If the rotameter contains a built-in needle valve, open its needle valve fully for unrestricted gas flow

Step 5

Open up the needle valve and adjust the back pressure regulator until the pressure gauge before the back pressure regulator indicates the rotameter's rated pressure

Step 6

Set the variable area flow meter's flow at desired level using the needle valve. The flow rate is indicated by the point on the printed scale where the float's center stabilizes

Step 7

If you are not using a direct scale rotameter, record the reflected flow rate reading from the reference flow table against the floating point

Step 8

Press 'Measure' or 'Read' on the DryCal and begin taking readings

Step 9

Determine the full scale accuracy of the variable area flow meter using the following formula

% Full scale accuracy = (MetLab's flow reading – VAF's indicated flow reading)/ VAF's full scale %

General Purpose Flow Calibration (models 100-030 L/H) Procedure Using the Bios Met Lab® Series and Bios Gas Flow Delivery System

Introduction:

The flow measurement professional is responsible for calibrating and/or verifying the accuracy of various flow measurement devices. This costly, time-consuming process typically involves sending devices out for calibration or verifying devices in-house. As the leader in primary gas flow measurement, Bios has developed a general purpose calibration procedure that combines the precision and high-speed of our Met Lab® Series of primary piston provers with carefully-selected instruments and gauges to enable the calibration of not only Bios primary standards, but other piston provers, bubble meters and variable area gas flow meters (rotameters).

Equipment required:

1. **Bios Met Lab Series primary piston prover (models ML-800, ML-500 or Definer 220)**
2. **Bios Gas Flow Delivery System (part number 100-030)**

The Bios Gas Flow Delivery System features an on/off valve, precision pressure regulator, high-side and low-side pressure gauges, needle valve, A-B switch (three-way valve), "quick connect" with male and female connectors, and breadboard.

Calibrating a Variable Area Flow Meter

Installation:

Step 1

Connect and/or verify all device connections. The Bios Gas Flow Delivery System comes with in-series, ¼" tubing connection of the on/off valve, pressure regulator, pressure gauges, needle valve and A-B switch, as well as a "quick connect" with male/female connectors for connection of the on/off valve to the gas cylinder/compressed air

Step 2

Connect one end of the A-B switch to the inlet fitting of the DUT (Device Under Test) and the other end to the inlet fitting of your Met Lab

Step 3

Using the quick connect, connect the on/off valve to the gas cylinder/compressed air. Gas inlet pressure should be approximately 80 to100 psi

Procedure:

Step 1

Close the needle valve, open the on/off valve and set the gas pressure by adjusting the pressure regulator to above 30 psi

Step 2

Turn on your Met Lab primary piston prover. Through its Setup menu, set the Met Lab's flow readings to either 'Vol' (Volumetric) or 'Std' (Standardized), depending on the reading type of the DUT (Device Under Test). If setting your Met Lab to standardized flow readings, set the Met Lab's standardizing temperature to match that of the DUT's standardizing temperature. For other flow measurement options (such as Continuous readings or the number of readings in the average), consult your Met Lab product manual

Step 3

Open the needle valve, flip the A-B switch to your Met Lab, and begin taking flow measurements with your Met Lab. Based upon your Met Lab's flow measurements, as necessary use the needle valve to adjust the flow to the desired rate

Step 4

Flip the A-B switch to the DUT. Begin taking flow measurements with the DUT

Step 5

Flip the A-B switch to your Met Lab. Begin taking flow measurements with your Met Lab. Since **Step 5** is a direct comparison of your Met Lab's measurements, your **Step 5** results should not differ from your **Step 3** results by more than twice your Met Lab's rated accuracy

Step 6

Determine the accuracy of the DUT using the following formula:

% Error = (DUT Reading / Met Lab Reading - 1) x 100

Step 7

To calibrate the DUT at alternate flow points, repeat **Step 3** and adjust the needle valve and/or the pressure to the needle valve to obtain alternate flow

Calibrating a Bios Definer 220

Application Notes:

- If using this procedure to calibrate variable area gas flow meters (rotameters), for best results consult our separate application note, entitled "Variable Area Gas Flow Meter Calibration Procedure Using Bios Met Lab® Series Primary Piston Provers"
- We recommend taking a minimum of ten flow measurements in an average. The more measurements in the average, the better the calibration results
- Allow the Met Lab to stabilize before beginning a calibration

About Bios

Bios is a recognized leader in **primary** gas flow measurement. We provide products, services and solutions for professionals in diverse disciplines, including environmental protection, occupational health and safety, industrial process control, research and development and calibration laboratories.

Our Butler, New Jersey facility is one of the world's most accurate gas flow measurement laboratories. Since 2004, we've been accredited to the calibration laboratory quality and proficiency standards set forth by ISO 17025, ANSI Z-540 and NIST Handbook 150, through the National Voluntary Laboratory Accreditation program (**NVLAP**) of the National Institute of Standards and Technology (**NIST**), the national lab of the United States.

We're pleased to state that our **Scope of Accreditation** uncertainty is ±0.071% of reading for gas flow measurements from 5 to 50,000 scc per minute. A current copy of our accreditation certificate and scope may be found on our website, at:
http://www.biosint.com/pdf/NVLAP-accreditation.pdf.

General Purpose Flow Bench, 5 to 500 SLM Procedures

Your Bios General Purpose Flow Bench, 5 to 500 SLM utilizes different technologies to provide a stable gas flow.

By closing both ½" valves flow is directed through a needle valve capable of providing a stable flow in the range of 5-50 SLm. The flow continues through a ¼" A/B valve and is diverted to either the DUT (Device Under Test) or the DryCal® Standard .

In addition to the needle valve, the Bios 500 SLm Flow Bench has two sonic nozzles that provide a stable flow source at higher flow rates, up to 500 SLm. By closing the ¼" valve flow is directed through the sonic nozzles and on through a ¾" A/B valve. By varying the upstream pressure different flow rates can be achieved by directing the flow through the 0.063" sonic nozzle, the 0.125" sonic nozzle, or both at the same time. Adjust the inlet pressure using the regulator with the appropriate valve(s) open and running.

This table provides approximate flow rates at 760mmHg and 21.1 °C:

Input Pressure psi	Sonic Nozzles		Flow Rate slpm
	0.063	0.125	
30	X		75
		X	290
	X	X	365
35	X		82
		X	325
	X	X	400
40	X		90
		X	360
	X	X	445
45	X		100
		X	390
	X	X	490
50	X		110
		X	420

MFC's can be calibrated by connecting to the ½"flow port upstream of the valves and closing the ¼" valve and both ½" valves. Use the regulator to set the proper inlet pressure for you DUT. Connect your DryCal® standard to the outlet of your DUT.

The following formula represents the MFC's accuracy in comparison to your DryCal®:

% Accuracy (full scale) = (DryCal® measurement – DUT reading) * 100 / DUT full scale %

Recalibration

No calibration is required for Bios Gas Flow Benches.

Bios

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