

Sierra Series 740

Flo-Trak™ Exhaust Flow Controller

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REV. A
Part Number: IM-74-AM

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CUSTOMER CAUTION
RE: OXYGEN SERVICE

Sierra Instruments, Inc., is not liable for any damages or personal injury, whatsoever, resulting from the use of Sierra Instruments' Mass Flow Meters or Controllers for oxygen gas. Although Sierra does clean its mass flow meters and controllers prior to shipment, we make no claim or warranty that its cleanliness renders it safe for oxygen service. The customer must clean Sierra's Mass Flow Meters or Controllers to the degree that they require for their oxygen flow applications.

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This instruction manual applies to Accu-Mass™ Series Mass Flow Systems, Transducers, and Transmitters. The part number on each unit fully describes the unit.

This manual is not intended to be an inclusive dissertation of operating theory or trouble shooting, but simply instructions for the user on the basics of the use of our systems, along with a few brief suggestions on troubleshooting.

1
INTRODUCTION

The gas mass flow enters the flow body and goes through a precision flow nozzle within the flow body and exits the system. Within the flow body is the Accu-Mass™ flow sensor which senses the flow.

The Accu-Mass™ flow sensor is a self-heated platinum resistance temperature detector (RTD) immersed in the flow. Another RTD senses the temperature of the gas and automatically maintains the velocity sensor at a constant temperature differential above ambient. The unexcelled stability and reproducibility of RTDs have made them the standard of NIST. The cooling effect of the gas as it passes over the heated sensor is measured by the bridge voltage. The resulting non-linear voltage/mass flow curve provides excellent rangeability and low flow sensitivity. Since the heat is carried away by the molecules in the gas, the sensor measures gas mass flow, referenced to standard conditions (70°F and 1 atmosphere). Direct measurement of mass flow means no temperature or pressure corrections are required a disadvantage of other flow meters.

2
**PRINCIPLE OF
OPERATION**

3
PLUMBING
HOO-K-UP

Good engineering practice dictates that 20 pipe diameters of straight pipe with the same pipe size as the flow body be installed on the inlet side of the flow body. An absolute minimum of 5 pipe diameters may be used with the chance of calibration accuracy degradation. The outlet side should have 10 pipe diameters of straight pipe with the same pipe size as the flow body. The purpose of the long entry length is to disperse the jet of air from a smaller inlet fitting. This can be done with screens alone or a screen with 90° elbows.

In cases where it is impossible to follow those guidelines, use a 90° elbow at five pipe diameters upstream and/or use screens to help “flatten” and “homogenize” the flow prior to entering the flow body.

4 CALCULATING VOLUMETRIC FLOW RATE

Sierra's Accu-Mass™ sensor measures the *mass* flow of gas, referenced to 70°F and 1 atmosphere. The units of measurement are either standard liters per minute (SLPM), standard cubic feet per minute (SCFM), or standard cubic centimeters per minute (SCCM). Gas mass flow, the quantity required for most applications, is measured directly by the readout meter or the output voltage indication. In cases where the volumetric flow rate (at the actual temperature and pressure at the time of measurement) is desired, a simple correction is required. In this case, the volumetric flow rate is in units of liters per minute (LPM), cubic feet per minute (CFM), or cubic centimeters per minute (CCM). The required correction factor is given in the following equation:

$$Q = Q_s \left(\frac{\rho_s}{\rho} \right) = Q \left(\frac{P_s}{P} \right) \left(\frac{T}{T_s} \right) \quad (1)$$

where

- Q = volumetric flow rate at "actual" conditions of ρ , P, and T (LPM, CFM, or CCM),
- Q = mass flow rate referenced to "standard" conditions of ρ_s , P_s , and T_s (SLPM, SCFM, or SCCM),
- ρ = air mass density at actual conditions, g/cc,
- ρ_s = air mass density at standard conditions, = 1.189×10^{-3} g/cc,
- T = absolute air temperature at actual conditions, °K,
- T_s = standard air temperature = 298°C,
- P = air pressure at actual conditions, atmospheres (or psia) and
- P_s = standard air pressure = 1 atmosphere (14.7 psia).

Example calculation:

If the flow meter indicates a reading of 20 SLPM and the actual air temperature is 50°C and the pressure -3 psig, the volumetric flow rate is calculated as follows, from equation (1):

$$Q = 20 \left(\frac{14.7}{14.7 - 3} \right) \left(\frac{50 + 273}{298} \right) = 27.2 \text{ LPM}$$

Typical problems and solutions are given in this section and following table. If other problems arise, or if the suggested action does not cure the problem, return your complete system to the factory for repair.

5 TROUBLE- SHOOTING

5.1 Troubleshooting Guide

Problem	Possible Cause	Action
Measurement seems low	A. Probe not oriented properly B. Sensors covered with contaminate	A. Orient probe with respect of flow B. Clean sensors
Measurement is erratic	A. Unsteady flow B. Sensor is broken C. Probe not aligned with flow D. Probe is not secured to a solid base	A. Install at least 10 pipe diameters of straight pipe, an in-line filter, or screen upstream B. Return flow body and meter to factory for repair or replacement and recalibration C. Check that flow arrow is facing in the right direction. Check that window in probe is open to flow D. Secure probe to a non-vibrating solid mount
Output pegs plus or minus	A. Flow body not plugged in B. Sensor is broken C. Liquid in line D. Bridge drive transistor is shorted	A. Plug in both connectors B. Return flow body and meter to factory for repair or replacement and recalibration C. Ensure that gas is dry D. Replace with same type transistor (available from Sierra) or return to factory
System won't zero	A. Out of calibration	A. Return flow body and meter to factory for repair or replacement and recalibration

FLOW RANGE

NPT SIZE	FLOW RANGES
¼"	20-200 SCCM to 0-4.5 SCFM
½"	0-15 SLPM to 0-12 SCFM
¾"	0-1 SCFM to 0-25 SCFM
1¼"	0-2 SCFM to 0-50 SCFM
2"	0-5 SCFM to 0-125 SCFM
3"	0-10 SCFM to 0-250 SCFM

Note: The above flow ranges are minimum and maximum ranges. You may specify other flow rates or units of measurement.

GAS

Air, nitrogen, natural gas, CO₂, Argon, Helium, Propane. Consult factory for other gases

OUTPUT SIGNAL

(Linearly Proportional to Mass Flow or Velocity). 0-5 VDC standard, 1000 ohms min. load resistance; 4-20 mA sourcing, total loop resistance, 150 ohm maximum, 450 ohm maximum.

INPUT POWER

+15 VDC; 1.5 A peak; .25 A continuous; .05 V noise and ripple
 -15 VDC; 1.5 A peak; 0.1 A continuous; .05 V noise and ripple
 System Electronics:
 115± 10% VAC, 60 hz, 10 watts or
 230± 10% VAC, 50 hz, 10 watts

ACCURACY

2% FS over ± 50° F and ± 20 PSI
 from customer specified conditions.*
 Temperature Range -40 to 250° F and -40 to 450° F (HT2) Pressure
 up to 400 PSI

REPEATABILITY

0.2% FS⁽¹⁾

VALVE RESPONSE

4 seconds (typical) to within 3% of set point or better

GAS PRESSURE

400 psig (10kg/cm G) max

GAS TEMPERATURE

Standard -40 to 250°F (-40 to 125°C); or "HT1" Option: 32 to 450°F
 (0-230° C)

ELECTRONICS OPERATING TEMPERATURE

32 to 122°F (0 to 50°C)

ELECTRONICS RELATIVE HUMIDITY

5-80%, non-condensing

ELECTRONICS STORAGE TEMPERATURE

32-158°F (0-70°C)

WETTED MATERIALS

Accu-Mass sensor; glass-coated sensor; epoxy; Viton "O"-Rings;
SS flow body.

DIGITAL READOUT

(Mass Flow in Engineering Units)

3½ digit LCD display (13 mm H); mounted in remote Single- or Dual-
Channel Electronics, 5 Channel Flo-Box Electronics, or power supply/
readout; stand-alone digital panel meter optional

ATTITUDE SENSITIVITY

None

ELECTRONICS

Transducer Mounted Electronics:

Aluminum NEMA 2 enclosure standard; Cast enclosure NEMA 4
optional.

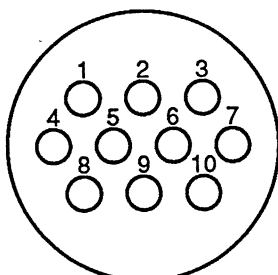
NOTES:

(1) FS=Full Scale; R=Reading

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Flo-Box-Sierra Instruments, Inc.

**For conditions beyond these ranges, please consult factory.*

APPENDIX A



Motor Operator
Connector Assembly
(Female Connector
Solder Side)

PIN NO.	DESCRIPTION	WIRE COLOR	Motor Operated Valve-Circular 10-Pin Connector
1	+15 VDC power	Red	
2	Common power supply return	Black	
3	-15 VDC power	Green	
4	Motor common	Blue	
5, 6, 7	Not Used	—	
8	Setpoint input 0-5 volts equals 0-100% flow, linear. Load impedance 2k ohms.	Brown or Orange	
9	Flow output signal 0-5 volts equals 0-100% flow, linear. Minimum load impedance 2k ohms.	Yellow or White	
10	4-20 mA Signal *	White	

* 4-20mA outputs must be returned to common. Please refer to the instruction manual for details. Load must be in the range of 50 to 100 ohms.