



Operating Manual



Portable Calibration Unit

The Fastest Flow Controller Company in the World!



RECALIBRATION

Your Alicat instrument is a precision device and Alicat strongly recommends that you send it to us on a yearly basis for recalibration.

A yearly recalibration does a few things:

- ▶ It insures that your unit is functioning according to specification.
- ▶ Contamination may cause the instrument to measure flow improperly. Recalibration insures the instrument is clean and free from debris.
- ▶ Recalibration maintains your LIFETIME WARRANTY!

Sending your unit for recalibration is easy and inexpensive. Recalibrations are usually shipped within five days of receipt, so it's fast too.

Please keep the original box to return your Alicat instrument for recalibration.

For more information regarding recalibration see page 40.

ACCESSORIES

Now that you have your Alicat instrument are you sure you've got everything you need? Alicat accessories can make your job easier.

Many of our customers also order:

- ▶ Power Supplies — A universal wall power supply that makes it easy to power your Alicat unit just about anywhere in the world.
- ▶ BB9 — Alicat's multi-drop box that allows easy connection of up to nine Alicat instruments to a single USB, RS-232 port.
- ▶ MD8DB9 — An RS-232 to 8 pin Mini-DIN cable to connect your Alicat instrument to a computer. A variety of other cables are also available.
- ▶ Flow Vision™ SC — A GUI based Windows® program that allows easy computer access and control for one or multiple Alicat instruments.
- ▶ Fittings and filters — Keep your instrument properly connected to your process and free from harmful contamination.

See pages 42 - 44 for a complete description and list of Alicat accessories.



Thank you for purchasing an Alicat Scientific Portable Calibration Unit (PCU).

Please take the time to find and read the information contained in this manual. This will help to ensure that you get the best possible service from your instrument.

The Alicat Scientific Portable Calibration Unit (**PCU**) is designed to accurately measure gas flow rates of common gases with three separate flow meters with ranges determined by your needs.

The laminar flow, differential pressure flow meters housed in the PCU are accurate and exceptionally repeatable devices, making the PCU an excellent portable secondary standard for field flow meter calibration.

The PCU's three separate displays allow you to monitor Mass Flow Rate, Absolute Pressure, Volumetric Flow Rate, and Temperature simultaneously. The PCU is also equipped with an RS-232 output port that can be connected to a computer or other data-logging device.

The Alicat PCU is designed for CLEAN, DRY, NON-CORROSIVE gases.



Please contact Alicat at 1-888-290-6060 or info@alicat.com if you have any questions regarding the use or operation of this device.



You can find a number of instructional videos related to the operation of this device by visiting the Alicat web site or scanning the QR code below.

<http://www.alicat.com/support/instructional-videos/>



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CONNECTING THE PCU

The inlet and outlet connections to the PCU are located below the displays for their respective flow ranges.

Inlet connections are located on the left and the outlet connections are located on the right (see page 6)

The connections are either 1/8", 1/4", 3/8" or 1/2" push-connect style tubing fittings with each fitting corresponding to a single flow range.

Use appropriately sized plastic tubing to connect the flow source to the corresponding inlet fitting.

If necessary, connect the corresponding outlet fitting to the original source destination with proper tubing.



CAUTION: Push-connect fittings are easy to use, as no special tools are required to make the joints. However, special attention must be paid when cutting the tube — as the O-ring inside of the fittings can easily be damaged.

It is essential to use the correct cutter such as a pipe slice for copper pipe or dedicated plastic pipe cutters for plastic tube — Do not use a saw because any burrs left on the tube can damage the O-ring and cause the joint to leak!

Cut your tube to the required length using the dedicated plastic pipe cutters, making sure you have a straight cut with no burrs. Then push the tubing carefully into the fitting on the bulkhead panel.

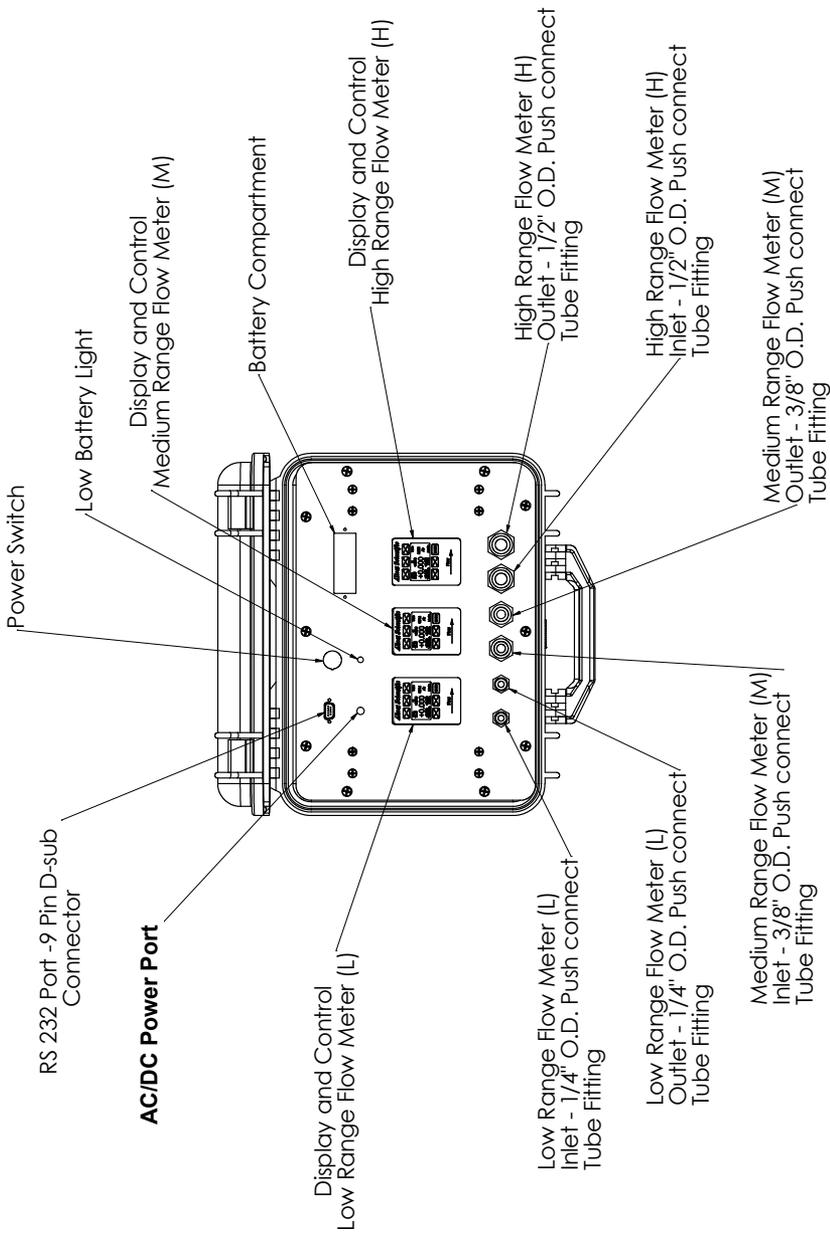
Softer polyurethane tubing will work best, as opposed to some of the harder plastic tubings available. It decreases the chances of damaging the O-rings.



IF THE OUTLET FITTINGS ARE NOT CONNECTED TO YOUR PIPING, THE GAS BEING MEASURED WILL VENT TO ATMOSPHERE AT THE OUTLET FITTINGS!

USE PROTECTIVE EYEWEAR!

NEVER VENT FLAMMABLE GASES TO ATMOSPHERE!



PCU Controls and Connections

POWER

The PCU is designed to operate on either two 9 Volt Alkaline batteries or via a 9-20 Vdc power supply running at a minimum 150 mA. The batteries will operate the PCU for about 8 hours under normal usage.

If the batteries drop below 7 volts, the low battery light will come on and the batteries should be replaced or alternate power should be applied.

When the replace battery light is on the accuracy of the meters' readings cannot be guaranteed.

PRESSURE

Maximum operating line pressure for PCUs with M-Series units is 145 psig (1 MPa).

If the line pressure is higher than 145 psig (1 MPa), use a pressure regulator upstream from the flow meter to reduce the pressure to 145 psig (1 MPa) or less.

Maximum operating line pressure for PCUs with WHISPER units is 50 psig.



Exceeding the maximum specified line pressure may cause permanent damage to the solid-state differential pressure sensor.



DO NOT SUBJECT AN M-SERIES DIFFERENTIAL PRESSURE SENSOR TO UPSTREAM-DOWNSTREAM PRESSURE DIFFERENTIALS EXCEEDING 75 PSID.

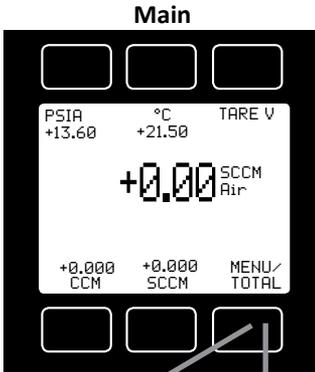
DO NOT SUBJECT A WHISPER DIFFERENTIAL PRESSURE SENSOR TO UPSTREAM-DOWNSTREAM PRESSURE DIFFERENTIALS EXCEEDING 15 PSID.

While high static pressure will typically not damage the dp sensor, sudden pressure “spikes” can result in complete failure of the sensor.

A common cause of this problem is instantaneous application of high-pressure gas as from a snap acting solenoid valve either upstream or downstream of the meter. If you suspect that your pressure sensor is damaged please discontinue use of the meter and contact Alicat.

DISPLAYS AND MENUS

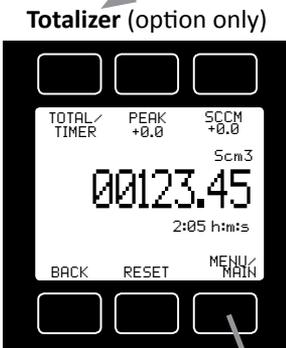
The device screen defaults to **Main** display as soon as power is applied to the meter.



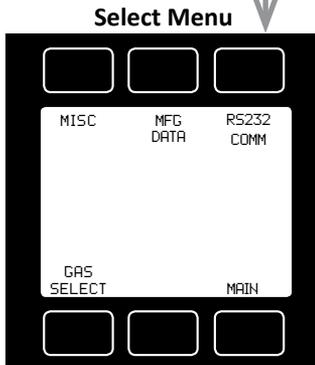
The **Main** display shows pressure, temperature, volumetric flow and mass flow.

Pressing the button adjacent to a parameter will make that parameter the primary display unit.

By hitting the **MENU** button at the bottom right of the screen you will enter the **Select Menu** display.



If your meter was ordered with the **Totalizer** option (page 41), pushing the **TOTAL** button once will bring up the **Totalizing Mode** display. Pushing **MENU** will bring up the **Select Menu** display.

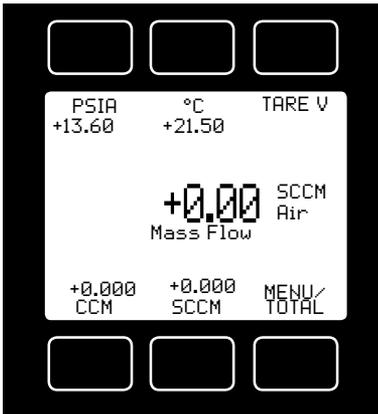


Select Menu

From **Select Menu** you can change the selected gas, interact with your RS-232 settings or read manufacturer's data.

Push **MAIN** to return to the Main display.

MAIN



This mode defaults on power up, with mass flow as the primary displayed parameter.

The following parameters are displayed in the Main mode.

Gas Absolute Pressure: This sensor references hard vacuum and reads incoming pressure both above and below local atmospheric pressure. This parameter is moved to the primary display by pushing the button above **PSIA**.

The engineering unit associated with absolute pressure is pounds per square inch absolute (psia). This can be converted to gage pressure (psig) by subtracting local atmospheric pressure from the absolute pressure reading:

$$\text{PSIG} = \text{PSIA} - (\text{Local Atmospheric Pressure})$$

Gas Temperature: M-Series flow meters measure the incoming temperature of the gas flow. The temperature is displayed in degrees Celsius (°C). This parameter is moved to the primary display by pushing the button above **°C**.

Pushing the button again allows you to select °C (Celsius), K (Kelvin), °F (Fahrenheit) or °R (Rankine) for the temperature scale.

To select a temperature scale, use the UP and DOWN buttons to position the arrow in front of the desired scale.

Press SET to record your selection and return to the MAIN display. The selected temperature scale will be displayed on the screen.

Tare: Pushing the **TARE V** button tares the flow meter and provides it with a reference point for zero flow. This is an important step in obtaining accurate measurements. It is best to zero the flow meter each time it is powered up. If the flow reading varies significantly from zero after an initial tare, give the unit a minute or so to warm up and re-zero it.

If possible, zero the unit near the expected operating pressure by positively blocking the flow downstream of the flow meter prior to pushing the TARE button.



Zeroing the unit while there is any flow will directly affect the accuracy by providing a false zero point.

If in doubt about whether a zero flow condition exists, remove the unit from the line and positively block both ports before pressing the TARE button. If the unit reads a significant negative value

when removed from the line and blocked, it was given a false zero. It is better to zero the unit at atmospheric pressure and a confirmed no flow condition than to give it a false zero under line pressure.

Volumetric Flow Rate: This parameter is located in the lower left of the display. It is moved to the primary display by pushing the button below **CCM** in this example. Your display may show a different unit of measure.

Mass Flow Rate: The mass flow rate is the volumetric flow rate corrected to a standard temperature and pressure (typically 14.696 psia and 25 °C).

This parameter is located in the lower middle of the display. It can be moved to the primary display by pushing the button below **SCCM** in this example. Your display may show a different unit of measure preceded by the letter **S**.

 **To get an accurate volumetric or mass flow rate, the gas being measured must be selected. See Gas Select, page 12.**

MENU: Pressing **MENU** switches the screen to the **Select Menu** display.



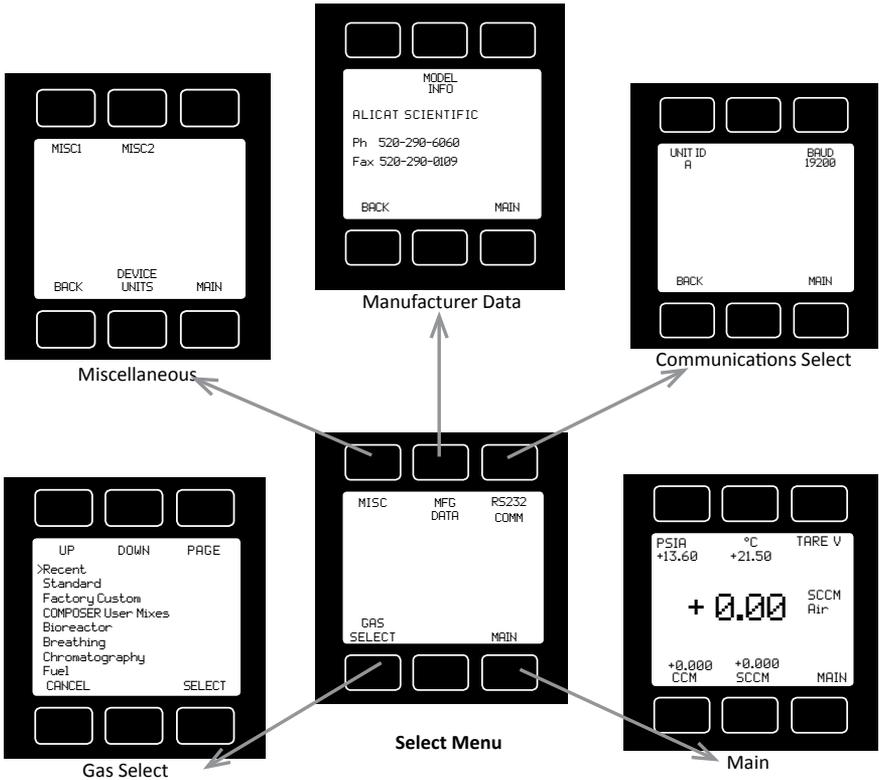
Flashing Error Message: An error message (**MOV** = mass overrange, **VOV** = volumetric overrange, **POV** = pressure overrange, **TOV** = temperature overrange) flashes when a measured parameter exceeds the range of the sensor. When any item flashes, neither the flashing parameter nor the mass flow measurement is accurate. Reducing the value of the flashing parameter to within specified limits will return the unit to normal operation and accuracy.

If the unit does not return to normal operation contact Alicat.

SELECT MENU

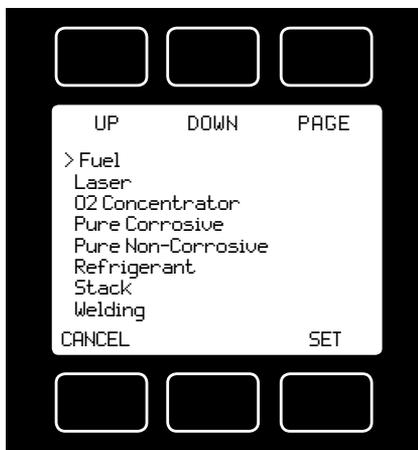
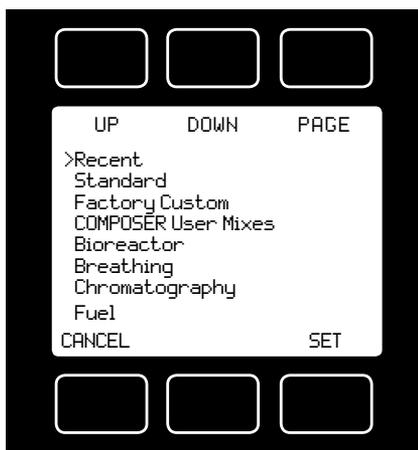
From Select Menu you can change the selected gas, interact with your RS-232 settings or read manufacturer's data.

Press the button next to the desired operation to bring that function to the screen.



An explanation for each screen can be found on the following pages.

GAS SELECT



Gas Select allows you to set your device to up to 150 standard gases and mixes. You can also use **COMPOSER** to program and store up to 20 additional gas mixes.

Gas Select is accessed by pressing the button below **GAS SELECT** on the Select Menu display.

To select a gas, use the UP and DOWN buttons to position the arrow in front of the desired gas category.

- » Recent: Eight most recent selections
- » Standard: Gases and mixes standard on earlier Alicat instruments (page 27)
- » Factory Custom: Present only if customer requested gases were added at the factory
- » COMPOSER User Mixes: Gas mixes programmed by the user (page 13)
- » Bioreactor (page 32)
- » Breathing (page 33)
- » Chromatography (page 35)
- » Fuel (page 34)
- » Laser (page 34)
- » O2 Concentrator (page 35)
- » Pure Corrosive* (page 29)
- » Pure Non-Corrosive (page 28)
- » Refrigerant* (page 30)
- » Stack (page 35)
- » Welding (page 31)

Press PAGE to view a new page in the gas category list.

Press SELECT to view the gases in the selected category. Align the arrow with the desired gas. Press SET to record your selection and return to the MAIN display. The selected gas will be displayed on the screen.

* Pure Corrosive and Refrigerant gases are only available on **S-Series** instruments that are compatible with these gases.

Note: Gas Select may not be available on units ordered with a custom gas or blend.

See pages 28 -35 for a full list of gases in each category.

COMPOSER

UP DOWN
>Add Mix: 20 Free
CANCEL SET

UP DOWN NEXT LETTER
COMPOSER Mix name:
MyGas
-----^
BACK/CANCEL CHANGE CASE SET

EDIT NAME ADD GAS GAS OPTNS
COMPOSER Mix: MyGAS
0.00% of Total
BACK/CANCEL CHANGE CASE SET

Composer allows you to program and save up to 20 custom gas mixes containing 2 to 5 component gases found in the gas lists (pages 28-35). The minimum resolution is 0.01%.

Composer is accessed by selecting **COMPOSER User Mixes** on the GAS SELECT display.

Press SET when the arrow is aligned with Add Mix.

Name the mix by pressing the UP and DOWN buttons for letters, numerals and symbols.

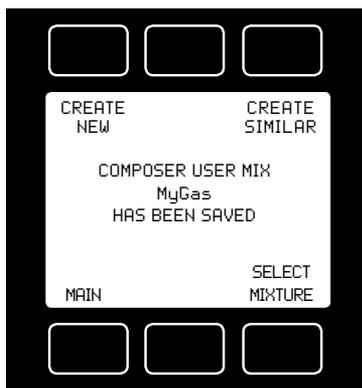
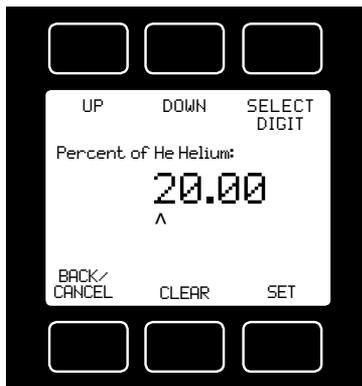
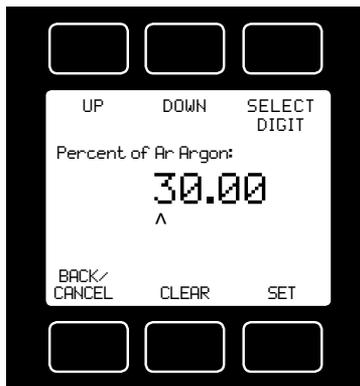
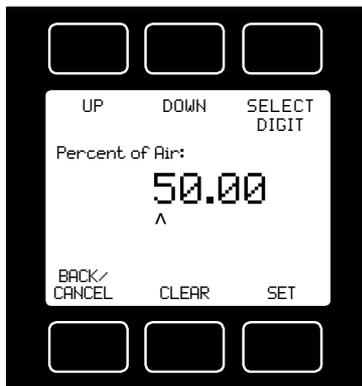
CHANGE CASE – Toggles the letter case. Letters remain in selected case until CHANGE CASE is pushed again.

Press SET to save the name.

After naming the mix, press **ADD GAS** and select the gas category and the component gas.

Select the digit with arrow and adjust the % with the UP and DOWN buttons. Press set to save. Add up to 4 more gases as needed. The total must equal 100% or an error message will appear.

GAS OPTNS allows you to adjust the percentage of the constituents or delete a gas from the mix. Gas mixes cannot be adjusted after they have been saved.

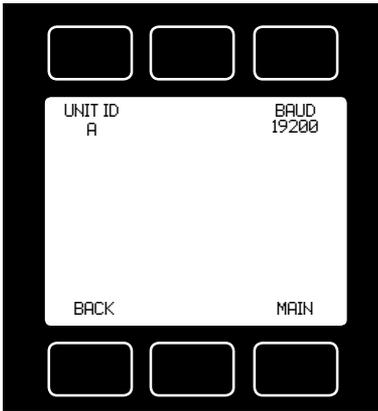


Once the mix has been saved, you may press **CREATE SIMILAR** to compose an additional mix based on the mix you have just saved. This CREATE SIMILAR option is not available after leaving this screen.

Press **CREATE NEW** to add a completely new mix.

Press **SELECT MIXTURE** to bring the custom mix onto the MAIN display.

COMMUNICATION SELECT



Access **Communication Select** by pressing the button above **RS232 COMM** on the **Select Menu** display.

Unit ID – Valid unit identifiers are the letters A-Z and @. The identifier allows you to assign a unique address to each device so that multiple units can be connected to a single RS-232 computer port.

Press **UNIT ID**. Use the UP and DOWN buttons to change the Unit ID. Press SET to record the ID. Press Reset to return to the previously recorded Unit ID.

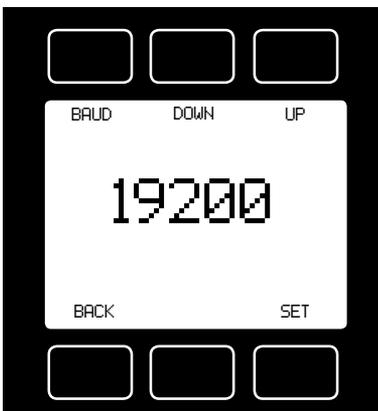
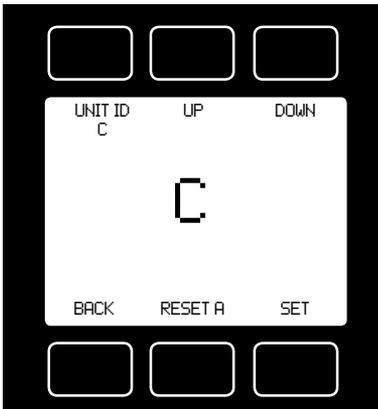
Any Unit ID change will take effect when Communication Select is exited.

If the symbol @ is selected as the Unit ID, the device will enter streaming mode when Communication Select is exited. See RS-232 Communications (page 19) for information about the streaming mode.

Baud – Both this instrument and your computer must send/receive data at the same baud rate. The default baud rate for this device is 19200 baud.

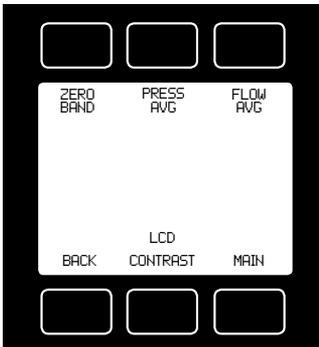
Press the Select button until the arrow is in front of **Baud**. Use the UP and DOWN buttons to select the baud rate that matches your computer. The choices are 38400, 19200, 9600, or 2400 baud.

Any baud rate change will not take effect until power to the unit is cycled.



MISCELLANEOUS

Miscellaneous is accessed by pressing the **MISC** button on the Select Menu display. Next select either **MISC1** or **MISC2**.



MISC1 will display as shown at left.

ZERO BAND refers to Display Zero Deadband.

Zero deadband is a value below which the display jumps to zero. This deadband is often desired to prevent electrical noise from showing up on the display as minor flows or pressures that do not exist. Display Zero Deadband does not affect the analog or digital signal outputs.

ZERO BAND can be adjusted between 0 and 6.3% of the sensor's Full Scale (FS).

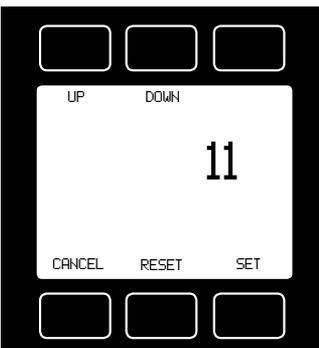
Press **ZERO BAND**. Then use SELECT to choose the digit with the arrow and the UP and DOWN buttons to change the value. Press SET to record your value. Press CLEAR to return to zero.

Pressure Averaging and Flow Averaging may be useful to make it easier to read and interpret rapidly fluctuating pressures and flows. Pressure and flow averaging can be adjusted between 1 (no averaging) and 256 (maximum averaging).

These are geometric running averages where the number between 1 and 256 can be considered roughly equivalent to the response time constant in milliseconds.

This can be effective at "smoothing" high frequency process oscillations such as those caused by diaphragm pumps.

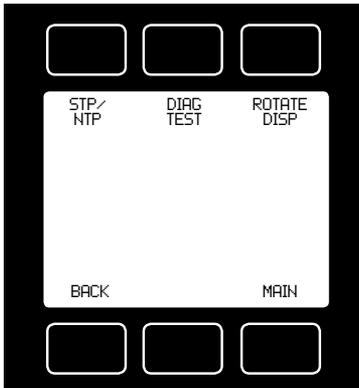
Press **PRESS AVG**. Then use SELECT to choose the digit with the arrow and the UP and DOWN buttons to change the value. Press SET to record your value. Press CLEAR to return to zero.



Press **FLOW AVG**. Then use SELECT to choose the digit with the arrow and the UP and DOWN buttons to change the value. Press SET to record your value. Press CLEAR to return to zero.

Setting a higher number will equal a smoother display.

LCD CONTRAST: The display contrast can be adjusted between 0 and 31, with zero being the lightest and 31 being the darkest. Use the UP and DOWN buttons to adjust the contrast. Press SET when you are satisfied. Press CANCEL to return to the MISC display.



MISC2 will display as shown at left.

STP/NPT refers to the functions that allow your selection of *standard* temperature and pressure conditions or *normal* temperature and pressure conditions. This feature is generally useful for comparison purposes to other devices or systems using different STP parameters.

The **STP** menu is comprised of the **STP TEMP** and **STP PRESS** screens.

STP TEMP allows you to select from °C, °F, K or °Ra. The arrow position will automatically default to the currently stored value.

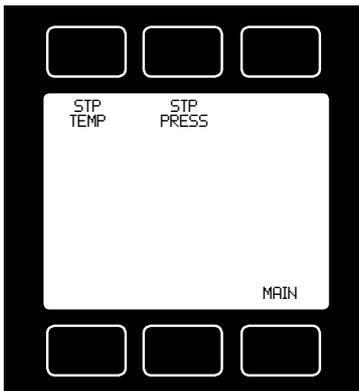
The **NTP** menu is comprised of the **NTP TEMP** and **NTP PRESS** screens.

Once a selection has been made and recorded using the **SET** button, a change acknowledgement message will be displayed on screen.

Selecting **MAIN** will revert screen to the Main display. If the **SET** selection is already the currently stored value, a message indicating that fact will appear.

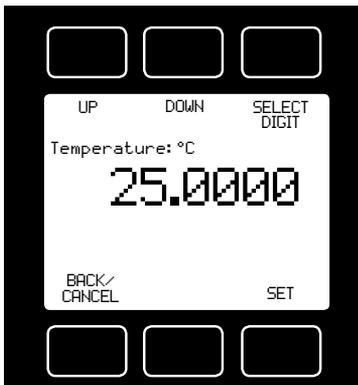
STP PRESS enables you to select from a menu pressure settings. Use the UP/DOWN or PAGE buttons to view the settings.

The arrow position will automatically default to the currently stored value.



Once a selection has been made and recorded using the **SET** button, a change acknowledgement message will be displayed on screen.

Pressing **SET** again will revert screen to the Main display. If the **SET** selection is already the currently stored value, a message indicating that fact will appear.



STP TEMP Display



STP PRESS Display

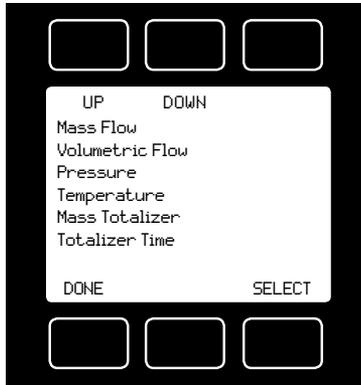


DIAG TEST: This diagnostic screen displays the current register values configured by the factory, which is useful for noting factory settings prior to making any changes. It is also helpful for troubleshooting with Alicat customer service personnel.

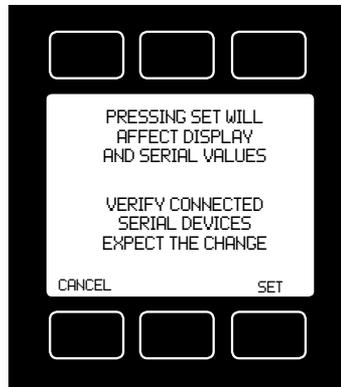
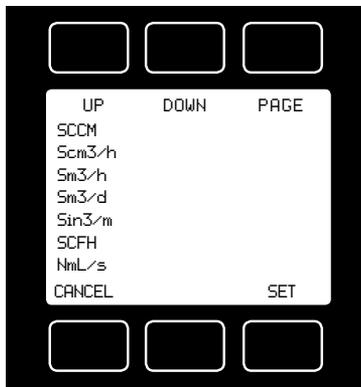
Select the **DIAG TEST** button from the **MISC2** screen to view a list of select register values. Pressing the **SCROLL** button will cycle the display through the register screens. An example screen is shown at left.

Press **ROTATE DISP** and **SET** to **Inverted 180°** if your device is inverted. The display and buttons will rotate together.

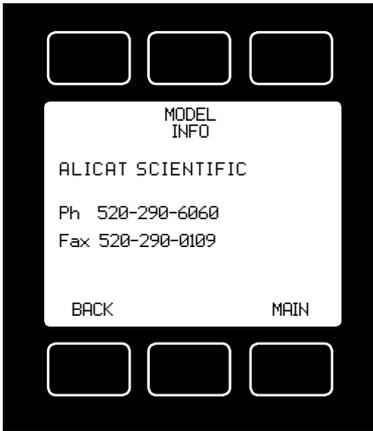
DEVICE UNITS



Press **DEVICE UNITS** to access menus of units of measure for each parameter (and totalizer if so equipped). Scroll to the desired unit and press select. Once selected, you will see the message shown below. Verify that all connected devices expect the change. See pages 36 and 37 for a full list of available units.



MANUFACTURER DATA



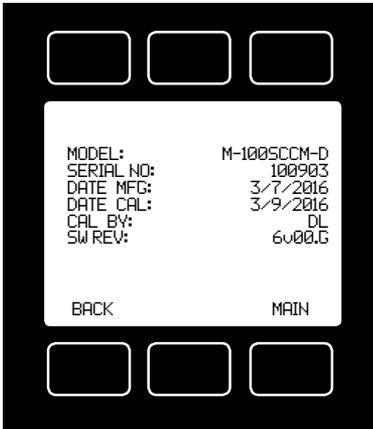
Manufacturer Data is accessed by pressing the **MFG DATA** button on the Select Menu display.

The initial display shows the name and telephone number of the manufacturer.

Press **MODEL INFO** to show important information about your flow device including the model number, serial number, and date of manufacture.

Press **BACK** to return to the MFG DATA display.

Push **MAIN** to return to the Main display.



RS-232 Output and Input

Connect the male RS-232 DB9 port (See Fig. 1) of the PCU to the serial port of your computer or data logger. This will normally require a female/female DB9 cable (included).

One of the most common ways to access the RS-232 output from your PCU is through a simple terminal program. Open your Hyperterminal RS-232 terminal program (installed under the "Accessories" menu on all Microsoft Windows operating systems). Select "Properties" from the file menu. Click on the "Configure" button under the "Connect To" tab.

Be sure the program is set for: 19200 baud and an 8-N-1-None (8 Data Bits, No Parity, 1 Stop Bit, and no Flow Control) protocol. Under the "Settings" tab, make sure the Terminal Emulation is set to ANSI.

Click on the "ASCII Setup" button and be sure the "Send Line Ends with Line Feeds" Box is not checked, and that the "Append Line Feeds to Incoming Lines" box is checked.

Those settings not mentioned here are normally okay in the default position. Type L, M or H to read data for the desired range.

When the queried the window will fill with 6 columns of data representing the range (L=Low, M=Medium, H=High), absolute pressure, temperature, volumetric flow, mass flow, and selected gas respectively. Pressure units are psia, temperature units are Degrees C, volumetric flow units are Liters Per Minute, and mass flow units are Standard Liters Per Minute. The Low range is 0-2 slpm, the Medium range is 0-50 slpm, and the High range is 0-1000 slpm.

```
L +014.70 +025.00 +02.004 +02.004 AIR
```

PCU Mass Flow Meter Data Format
(Low Range)

Note: On units with the totalizer function the sixth column will be the totalizer value, with gas select moving to a seventh column.

RS-232 Output and Input

Configuring HyperTerminal®:

1. Open your HyperTerminal® RS-232 terminal program (installed under the “Accessories” menu on all Microsoft Windows® operating systems).
2. Select “Properties” from the file menu.
3. Click on the “Configure” button under the “Connect To” tab. Be sure the program is set for: 19,200 baud (or matches the baud rate selected in the RS-232 communications menu on the meter) and an 8-N-1-None (8 Data Bits, No Parity, 1 Stop Bit, and no Flow Control) protocol.
4. Under the “Settings” tab, make sure the Terminal Emulation is set to ANSI or Auto Detect.
5. Click on the “ASCII Setup” button and be sure the “Send Line Ends with Line Feeds” box is not checked and the “Echo Typed Characters Locally” box and the “Append Line Feeds to Incoming Lines” boxes are checked. Those settings not mentioned here are normally okay in the default position.
6. Save the settings, close HyperTerminal® and reopen it.

Streaming Mode

In the **default** Polling Mode, the screen should be blank except the blinking cursor. In order to get the data streaming to the screen, hit the “Enter” key several times to clear any extraneous information. Type “*@=@” followed by “Enter” (or using the RS-232 communication select menu, select @ as identifier and exit the screen). If data still does not appear, check all the connections and COM port assignments.

Streaming Mode – Advanced

The streaming data rate is controlled by register 91. The recommended default rate of data provision is once every 50 milliseconds and this is suitable for most purposes.

If a slower or faster streaming data rate is desired, register 91 can be changed to a value from 1 millisecond to 65535 milliseconds, or slightly over once every minute.

Below approximately 40 milliseconds, data provision will be dependent upon how many parameters are selected. Fewer data parameters can be streamed more quickly than more. It is left to the user to balance streaming speed with number of parameters streamed.

To read register 91, type “*r91” followed by “Enter”.

To modify register 91, type “*w91=X”, where X is a positive integer from 1 to 65535, followed by “Enter”.

To return to the recommended factory default streaming speed, type “*w91= 50”.



Communication Set Up

<http://www.alicat.com/support/instructional-videos/>

Tareing via RS-232:

Tare –Tareing (or zeroing) the flow meter provides it with a reference point for zero flow. This is a simple but important step in obtaining accurate measurements. It is good practice to “zero” the flow meter each time it is powered up. A unit may be Tared by following the instructions on page 9 or it may be Tared via RS-232 input.

To send a Tare command via RS-232, enter the following strings:

In Polling Mode: Address\$\$V<Enter> (e.g. B\$\$V<Enter>)

Changing From Streaming to Polling Mode:

When the meter is in the Streaming Mode, the screen is updated approximately 10-60 times per second (depending on the amount of data on each line) so that the user sees the data essentially in real time. It is sometimes desirable, and necessary when using more than one unit on a single RS-232 line, to be able to poll the unit.

In Polling Mode the unit measures the flow normally, but only sends a line of data when it is “polled”. Each unit can be given its own unique identifier or address. Unless otherwise specified each unit is shipped with a default address of capital A. Other valid addresses are B thru Z.

Once you have established communication with the unit and have a stream of information filling your screen:

1. Type *@=A followed by “Enter” (or using the RS-232 communication select menu, select A as identifier and exit the screen) to stop the streaming mode of information. Note that the flow of information will not stop while you are typing and you will not be able to read what you have typed. Also, the unit does not accept a backspace or delete in the line so it must be typed correctly. If in doubt, simply hit enter and start again. If the unit does not get exactly what it is expecting, it will ignore it. If the line has been typed correctly, the data will stop.
2. You may now poll the unit by typing A followed by “Enter”. This does an instantaneous poll of unit A and returns the values once. You may type A “Enter” as many times as you like. Alternately you could resume streaming mode by typing *@=@ followed by “Enter”. Repeat step 1 to remove the unit from the streaming mode.
3. To assign the unit a new address, type *@=New Address, e.g. *@=B. Care should be taken not to assign an address to a unit if more than one unit is on the RS-232 line as all of the addresses will be reassigned. Instead, each should be individually attached to the RS-232 line, given an address, and taken off. After each unit has been given a unique address, they can all be put back on the same line and polled individually.

Gas Select – The selected gas can be changed via RS-232 input. To change the selected gas, enter the following commands:

In Polling Mode: Address\$\$#<Enter> (e.g. B\$\$#<Enter>)

Where # is the number of the gas selected from the table below. Note that this also corresponds to the gas select menu on the flow controller screen (the **Standard** gas category is shown in the example below):

#	GAS	
0	Air	Air
1	Argon	Ar
2	Methane	CH4
3	Carbon Monoxide	CO
4	Carbon Dioxide	CO2
5	Ethane	C2H6
6	Hydrogen	H2
7	Helium	He
8	Nitrogen	N2
9	Nitrous Oxide	N2O
10	Neon	Ne
11	Oxygen	O2
12	Propane	C3H8
13	normal-Butane	n-C4H10
14	Acetylene	C2H2
15	Ethylene	C2H4
16	iso-Butane	i-C2H10
17	Krypton	Kr
18	Xenon	Xe
19	Sulfur Hexafluoride	SF6
20	75% Argon / 25% CO2	C-25
21	90% Argon / 10% CO2	C-10
22	92% Argon / 8% CO2	C-8
23	98% Argon / 2% CO2	C-2
24	75% CO2 / 25% Argon	C-75
25	75% Argon / 25% Helium	HE-75
26	75% Helium / 25% Argon	HE-25
27	90% Helium / 7.5% Argon / 2.5% CO2 (Praxair - Helistar® A1025)	A1025
28	90% Argon / 8% CO2 / 2% Oxygen (Praxair - Stargon® CS)	Star29
29	95% Argon / 5% Methane	P-5

For example, to select Propane, enter: \$\$12<Enter>

Creating and Deleting Gas Mixtures with COMPOSER™ using RS-232

Note: All commands must be prefixed with the unit ID letter. The unit should not be in streaming mode.

You may create and store up to 20 gas mixtures containing up to five constituent gases each. The constituent gases must be chosen from the existing list of gases installed on the device (which may vary model to model). Please see pages 27 – 34 for lists of gases and their corresponding gas numbers.

Create a Gas Mixture

To create a gas mixture, enter a single-line command according to the following formula:
[Unit ID] GM [Gas Name] [Gas Mix Number] [Percent 1] [Gas Number 1]
[Percent 2] [Gas Number 2] ...etc. etc.

Notes: Do not type the brackets. There should be only one space between all items. Any percentages less than 1, should have a leading zero before the decimal (i.e. 0.25 for .25%). Trailing zeros are not necessary but they are allowed to help visualize the percentages on screen (as in the example). The sum of all percentages must be 100.00 otherwise an error will occur.

Here is an example of a three gas mixture for a new gas called “MyMix1” (50% O₂, 49.5% Helium, and .5% Neon), stored in user location #236, where the unit ID of the device is “A”:

A GM MyMix1 236 50.00 11 49.50 7 0.50 10 <ENTER>

Gas Name: Name your mixture using a maximum of 6 characters.

Gas Mix Number: COMPOSER™ user mixes have Alicat gas numbers between 236 and 255. You can assign any number in this range to your new mixture. If another mixture with the same number exists, it will be overwritten, even if that gas is currently selected on the unit. If you enter a 0 here, the new mix will be assigned the next available number between 236 and 255.

Percent 1: The percentage of the first constituent gas. The percentage of each constituent must be between 0.01 and 99.99. Values entered beyond two decimal points will be rounded to the nearest 0.01%.

Gas Number 1: The Alicat gas number of the first constituent gas.

Percent 2: The percentage of the second constituent gas. Values entered beyond two decimal points will be rounded to the nearest 0.01%.

Gas Number 2: The Alicat gas number of the second constituent gas.

Additional Gases: (Optional) The above pattern of [Percent] + [Gas Number] may be repeated for additional constituent gases (up to a total of five).

Upon success, the unit ID (if set) is returned followed by a space. The number of the gas mixture is then returned, followed by the percentages and names of each constituent in the mix. If the gas mix is not successfully created, a “?” is returned, and you must start over.

Delete a Gas Mixture

To delete a gas mixture, enter:

[Unit ID]GD [Gas Number]: The number of the COMPOSER™ user mixture you wish to delete from the unit

Only COMPOSER™ user mixtures can be deleted with this command.

On success, the unit ID (if set) is returned followed by a space and the number of the gas deleted. If the gas is not successfully deleted, a “?” is returned.

Collecting Data:

The RS-232 output updates to the screen many times per second. Very short-term events can be captured simply by disconnecting (there are two telephone symbol icons at the top of the HyperTerminal® screen for disconnecting and connecting) immediately after the event in question. The scroll bar can be driven up to the event and all of the data associated with the event can be selected, copied, and pasted into Microsoft® Excel® or other spreadsheet program as described below.

For longer term data, it is useful to capture the data in a text file. With the desired data streaming to the screen, select "Capture Text" from the Transfer Menu. Type in the path and file name you wish to use. Push the start button. When the data collection period is complete, simply select "Capture Text" from the Transfer Menu and select "Stop" from the sub-menu that appears.

Data that is selected and copied, either directly from HyperTerminal® or from a text file can be pasted directly into Excel®. When the data is pasted it will all be in the selected column. Select "Text to Columns..." under the Data menu in Excel® and a Text to Columns Wizard (dialog box) will appear. Make sure that "Fixed Width" is selected under Original Data Type in the first dialog box and click "Next". In the second dialog box, set the column widths as desired, but the default is usually acceptable. Click on "Next" again. In the third dialog box, make sure the column data format is set to "General", and click "Finish". This separates the data into columns for manipulation and removes symbols such as the plus signs from the numbers. Once the data is in this format, it can be graphed or manipulated as desired. ***For extended term data capture see page 26.***

Data Format:

The data stream on the screen represents the flow parameters of the main mode in the units shown on the display.

For mass flow meters, there are five columns of data representing pressure, temperature, volumetric flow, mass flow and the selected gas.

The first column is absolute pressure (normally in psia), the second column is temperature (normally in °C), the third column is volumetric flow rate (in the units specified at time of order and shown on the display), and the fourth column is mass flow (also in the units specified at time of order and shown on the display). For instance, if the meter was ordered in units of scfm, the display on the meter would read 2.004 scfm and the last two columns of the output below would represent volumetric flow and mass flow in cfm and scfm respectively.

+014.70	+025.00	+02.004	+02.004	Air
+014.70	+025.00	+02.004	+02.004	Air
+014.70	+025.00	+02.004	+02.004	Air
+014.70	+025.00	+02.004	+02.004	Air
Pressure	Temp	Vol. Flow	Mass Flow	Gas

M-Series Mass Flow Meter Data Format

Note: On units with the totalizer function the fifth column will be the totalizer value, with gas select moving to a sixth column.

Sending a Simple Script File to HyperTerminal®

It is sometimes desirable to capture data for an extended period of time. Standard streaming mode information is useful for short term events, however, when capturing data for an extended period of time, the amount of data and thus the file size can become too large very quickly. Without any special programming skills, you can use HyperTerminal® and a text editing program such as Microsoft® Word® to capture text at defined intervals.

1. Open your text editing program, MS Word for example.
2. Set the cap lock on so that you are typing in capital letters.
3. Beginning at the top of the page, type A<Enter> repeatedly. If you're using MS Word, you can tell how many lines you have by the line count at the bottom of the screen. The number of lines will correspond to the total number of times the flow device will be polled, and thus the total number of lines of data it will produce.

For example: A
 A
 A
 A
 A
 A
 A

will get a total of six lines of data from the flow meter, but you can enter as many as you like.

The time between each line will be set in HyperTerminal.

4. When you have as many lines as you wish, go to the File menu and select save. In the save dialog box, enter a path and file name as desired and in the "Save as Type" box, select the plain text (.txt) option. It is important that it be saved as a generic text file for HyperTerminal to work with it.
5. Click Save.
6. A file conversion box will appear. In the "End Lines With" drop down box, select CR Only. Everything else can be left as default.
7. Click O.K.
8. You have now created a "script" file to send to HyperTerminal. Close the file and exit the text editing program.
9. Open HyperTerminal and establish communication with your flow device as outlined in the manual.
10. Set the flow device to Polling Mode as described in the manual. Each time you type A<Enter>, the meter should return one line of data to the screen.
11. Go to the File menu in HyperTerminal and select "Properties".
12. Select the "Settings" tab.
13. Click on the "ASCII Setup" button.

14. The “Line Delay” box is defaulted to 0 milliseconds. This is where you will tell the program how often to read a line from the script file you’ve created. 1000 milliseconds is one second, so if you want a line of data every 30 seconds, you would enter 30000 into the box. If you want a line every 5 minutes, you would enter 300000 into the box.

15. When you have entered the value you want, click on OK and OK in the Properties dialog box.

16. Go the Transfer menu and select “Send **Text** File...” (NOT Send File...).

17. Browse and select the text “script” file you created.

18. Click Open.

19. The program will begin “executing” your script file, reading one line at a time with the line delay you specified and the flow device will respond by sending one line of data for each poll it receives, when it receives it.

You can also capture the data to another file as described in the manual under “Collecting Data”. You will be simultaneously sending it a script file and capturing the output to a separate file for analysis.

Operating Principle

All M-Series Gas Flow Meters (and MC Series Gas Flow Controllers) are based on the accurate measurement of volumetric flow. The volumetric flow rate is determined by creating a pressure drop across a unique internal restriction, known as a Laminar Flow Element (LFE), and measuring differential pressure across it. The restriction is designed so that the gas molecules are forced to move in parallel paths along the entire length of the passage; hence laminar (streamline) flow is established for the entire range of operation of the device. Unlike other flow measuring devices, in laminar flow meters the relationship between pressure drop and flow is linear.



Please visit the Alicat web site for a detailed explanation this principle.
<http://www.alicat.com/technical-information/theory-of-operation/>

STANDARD GAS DATA TABLES: Those of you who have older Alicat products may notice small discrepancies between the gas property tables of your old and new units. Alicat Scientific, Inc. has incorporated the latest data sets from NIST (including their REFPROP 9 data where available) in our products’ built-in gas property models. Be aware that the calibrators that you may be using may be checking against older data sets such as the widely distributed Air Liquide data. This may generate apparent calibration discrepancies of up to 0.6% of reading on well behaved gases and as much as 3% of reading on some gases such as propane and butane, unless the standard was directly calibrated on the gas in question.

As the older standards are phased out, this difference in readings will cease to be a problem. If you see a difference between the Alicat meter and your in-house standard, in addition to calling Alicat Scientific at (520) 290-6060, call the manufacturer of your standard for clarification as to which data set they used in their calibration. This comparison will in all likelihood resolve the problem.

GAS SELECT > Standard:

MI Meters will display: Acetylene, Air, Argon, Butane, Carbon Dioxide, Carbon Monoxide, Ethane, Ethylene (Ethene), Helium, Hydrogen, Iso-Butane, Krypton, Methane, Neon, Nitrogen, Nitrous Oxide, Oxygen, Propane, Sulfur Hexafluoride, Xenon, A-25, A-75, A1025, C-2, C-8, C-10, C-25, C-75, P-5, Star29.

MS Meters add the following: Ammonia, Chlorine Gas, Hydrogen Sulfide, Nitric Oxide, Nitrogen Trifluoride, Propylene, Sulfur Dioxide, and Nitrogen Dioxide to 0.5% in an inert carrier, Refrigerant gases.

PURE NON-CORROSIVE GASES								
Gas Number	Short Name	Long Name	25°C			0°C		
			Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA
14	C2H2	Acetylene	104.44800	1.07200	0.9928000	97.374	1.1728	0.9905
0	Air	Air	184.89890	1.18402	0.9996967	172.574	1.2930	0.9994
1	Ar	Argon	226.23990	1.63387	0.9993656	210.167	1.7840	0.9991
16	i-C4H10	i-Butane	74.97846	2.44028	0.9735331	68.759	2.6887	0.9645
13	n-C4H10	n-Butane	74.05358	2.44930	0.9699493	67.690	2.7037	0.9591
4	CO2	Carbon Dioxide	149.31840	1.80798	0.9949545	137.107	1.9768	0.9933
3	CO	Carbon Monoxide	176.49330	1.14530	0.9996406	165.151	1.2505	0.9993
60	D2	Deuterium	126.59836	0.16455	1.0005970	119.196	0.1796	1.0006
5	C2H6	Ethane	93.54117	1.23846	0.9923987	86.129	1.3550	0.9901
15	C2H4	Ethylene (Ethene)	103.18390	1.15329	0.9942550	94.697	1.2611	0.9925
7	He	Helium	198.45610	0.16353	1.0004720	186.945	0.1785	1.0005
6	H2	Hydrogen	89.15355	0.08235	1.0005940	83.969	0.0899	1.0006
17	Kr	Krypton	251.32490	3.43229	0.9979266	232.193	3.7490	0.9972
2	CH4	Methane	110.75950	0.65688	0.9882472	102.550	0.7175	0.9976
10	Ne	Neon	311.12640	0.82442	1.0004810	293.822	0.8999	1.0005
8	N2	Nitrogen	178.04740	1.14525	0.9998016	166.287	1.2504	0.9995
9	N2O	Nitrous Oxide	148.41240	1.80888	0.9945327	136.310	1.9779	0.9928
11	O2	Oxygen	205.50210	1.30879	0.9993530	191.433	1.4290	0.9990
12	C3H8	Propane	81.46309	1.83204	0.9838054	74.692	2.0105	0.9785
19	SF6	Sulfur Hexafluoride	153.53200	6.03832	0.9886681	140.890	6.6162	0.9849
18	Xe	Xenon	229.84830	5.39502	0.9947117	212.157	5.8980	0.9932

PURE CORROSIVES*			25°C			0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA
32	NH3	Ammonia	100.92580	0.70352	0.9894555	91.930	0.7715	0.9848612
80	1Butene	Butylene (1-Butene)	81.62541	2.35906	0.9721251	74.354	2.6036	0.9614456
81	cButene	Cis-Butene (cis-2-butene)	79.96139	2.36608	0.9692405	Liquid	Liquid	Liquid
82	iButene	Iso-Butene	80.84175	2.35897	0.9721626	73.640	2.6038	0.9613501
83	tButene	Trans-Butene	80.28018	2.36596	0.9692902	Liquid	Liquid	Liquid
84	COS	Carbonyl Sulfide	124.09600	2.48322	0.9888443	113.127	2.7202	0.985328
33	Cl2	Chlorine	134.56600	2.93506	0.9874470	125.464	3.1635	0.98407
85	CH3OCH3	Dimethylether	90.99451	1.91822	0.9816453	82.865	2.1090	0.9745473
34	H2S	Hydrogen Sulfide (H2S)	123.86890	1.40376	0.9923556	112.982	1.5361	0.9898858
31	NF3	NF3 (Nitrogen Trifluoride)	175.42500	2.91339	0.9963859	162.426	3.1840	0.9951506
30	NO	NO (Nitric Oxide)	190.05950	1.22672	0.9997970	176.754	1.3394	0.9995317
36	C3H6	Propylene (Propylene)	85.59895	1.74509	0.9856064	78.129	1.9139	0.9809373
86	SiH4	Silane (SiH4)	115.94400	1.32003	0.9945000	107.053	1.4433	0.99282
35	SO2	Sulfur Dioxide	127.83100	2.66427	0.9828407	116.717	2.9312	0.9750866

*Pure Corrosive gases are only available on S-Series instruments that are compatible with these gases. Gas numbers 33 and 35 are not available on controllers.

REFRIGERANTS			25°C				0°C				
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA
100	R-11	Trichlorofluoromethane	101.60480	5.82358	0.9641448	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid
101	R-115	Chloropentafluoroethane	125.14780	6.43293	0.9814628	114.891	7.0666	0.9752287	114.891	7.0666	0.9752287
102	R-116	Hexafluoroethane	137.81730	5.70097	0.9895011	126.635	6.2458	0.9858448	126.635	6.2458	0.9858448
103	R-124	Chlorotetrafluoroethane	115.93110	5.72821	0.9738286	105.808	6.3175	0.963807	105.808	6.3175	0.963807
104	R-125	Pentafluoroethane	129.61740	4.98169	0.9847599	118.793	5.4689	0.979137	118.793	5.4689	0.979137
105	R-134A	Tetrafluoroethane	118.18820	4.25784	0.9794810	108.311	4.6863	0.9713825	108.311	4.6863	0.9713825
106	R-14	Tetrafluoromethane	172.44680	3.61084	0.9962553	159.688	3.9467	0.9948964	159.688	3.9467	0.9948964
107	R-142b	Chlorodifluoroethane	104.20190	4.21632	0.9742264	95.092	4.6509	0.9640371	95.092	4.6509	0.9640371
108	R-143a	Trifluoroethane	110.86600	3.49451	0.9830011	101.344	3.8394	0.9765755	101.344	3.8394	0.9765755
109	R-152a	Difluoroethane	100.81320	2.75903	0.9785245	91.952	3.0377	0.9701025	91.952	3.0377	0.9701025
110	R-22	Difluoromonochloromethane	126.30390	3.58679	0.9853641	115.325	3.9360	0.9801128	115.325	3.9360	0.9801128
111	R-23	Trifluoromethane	149.13160	2.88404	0.9922734	136.997	3.1568	0.9895204	136.997	3.1568	0.9895204
112	R-32	Difluoromethane	126.13140	2.15314	0.9875960	115.303	2.3619	0.9827161	115.303	2.3619	0.9827161
113	RC-318	Octafluorocyclobutane	115.04690	8.42917	0.9700156	104.785	9.3017	0.9594738	104.785	9.3017	0.9594738
114	R-404A	44% R-125 / 4% R-134A / 52% R-143A	120.30982	4.18002	0.9836342	111.584	4.5932	0.9770889	111.584	4.5932	0.9770889
115	R-407C	23% R-32 / 25% R-125 / 52% R-134A	123.55369	3.95268	0.9826672	112.698	4.3427	0.9762849	112.698	4.3427	0.9762849
116	R-410A	50% R-32 / 50% R-125	130.24384	3.56538	0.9861780	122.417	3.9118	0.9811061	122.417	3.9118	0.9811061
117	R-507A	50% R-125 / 50% R-143A	121.18202	4.23876	0.9838805	112.445	4.6573	0.9774207	112.445	4.6573	0.9774207

*Refrigerant gases are only available on S-Series instruments that are compatible with these gases.

WELDING GASES		Long Name	25°C			0°C		
Gas Number	Short Name		Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA
23	C-2	2% CO ₂ / 98% Ar	224.71480	1.63727	0.9993165	208.673	1.7877	0.998993
22	C-8	8% CO ₂ / 92% Ar	220.13520	1.64749	0.9991624	204.199	1.7989	0.9987964
21	C-10	10% CO ₂ / 90% Ar	218.60260	1.65091	0.9991086	202.706	1.8027	0.9987278
140	C-15	15% CO ₂ / 85% Ar	214.74960	1.65945	0.9989687	198.960	1.8121	0.9985493
141	C-20	20% CO ₂ / 80% Ar	210.86960	1.66800	0.9988210	195.198	1.8215	0.9983605
20	C-25	25% CO ₂ / 75% Ar	206.97630	1.67658	0.9986652	191.436	1.8309	0.9981609
142	C-50	50% CO ₂ / 50% Ar	187.53160	1.71972	0.9977484	172.843	1.8786	0.9969777
24	C-75	75% CO ₂ / 25% Ar	168.22500	1.76344	0.9965484	154.670	1.9271	0.995401
25	He-25	25% He / 75% Ar	231.60563	1.26598	0.9996422	216.008	1.3814	0.9999341
143	He-50	50% He / 50% Ar	236.15149	0.89829	0.9999188	220.464	0.9800	1.00039
26	He-75	75% He / 25% Ar	234.68601	0.53081	1.0001954	216.937	0.5792	1.000571
144	He-90	90% He / 10% Ar	222.14566	0.31041	1.0003614	205.813	0.3388	1.00057
27	A1025	90% He / 7.5% Ar / 2.5% CO ₂	214.97608	0.31460	1.0002511	201.175	0.3433	1.000556
28	Star29	Stargon C5 90% Ar / 8% CO ₂ / 2% O ₂	219.79340	1.64099	0.9991638	203.890	1.7918	0.998798

BIOREACTOR GASES			25°C				0°C			
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA		
145	Bio-5M	5% CH4 / 95% CO2	148.46635	1.75026	0.9951191	136.268	1.9134	0.9935816		
146	Bio-10M	10% CH4 / 90% CO2	147.54809	1.69254	0.9952838	135.383	1.8500	0.993893		
147	Bio-15M	15% CH4 / 85% CO2	146.55859	1.63484	0.9954484	134.447	1.7867	0.9941932		
148	Bio-20M	20% CH4 / 80% CO2	145.49238	1.57716	0.9956130	133.457	1.7235	0.994482		
149	Bio-25M	25% CH4 / 75% CO2	144.34349	1.51950	0.9957777	132.407	1.6603	0.9947594		
150	Bio-30M	30% CH4 / 70% CO2	143.10541	1.46186	0.9959423	131.290	1.5971	0.9950255		
151	Bio-35M	35% CH4 / 65% CO2	141.77101	1.40424	0.9961069	130.102	1.5340	0.9952803		
152	Bio-40M	40% CH4 / 60% CO2	140.33250	1.34664	0.9962716	128.834	1.4710	0.9955239		
153	Bio-45M	45% CH4 / 55% CO2	138.78134	1.28905	0.9964362	127.478	1.4080	0.9957564		
154	Bio-50M	50% CH4 / 50% CO2	137.10815	1.23149	0.9966009	126.025	1.3450	0.9959779		
155	Bio-55M	55% CH4 / 45% CO2	135.30261	1.17394	0.9967655	124.462	1.2821	0.9961886		
156	Bio-60M	60% CH4 / 40% CO2	133.35338	1.11642	0.9969301	122.779	1.2193	0.9963885		
157	Bio-65M	65% CH4 / 35% CO2	131.24791	1.05891	0.9970948	120.959	1.1564	0.9965779		
158	Bio-70M	70% CH4 / 30% CO2	128.97238	1.00142	0.9972594	118.987	1.0936	0.9967567		
159	Bio-75M	75% CH4 / 25% CO2	126.51146	0.94395	0.9974240	116.842	1.0309	0.9969251		
160	Bio-80M	80% CH4 / 20% CO2	123.84817	0.88650	0.9975887	114.501	0.9681	0.9970832		
161	Bio-85M	85% CH4 / 15% CO2	120.96360	0.82907	0.9977533	111.938	0.9054	0.9972309		
162	Bio-90M	90% CH4 / 10% CO2	117.83674	0.77166	0.9979179	109.119	0.8427	0.9973684		
163	Bio-95M	95% CH4 / 5% CO2	114.44413	0.71426	0.9980826	106.005	0.7801	0.9974957		

BREATHING GASES			25°C			0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA
164	EAN-32	32% O ₂ / 68% N ₂	186.86315	1.19757	0.9996580	174.925	1.3075	0.9993715
165	EAN	36% O ₂ / 64% N ₂	187.96313	1.20411	0.9996401	175.963	1.3147	0.9993508
166	EAN-40	40% O ₂ / 60% N ₂	189.06268	1.21065	0.9996222	176.993	1.3218	0.9993302
167	HeOx-20	20% O ₂ / 80% He	217.88794	0.39237	1.0002482	204.175	0.4281	1.000593
168	HeOx-21	21% O ₂ / 79% He	218.15984	0.40382	1.0002370	204.395	0.4406	1.000591
169	HeOx-30	30% O ₂ / 70% He	219.24536	0.50683	1.0001363	205.140	0.5530	1.000565
170	HeOx-40	40% O ₂ / 60% He	218.59913	0.62132	1.0000244	204.307	0.6779	1.000502
171	HeOx-50	50% O ₂ / 50% He	216.95310	0.73583	0.9999125	202.592	0.8028	1.000401
172	HeOx-60	60% O ₂ / 40% He	214.82626	0.85037	0.9998006	200.467	0.9278	1.000257
173	HeOx-80	80% O ₂ / 20% He	210.11726	1.07952	0.9995768	195.872	1.1781	0.9998019
174	HeOx-99	99% O ₂ / 1% He	205.72469	1.29731	0.9993642	191.646	1.4165	0.9990796
175	EA-40	Enriched Air-40% O ₂	189.42518	1.21429	0.9996177	177.396	1.3258	0.9993261
176	EA-60	Enriched Air-60% O ₂	194.79159	1.24578	0.9995295	182.261	1.3602	0.9992266
177	EA-80	Enriched Air-80% O ₂	200.15060	1.27727	0.9994412	186.937	1.3946	0.9991288
178	Metabol	Metabolic Exhalant (16% O ₂ / 78.04% N ₂ / 5% CO ₂ / 0.96% Ar)	180.95936	1.20909	0.9994833	170.051	1.3200	0.9992587

FUEL GASES			25°C				0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA	
185	Syn Gas-1	40% H2 + 29% CO + 20% CO2 + 11% CH4	155.64744	0.79774	0.9989315	144.565	0.8704	0.9992763	
186	Syn Gas-2	64% H2 + 28% CO + 1% CO2 + 7% CH4	151.98915	0.43715	1.0001064	142.249	0.4771	1.000263	
187	Syn Gas-3	70% H2 + 4% CO + 25% CO2 + 1% CH4	147.33686	0.56024	0.9991225	136.493	0.6111	0.9997559	
188	Syn Gas-4	88% H2 + 14% CO + 3% CH4	133.63682	0.24825	1.0003901	125.388	0.2709	1.000509	
189	Nat Gas-1	93% CH4 / 3% C2H6 / 1% C3H8 / 2% N2 / 1% CO2	111.77027	0.70709	0.9979255	103.189	0.7722	0.9973965	
190	Nat Gas-2	95% CH4 / 3% C2H6 / 1% N2 / 1% CO2	111.55570	0.69061	0.9980544	103.027	0.7543	0.9974642	
191	Nat Gas-3	95.2% CH4 / 2.5% C2H6 / 0.2% C3H8 / 0.1% C4H10 / 1.3% N2 / 0.7% CO2	111.49608	0.68980	0.9980410	102.980	0.7534	0.9974725	
192	Coal Gas	50% H2 / 35% CH4 / 10% CO / 5% C2H4	123.68517	0.44281	0.9993603	115.045	0.6589	0.996387	
193	Endo	75% H2 + 25% N2	141.72100	0.34787	1.0005210	133.088	0.3797	1.000511	
194	HHO	66.67% H2 / 33.33% O2	180.46190	0.49078	1.0001804	168.664	0.5356	1.000396	
195	HD-5	LPG 96.1% C3H8 / 1.5% C2H6 / 0.4% C3H6 / 1.9% n-C4H10	81.45829	1.83428	0.9836781	74.933	2.0128	0.9784565	
196	HD-10	LPG 85% C3H8 / 10% C3H6 / 5% n-C4H10	81.41997	1.85378	0.9832927	74.934	2.0343	0.9780499	

LASER GASES			25°C				0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA	
179	LG-4.5	4.5% CO2 / 13.5% N2 / 82% He	199.24300	0.36963	1.0001332	187.438	0.4033	1.000551	
180	LG-6	6% CO2 / 14% N2 / 80% He	197.87765	0.39910	1.0000471	186.670	0.4354	1.00053	
181	LG-7	7% CO2 / 14% N2 / 79% He	197.00519	0.41548	0.9999919	186.204	0.4533	1.000514	
182	LG-9	9% CO2 / 15% N2 / 76% He	195.06655	0.45805	0.9998749	184.835	0.4997	1.000478	
183	HeNe-9	9% Ne / 91% He	224.68017	0.22301	1.0004728	211.756	0.2276	1.000516	
184	LG-9.4	9.4% CO2 / 19.25% N2 / 71.35% He	193.78311	0.50633	0.9998243	183.261	0.5523	1.000458	

O2 CONCENTRATOR GASES				25°C		0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA
197	OCG-89	89% O2 / 7% N2 / 4% Ar	204.53313	1.31033	0.9993849	190.897	1.4307	0.9990695
198	OCG-93	93% O2 / 3% N2 / 4% Ar	205.62114	1.31687	0.9993670	191.795	1.4379	0.9990499
199	OCG-95	95% O2 / 1% N2 / 4% Ar	206.16497	1.32014	0.9993580	192.241	1.4414	0.99904

STACK GASES				25°C		0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA
200	FG-1	2.5% O2 / 10.8% CO2 / 85.7% N2 / 1% Ar	175.22575	1.22550	0.9992625	165.222	1.3379	0.9990842
201	FG-2	2.9% O2 / 14% CO2 / 82.1% N2 / 1% Ar	174.18002	1.24729	0.9991056	164.501	1.3617	0.9989417
202	FG-3	3.7% O2 / 15% CO2 / 80.3% N2 / 1% Ar	174.02840	1.25520	0.9990536	164.426	1.3703	0.9988933
203	FG-4	7% O2 / 12% CO2 / 80% N2 / 1% Ar	175.95200	1.24078	0.9991842	166.012	1.3546	0.9990116
204	FG-5	10% O2 / 9.5% CO2 / 79.5% N2 / 1% Ar	177.65729	1.22918	0.9992919	167.401	1.3419	0.9991044
205	FG-6	13% O2 / 7% CO2 / 79% N2 / 1% Ar	179.39914	1.21759	0.9993996	168.799	1.3293	0.9991932

CHROMATOGRAPHY GASES				25°C		0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibility 14.696 PSIA
29	P-5	5% CH4 / 95% Ar	223.91060	1.58505	0.9993265	207.988	1.7307	0.9990036
206	P-10	10% CH4 90% Ar	221.41810	1.53622	0.9992857	205.657	1.6774	0.99895

Supported Units: This device supports many different units. You may select the desired units (see page 28). Note that only units appropriate to this device are available for selection.

Pressure Units

Absolute	Gauge	Differential	Notes
PaA	PaG	PaD	pascal
hPaA	hPaG	hPaD	hectopascal
kPaA	kPaG	kPaD	kilopascal
MPaA	MPaG	MPaD	megapascal
mbarA	mbarG	mbarD	millibar
barA	barG	barD	bar
g/cm2A	g/cm2G	g/cm2D	gram force per square centimeter
kg/cmA	kg/cmG	kg/cmD	kilogram force per square centimeter
PSIA	PSIG	PSID	pound force per square inch
PSFA	PSFG	PSFD	pound force per square foot
mTorrA	mTorrG	mTorrD	millitorr
torrA	torrG	torrD	torr
mmHgA	mmHgG	mmHgD	millimeter of mercury at 0 C
inHgA	inHgG	inHgD	inch of mercury at 0 C
mmH2OA	mmH2OG	mmH2OD	millimeter of water at 4 C (NIST conventional)
mmH2OA	mmH2OG	mmH2OD	millimeter of water at 60 C
cmH2OA	cmH2OG	cmH2OD	centimeter of water at 4 C (NIST conventional)
cmH2OA	cmH2OG	cmH2OD	centimeter of water at 60 C
inH2OA	inH2OG	inH2OD	inch of water at 4 C (NIST conventional)
inH2OA	inH2OG	inH2OD	inch of water at 60 C
atm			atmosphere
m asl			meter above sea level (only in /ALT builds)
ft asl			foot above sea level (only in /ALT builds)
V	volt; no conversions are performed to or from other units		
count	count	count	setpoint count, 0 – 64000
%	%	%	percent of full scale

Flow Units

Volumetric	Standard	Normal	Notes
uL/m	SuL/m	NuL/m	microliter per minute
mL/s	SmL/s	NmL/s	milliliter per second
mL/m	SmL/m	NmL/m	milliliter per minute
mL/h	SmL/h	NmL/h	milliliter per hour
L/s	SL/s	NL/s	liter per second
LPM	SLPM	NLPM	liter per minute
L/h	SL/h	NL/h	liter per hour
US GPM			US gallon per minute
US GPH			US gallon per hour
CCS	SCCS	NCCS	cubic centimeter per second
CCM	SCCM	NCCM	cubic centimeter per minute
cm3/h	Scm3/h	Ncm3/h	cubic centimeter per hour
m3/m	Sm3/m	Nm3/m	cubic meter per minute
m3/h	Sm3/h	Nm3/h	cubic meter per hour
m3/d	Sm3/d	Nm3/d	cubic meter per day
in3/m	Sin3/m		cubic inch per minute
CFM	SCFM		cubic foot per minute
CFH	SCFH		cubic foot per hour
	kSCFM		1000 cubic feet per minute
count	count	count	setpoint count, 0 – 64000
%	%	%	percent of full scale

True Mass Flow Units

Label	Notes
mg/s	milligram per second
mg/m	milligram per minute
g/s	gram per second
g/m	gram per minute
g/h	gram per hour
kg/m	kilogram per minute
kg/h	kilogram per hour
oz/s	ounce per second
oz/m	ounce per minute
lb/m	pound per minute
lb/h	pound per hour

These can be used for mass flow on gas devices. These can also be used for volumetric flow on liquid devices calibrated in one of these units (liquid density is not yet supported).

Totalizer Units

Volumetric	Standard	Normal	Notes
uL	SuL	NuL	microliter
mL	SmL	NmL	milliliter
L	SL	NL	liter
US GAL			US gallon
cm3	Scm3	Ncm3	cubic centimeter
m3	Sm3	Nm3	cubic meter
in3	Sin3		cubic inch
ft3	Sft3		cubic foot
	kSft3		1000 cubic feet
uP	micropoise, a measure of viscosity; no conversions are performed to or from other units		

Total Mass Units

Label	Notes
mg	milligram
g	gram
kg	kilogram
oz	ounce
lb	pound

These can be used for totalized mass on gas devices. These can also be used for totalized volume on liquid devices calibrated in one of these units (liquid density is not yet supported).

Temperature Units

Label	Notes
°C	degree Celsius
°F	degree Fahrenheit
K	Kelvin
°R	degree Rankine

Time Units

Label	Notes
h:m:s	Displayed value is hours:minutes:seconds
ms	millisecond
s	second
m	minute
hour	hour
day	day

TROUBLESHOOTING

Display does not come on or is weak.

Check power and ground connections.

Flow reading is approximately fixed either near zero or near full scale regardless of actual line flow.

Differential pressure sensor may be damaged. Avoid installations that can subject sensor to pressure drops in excess of 10 psid. A common cause of this problem is instantaneous application of high-pressure gas as from a snap acting solenoid valve upstream of the meter. If you suspect that your pressure sensor is damaged please discontinue use of the meter and contact Alicat.

Displayed mass flow, volumetric flow, pressure or temperature is flashing and message MOV, VOV, POV or TOV is displayed:

Our flow meters and controllers display an error message (MOV = mass overrange, VOV = volumetric overrange, POV = pressure overrange, TOV = temperature overrange) when a measured parameter exceeds the range of the sensors in the device. When any item flashes on the display, neither the flashing parameter nor the mass flow measurement is accurate. Reducing the value of the flashing parameter to within specified limits will return the unit to normal operation and accuracy. If the unit does not return to normal contact Alicat.

Meter reads negative flow when there is a confirmed no flow condition.

This is an indication of an improper tare. If the meter is tared while there is flow, that flow is accepted as zero flow. When an actual zero flow condition exists, the meter will read a negative flow. Simply re-tare at the confirmed zero flow condition. Also note that while the meter is intended for positive flow, it will read negative flow with reasonable accuracy, but not to the full scale flow rate (it is not calibrated for bi-directional flow) and no damage will result.

Meter does not agree with another meter I have in line.

Volumetric meters are affected by pressure drops. Volumetric flow meters should not be compared to mass flow meters. Mass flow meters can be compared against one another provided there are no leaks between the two meters and they are set to the same standard temperature and pressure. Both meters must also be calibrated (or set) for the gas being measured. M-Series mass flow meters are normally set to Standard Temperature and Pressure conditions of 25° C and 14.696 psia. Note: it is possible to special order meters with a customer specified set of standard conditions. The calibration sheet provided with each meter lists its standard conditions.

When performing this comparison it is best to use the smallest transition possible between the two devices. Using small transitions will minimize lag and dead volume.

Flow flutters or is jumpy.

The meters are very fast and will pick up any actual flow fluctuations such as from a diaphragm pump, etc. Also, inspect the inside of the upstream connection for debris such a Teflon tape shreds.

Note: PCU meters feature a programmable geometric running average (GRA) that can aid in allowing a rapidly fluctuating flow to be read (see “Pressure Averaging” and “Flow Averaging” page 16).

The output signal is lower than the reading at the display.

This can occur if the output signal is measured some distance from the meter, as voltage drops in the wires increase with distance. Using heavier gauge wires, especially in the ground wire, can reduce this effect.

RS-232 Serial Communications is not responding.

Check that your meter is powered and connected properly. Be sure that the port on the computer to which the meter is connected is active. Confirm that the port settings are correct per the RS-232 instructions in this manual (Check the RS-232 communications select screen for current meter readings). Close Hyperterminal® and reopen it. Reboot your PC. See pages 20 - 26 for more information on RS-232 signals and communications.

Slower response than specified.

PCU Meters feature a programmable Geometric Running Average (GRA). Depending on the full scale range of the meter, it may have the GRA set to enhance the stability/readability of the display, which would result in slower perceived response time. Please see “Pressure Averaging” and “Flow Averaging” on page 16.

Jumps to zero at low flow.

PCU Meters feature a programmable zero deadband. The factory setting is usually 0.5% of full scale. This can be adjusted between NONE and 6.3% of full scale. See page 16.

Discrepancies between old and new units.

Please see “Standard Gas Data Tables” explanation on page 27.

Maintenance and Recalibration

General: Portable Calibration Units require minimal maintenance. They have no moving parts. The single most important thing that affects the life and accuracy of these devices is the quality of the gas being measured. The meters are designed to measure CLEAN, DRY, NON-CORROSIVE gases.

Moisture, oil and other contaminants can affect the laminar flow elements.

Recalibration: The recommended period for recalibration is once every year. A label located on the PCU lists the most recent calibration date. The PCU should be returned to the factory for recalibration within one year from the listed date. Before calling to schedule a recalibration, please note the serial number on the back of the meter. The Serial Number, Model Number, and Date of Manufacture are also available on the Model Info display (page 19).

Cleaning: PCU meters require no periodic cleaning. If necessary, the outside of the meter can be cleaned with a soft dry cloth. Avoid excess moisture or solvents.

For repair, recalibration or recycling of this product contact:

Alicat Scientific, Inc.
7641 N Business Park Drive
Tucson, Arizona 85743
USA
Phone: 520-290-6060
Fax: 520-290-0109
e-mail: info@alicat.com
Web site: www.alicat.com

Option: Totalizing Mode - Meters

Meters can be purchased with the Totalizing Mode option. This option adds an additional mode screen that displays the total flow (normally in the units of the main flow screen) that has passed through the device since the last time the totalizer was cleared. The Totalizing Mode screen is accessed by pushing the **TOTAL/TIMER** button on the **MAIN** display.



TOTAL/TIMER: Pushing the TOTAL/TIMER button will cycle the large numbers on the display between total mass and time elapsed.

Rollover – The customer can also specify at the time of order what the totalizer is to do when the maximum count is reached. The following options may be specified:

No Rollover – When the counter reaches the maximum count it stops counting until the counter is cleared.

Rollover – When the counter reaches the maximum count it automatically rolls over to zero and continues counting until the counter is cleared.

Rollover with Notification – When the counter reaches the maximum count it automatically rolls over to zero, displays an overflow error, and continues counting until the counter is cleared.

TOTAL MASS: The counter can have as many as seven digits. At the time of order, the customer must specify the range. This directly affects the maximum count. For instance, if a range of 1/100ths of a liter is specified on a meter which is totalizing in liters, the maximum count would be 99999.99 liters. If the same unit were specified with a 1 liter range, the maximum count would be 9999999 liters.

ELAPSED TIME: The small numbers below the mass total show the elapsed time since the last reset in hours, minutes and seconds. The maximum measurable elapsed time is 9999 hours 59 minutes 59 seconds. The hours count resets when **RESET** is pushed, an RS-232 clear is executed or on loss of power. Press **TOTAL/TIMER** to show this as the primary display.

SETPT: Pushing SETPT will allow you to change the controller's set-point.

RESET – The counter can be reset to zero at any time by pushing the RESET button. To clear the counter via RS-232, establish serial communication with the meter or controller as described in the RS-232 or RS-485 section of the manual. To reset the counter, enter the following commands:

In Polling (addressable) Mode: Address\$\$T <Enter> (e.g. B\$\$T <Enter>)

Accessory: Flow Vision™ SC Software

Flow Vision™ SC is an intuitive software interface to help your test cycles run smoother and shorten your engineering time!

Flow Vision™ SC lets you connect to and communicate with multiple Alicat units simultaneously. Now you can view virtual displays, control tabs, charts and data lines from every connected Alicat device on the same screen.

Flow Vision™ SC supports all RS-232 and RS-485 Serial communication functions, including: **gas selection, taring, set-point control, valve tuning and flow averaging.**

Session Saving: Save and reload your configuration data with confidence.

Script Building: Create scripts to adjust a controller's set-point value at variable specified time intervals.

Charting: Chart as many parameters as you want off as many devices as you want, with color coding, zooming, and printing functionality.

Alarms: Create software alarms that will notify you of given parameter conditions.

Data Capture & Logging: Capture and log data to either a .csv file or a .txt file. Improved Data Logging and Data Log File Splitting for easy to manage data.

Accessory: Flow Vision™ MX Software

Alicat's New Flow Vision™ MX software gives you an easy way to do GAS BLENDING using Alicat Mass Flow Controllers and your own PC.

Flow Vision™ MX software is a simple way to connect up to six Alicat mass flow controllers and create your own gas mix concentrations.

Using our inexpensive **BB9-USB** and a single USB connection you can:

- **Create** your own gas blends
- **Adjust** flow rates
- **Save** your specific blend formulas.

All the controllers can be powered through the BB9-USB with a single power supply.

Just connect your unique gases to each controller, select the gas type either locally on the controller or through Flow Vision™ MX, manifold the flow outputs and create your gas mix.

Accessories

Part Number	Description
FLOWVISIONSC	Flow Vision™ SC software for interface with all Alicat instruments
FLOWVISIONMX	Flow Vision™ MX software for gas blending
BB9	9 position Multi-Drop Box
BB9-I	9 position Multi-Drop Box, Industrial connectors
PVPS24U	Universal 100-240 VAC to 24 Volt DC Power Supply Adapter
PS24VHC	High current power supply for BB9 use with Large Valve Controllers
PCASE	Industrial carry and storage case for portable meters/gauges
DC-61	8 Pin Male Mini-DIN connector cable, single ended, 6 foot length
DC-251	8 Pin Male Mini-DIN connector cable, single ended, 25 foot length
DC-301	8 Pin Male Mini-DIN connector cable, single ended, 30 foot length
DC-501	8 Pin Male Mini-DIN connector cable, single ended, 50 foot length
DC-751	8 Pin Male Mini-DIN connector cable, single ended, 75 foot length
DC-6RT	8 Pin Male Right Angle Mini-Din Cable, single ended, 6 foot length
DC-62	8 Pin Male Mini-DIN connector cable, double ended, 6 foot length
DC-252	8 Pin Male Mini-DIN connector cable, double ended, 25 foot length
DC-502	8 Pin Male Mini-DIN connector cable, double ended, 50 foot length
DC-602	8 Pin Male Mini-DIN connector cable, double ended, 60 foot length
MD8DB9	8 Pin Male Mini-DIN to DB9 Female Adapter, 6 foot length
DBC-251	DB15 cable, single ended, 25 foot length
510199	DB9 cable, double-ended female, 3 meter length
IC10	Industrial cable, 6 Pin, single ended, 10 foot length
IC10-18G	18 gauge industrial cable, 6 Pin, single ended, 10 foot length
IC20	Industrial cable, 6 Pin, single ended, 20 foot length
IC24-18G	18 gauge industrial cable, 6 Pin, single ended, 24 foot length
IC50	Industrial cable, 6 Pin, single ended, 50 foot length
IC-102	Industrial cable, 6 pin double ended, 10 foot length
USB-RS232	RS-232 to USB Converter

Accessories

MNPT to Compression Fittings	
10-32 - 1/8"	SS-200-1-0157
10-32 - 1/4"	SS-400-1-0256
1/8" - 1/8"	SS-200-1-2
1/8" - 1/4"	SS-400-1-2
1/8" - 3/8"	SS-600-1-2
1/8" - 1/2"	SS-810-1-2
1/8" - 3mm	SS-3M0-1-2
1/8" - 4mm	SS-4M0-1-2
1/8" - 6mm	SS-6M0-1-2
1/8" - 8mm	SS-8M0-1-2
1/8" - 12mm	SS-12M0-1-2
1/4" - 1/8"	SS-200-1-4
1/4" - 1/4"	SS-400-1-4
1/4" - 3/8"	SS-600-1-4
1/4" - 1/2"	SS-810-1-4
1/4" - 3mm	SS-3M0-1-4
1/4" - 4mm	SS-4M0-1-4
1/4" - 6mm	SS-6M0-1-4
1/4" - 8mm	SS-8M0-1-4
1/4" - 12mm	SS-12M0-1-4
1/2" - 1/8"	SS-200-1-8
1/2" - 1/4"	SS-400-1-8
1/2" - 3/8"	SS-600-1-8
1/2" - 1/2"	SS-810-1-8
1/2" - 3/4"	SS-1210-1-8
1/2" - 6mm	SS-6M0-1-8
1/2" - 8mm	SS-8M0-1-8
1/2" - 12mm	SS-12M0-1-8
1/2" - 16mm	SS-16M0-1-8
3/4" - 1/4"	SS-400-1-12
3/4" - 1/2"	SS-810-1-12
3/4" - 3/4"	SS-1210-1-12
3/4" - 12mm	SS-12M0-1-12
3/4" - 16mm	SS-16M0-1-12

Filters & Elements FNPT-MNPT	
10-32 5μ	510053
10-32 20μ	510054
1/8" 20μ	ILF-1/8-20
1/4" 40μ	ILF-1/4-40
1/2" 40μ	ILF-1/2-40*
3/4" 40μ	ILF-3/4-40*
20μ element	ILFE20
40μ element	ILFE40
40μ element	ILFE40L*

Filters & Elements FNPT-FNPT*	
10-32 5μ	CF-303-20-316
*requires MNPT to MNPT coupler to interface with Alicat flow bodies	

10-32 Male UNF to 1/8 FNPT Adapter	
410133	
Male M5 (10-32) Buna-N O-ring face seal to 1/8" Female NPT	

Information for Alicat TFT (Color Display) Instruments

Alicat TFT (color display) instruments have a high contrast back-lit LCD display. TFT instruments operate in accordance with Alicat standard operating instructions for our monochrome menus and displays with the following differences.

Multi-Color Display Color Codes:

GREEN: Green labels identify the parameters and/or adjustments associated with the button directly above or below the label.

WHITE: The color of each parameter is displayed in white while operating under normal conditions.

RED: The color of a parameter is displayed in red when operating conditions for that parameter exceed 128% of the device's specifications.

YELLOW: Yellow is the equivalent of the selection arrow on the monochrome display.

LCD Contrast:

LCD contrast is ranged from 0 to 11 on color displays with 11 being the greatest contrast.

Display On/Off:

Pushing the button under the Alicat name will turn the device display on or off. This feature is not available on monochrome displays.



NOTE: A color display will result in significantly reduced battery life in PCU and portable instruments.

Technical Data for TFT (Color Display) Meters, Gauges and Controllers

The following specifications are applicable to Alicat **TFT** (color display) meters, gauges and controllers only. All other operating specifications are shown in the Technical Data page for standard Alicat instruments. All standard device features and functions are available and operate in accordance with the Alicat operating manual provided with the device.

Specification	Meter or Gauge	Small Valve Controller	Large Valve Controller
Supply Voltage	7 to 30 Vdc	12 to 30 Vdc	24 to 30 Vdc
Supply Current	80 mA @ 12Vdc 70 mA @ 24Vdc	290 mA @ 12Vdc 200 mA @ 24Vdc	780 mA @ 24Vdc

Technical Data for Alicat PCU Mass Flow Meters

M Series 0 to 0.5 sccm Full Scale through 0 to 1500 slpm Full Scale

Whisper 0 to 0.5 sccm Full Scale through 0 to 250 slpm Full Scale

Standard Operating Specifications (Contact Alicat for available options)

Performance	PCU Mass Flow Meter
Accuracy at calibration conditions after tare	± (0.8% of Reading + 0.2% of Full Scale)
High Accuracy at calibration conditions after tare	± (0.4% of Reading + 0.2% of Full Scale) High Accuracy option not available for units ranged under 5 sccm or over 500 slpm.
Repeatability	± 0.2% Full Scale
Zero Shift and Span Shift	0.02% Full Scale / °Celsius / Atm
Operating Range / Turndown Ratio	0.5% to 100% Full Scale / 200:1 Turndown
Maximum Measurable Flow Rate	128% Full Scale
Typical Response Time	10 ms (Adjustable)
Warm-up Time	< 1 Second

Operating Conditions	PCU Mass Flow Meter
Mass Reference Conditions (STP)	25 °C & 14.696 psia (standard — others available on request)
Operating Temperature	-10 to +50 °Celsius
Humidity Range (Non-Condensing)	0 to 100%
Maximum Pressure	M Series: 145 psig Whisper: 50 psig ¹
Ingress Protection	IP40
Wetted Materials	303 & 302 Stainless Steel, Viton®, Heat Cured Silicone Rubber, Glass Reinforced Polyphenylene Sulfide, Heat Cured Epoxy, Aluminum, Gold, Silicon, Glass. If your application demands a different material, please contact Alicat.
1. Do Not subject a WHISPER Differential Pressure sensor to upstream-downstream pressure differentials exceeding 15 psid.	

Communications / Power	PCU Mass Flow Meter
Monochrome LCD Display with integrated touchpad	Simultaneously displays Mass Flow, Volumetric Flow, Pressure and Temperature
Digital Output Signal ¹	RS-232 Serial
Electrical Supply	Two 9 Vdc batteries 9-20 Vdc wall outlet adaptor minimum 150 mA
1. The Digital Output Signal communicates Mass Flow, Volumetric Flow, Pressure and Temperature	

Range Specific Specifications

FS Flow M-Series Meter	Pressure Drop at FS Flow (psid)*
0.5 sccm to 1 sccm	1.0
2 sccm to 50 sccm	1.0
100 sccm to 20 slpm	1.0
50 slpm	2.0
100 slpm	2.5
250 slpm	2.1
500 slpm	4.0
1000 slpm	6.0
1500 slpm	9.0
*Venting to atmosphere	

FS Flow Whisper Meter	Pressure Drop at FS Flow (psid)*
0.5 sccm to 2 sccm	0.06
5 sccm to 20 sccm	0.07
50 sccm	0.07
100 sccm to 200 sccm	0.06
500 sccm	0.07
1 slpm to 5 slpm	0.07
10 slpm	0.08
20 slpm	0.25
40 slpm	0.12
50 slpm	0.14
100 slpm	0.24
250 slpm	0.60
*Venting to atmosphere	

No charge for alternate full scale ranges to increase accuracy (e.g. 2.5 slpm) or alternate units of measure (e.g. 133 scfh).

Full Scale range applies for all gases and mixtures in the tables (pages 28-35).

Weight: 12 - 20 lb depending on configuration

PCU Case Dimensions: 16" L x 13" W x 7" H

Process Connections: 1/8", 1/4", 3/8" or 1/2" push-connect style tubing fittings

Serial Number: _____

Model Number: _____

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Note: Although we provide assistance on Alicat Scientific products both personally and through our literature, it is the complete responsibility of the user to determine the suitability of any product to their application.

Limited Lifetime Warranty

Alicat Scientific, Inc. warrants to the original purchaser (hereinafter referred to as "Buyer") that instruments manufactured by Alicat Scientific (hereinafter referred to as "Product") shall be free from defects in materials and workmanship for the life of the Products.

Under this warranty, the Products will be repaired or replaced at manufacturer's option, without charge for parts or labor when the Product is carried or shipped prepaid to the factory together with proof of purchase. The foregoing shall constitute the exclusive and sole remedy in lieu of other remedies of the Buyer for any breach by Alicat Scientific of this warranty to the maximum extent permitted by law.

This warranty does not apply to any Product which has not been installed or used in accordance with the Product operation and installation specifications provided to Buyer verbally or in writing by Alicat Scientific for the proper and normal use of the Product.

Buyer agrees hereunder that Alicat reserves the right to void any warranty, written or implied, if upon Alicat's examination of Product shall disclose to Alicat's satisfaction that the Product failure was due solely, or in part, to accident, misuse, neglect, abuse, alteration, improper installation, unauthorized repair or improper testing by Buyer or agent of Buyer.

Alicat Scientific shall not be liable under any circumstances for indirect, special, consequential, or incidental damages in connection with, or arising out of, the sale, performance, or use of the Products covered by this warranty.

Alicat Scientific does not recommend, warrant or assume responsibility for the use of the Products in life support applications or systems.

Alicat's warranties as herein above set forth shall not be enlarged, diminished or affected by, and no obligation or liability shall arise or grow out of Alicat's rendering of technical advice in connection with Buyer's order of the Products furnished hereunder.

If Product becomes obsolete, Alicat Scientific, at its own discretion, reserves the right to repair the Product with available replacement parts or upgrade the Product to a current, commercially available version of the original Product. Should upgrading the Product be deemed necessary by Alicat, Buyer hereby agrees to pay an upgrade fee equal to seventy percent of the retail value of the replacement Product. Alicat Scientific hereunder makes no claim that replacement Products will look, function or operate in the same or similar manner as the original product.

When a Product is returned to Alicat Scientific for recalibration this service is considered normal preventative maintenance. Recalibration of Product shall not be treated as a warranty service unless recalibration of Product is required as the result of repairs to Product pursuant to this Warranty. Failure of Buyer to send Product to Alicat Scientific for recalibration on a yearly basis after a period of 36 months from date of manufacture will remove any and all obligations regarding repair or replacement of Product as outlined by this Warranty to Buyer from Alicat Scientific.

This Warranty is in lieu of all other relevant warranties, expressed or implied, including the implied warranty of merchantability and the implied warranty of fitness for a particular purpose, and any warranty against infringement of any patent.

Continued use or possession of Products after expiration of the applicable warranty period stated above shall be conclusive evidence that the warranty is fulfilled to the full satisfaction of Buyer.

Alicat makes no warranty as to experimental, non-standard or developmental Products.

Accessories purchased from Alicat are not covered by this warranty.

Conformity / Supplemental Information:

The product complies with the requirements of the Low Voltage Directive 2006/95/EC and the EMC Directive 2004/108/EC and carries the CE Marking accordingly. Contact the manufacturer for more information.

Gas Viscosity, Density and Compressibility:

#	Gas	Absolute Viscosity* 25°C	Density ** 25°C	Compressibility 25°C
0	Air	184.8989	1.1840	0.9997
1	Argon	226.2399	1.6339	0.9994
2	Methane	110.7595	0.6569	0.9982
3	Carbon Monoxide	176.4933	1.1453	0.9996
4	Carbon Dioxide	149.3184	1.8080	0.9950
5	Ethane	93.5412	1.2385	0.9924
6	Hydrogen	89.1535	0.08235	1.0006
7	Helium	198.4561	0.16353	1.0005
8	Nitrogen	178.0474	1.1453	0.9998
9	Nitrous Oxide	148.4124	1.8089	0.9945
10	Neon	311.1264	0.8244	1.0005
11	Oxygen	205.5021	1.3088	0.9994
12	Propane	81.4631	1.8320	0.9838
13	normal-Butane	74.0536	2.4493	0.9699
14	Acetylene	104.4480	1.0720	0.9928
15	Ethylene	103.1839	1.1533	0.9943
16	iso-Butane	74.7846	2.4403	0.9735
17	Krypton	251.3249	3.4323	0.9979
18	Xenon	229.8483	5.3950	0.9947
19	Sulfur Hexafluoride	153.5320	6.0383	0.9887

Flow Conversions:

SCFM	1.00 = 28.3160	SLPM	SLPM	100.00 = 3.5316	SCFM
SCFH	1.00 = 0.4719	SLPM	SLPM	100.00 = 211.9093	SCFH
SCIM	100.00 = 1.6390	SLPM	SLPM	1.00 = 61.0128	SCIM
SCIH	1000.00 = 0.2732	SLPM	SLPM	1.00 = 3660.7688	SCIH

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#	Gas	Absolute Viscosity* 25°C	Density ** 25°C	Compressibility 25°C
20	75%Ar / 25% CO2	206.9763	1.6766	0.9987
21	90%Ar / 10% CO2	218.6026	1.6509	0.9991
22	92% Ar / 8% CO2	220.1352	1.6475	0.9992
23	98% Ar / 2% CO2	224.7148	1.6373	0.9993
24	75% CO2 / 25% Ar	168.2250	1.7634	0.9966
25	75% Ar / 25% He	231.6056	1.2660	0.9997
26	75% He / 25% Ar	234.6860	0.5308	1.0002
27	90% He / 7.5% Ar / 2.5% CO2 Helistar® A1025	214.9760	0.3146	1.0003
28	90% Ar / 8% CO2 / 2% O2 Star29	219.7934	1.6410	0.9992
29	95% Ar / 5% CH4 Star29 @ CS	223.9106	1.5850	0.9993

*In micropoise (1 Poise = gram / (cm) (sec))

**Grams/Liter

Reference: NIST REFPROP 9 Database



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