Installation and Operation Manual
X-TMF-5850i-MFC-eng
Part Number: 541B108AAG
December, 2008

Model 5850*i* Mass Flow Controller

Essential Instructions

Read this page before proceeding!

Brooks Instrument designs, manufactures and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you must properly install, use and maintain them to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, using and maintaining Brooks Products.

- Read all instructions prior to installing, operating and servicing the product. If this instruction manual is not the correct manual, please see back cover for local sales office contact information. Save this instruction manual for future reference.
- If you do not understand any of the instructions, contact your Brooks Instrument representative for clarification.
- Follow all warnings, cautions and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation and maintenance of the product.
- Install your equipment as specified in the installation instructions of the appropriate instruction manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Brooks Instrument. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look-alike substitutions may result in fire, electrical hazards or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury.

Pressure Equipment Directive (PED)

All pressure equipment with an internal pressure greater than 0.5 bar (g) and a size larger than 25mm or 1" (inch) falls under the Pressure Equipment Directive (PED). The Directive is applicable within the European Economic Area (EU plus Norway, Iceland and Liechtenstein). Pressure equipment can be traded freely within this area once the PED has been complied with.

- Section 1 of this manual contains important safety and operating instructions related to the PED directive.
- Meters described in this manual are in compliance with EN directive 97/23/EC module H *Conformity Assessment.*
- All Brooks Instrument Flowmeters fall under fluid group 1.
- Meters larger than 25mm or 1" (inch) are in compliance with category I, II, III of PED.
- Meters of 25mm or 1" (inch) or smaller are Sound Engineering Practice (SEP).

ESD (Electrostatic Discharge)

⚠ CAUTION

This instrument contains electronic components that are susceptible to damage by static electricity. proper handling procedures must be observed during the removal, installation or other handling of internal circuit boards or devices.

Handling Procedure:

1. Power to unit must be removed.
2. Personnel must be grounded, via a wrist strap or other safe, suitable means before any printed circuit card or other internal device is installed, removed or adjusted.
3. Printed circuit cards must be transported in a conductive container. Boards must not be removed from protective enclosure until immediately before installation. Removed boards must immediately be placed in protective container for transport, storage or return to factory.

Comments

This instrument is not unique in its content of ESD (electrostatic discharge) sensitive components. Most modern electronic designs contain components that utilize metal oxide technology (NMOS, SMOS, etc.). Experience has proven that even small amounts of static electricity can damage or destroy these devices. Damaged components, even though they appear to function properly, exhibit early failure.

Dear Customer,

We appreciate this opportunity to service your flow measurement and control requirements with a Brooks Instrument device. Every day, flow customers all over the world turn to Brooks Instrument for solutions to their gas and liquid low-flow applications. Brooks provides an array of flow measurement and control products for various industries from biopharmaceuticals, oil and gas, fuel cell research and chemicals, to medical devices, analytical instrumentation, semiconductor manufacturing, and more.

The Brooks product you have just received is of the highest quality available, offering superior performance, reliability and value to the user. It is designed with the ever changing process conditions, accuracy requirements and hostile process environments in mind to provide you with a lifetime of dependable service.

We recommend that you read this manual in its entirety. Should you require any additional information concerning Brooks products and services, please contact your local Brooks Sales and Service Office listed on the back cover of this manual or visit www.BrooksInstrument.com

Yours sincerely,

Brooks Instrument

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1-1 Purpose

The Brooks® Model 5850*i* Mass Flow Controller is a mass flow measurement device designed for accurately measuring and rapidly controlling flows of gases. This instruction manual is intended to provide the user with all the information necessary to install, operate and maintain the Brooks 5850*i* Mass Flow Controller. This manual is organized into five sections:

Section 1	Introduction
Section 2	Installation
Section 3	Operation
Section 4	Maintenance
Section 5	Parts List

It is recommended that this manual be read in its entirety before attempting to operate or repair the Model 5850*i*.

1-2 Description

The Brooks Model 5850*i* Mass Flow Controller is used widely in the Semiconductor Industry as well as many others, where manual, electronic or computer controlled gas handling occurs. The Model 5850*i* consists of three basic units: a flow sensor, a control valve and an integral electronic control system. This combination produces a stable gas flow, which eliminates the need to continuously monitor and readjust gas pressures. Standard features include:

Fast Response Control permits rapid gas settling times with little or no over/undershoot. Refer to Figure 1-1.

Soft Start provides a flow ramping function which slows down the introduction of the process gas for those processes which cannot tolerate rapid flow transition. Refer to Section 2-7 and Figure 1-2.

Valve Override permits the user to fully open and close the control valve independent of the setpoint (command) setting. Refer to Section 2-6.

Setpoint (Command) permits the user to program the mass flow controller with an external 0-5 Vdc or 4-20 mAdc signal. Refer to Section 2-6.

Low Command Valve Inhibit (Auto Shutoff) prevents the valve from opening whenever the setpoint is less than 2% of full scale.

Removable Cleanable Sensor permits the user to clean or replace the sensor. Refer to Section 4-4.

Output Limiting prevents possible damage to delicate data acquisition devices by limiting the output to -0.7 Vdc and +6.8 Vdc on the voltage signal output and 0 to 26 mA on the current output.

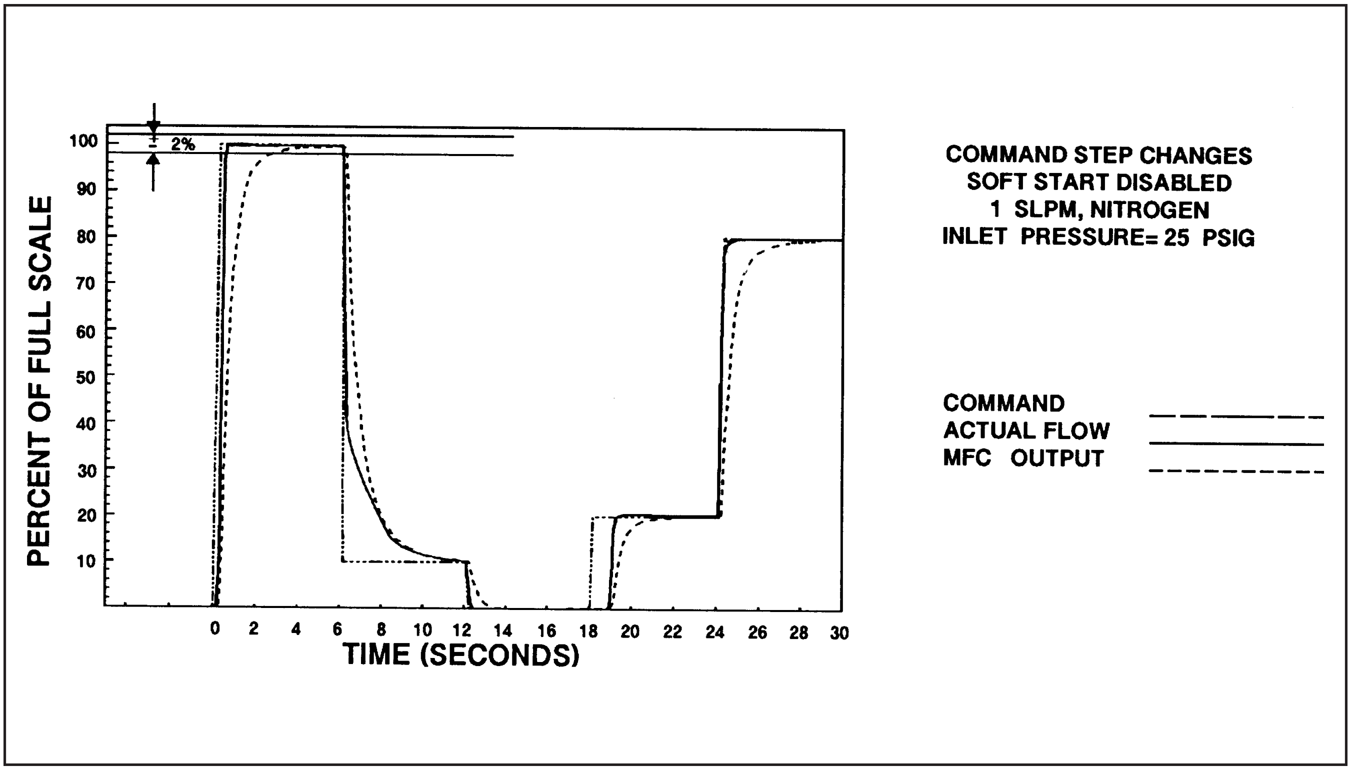

Figure 1-1 Command Steps, Soft Start Disabled

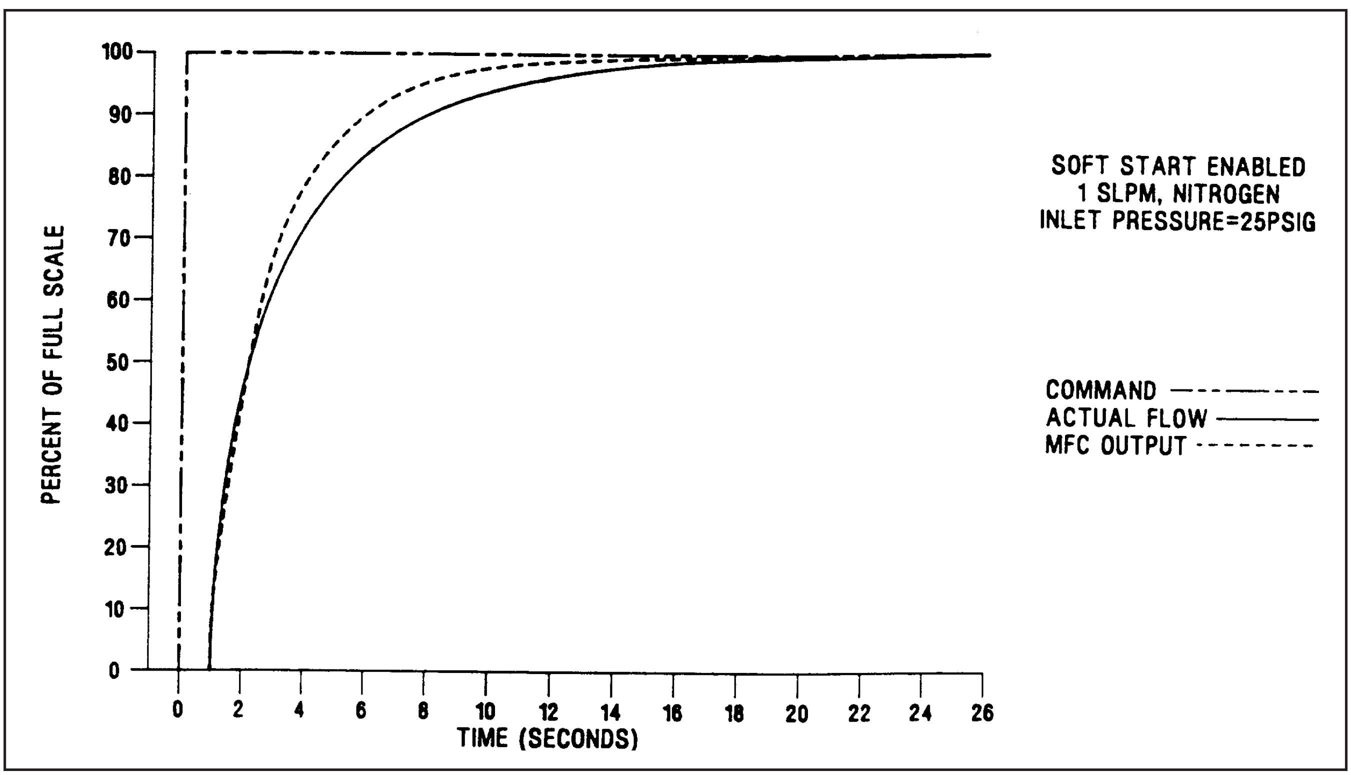

Figure 1-2 0 - 100% Command Step, Soft Start Enabled

1-3 Specifications

⚠ WARNING

Do not operate this instrument in excess of the specifications listed below. Failure to heed this warning can result in serious personal injury and/or damage to the equipment.

Standard Ranges

3 sccm to slpm* (nitrogen equivalent)

Accuracy

±1% full scale including linearity at calibrated conditions

±1.5% full scale including linearity for flow ranges greater than 20 slpm.

Repeatability

0.25% of rate

Response Time

Less than 6 seconds to within 2% of full scale final value with a 0 to 100% command step.

Power Requirements

+15 to +28 Vdc — 245 mA @ +15 Vdc to 370 mA @ +28 Vdc

Ambient Temperature Limits

Operating: 5 to 65°C (40 to 150°F)

Non-Operating: -25 to 100°C (-13 to +212°F)

Working Pressure

1500 psi (10.342 MPa) maximum

Allowable Differential Pressure

5 psi minimum, 50 psi maximum. Higher differential pressures are allowable depending on gas and range. Consult factory for details.

Output Signal

0-5 Vdc into 2,000 ohms or greater. Maximum ripple 3 mV.

Jumper selectable 4-20 mAdc or 0-20 mAdc.

Refer to Fig. 2-3 for maximum total loop resistance.

5 Volt Reference Output

5 Volts ±0.2%. Maximum load 1k ohms.

Temperature Sensitivity

Zero: Less than ±0.075% full scale per degree C.

Span: Less than ±1.0% full scale shift over 10-50°C range.

Mounting Attitude Sensitivity

±0.5% maximum full scale deviation after re-zeroing.

Command Input

Jumper Selectable: 0-5 Vdc, Input resistance 200k ohm or 4-20 mAdc, Input resistance 75 ohm.

Leak Integrity

1 x 10^{-9} Atm. scc/sec Helium

Control Range

50 to 1

Mechanical Connection

Interchangeable with most popular mass flow controllers.

Refer to Figure 2-1.

Electrical Connections

D-type, 15-pin connector (DA-15P). Mating connector supplied.

*Standard temperature and pressure in accordance with SEMI (Semiconductor Equipment and Materials International) standard: 0°C and 101.3 kPa (760 Torr). The mass flow controller can be calibrated to other reference standard conditions. Specify at time of ordering.

2-1 Receipt of Equipment

When the equipment is received, the outside packing case should be checked for damage incurred during shipment. If the packing case is damaged, the local carrier should be notified at once regarding his liability. A report should be submitted to the Product Service Department, Brooks Instrument, Hatfield, Pennsylvania 19440-0903.

Remove the envelope containing the packing list. Carefully remove the equipment from the packing case. Make sure spare parts are not discarded with the packing materials. Inspect for damaged or missing parts.

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2-2 Recommended Storage Practice

If intermediate or long-term storage is required for equipment as supplied by Brooks Instrument, it is recommended that said equipment be stored in accordance with the following:

a. Within the original shipping container.

b. Store in a sheltered area with the following conditions:

1. Ambient temperature 21°C (70°F) nominal.
2. Relative humidity 45% nominal, 60% maximum/25% minimum. Upon removal from storage, a visual inspection should be conducted to verify its condi-tion is “as received.” If the equipment has been in storage for an excess of ten (10) months or in conditions in excess of those recommended, all pressure boundary seals should be replaced and the device subjected to a pneumatic pressure test in accordance with applicable vessel codes.

2-3 Return Shipment

Prior to returning any Brooks equipment to the factory, contact the factory - for a Return Materials Authorization Number (RMA#). This can be obtained at Brooks Instrument, Product Service Department, 407 West Vine Street, Hatfield, PA 19440-0903, or call toll free 1-888-554-FLOW (3569).

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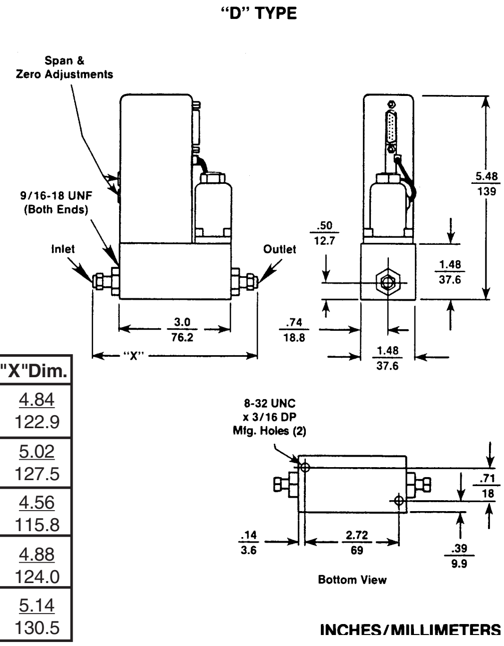
Email: BrooksAs@BrooksInstrument.com

Also, completion of Form RPR003-1, Brooks Instrument Decontamination Statement, as well as, a Material Safety Data Sheet (MSDS) for the fluid(s) used in the meter, is required before any Brooks Personnel can begin processing the equipment. Copies of the form can be obtained at one of the locations above.

2-4 Gas Connections

Standard inlet and outlet connections supplied on the Model 5850*i* are 1/4" compression fittings.

Optional 1/8" compression, VCO™ and VCR™ connections are available upon request. Prior to installation, make certain all piping is clean and free of obstructions. Install the piping in such a manner that permits easy removal if the instrument is to be removed for cleaning or test bench troubleshooting.



Connection	"X"Dim.
1/8"Compression Fitting	4.84 122.9
1/4"Compression Fitting	5.02 127.5
1/4" Tube VCO	4.56 115.8
1/4" Tube VCR	4.88 124.0
3/8"Compression Fitting	5.14 130.5

Figure 2-1 Model 5850i Dimensions

2-5 Installation (Refer to Figures 2-1 through 2-4)

CAUTION

When installing the controller, care should be taken that no foreign materials enter the inlet or outlet of the instrument. Do not remove the protective end caps until time of installation.

Recommended installation procedures:

a. The Model 5850*i* should be located in a clean dry atmosphere relatively free from shock and vibration.

b. Leave sufficient room for access to the electrical components.

c. Install in such a manner that permits easy removal if the instrument requires cleaning.

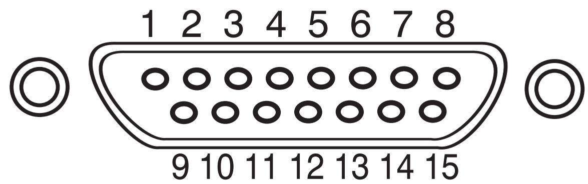
CAUTION

When used with a reactive (sometimes toxic) gas, contamination or corrosion may occur as a result of plumbing leaks or improper purging. Plumbing should be checked carefully for leaks and the controller purged with clean, dry N_2 before use.

d. The Model 5850*i* Mass Flow Controller can be installed in any position. However, mounting orientations other than the original factory calibration (see data sheet) will result in a ±0.5% maximum full scale shift after re-zeroing.

e. When installing controllers with full scale flow rates of 10 slpm or greater, be aware that sharp abrupt angles in the system piping directly upstream of the controller may cause a small shift in accuracy. If possible, have at least ten pipe diameters of straight tubing upstream of the 5850*i* MFC.

PIN OUT - TOP VIEW



1	SETPOINT RETURN	9	SUPPLY COMMON
2	VOLTAGE SIGNAL OUTPUT	10	SIGNAL OUTPUT RETURN
3	NOT USED	11	5V REFERENCE OUTPUT
4	CURRENT SIGNAL OUTPUT	12	VALVE OVERRIDE INPUT
5	+15 TO +28 Vdc SUPPLY	13	NOT USED
6	NOT USED	14	CHASSIS GROUND
7	CURRENT SETPOINT INPUT	15	NOT USED
8	VOLTAGE SETPOINT INPUT		

***JUMPER SELECTABLE**

NOTE: Cable shield tied to chassis ground in connector. Make no connection on customer end.

Figure 2-2 "D" Type Connector Pin Arrangement

Note: The control valve in the Model 5850*i* provides precision control and is not designed for positive shut-off. If positive shut-off is required, it is recommended that a separate shut-off valve be installed in-line.

CAUTION

Since the Model 5850*i* control valve is not a positive shutoff, a separate solenoid valve may have been installed for that purpose. It should be noted that a small amount of gas may be trapped between the downstream side of the mass flow controller and the solenoid resulting in a surge upon actuation of the controller. This surge can be reduced in magnitude by location the controller and solenoid valve close together or by moving the solenoid valve close together or by moving the solenoid valve upstream of the controller.

2-6 In-Line Filter

It is recommended that an in-line filter be installed upstream from the controller to prevent the possibility of any foreign material entering the flow sensor or control valve. The filtering element should be replaced periodically or ultrasonically cleaned.

Table 2-1 Recommended Filter Size

Maximum Flow Rate	Recommended Filter Size
100 sccm	1 micron
500 sccm	2 microns
1 to 5 slpm	7 microns
10 to 30 slpm	15 microns

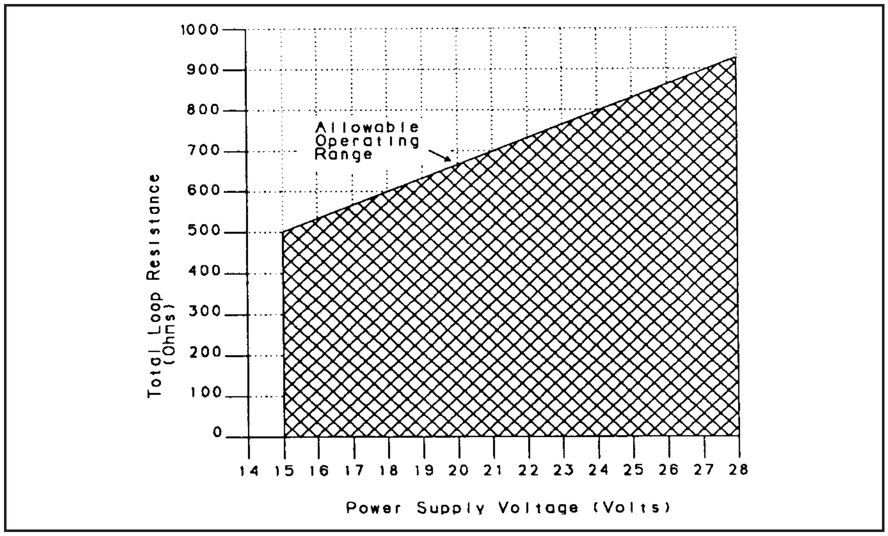


Figure 2-3 Maximum Allowable Loop Resistance

2-7 Electrical Interfacing

To insure proper operation, the 5850*i* must be connected per Figures 2-2, 2-3 and 2-4 and configured according to Section 2-7. As a minimum, the following connections must be made for new installations:

Function
Chassis Ground
Signal Output Return
Voltage or Current Signal Output
22.5-28 Vdc Supply
Supply Common
Voltage or Current Setpoint Input
Setpoint Return

Electrical Hook-up

Setpoint (Command) Input

The 5850*i* Mass Flow Controller can be used with a current (4-20 mAdc) or voltage (0-5 Vdc) setpoint. To use the current setpoint, connect the setpoint (+) signal to pin 7 and the setpoint return (-) signal to pin 1 of the D-connector and configure the PC Board per Section 2-7. To use the voltage setpoint, connect the setpoint signal to pin 8 and the voltage setpoint return to pin 1 of the D-connector and configure the PC Board per Section 2-7.

(The Brook's MFC acts as a current sink to a setpoint input signal.
The 0/4-20 mA setpoint signal should be "driven" into the MFC input by a controlled current source. Reference Brook's device specifications for the setpoint input impedance.)

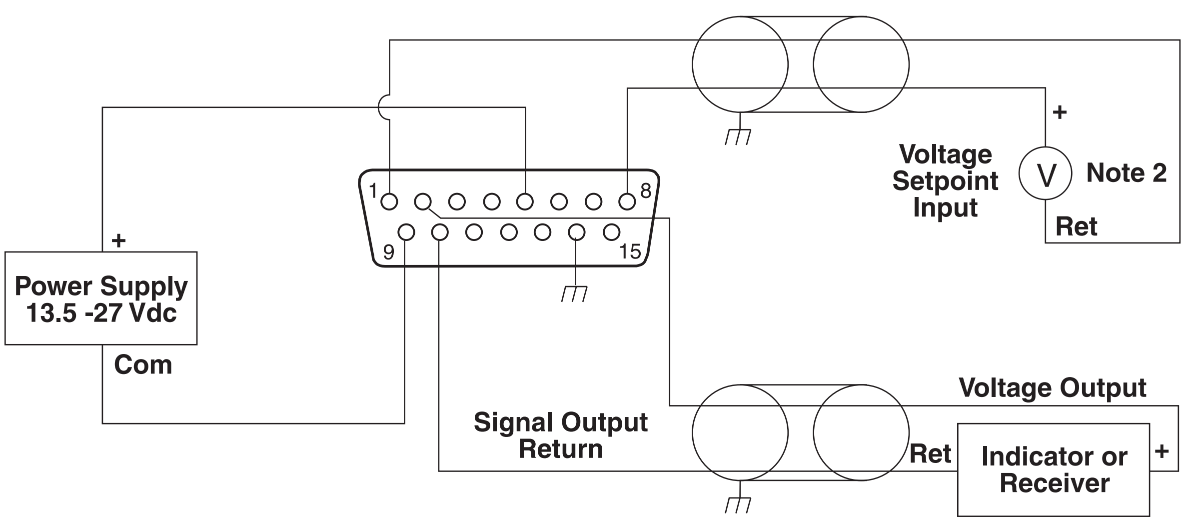
Signal Output

The flow signal output can be measured as a voltage and a current simultaneously on two different pins of the D-connector. Pin 2 indicates the flowrate with a 0-5 Vdc signal proportional to the mass flow rate. Pin 4 indicates the flowrate with either a 0-20 mAdc or 4-20 mAdc current signal as determined by jumpers on the pc board (refer to Section 2-7 for jumper positions). Both the current and voltage signals are returned on pin 10 of the D-connector.

(The Brook's MFC acts as the current source when providing a 0/4-20 mA output signal to the load. The output signal is "driven" by the MFC into the customer load. Reference Brook's device specifications for maximum load capacity.)

Supply

The power for the mass flow controller is connected to pin 5 (+22.5 to +28 Vdc) and pin 9 (supply common) of the D-connector. Refer to Section 1-3 for the power requirements.



Voltage Signal: Setpoint and Output

Notes:
1. The returns for the command input and current output are not isolated from power supply common.
2. Tie cable shields to ground at one end only. (MFC only)
3. Current and Voltage I/O may not be used simultaneously.

NOTE: The length of wire for the power supply connections (pins 5 & 9) must be kept as short as possible to insure the minimum voltage (+15) is available at the mass flow controller.

Figure 2-4 Common Electrical Hook-Ups, Voltage I/O version

Chassis Ground

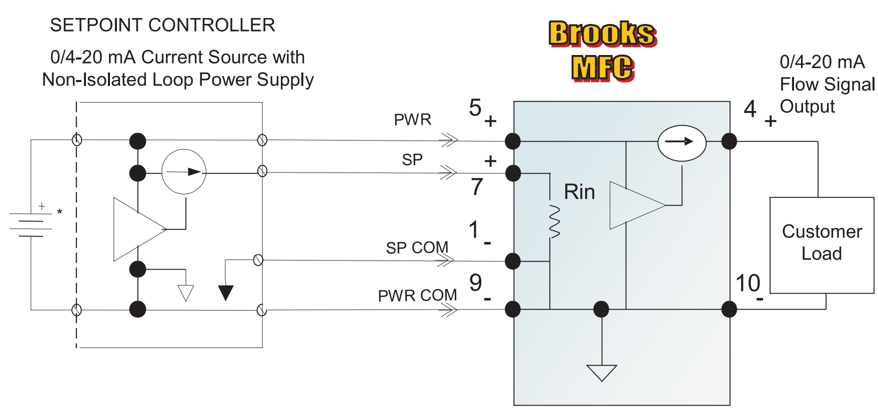
Connect earth ground to pin 14 of the D-connector.

Valve Override (connection optional)

The valve override function allows full opening and closing of the valve independent of the setpoint:

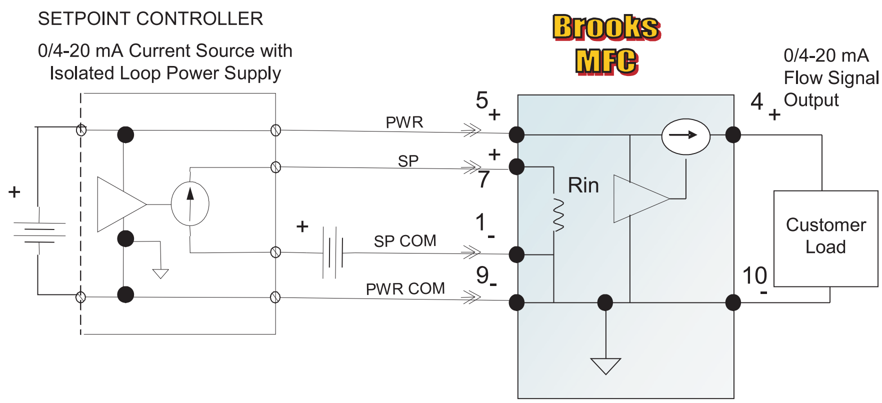
To open the valve, apply +15 to +28 Vdc to pin 12
To close the valve, connect pin 12 to ground.
Isolating pin 12 (no connection) returns the
controller to normal operation.

NOTE: For normal operation, pin 12 must be left open (floating).



Note: Setpoint common, flow signal output common, and power supply common are connected internally in the MFC. Reference Brook's device specifications for power supply voltage and setpoint input impedance.
Input: The 4/20 mA setpoint signal is "driven" into the MFC input using a controlled source.
Output: The 4/20 mA output signal is "sourced" by the MFC into the customer load.

Figure 2-5 Recommended I/O Wiring Configuration for Current Signals (Non-Isolated Power Supply)



Note: Setpoint common, flow signal output common, and power supply common are connected internally in the MFC. Reference Brook's device specifications for power supply voltage and setpoint input impedance.
Input: The 4/20 mA setpoint signal is "driven" into the MFC input using a controlled source.
Output: The 4/20 mA output signal is "sourced" by the MFC into the customer load.

Figure 2-6 Recommended I/O Wiring Configuration for Current Signals (Isolated Power Supply)

2-8 Configuring the PC Board

NOTE: To obtain access to the jumpers, the electronics cover can must be removed. Disconnect the power to the mass flow controller and any cables to the D-connector and the valve coil connector. Remove the three screws at the base of the can and remove the top jack post of the D-connector. Remove the can. The can must be replaced before returning the unit to service. Refer to Section 2-6 for the proper electrical hook-up. Refer to Figure 3-5 **for pc board jumper locations and functions.**

Setpoint (Command) Input

The mass flow controller can be configured for voltage or current setpoint (command) input. Jumper J7 (green) must be in the right-hand position for 0-5 Vdc setpoint and in the left-hand position for a 4-20 mAdc setpoint input.

Signal Output

A 0-5 Vdc flow signal output is always available. The current signal output is jumper selectable for either 0-20 mAdc or 4-20 mAdc. Jumpers J3 and J4 (blue) must be in the upper position for 0-20 mAdc output and in the lower position for 4-20 mAdc output.

NOTE: Both J3 and J4 must be in the same position. Jumpers J3 and J4 do not affect the voltage output.

Soft Start

To enable soft start, place Jumper J2 (red) in the right-hand position (SS). To disable soft start, place jumper J2 in the left-hand position (N).

3-1 Theory of Operation

The thermal mass flow sensing technique used in the 5850*i* works as follows:

A precision power supply provides a constant power heat input (P) at the heater which is located at the midpoint of the sensor tube. (Refer to Figure 3-1) At zero or no flow conditions, the heat reaching each temperature sensor (one upstream and one downstream of the heater) is equal. Therefore, the temperatures T1 and T2 are equal. When gas flows through the tube, the upstream sensor is cooled and the downstream sensor is heated, producing a temperature difference. The temperature difference T2-T1 is directly proportional to the gas mass flow.

The equation is: $\Delta T = A * P * C_p * m$

Where,

ΔT	=	temperature difference T2 - T1 (°K)
C_p	=	specific heat of the gas at constant pressure (kJ/kg-°K)
P	=	heater power (kJ/s)
m	=	mass flow (kg/s)
A	=	constant of proportionality (S^2-°K^2/kJ^2)

A bridge circuit interprets the temperature difference and a differential amplifier generates a linear 0-5 Vdc signal directly proportional to the gas mass flow rate. The flow restrictor shown in Figure 3-1 performs a ranging function similar to a shunt resistor in an electrical ammeter. The restrictor provides a pressure drop that is linear with flow rate. The sensor tube has the same linear pressure drop/flow relationship. The ratio of the restrictor flow to the sensor tube flow remains constant over the range of the meter. Different restrictors have different pressure drops and produce controllers with different full scale flow rates. The span adjustment in the electronics affects the fine adjustment of the controller's full scale flow.

In addition to the mass flow sensor, the Model 5850*i* Mass Flow Controller has an integral control valve and control circuit, as shown in Figure 3-2. The control circuit senses any difference between setpoint and the flow sensor signal and adjusts the current in the modulating solenoid valve to increase or decrease the flow.

The Model 5850*i* has the following features incorporated in the integral control circuit:

Fast Response adjusted by the anticipate potentiometer. This circuit, when properly adjusted, allows the high frequency information contained in the sensor signal to be amplified to provide a faster responding flow signal for remote indication and use by the control valve.

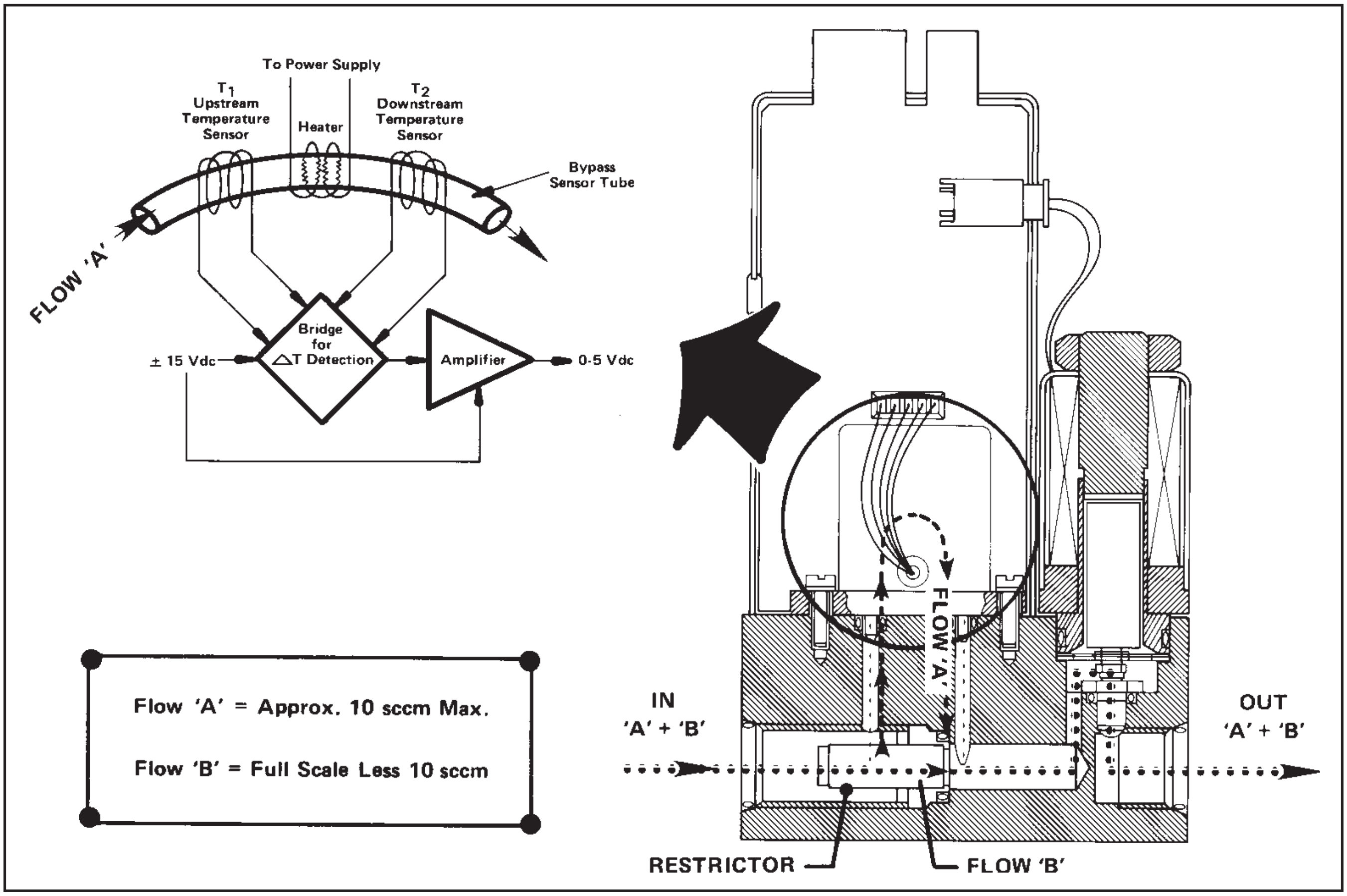


Figure 3-1 Flow Sensor Operational Diagram

Soft Start enabled by moving a jumper on the PC Board. This circuit provides a slow injection of the gas as a protection to the process, particularly those using a volatile or reactive gas. Full gas flow is achieved in approximately 20 seconds. Refer to Section 2-7.

Precision 5 Volt Reference allows the direct connection of a setpoint potentiometer to produce a 0-5 Volt command signal to the controller. A precision ten-turn 2k ohm potentiometer with an integral turns counter is recommended. This will permit repeatable adjustments of setpoint to 1 part in 1,000.

Valve Override allows full opening and closing of the control valve independent of the command setting. (Refer to Section 2-6)

3-2 Operating Procedure

a. Apply power to the controller and allow approximately 45 minutes for the instrument to warm up and stabilize its temperature.
b. Turn on the gas supply.
c. Command 0% flow and observe the controller's output signal. If the output is not zero mVdc ±10 mVdc or 4 mAdc ±0.05 mAdc, check for leaks and if none are found, refer to the re-zeroing procedure in Sect. 3-3.
d. Set the command for the desired flow rate to assume normal operation.

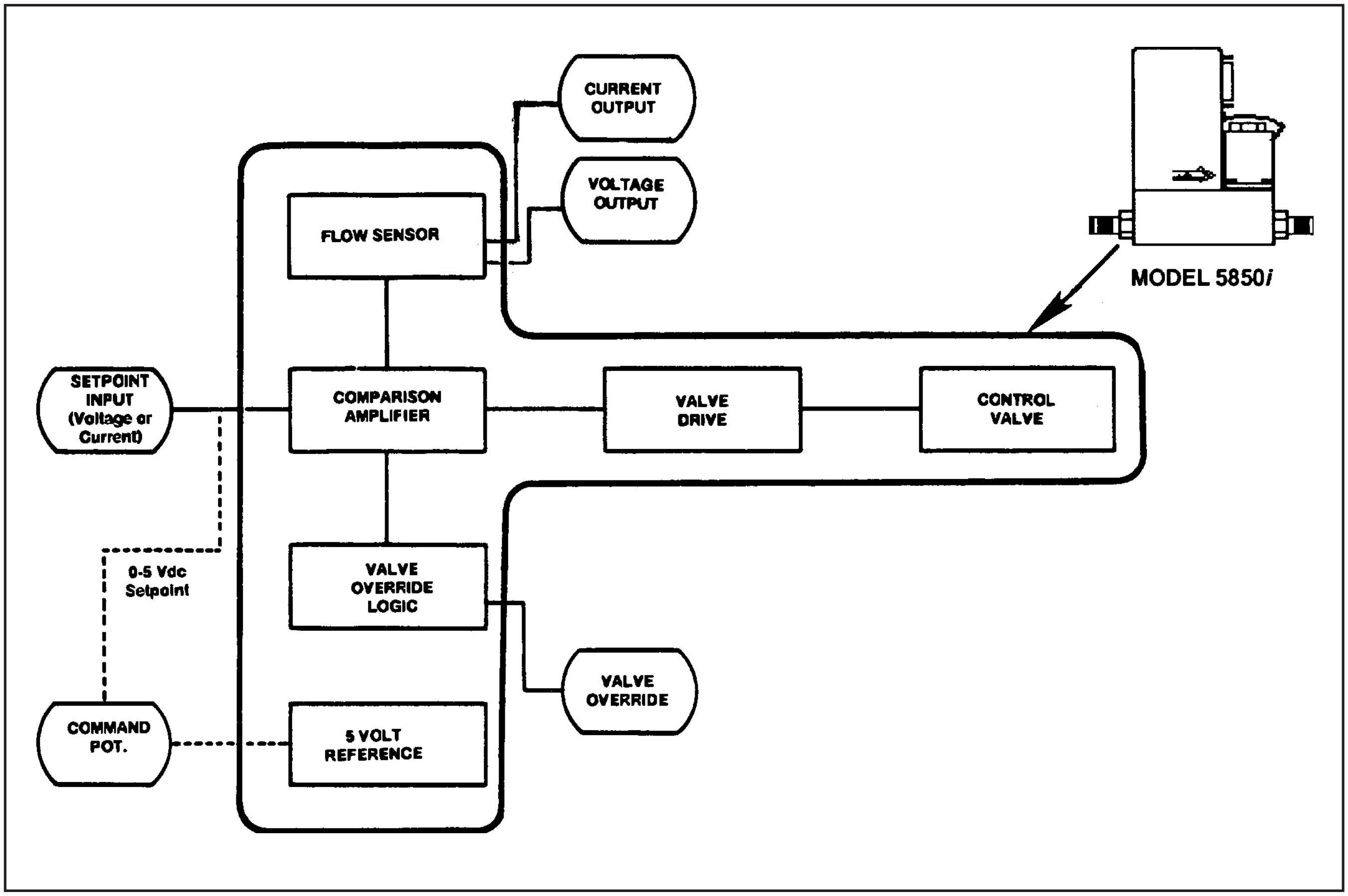


Figure 3-2 Flow Control System Block Diagram

3-3 Zero Adjustment

Each 5850*i* is factory adjusted to provide a zero ±10 mVdc signal or a 4 mAdc ±0.05 mAdc signal at zero flow. The adjustment is made in our calibration laboratory which is temperature controlled to 21.1°C (70°F ±2°F). After initial installation and warm-up in the gas system, the zero flow indication may be other than the factory setting. This is primarily caused by changes in temperature between our calibration laboratory and the final installation. The zero flow reading can also be affected, to a small degree, by changes in line pressure and mounting attitude.

To check zero, always mount the controller in its final configuration and allow a minimum of twenty minutes for the temperature of the controller and its environment to stabilize. Using a suitable voltmeter or current meter, check the controller output signal. If it differs from the factory setting, adjust it by removing the lower pot hole plug which is located closest to the controller body. Adjust the zero potentiometer (refer to Figure 3-6) until the desired output signal is obtained.

NOTE: If the 0-20 mA output is used, adjust zero by monitoring the voltage output signal. This is required because the current output cannot go negative.

3-4 Calibration Procedure

NOTE 1: If the valve has been disassembled and any of the following parts have been replaced, the control valve adjusting procedure in Section 4-4c must be performed before the Model 5850*i* is calibrated.

orifice
valve stem
plunger
lower guide spring
valve seat

NOTE 2: Calibration of the 5850*i* mass flow controller requires the use of a digital voltmeter (DVM) and a precision flow standard calibrator such as the Brooks Vol-U-Meter. It is recommended that the calibration be performed only by trained and qualified service personnel.

NOTE 3: If the mass flow controller is to be used on a gas other than the calibration gas, apply the appropriate sensor conversion factor. Size the orifice for actual operating conditions (refer to Section 4-5).

a. With the controller installed in an unpressurized gas line, apply power and allow approximately 45 minutes for warm-up. During the warm-up, adjustment and calibration check procedures, do not allow the control valve to open when gas flow is not present. This situation is not a normal operating mode; it will cause the control valve to abnormally heat up. A meter with an abnormally warm valve will be difficult to calibrate. This situation can be prevented by the valve override “closed” when there is no gas flow, or setting the setpoint to less than 1%. Also avoid unnecessary periods with the valve override “open.”

b. Adjust the anticipate potentiometer fully clockwise (twenty turns). Then adjust the anticipate potentiometer ten turns counterclockwise to center the potentiometer. This will provide a rough adjustment of this circuit and make the flow more stable for calibration.

c. Connect the DVM positive lead to the 0-5V signal output (pin 2) and the negative lead to signal common (TP4). Adjust the zero potentiometer for an output of 0mV ±2 mV.

d. Apply pressure to the system and insure that the zero signal repeats within 2 mV of the voltage set in step “c” above. If the zero does not repeat, check for leakage.

NOTE: Controllers supplied with all-metal valve seats do not provide tight shut-off. A 0-8% leak-through is typical. For metal seat controllers, close a downstream shut-off valve and observe the zero signal.

e. Adjust the setpoint for 100% flow (5.000V or 20 mAdc). Connect the DVM positive lead to TP2 (linearity voltage) and the negative lead to TP4 (signal common). Adjust the linearity potentiometer for an output of 0.0V (zero volts).

f. Connect the DVM positive lead to TP1 (100x sensor voltage) and the negative lead to TP4 (circuit common). The setpoint should still be set at 100% flow (5.000V). Measure the flow rate using suitable volumetric calibration equipment. To adjust the controller to the

proper full scale flow, calculate a new TP1 voltage using the following equation:

$$\text{New TP1 Voltage} = \frac{\text{measured TP1 voltage}}{\text{measured flow rate}} \times \text{desired flow rate}$$

Adjust the span potentiometer until the voltage at TP1 is equal to the value calculated above. Recheck the flow rate after the flow is stable (at least two minutes). Repeat this check and adjustment procedure until the measured flow rate is within 1% of the desired flow rate.

NOTE: The voltage at TP1 is 100 times the output voltage of the sensor. This voltage can range from 1.2 to 12 volts, however, it is recommended that this voltage stays between 2.0 and 9.0 volts for proper operation. If the recommended voltage range exceeds that desired, accuracy and/or signal stability may not be achieved. If one of the limits is reached, check the orifice and restrictor sizing procedures. Refer to Sections 4-6 and 4-7 respectively.

g. Adjust the setpoint for 0 % flow. Connect the DVM positive lead to 0-5V signal output (Pin 2) and the negative lead to TP4. Readjust the zero potentiometer for an output of 0 mV ±2 mV as necessary.

h. Adjust the setpoint for 50% flow and measure the flow rate. Calculate the error as a percentage of full scale.

$$\text{Full Scale Error} = 100\% \times \frac{\text{Measured Flow Rate} - \text{Desired Flow Rate}}{\text{Full Scale Flow Rate}}$$

i. Calculate the TP2 correction voltage: (error recorded in step “h”) x 0.450 volts

Example:
Error = -1.5%

TP2 correction voltage	= -1.5 x 0.450	= -0.675 volts
New TP2 voltage	= 0 volts + (-0.675)	= -0.675 volts

j. Set the command potentiometer for 100% flow (5.000V). Connect the DVM positive lead to TP2 and the negative lead to TP4.

k. Adjust the linearity potentiometer for an output equal to the new calculated TP2 voltage.

l. Repeat steps f, g and h.

1. If the error recorded in step “h” is less than 0.5%, then the calibration procedure is complete.

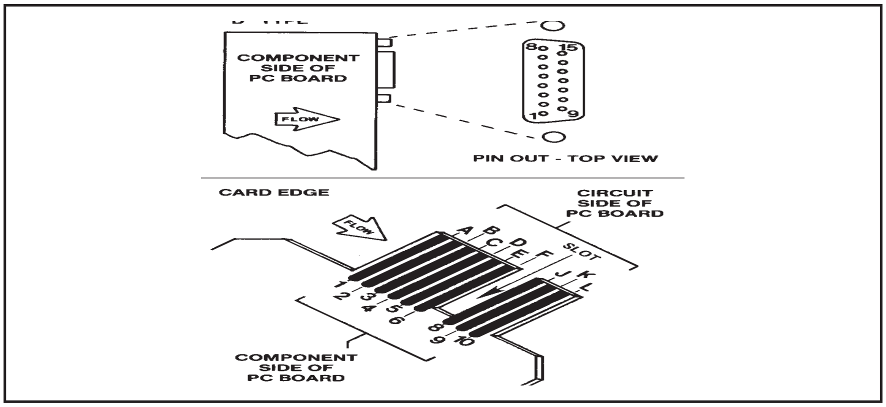


Figure 3-3 Model 5850i Calibration Connections

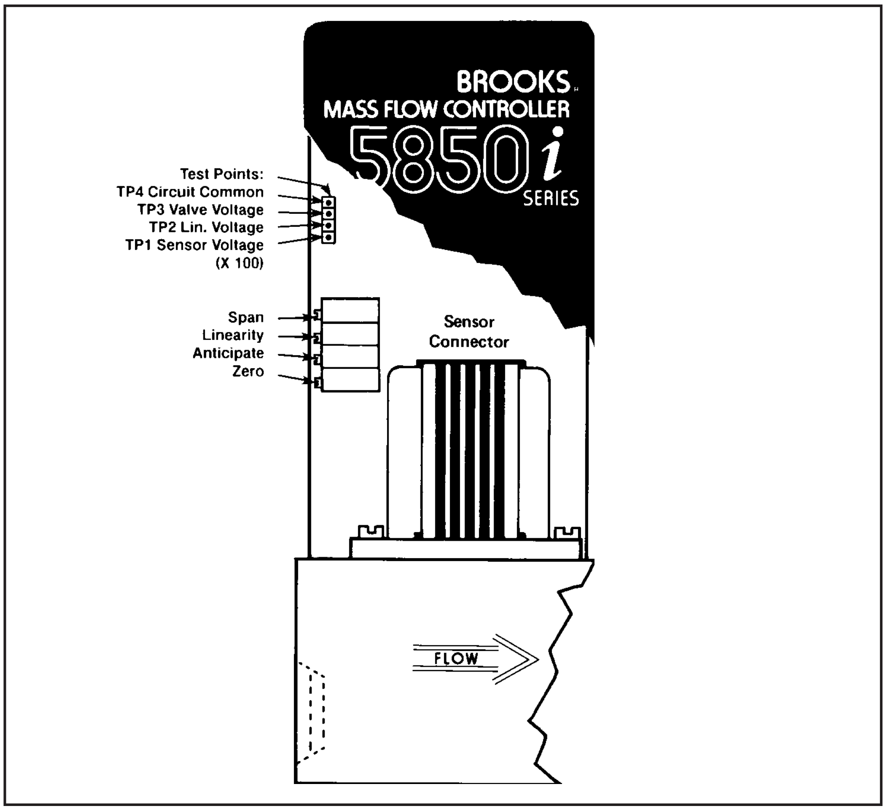


Figure 3-4 Adjustment Potentiometer Location

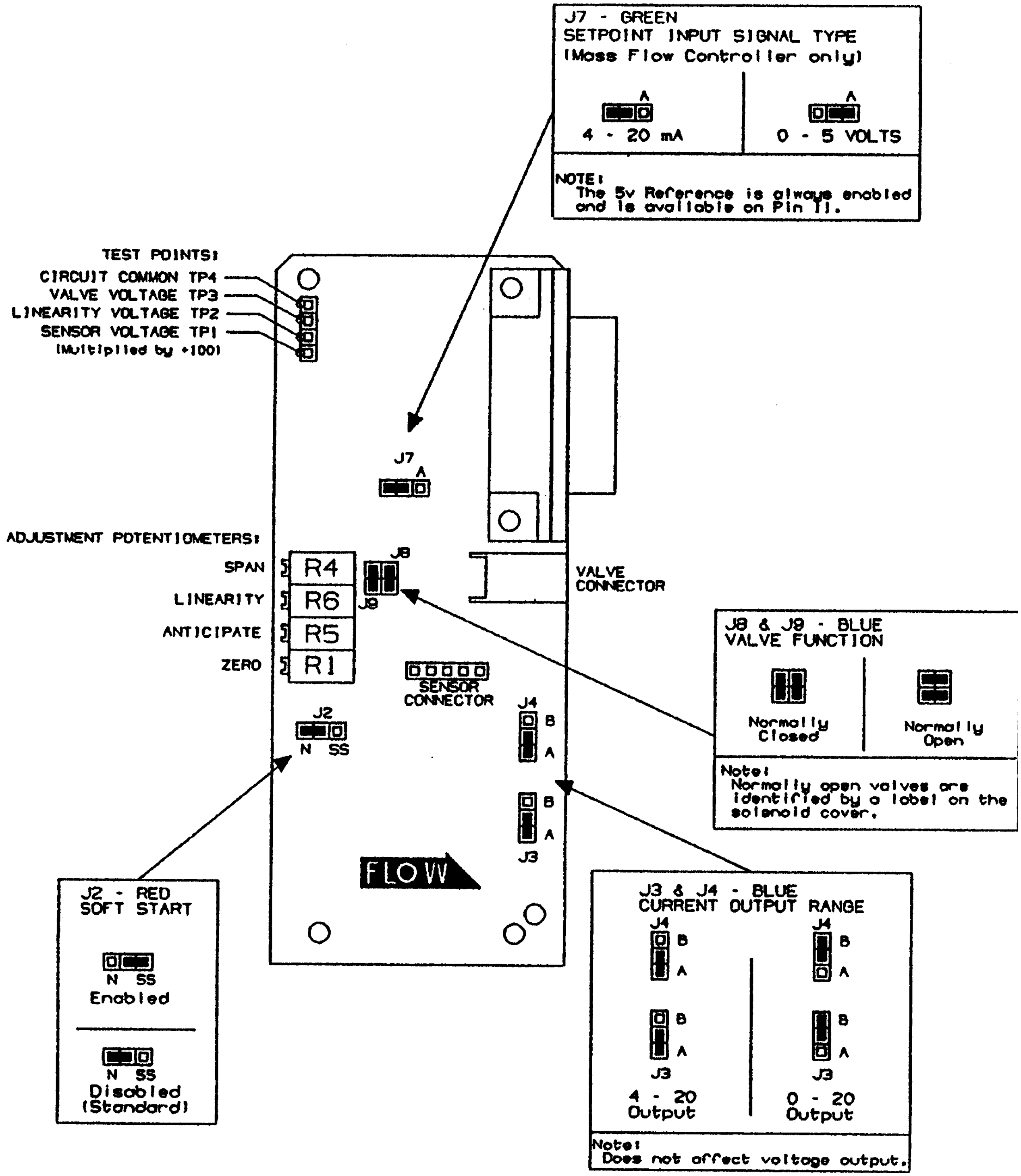


Figure 3-5 PC Board Jumper Location & Function

2. If the error is greater than 0.5% set the command potentiometer for 100% (5.000V). Connect the DVM positive lead to TP2 (linearity voltage) and the negative lead to TP4 (circuit common). Calculate a new TP2 voltage as follows:

$$\text{New TP2 voltage} = \text{error recorded in Step i} \times 0.450\text{V} + \text{measured TP2 voltage}$$

Example:
Controller error = 0.7%
Measured TP2 voltage = -0.567 volts
TP2 correction = 0.7 x 0.450 = 0.315 volts
New TP2 correction = 0.315 + (-0.567) = -0.252 volts

Adjust the linearity potentiometer for an output equal to the new TP2 voltage and then repeat steps f, g and h.

NOTE: The voltage at TP2 can range from -10 to +3 volts, however, it is recommended that this voltage stays between -2.5 and +2.5 volts for proper operation. If the recommended voltage range is exceeded, the desired accuracy and/or signal stability may not be achieved. If one of the limits is reached, check the restrictor sizing. Refer to Section 4-7.

3-5 Response

Fast Response Adjustment

Two methods of adjusting the step response of the 5850*i* mass flow controllers can be used.

Method Number 1 describes a procedure that will get the step response close to optimum quickly and without any flow measuring equipment. This method should be used when the response time of the flow controller is not critical to overall system performance.

Method Number 2 describes a procedure that will allow adjustment of your 5850*i* mass flow controller to optimum step response performance. This method is the preferred way to adjust the step response. Adjustment of the fast response circuit will not affect the accuracy of the flow controller as adjusted in Section 3-4.

1. Fast response adjustment (six seconds response specification not guaranteed)

NOTE: This procedure requires an oscilloscope, chart recorder or a DVM with a sample speed of three samples per second or greater to monitor the rate of change of the output signal.

a. Adjust the setpoint for 100% flow and wait about 45 seconds for the flow output signal to stabilize.
b. Step the command signal to 0% or activate valve override closed to stop the flow. Observe the flow signal output as it decays.
c. The behavior of the flow signal during this transition between 100%

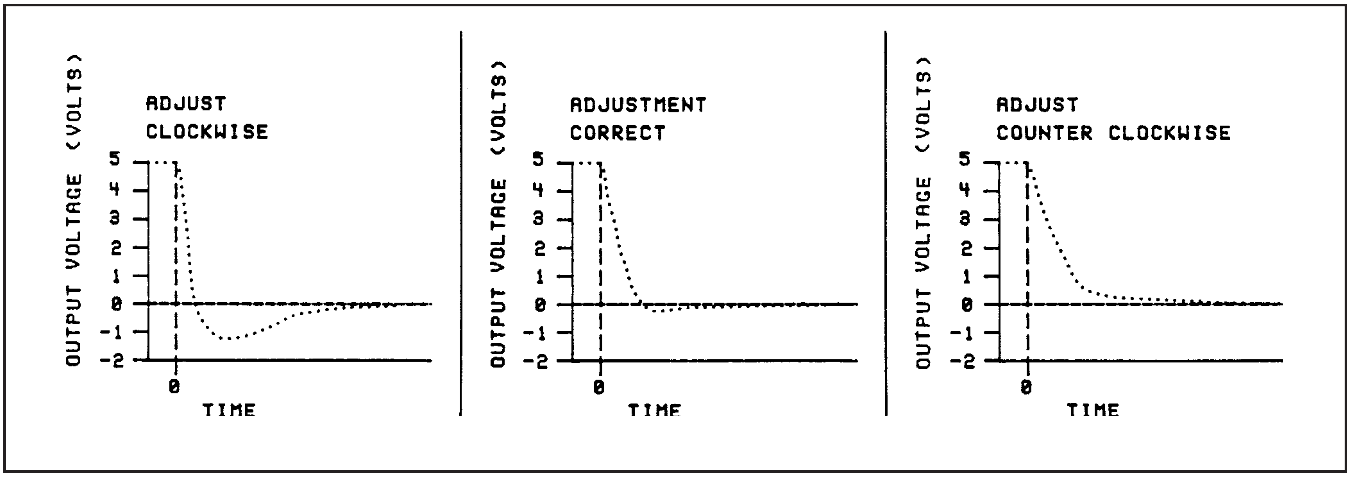


Figure 3-6 Fast Response Adjustment

and 0% flow indicates the adjustment required of the anticipate potentiometer. Refer to Figure 3-6.

1. If the flow signal measured on pin 2 decays to -0.05 to -0.5V, then rises to 0V, the anticipate potentiometer is properly adjusted.
2. If the flow signal decays rapidly and goes below -0.5V before rising to 0 V, the anticipate potentiometer must be adjusted clockwise and steps a and b repeated.
3. If the flow signal decays slowly and does not go below -0.05 V, the anticipate potentiometer must be adjusted counterclockwise and steps a and b repeated.

2. Fast response adjustment (six second response specification guaranteed)

Adjustment of the anticipate potentiometer to obtain a flow rate performance to be within 2% of flow rate commanded in less than six seconds after setpoint change requires the use of a fast response flowmeter (500 millisecond response to be within 0.2% of final value or better) in series with the 5850*i* and a storage oscilloscope or recorder.

a. Allow the flow controller to stabilize at 0% setpoint for at least thirty seconds. Make a step in setpoint to the controller from 0-100% of full scale flow and record the output signal of the fast response flowmeter.

b. If this signal shows more than 4% overshoot, adjust the anticipate potentiometer one-half to one turn counterclockwise. If the signal does not show overshoot but is not within 2% full scale of final value after six seconds, adjust the anticipate potentiometer one-half to one turn clockwise. Set command potentiometer for 0% of flow.

c. Repeat steps a and b until the fast response flowmeter output signal meets the specified response requirements.

NOTE: With the equipment on the previous page (3-9), the anticipate potentiometer can be adjusted to give optimum response characteristics for any process.

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4-1 General

No routine maintenance is required on the Model 5850*i* other than an occasional cleaning. If an in-line filter is used, the filtering element should periodically be replaced or ultrasonically cleaned.

4-2 Troubleshooting

⚠ CAUTION

It is important that this controller only be serviced by properly trained and qualified personnel.

A. System Checks

The 5850*i* is generally used as a component in gas handling systems which can be quite complex. This can make the task of isolating a malfunction in the system a difficult one. An incorrectly diagnosed malfunction can cause many hours of unnecessary downtime. If possible, make the following system checks before removing a suspected defective mass flow controller for bench troubleshooting or return, especially if the system is new:

1. Verify low resistance power supply connections and that the correct power supply voltage and signals are reaching and leaving the controller. The breakout board (P/N S-273-Z-668-AAA) listed in Section 5 will make this job much easier.
2. Verify that the process gas connections have been correctly terminated and leak checked.
3. If the mass flow controller appears to be functioning but cannot achieve setpoint, verify that sufficient inlet pressure and pressure drop are available at the controller to provide the required flow.
4. Verify that all user selectable jumpers are in their desired positions. Refer to Figure 3-5.

⚠ WARNING

If it becomes necessary to remove the controller from the system after exposure to toxic, pyrophoric, flammable or corrosive gas, purge the controller thoroughly with a dry inert gas such as Nitrogen before disconnection the gas connections. Failure to correctly purge the controller could result in fire, explosion or death. Corrosion or contamination of the mass flow controller, upon exposure to air, may also occur.

B. Bench Troubleshooting

1. Properly connect the mass flow controller to a +15-28 Vdc power supply, setpoint source and connect an output signal readout device (4-1/2 digit voltmeter recommended) to pins 2 and 10 of the D-connector (refer to Figure 2-2). Apply power, set the setpoint to zero and allow the controller to warm up for 45 minutes. Do not connect to a gas source at this time. Observe the output signal and, if necessary, perform the zero adjustment procedure (Section 3-3). If

Table 4-1 Bench Troubleshooting

Trouble	Possible Cause	Check/Corrective Action
Actual flow overshoots setpoint by more than 5% full scale.	Anticipate potentiometer out of adjustment.	Adjust anticipate potentiometer. Refer to Section 3-5 .
Output stays at zero regardless of setpoint and there is no flow through the controller.	Clogged Sensor. Refer to Section 4-4.	Clean sensor. Refer to cleaning.
	Clogged Control Valve.	Check TP3 with the setpoint at 100%. If the voltage is greater than 11V, disassemble and repair the control valve. Refer to Sections 4-4c and 2-10.
	Valve override input is grounded.	Check valve override input (Pin 12)
	Defective PC Board.	Replace PC Board. Refer to Section 4-4.
Output signal stays at +6.8V or 26 mA regardless of command and there is flow through the controller.	Valve stuck open or leaky.	Clean and/or adjust control valve. Refer to cleaning procedure and/or Section 4-4C.
	+15V -28Vdc applied to the valve override input.	Check the valve override terminal. (Pin 12)
	Defective PC Board.	Replace PC Board. Refer to Section 4-4.
Output signal follows setpoint at higher setpoints but will not go below 2% (8% for all-metal seat).	Leaky control valve.	Disassemble and repair valve. Refer to Section 4-4C.
Output signal follows setpoint at lower setpoints but does not reach full scale.	Insufficient inlet pressure or pressure drop.	Adjust pressure, inspect the filters and clean/replace as necessary.
	Partially clogged sensor.	Check calibration. Refer to Section 3-4.
	Partially clogged valve.	Disassemble and repair control valve. Refer to Section 4-4.
	Valve out of adjustment.	Adjust valve. Refer to Section 4-4.
	Valve guide spring failure.	Controller oscillates (see below).
Controller grossly out of calibration. Flow is higher than desired.	Partially clogged sensor.	Clean sensor, refer to the cleaning procedure.
Controller grossly out of calibration. Flow is lower than desired.	Partially clogged restrictor.	Replace restrictor. Refer to Section 4-4.
Controller oscillates.	Pressure drop or inlet pressure excessive.	Adjust pressures.
	Oversized orifice.	Check orifice size. Refer to Section 4-6.
	Valve out of adjustment.	Adjust valve. Refer to Section 4-4.
	Anticipate potentiometer out of adjustment.	Adjust anticipate potentiometer. Refer to Section 3-5.
	Faulty pressure regulator.	Check regulator output.
	Defective PC Board.	Replace PC Board. Refer to Section 4-4.

the output signal will not zero properly, refer to the sensor troubleshooting section and check the sensor. If the sensor is electrically functional, the printed circuit board is defective and will require replacement.

2. Connect the controller to a source of the gas on which it was originally calibrated. Command 100% flow and adjust the inlet and outlet pressures to the calibration conditions. Verify that the output signal reaches and stabilizes at 5.00 volts or 20mA. Vary the setpoint over the 2 to 100% range and verify that the output signal follows the setpoint. Apply +15-28 volts to the valve override input (pin 12) and verify that the output exceeds 100%. Connect the valve override pin to ground and verify that the output signal falls below 2%. If possible, connect a flow measurement device in series with the mass flow controller to observe the actual flow behavior and verify the accuracy of the mass flow controller. If the mass flow controller functions as described above, it is functioning properly and the problem may lie elsewhere.

Table 4-1 lists possible malfunctions which may be encountered during bench troubleshooting.

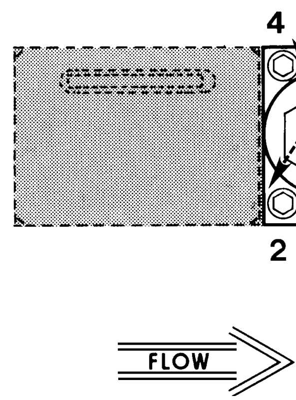


Figure 4-1 Torque Sequence for the Valve Retainer Plate

Sensor Troubleshooting

If it is believed the sensor coils are either open or shorted, troubleshoot using Table 4-2. If any of the steps do not produce the expected results, the sensor assembly is defective and must be replaced. Refer to Section 4-4 for the disassembly and assembly procedures to use when replacing the sensor.

NOTE: Do not attempt to disassemble the sensor.

Cleaning Procedures

Should the Model 5850*i* Mass Flow Controller require cleaning due to deposition, use the following procedures:

1. Remove the unit from the system.
2. Refer to Section 4-4 to disassemble the controller.

CAUTION

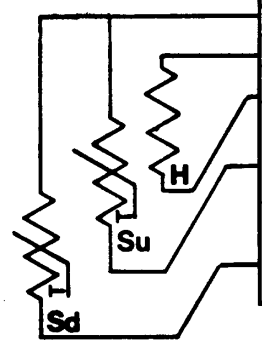
Do not soak the sensor assembly in a cleaning solution. If solvent seeps into the sensor assembly, it will probably damage the sensor, or, at least, significantly alter its operating characteristics.

3. Use a hemostat or tweezers to push a 0.007" diameter piano wire through the flow sensor tube to remove any contamination. For best results, push the wire into the downstream opening of the sensor tube (end closest to the control valve). The sensor tube can be flushed with a non-residuous solvent (Freon TF** recommended). A hypodermic needle filled with solvent is a convenient means to accomplish this.

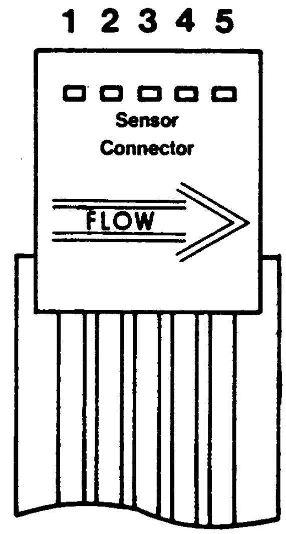
An alternate method for flushing out the sensor is to replace the restrictor element with a low flow plug restrictor. This plug forces all the flow through the sensor and may dislodge any obstructions. With the valve orifice removed, subject the flow controller to a high differential pressure. Pressurizing the outlet of the MFC higher than the inlet may help force the obstruction upstream and out of the sensor tube.

Table 4-2 Sensor Troubleshooting

SENSOR SCHEMATIC



PIN NO.	FUNCTION
4	Sensor Common
1	Heater
5	Heater Common
2	Upstream Temperature Sensor (Su)
3	Downstream Temperature Sensor (Sd)



Flex Circuit Wire Numbers

OHMMETER CONNECTION	RESULT IF ELECTRICALLY FUNCTIONAL
Pin 1 or 4 to Body (Ground)	Open circuit on ohmmeter. If either heater or sensor common are shorted, an ohmmeter reading will be obtained.
Pin 4 to Pin 2	Nominal 1100 ohms reading, depending on temperature and ohmmeter current.
Pin 4 to Pin 3	
Pin 5 to Pin 1	Nominal 1000 ohm reading.

NOTE: Remove the sensor connector from the PC Board for this procedure.

4. Inspect the orifice for clogging by holding it in front of a light source and looking for light through the bore. Clean by soaking in a suitable non-residuous solvent and directing a stream of compressed dry nitrogen through the bore.
5. Deposits of silicon dioxide may be removed by soaking the internal parts in a solution of 5 parts hydrofluoric acid (HF) and 95 parts water (H_2O) followed by Freon TF.
6. Restrictor elements can be cleaned in an ultrasonic bath. Refer to Section 4-7 for the correct restrictor to use.
7. Blow all parts dry with dry nitrogen and reassemble. Refer to Section 4-4b (assembly).
8. Purge the assembled controller with dry nitrogen.
9. Perform the calibration procedure in Section 3-4.
10. When the controller is re-installed in the system, the connections should be leak-tested and the system should be purged with dry nitrogen for 30 minutes prior to start-up to prevent the formation of deposits.

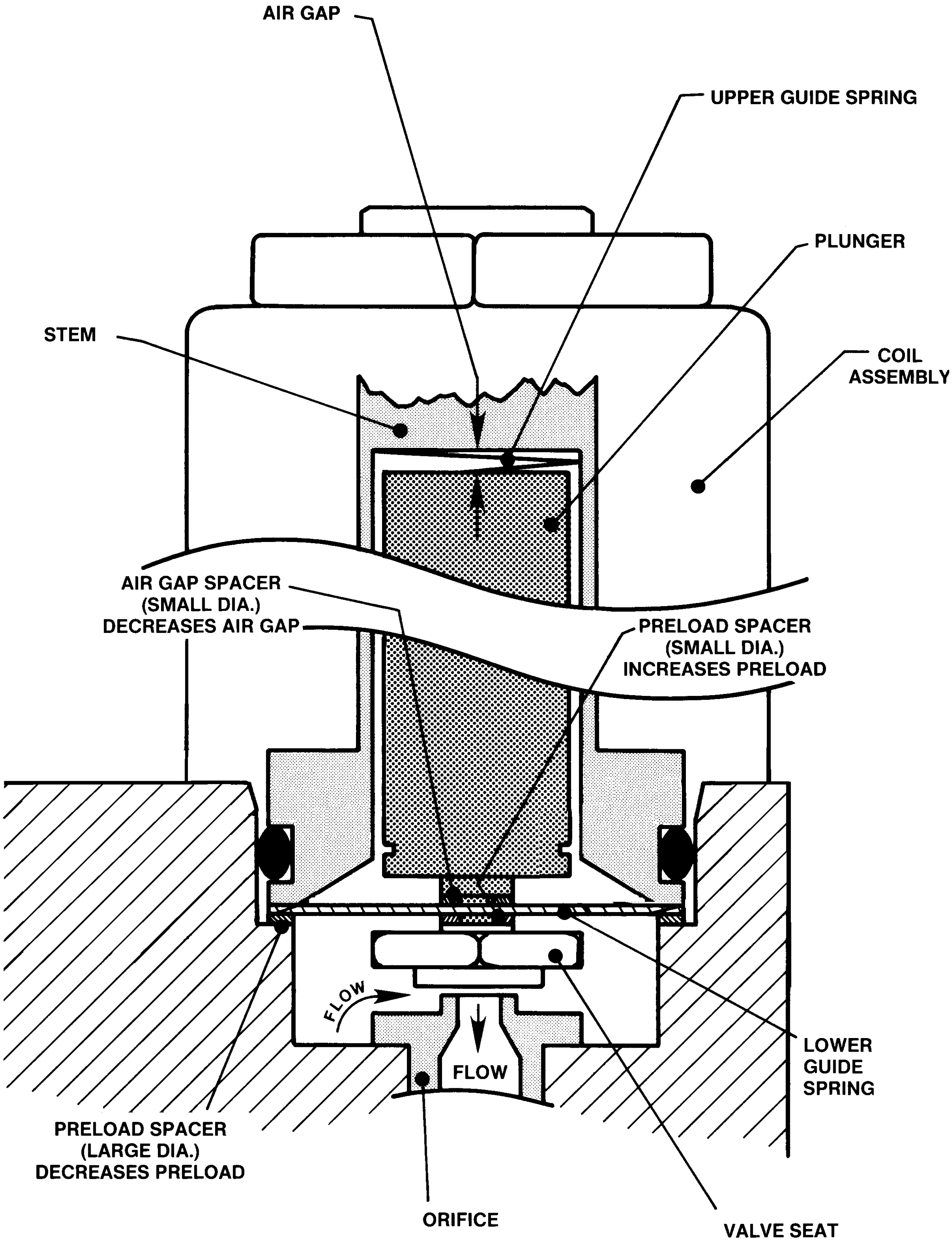


Figure 4-2a Valve Adjusting Spacer Locations (Normally Closed Valve N.C.)

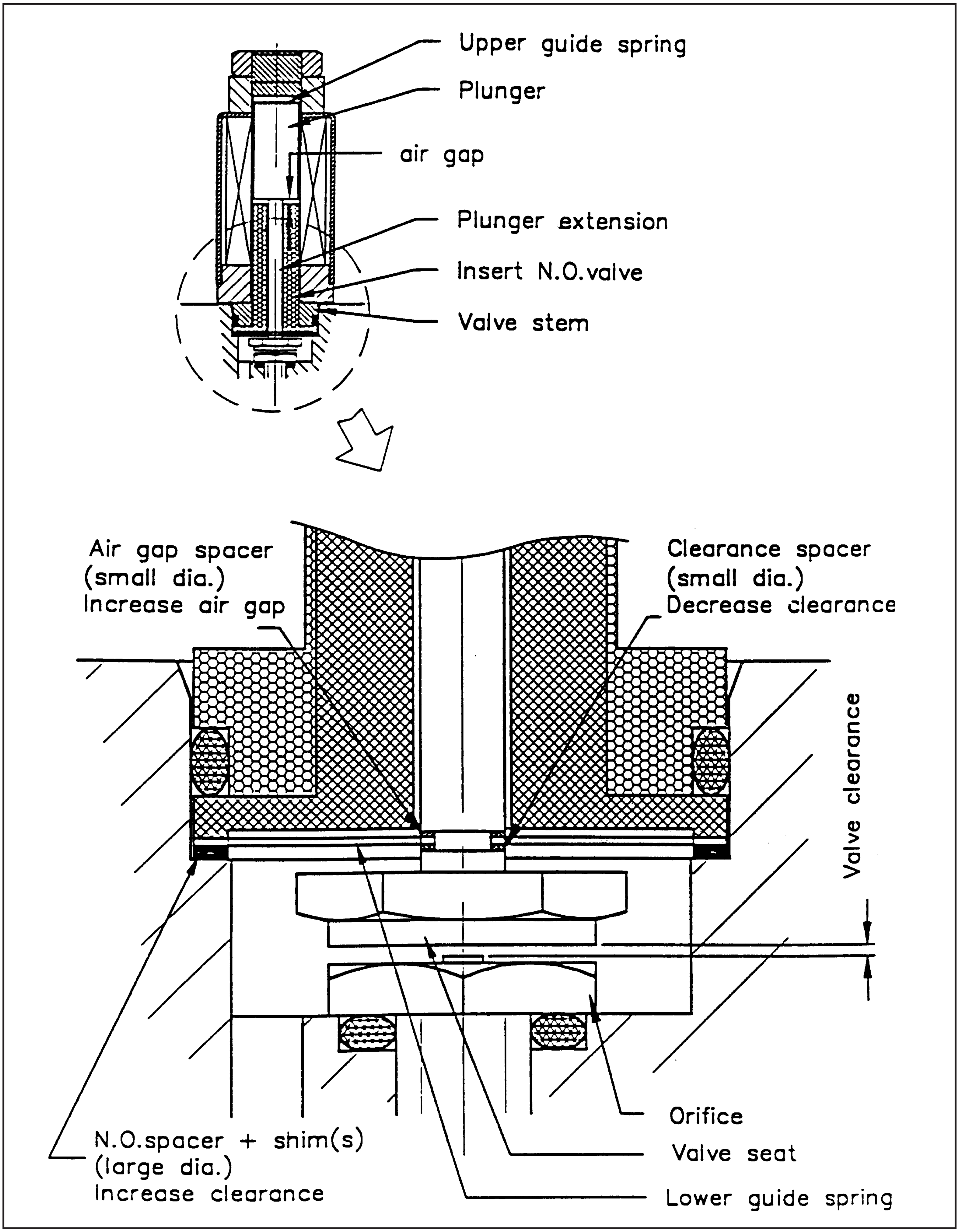


 Figure 4-2b Valve Adjusting Spacer Locations (Normally Open Valve N.O.)

4-3 Sensor Tube

The sensor tube is part of a calibrated flow divider that is designed to operate within a preset gas flow range. The sensor assembly may be removed or replaced by referring to Section 4-4, Disassembly and Assembly. If the sensor assembly is cleaned and reinstalled, a calibration check should be performed. Refer to Section 3-4.

4-4 Disassembly and Assembly

The Model 5850*i* Mass Flow Controller may be disassembled in the field by the user for cleaning, re-ranging or servicing. Disassemble and assemble the controller as follows: (for normally open valves N.O.)

Figure 3-5 shows the location and function of jumpers. The jumpers J4 and J1 (blue) must be in the position indicated for a normally open valve.

Figures (labeled 4-2a and 4-2b) shows the location and function of valve adjustment spacers for normally closed and normally open valves.Valve adjustment is not required for normal installation and operation of the mass flow controller. If adjustment is required, consult the factory for information.

Figure (labeled 5-1) shows an exploded view of the controller and specific parts to the (normally closed NC and normally open NO valve.)

Note: The Model 5850*i* Mass Flow Controller should be disassembled and assembled in a clean environment to prevent particulate contamination.

A. Disassembly (Normally Closed)

The numbers in () refer to the spare parts exploded view in Figure 5-1.

⚠ WARNING

Do not attempt to disassemble the mass flow controller until pressure has been removed and purging has been performed. Hazardous gas may be trapped in the valve assembly which could result in explosion, fire or serious injury.

1. Remove the jam nut (1) on top of the valve assembly.
2. Unplug the valve connector from the electronics cover and remove the coil assembly (2).
3. Remove the hex socket screws (3) securing the valve retaining plate (4) attaching the valve stem assembly (6)(NC valve - Normally Closed) or (34) (NO Valve - Normally Open).

⚠ CAUTION

When performing the following procedure the valve stem must be removed without cocking it to prevent damage to the valve spring.

4. Carefully remove the valve stem assembly (6)(NC Valve) or (34)(NO Valve).
5. Remove the plunger assembly (7,8,9,11)(NC Valve) or (35,31,32,8,9,11)(NO Valve).

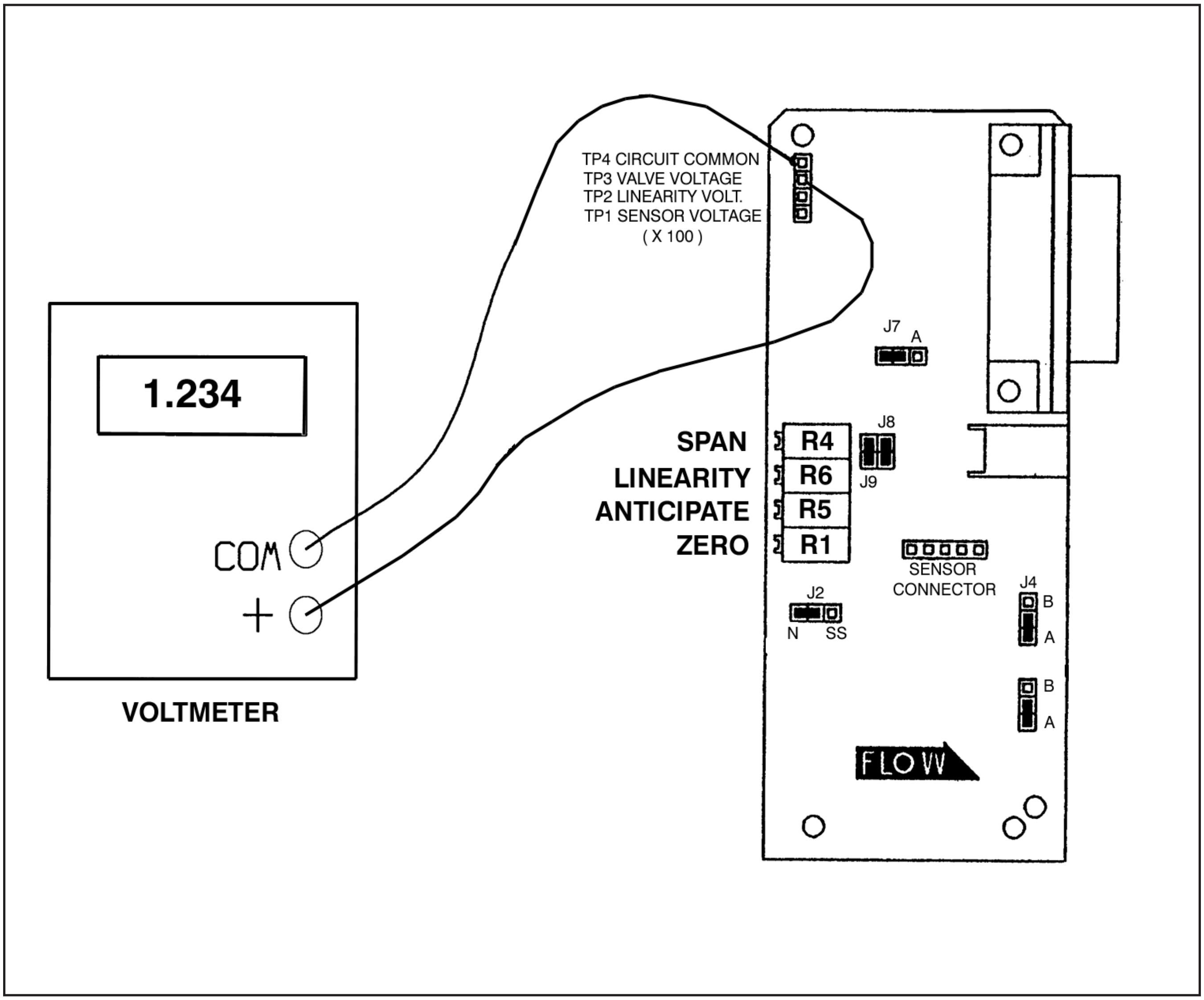


Figure 4-3 Voltmeter Connections for Valve Adjustment

6. Remove and note the position of the valve spring spacers (10), which may be located above and/or below the lower guide spring (8). Remove the preload spacer spring (33)(NO Valve).
7. Unscrew the orifice (12) from the flow controller body(14).
8. Carefully unscrew the valve seat (11) from the plunger assembly (7)(NC Valve) or the plunger assembly (31,32,35)(NO Valve).

Note the position and number of spacers (9) that are stacked on the threaded end of the valve seat.

9. Remove the three screws (20) attaching the electronics cover. Remove the electronics cover (23).

CAUTION

Be careful not to stress the sensor lead wire to sensor assembly junction when removing the sensor connector from the PC Board. If the sensor lead wires are stressed an open in the sensor wiring could result.

10. Unplug the sensor connector from the PC Board. Remove the two screws securing the bracket (24) and PC Board (15). Remove the bracket and PC Board.

11. Remove the two screws (18) and washers (19) securing the sensor assembly (16). Remove the sensor assembly.

Note: Do not attempt to disassemble the sensor assembly.

⚠ CAUTION

Do not scratch the O-ring sealing surface.

12. Remove the sensor assembly O-rings (17) from the flow controller body (14). Using the Brooks O-ring removal tool will help prevent scratching the sealing surface.
13. Remove the adapter fittings (27) from the flow controller body (14).
14. Remove the restrictor assembly (21) from the inlet side of the flow controller body (14) using the restrictor tool (part of service tool kit listed in Section 5, Table 5-2).

B. ASSEMBLY (Normally Closed)

⚠ CAUTION

Do not get Halocarbon lubricant on the restrictor element (21) or hands. This is a special inert lubricant which is not easily removed.

Note: It is recommended that all O-rings be replaced during controller assembly. All O-rings should be lightly lubricated with Halocarbon lubricant (part of O-ring kit, Section 5) prior to their installation.

1. Examine all parts for signs of wear or damage, replace as necessary.
2. Place the restrictor O-ring (22) on the restrictor assembly. Screw the restrictor assembly (21) into the inlet side of the flow controller body using the restrictor tool, tighten hand tight.

⚠ CAUTION

The following steps must be performed as written. Placing the O-rings on the sensor before it is installed will result in damage to the O-rings causing a leak.

3. Press the lubricated sensor O-rings (17) into the flow controller body (14). Install the sensor assembly and secure with two screws (18) and washers (19) tightened to 15 in/lbs.
4. Install the orifice (12) and its O-ring (13), using a 3/8 nut driver. Insure that the orifice is fully seated but do not overtighten.
5. Insert the valve preload spacers (10)(NC Valve) or (33)(NO Valve), if used, into the valve cavity in the flow controller body (14). Use care to preserve the correct order.
6. Place the spacers (9) and spring (8) on the valve seat (11) in the same order as noted in step 8 of the disassembly. Screw the valve seat (11) into the plunger assembly (7)(NC Valve) or (35,31,32)(NO Valve).

Tighten the assembly until there is no looseness, but do not over-tighten.

7. Install the valve plunger assembly (7, 8, 9 and 11)(NC Valve) or (35,31,32,8,9,11)(NO Valve) on the preload spacers (10). Install air gap spacers (10), if used on top of the valve spring.
8. Install the valve stem assembly (6), secure with the valve retaining plate (4) and four hex socket screws (3). When installing the screws they should first make light contact with the plate, which should be checked to insure that it makes full contact around the stem assembly. Torque the screws securing the valve retaining plate in diagonal pattern (Refer to Figure 4-1) to 17 in/lbs.
9. Install the coil assembly (2) over the valve stem assembly (6)(NC Valve) or (34)(NO Valve) install extension spacer nut (3)(NO Valve) and secure with jam nut (1).
10. Install the printed circuit (PC) Board (15), secure with the bracket (24) and two screws. Plug the connector from the sensor assembly onto the PC Board. The flow arrow on the connector should be pointing toward the valve assembly.
11. Install the electronics cover (23) on the controller, secure with three screws (20). Plug the connector from the valve coil into the PC Board through the hole in the electronics cover.
12. Prior to installation leak and pressure test to any applicable pressure vessel codes.

C. Adjusting the Control Valve

The 5850*i* control valve has been factory adjusted to insure proper operation. Readjustment is only required if any of the following parts have been replaced:

orifice (12)
valve stem (6)
plunger (7)
lower guide springs (8)
valve seat (11)

The valve is adjusted in Brooks Mass Flow Controllers by adding spacers (9 and 10) to the control valve assembly to vary the air gap and initial preload. Spacers are used to affect the proper adjustment because they provide a reliable and repeatable means for adjustment. Screw type adjustment mechanisms can change with pressure or vibration and introduce an additional dynamic seal that is a potential leak site and source for contamination. Refer to Figure 4-2 for spacer locations.

The preload determines the initial force that is required to raise the valve seat off the orifice and start gas flow. If the preload is insufficient, the valve will not fully close and gas will leak through. If the preload is excessive, the magnetic force generated between the plunger and stem will be insufficient to raise the plunger and the valve will not open.

The air gap is the space between the top of the plunger and stem. The air gap determines the force between the plunger and stem at a given voltage and the total travel of the valve. If the air gap is too small, the plunger travel may be insufficient to fully open the valve. Also, the magnetic force may be too high for a given valve coil voltage. If the air gap is too large, the magnetic force will be insufficient to raise the plunger and the valve will not open.

NOTE: Prior to starting the valve adjustment procedure, check to insure that the orifice is properly seated and that the valve parts are not bent or damaged.

D. Adjustment Procedure

(Refer to Section 5, Spare Parts for Spacer Kit)

a. Remove the electronics cover (23) from the controller. Insure that the connector from the coil assembly (2) is properly reconnected to the PC Board after the electronics cover is removed.
b. Perform the electrical and gas connections to the controller following the instructions in Section 2 of this manual. Use a clean dry inert gas, such as nitrogen, for this procedure. Do not apply gas pressure to the controller at this time.
c. Disassemble the control valve following the procedure given in Section 4-4A above. Note the number, locations and thicknesses of all spacers (9 and 10).
d. Decrease the preload of the valve by 0.005 inches by either removing a 0.005-inch small preload spacer or by adding a 0.005-inch large preload spacer. Refer to Figure 4-2.
e. Reassemble the valve following the assembly procedure in Section 4-4a.
f. Adjust setpoint for zero percent flow, apply normal operating pressure and check for valve leak-through by observing the output signal.
g. If the valve leaks through, increase the preload by 0.005" and go to Step h. If the valve does not leak through, repeat Steps d, e, f and g.
h. Apply normal operating gas pressure and adjust setpoint for 100% flow.

Note: Due to possible heat capacity and density differences between the test gas and actual process gas for which the MFC was sized, it may be necessary to increase the inlet pressure to obtain proper control at 100% flow.

i. Measure the valve voltage by connecting a voltmeter between test point 3 (TP3) and test point 4 (TP4). Refer to Figure 4-3.
j1. If the flow controller output signal is 100% and the valve voltage is less than 11.5 V, the valve adjustment is complete.
j2. If the flow controller output signal is 100% and the valve voltage is greater than 11.5 V, decrease the air gap with a small 0.005 inch air gap spacer. Refer to Figure 4-2. Repeat Steps h and i.
j3. If the flow controller output signal is less than 100% and the valve voltage is greater than 11.5 V, this condition indicates that the inlet pressure is too low and/or the orifice size is too small. First check Section 4-6 to insure that the orifice size is correct.
k. Proceed to Section 3 and perform “3-4 Calibration Procedure,” if required.

4-5 Use of the Conversion Tables

If a mass flow controller is operated on a gas other than the gas it was calibrated with, a scale shift will occur in the relation between the output signal and the mass flow rate. This is due to the difference in heat capacities between the two gases. This scale shift can be approximated by using the ratio of the molar specific heat of the two gases or by sensor conversion factor. A list of sensor conversion factors is given in Table 4-3. To change eo a new gas, multiply the output reading by the ratio of the gas factor for the desired gas to the gas factor for the calibration gas.

$$\text{Actual gas flow rate} = \text{Output reading} \times \frac{\text{factor of the new gas}}{\text{factor of the calibrated gas}}$$

Example:
The controller is calibrated for Nitrogen.
The desired gas is Carbon Dioxide.
The output reading is 75 sccm when Carbon Dioxide is flowing.
Then 75 x 0.78 = 58.50 sccm

In order to calculate the conversion factor for a gas mixture, the following formula should be used:

$$\text{Sensor Conversion Factor Mixture} = \frac{100}{\dfrac{P1}{\text{Sensor Conversion Factor 1}} + \dfrac{P2}{\text{Sensor Conversion Factor 2}} + \dfrac{Pn}{\text{Sensor Conversion Factor n}}}$$

Where,
P1 = percentage (%) of gas 1 (by volume)
P2 = percentage (%) of gas 2 (by volume)
Pn = percentage (%) of gas n (by volume)
Example: The desired gas is 20% Helium (He) and 80% Chlorine (Cl) by volume. The desired full scale flow rate of the mixture is 20 slpm. Sensor conversion factor for the mixture is:

$$\text{Mixture Factor} = \frac{100}{\dfrac{20}{1.39} + \dfrac{80}{.83}} = .903$$

Air equivalent flow = 20/.903 = 22.15 slpm air

It is generally accepted that the mass flow rate derived from this equation is only accurate to ±5%. The sensor conversion factors given in Table 4-3 are calculated based on a gas temperature of 21°C and a pressure of one atmosphere. The specific heat of most gases is not strongly pressure- and/or temperature-dependent. However, gas conditions that vary widely, from these reference conditions, may cause an additional error due to the change in specific heat caused by temperature and/or pressure.

Table 4-3 Conversion Factors (Nitrogen Base)

GAS NAME	FORMULA	SENSOR FACTOR	ORIFICE FACTOR	DENSITY (kg/m³)
Acetylene	C_2H_2	0.615	0.970	1.173
Air	Mixture	0.998	1.018	1.293
Allene	C_3H_4	0.478	1.199	1.787
Ammonia	NH_3	0.786	0.781	0.771
Argon	Ar	1.395	1.195	1.784
Arsine	AsH_3	0.754	1.661	3.478
Boron Trichloride	BCL_3	0.443	2.044	5.227
Boron Trifluoride	BF_3	0.579	1.569	3.025
Bromine Pentafluoride	BrF_5	0.287	2.502	7.806
Bromine Trifluoride	BrF_3	0.439	2.214	6.108
Bromotrifluoroethylene	C_2BrF_3	0.326	2.397	7.165
Bromotrifluoromethane f-13B1	$CBrF_3$	0.412	2.303	6.615
1,3-Butadiene	C_4H_6	0.354	1.413	2.491
Butane	C_4H_{10}	0.257	1.467	2.593
1-Butene	C_4H_8	0.294	1.435	2.503
CIS-2-Butene	C_4H_8	0.320	1.435	2.503
Trans-2-Butene	C_4H_8	0.291	1.435	2.503
Carbon Dioxide	CO_2	0.740	1.255	1.977
Carbon Disulfide	CS_2	0.638	1.650	3.393
Carbon Monoxide	CO	0.995	1.000	1.250
Carbon Tetrachloride	CCL_4	0.344	2.345	6.860
Carbon Tetrafluoride f-14	CF_4	0.440	1.770	3.926
Carbonyl Fluoride	COF_2	0.567	1.555	2.045
Carbonyl Sulfide	COS	0.680	1.463	2.180
Chlorine	CL_2	0.876	1.598	3.214
Chlorine Dioxide	CLO_2	0.693	1.554	3.011
Chlorine Trifluoride	CLF_3	0.433	1.812	4.125
2-Chlorobutane	C_4H_9Cl	0.234	1.818	4.134
Chlorodifluoromethane f-22	$CHCLF_2$	0.505	1.770	3.906
Chloroform (Trichloromethane)	$CHCL_3$	0.442	2.066	5.340
Chloropentafluoroethane f-115	C_2CLF_5	0.243	2.397	7.165
Chlorotrifluoroethylene	C_2CLF_3	0.337	2.044	5.208
Chlorotrifluoromethane f-13	$CCLF_3$	0.430	1.985	4.912
Cyanogen	$(CN)_2$	0.498	1.366	2.322
Cyanogen Chloride	CLCN	0.618	1.480	2.730
Cyclobutane	C_4H_8	0.387	1.413	2.491
Cyclopropane	C_3H_6	0.505	1.224	1.877
Deuterium	D_2	0.995	0.379	0.177
Diborane	B_2H_6	0.448	1.000	1.235
Diboromodifluoromethane f-12B2	CBr_2F_2	0.363	2.652	8.768
1,2-Dibromotetrafluoroethane f-114B2	$C_2Br_2F_4$	0.215	2.905	10.53
Dichlorodifluoromethane f-12	CCL_2F_2	0.390	2.099	5.492
Dichlorofluoromethane f-21	$CHCL_2F$	0.456	1.985	4.912
Dichlorosilane	SiH_2CL_2	0.442	1.897	4.506
1,2-Dichloroethane	$C_2H_4Cl_2$	0.382	1.879	4.419
1,2-Dichlorotetrafluoroethane f-114	$C_2CL_2F_4$	0.231	2.449	7.479
2,2 Dichloro	$C_2HC_{12}F_3$	0.259	2.336	6.829
1,1-Difluoro-1-Chloroethane	$C_2H_3CLF_2$	0.341	1.957	4.776
1,1-Difluoroethane	CH_3CHF_2	0.415	1.536	2.940
1,1-Difluoroethylene	CH_2CF_2	0.458	1.512	2.860
Diethylsilane	$C_4H_{12}Si$	0.183	1.775	3.940
Difluoromethane f-32	CF_2H_2	0.627	1.360	2.411
Dimethylamine	$(CH_3)_2NH$	0.370	1.269	2.013
Dimethylether	$(CH_3)_2O$	0.392	1.281	2.055
2,2-Dimethylpropane	$C(CH_3)_4$	0.247	1.613	3.244
Disilane	Si_2H_6	0.332	1.493	2.779
Ethane	C_2H_6	0.490	1.038	1.357
Ethanol	C_2H_6O	0.394	1.282	2.057
Ethylacetylene	C_4H_6	0.365	1.384	2.388
Ethyl Chloride	C_2H_5CL	0.408	1.516	2.879
Ethylene	C_2H_4	0.619	1.000	1.261
Ethylene Oxide	C_2H_4O	0.589	1.254	1.965
Fluorine	F_2	0.924	1.163	1.695
Fluoroform f-23	CHF_3	0.529	1.584	3.127
Germane	GeH_4	0.649	1.653	3.418
Germanium Tetrachloride	$GeCl_4$	0.268	2.766	9.574
Halothane (R-123B1)	$C_2HBrClF_3$	0.257	2.654	8.814
Helium	He	1.386	0.378	0.178
Hexafluoroacetone	F_3CCOCF_3	0.219	2.434	7.414
Hexaflorobenzine	C_6F_6	0.632	2.577	8.309
Hexafluoroethane f-116	C_2F_6	0.255	2.219	6.139
Hexafuoropropylene (HFP)	C_3F_6	0.249	2.312	6.663
Hexamethyldisilane (HMDS)	$(CH_2)_6Si_2$	0.139	2.404	7.208
Hexane	C_6H_{14}	0.204	1.757	3.847

Table 4-3 Conversion Factors (Nitrogen Base) Continued.

GAS NAME	FORMULA	SENSOR FACTOR	ORIFICE FACTOR	DENSITY (kg/m³)
Hydrogen	H_2	1.008	0.269	0.090
Hydrogen Bromide	HBr	0.987	1.695	3.645
Hydrogen Chloride	HCL	0.983	1.141	1.639
Hydrogen Cyanide	HCN	0.744	0.973	1.179
Hydrogen Fluoride	HF	0.998	0.845	0.893
Hydrogen Iodide	HI	0.953	2.144	5.789
Hydrogen Selenide	H_2Se	0.837	1.695	3.613
Hydrogen Sulfide	H_2S	0.850	1.108	1.539
Iodine Pentafluoride	IF_5	0.283	2.819	9.907
Isobutane	C_4H_{10}	0.260	1.440	2.593
Isobutene	C_4H_8	0.289	1.435	2.503
Isopentane	C_5H_{12}	0.211	1.605	3.222
Krypton	Kr	1.382	1.729	3.708
Methane	CH_4	0.763	0.763	0.717
Methylacetylene	C_3H_4	0.473	1.196	1.782
Methyl Bromide	CH_3Br	0.646	1.834	4.236
3-Methyl-1-butene	C_5H_{10}	0.252	1.584	3.127
Methyl Chloride	CH_3CL	0.687	1.347	2.308
Methyl Fluoride	CH_3F	0.761	1.102	1.518
Methyl Mercaptan	CH_4S	0.588	1.313	2.146
Methyl Silane	CH_6Si	0.393	1.283	2.061
Methyl Trichlorosilane (MTS)	CH_3Cl_3Si	0.267	2.310	6.675
Methyl Vinyl Ether	C_3H_6O	0.377	1.435	2.567
Monoethanolamine	C_2H_7NO	0.305	1.477	2.728
Monoethylamine	$C_2HH_5NH_2$	0.359	1.269	2.013
Monomethylamine	CH_3NH_2	0.565	1.067	1.420
Neon	Ne	1.398	0.847	0.902
Nickel Carbonyl	$Ni(CO)_4$	0.212	2.371	7.008
Nitric Oxide	NO	0.995	1.030	1.339
Nitrogen	N_2	1.000	1.000	1.251
Nitrogen Dioxide	NO_2	0.758	1.713	2.052
Nitrogen Trifluoride	NF_3	0.501	1.598	3.168
Nitrogen Trioxide	N_2O_3	0.443	1.649	3.389
Nitrosyl Chloride	NOCL	0.644	1.529	2.913
Nitrous Oxide	N_2O	0.752	1.259	1.964
Octofluorocyclobutane	C_4F_8	0.169	2.672	8.933
Oxygen	O_2	0.988	1.067	1.429
Oxygen Difluoride	OF_2	0.672	1.388	2.402
Ozone	O_3	0.738	1.310	2.138
Pentafluorethane f-125	C_2HF_5	0.287	2.070	5.360
Pentane (n-Pentane)	C_5H_{12}	0.212	1.605	3.222
Perchloryl Fluoride	CLO_3F	0.448	1.905	4.571
Perfluorobutane	C_4F_{10}	0.738	2.918	10.61
Perfluoro-2-Butene	C_4F_8	0.268	2.672	8.933
Perfluoromethyl-vinylether	PMVE	0.296	2.029	5.131
Perfluoropropane	C_3F_8	0.179	2.591	8.396
Pentane (n-Pentane)	C_5H_{12}	0.212	1.605	3.222
Phosgene	$COCL_2$	0.504	1.881	4.418
Phosphine	PH_3	0.783	1.100	1.517
Phosphorous Pentafluoride	PF_5	0.346	2.109	5.620
Phosphorous Trifluoride	PF_3	0.495	1.770	3.906
Propane (same as $CH_3CH_2CH_3$)	C_3H_8	0.343	1.274	2.008
Propylene (Propene)	C_3H_6	0.401	1.234	1.875
Rhenium Hexafluoride	ReF_6	0.230	3.279	13.41
Silane	SiH_4	0.625	1.070	1.440
Silicon Tetrachloride	$SiCL_4$	0.310	2.465	7.579
Silicon Tetrafluoride	SiF_4	0.395	1.931	4.648
Sulfur Dioxide	SO_2	0.728	1.529	2.858
Sulfur Hexafluoride	SF_6	0.270	2.348	6.516
Sulfur Tetrafluoride	SF_4	0.353	1.957	4.776
Sulfur Trioxide	SO_3	0.535	1.691	3.575
Sulfuryl Fluoride	SO_2F_2	0.423	1.931	4.648
Tetrachloromethane	CCL_4	0.344	2.345	6.858
Tetrafluoroethylene (TFE)	C_2F_4	0.361	1.905	4.526
Tetrafluorohydrazine	N_2F_4	0.367	1.926	4.624
Trichlorofluoromethane f-11	CCL_3F	0.374	2.244	6.281
Trichlorosilane	$SiHCL_3$	0.329	2.201	6.038
Trimethyloxyborane (TMB)	$B(OCH_3)_3$	0.300	1.929	4.638
1,1,2-Trichloro-1,1,2-Triflouroet f-113	$C_2CL_3F_3$	0.231	2.520	7.920
Trimethylamine	$(CH_3)_3N$	0.316	1.467	2.639
Tungsten Hexafluoride	WF_6	0.227	3.264	13.28
Uranimum Hexafluoride	UF_6	0.220	3.548	15.70
Vinyl Bromide	C_2H_3Br	0.524	1.985	4.772
Vinyl Chloride	C_2H_3CL	0.542	1.492	2.788
Vinyl Fluoride	C_2H_3F	0.576	1.281	2.046
Water Vapor	H_2O	0.861	0.802	0.804
Xenon	Xe	1.383	2.180	5.851

4-6 Use of Orifice Sizing Nomograph

The Orifice and Restrictor Sizes for 5850*i* should be sized using the "Brooks Thermal Mass Flowmeter Sizing Selection Program" Revision 8.6 or later. A copy can be requested through your local Brooks Sales Representive or through the Brooks Customer Service Department.

The Orifice Sizing Nomograph, Table 4-4, is used to calculate the control valve's orifice size when changing any or all of the following factors from the original factory calibration.

gas
operating pressure (inlet and outlet)
flow range

The flow controller's orifice is factory-sized to a preselected gas, operating pressure and flow range. Note that the orifice is marked with its size in thousandths of an inch. When changing the aforementioned factors, calculate the new orifice size by following the procedure and example outlined below.

Example: Determine the orifice size for the following conditions:

Gas: Hydrogen
Flow Rate: 2000 sccm
Outlet Pressure: 30 psig
Inlet Pressure: 50 psig

1. Determine air equivalent flow rate (refer to Table 4-3).

$$Q_{AIR} = Q_{GAS}\sqrt{\frac{\rho_{GAS}}{\rho_{AIR}}} \quad \text{or}$$

$$Q_{AIR} = Q_{GAS}\sqrt{SG_{GAS}}$$

where $SG_{AIR} = 1.00$

Q_{Air}	=	Air equivalent flow rate (sccm)
Q_{gas}	=	Desired flow rate of the gas (sccm) (Based on 0°C Standard temperature)
D_{Air}	=	Density of Air at 70°F
D_{gas}	=	Density of the gas (taken at customer temperature)
SG_{gas}	=	Specific gravity of the gas (taken at customer temperature)

Refer to Table 4-3 for specific gravities.

Example: What is the air equivalent flow rate of 2000 sccm Hydrogen?

$$Q_{GAS} = 2000 \text{ sccm}$$
$$\sqrt{SG_{GAS}} = .264$$
$$Q_{AIR} = Q_{GAS} \sqrt{SG_{GAS}}$$
$$= 2000 \times .264$$
$$= 528 \text{ sccm air}$$

In order to calculate the orifice conversion factor when using a gas mixture, the following formula must be used:

$$\text{Orifice Conversion Factor Mixture} = \sqrt{\frac{P_1 \left(\text{Orfice Conversion Factor 1}\right) + P_2 \left(\text{Orfice Conversion Factor 2}\right) + P_n \left(\text{Orfice Conversion Factor n}\right)}{100}}$$

Where P1 = percentage by volume of gas 1
P2 = percentage by volume of gas 2
Pn = percentage by volume of gas n

Example: Find the Air equivalent flow for 20 slpm of a 20% Helium and 80% Chlorine gas mixture.

$$\text{Orifice Conversion Factor Mixture} = \sqrt{\frac{20\,(.371)^2 + 80\,(1.573)^2}{100}}$$
$$= 1.417$$

$$Q_{AIR} = Q_{gas} \text{(orifice conversion factor)}$$
$$= 20 \times 1.417$$
$$= 28.34 \text{ slpm air}$$

2. If inlet and outlet pressures are given in gauge pressure (psig) add14.7 to convert to absolute pressure (psia).

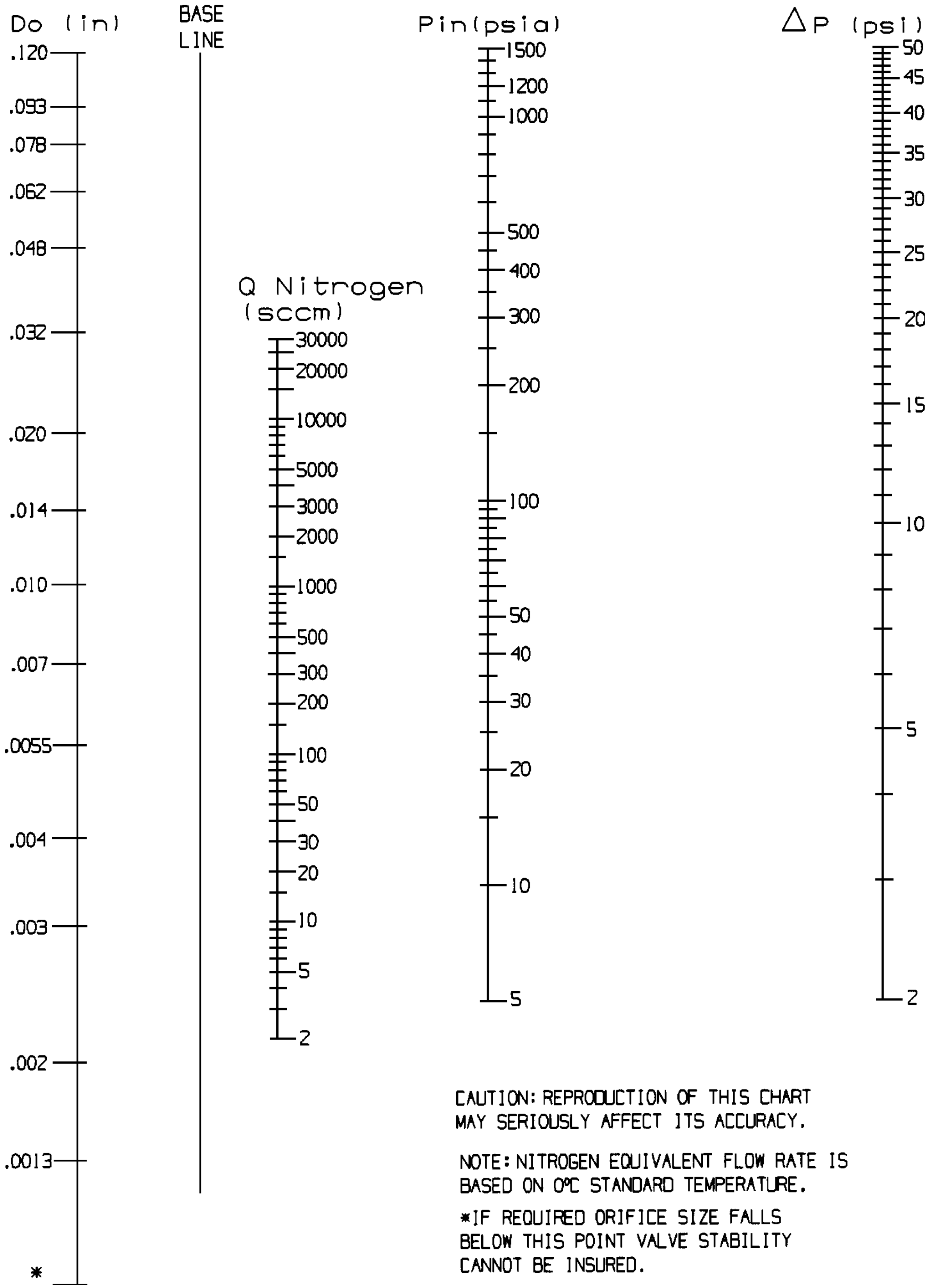
Outlet Pressure — 30 psig + 14.7 = 44.7 psia
Inlet Pressure — 50 psig + 14.7 = 64.7 psia

3. Determine Critical Pressure Drop
Critical pressure drop occurs when the outlet pressure (psia) is less than half the inlet pressure (psia) or

$$P \text{ outlet} < \frac{P \text{ inlet}}{2}$$

If these conditions exist, the pressure drop (Δp) should be calculated as follows:

Table 4-4 Model 5850i Orifice Sizing Nomograph



CAUTION: REPRODUCTION OF THIS CHART MAY SERIOUSLY AFFECT ITS ACCURACY.

NOTE: NITROGEN EQUIVALENT FLOW RATE IS BASED ON 0°C STANDARD TEMPERATURE.

*IF REQUIRED ORIFICE SIZE FALLS BELOW THIS POINT VALVE STABILITY CANNOT BE INSURED.

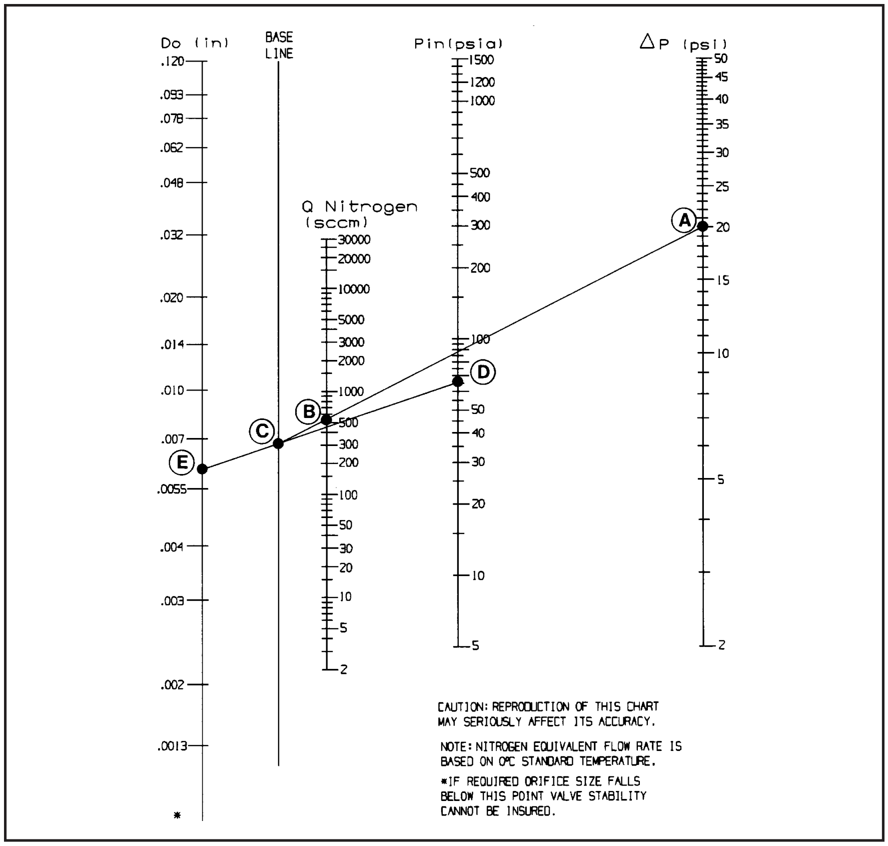


Figure 4-4 Example Nomograph

$$\Delta P = \frac{P_{in}}{2}$$

ΔP = Pressure Drop (psi)

P_{IN} = Inlet Pressure (psia)

If these conditions do not exist, pressure drop equals the inlet pressure minus the outlet pressure.

Is 44.7 psia $< \frac{64.7 \text{ psia}}{2}$? No.

Then $\Delta p = 64.7 - 44.7 = 20$ psi

Using the nomograph, locate the pressure drop (psi) on the vertical line marked "Δp" (Point A).

4. Using the nomograph, locate the pressure drop (psi) on the vertical line marked "Dp" (Point A).
5. Locate the Nitrogen equivalent flow rate (sccm Nitrogen) on the vertical line marked "$Q_{Nitrogen}$" (Point B).
6. Draw a line connecting Dp and QNitrogen and extend it to the baseline. Mark this point (Point C).
7. Locate inlet pressure (psia) on the vertical line marked "P_{in}" (Point D).
8. Draw a line connection P_{in} (Point D) and baseline (Point C) and then extend this line to the vertical line marked D_o (orifice diameter, inches). (Point E).
9. This point on the line is the minimum orifice size for the given

conditions. If this point is between two orifice sizes, select the next largest size orifice to ensure adequate flow. If the orifice selected falls below .0013, choose .0013 size orifice.

For this example the .007 size orifice would be selected.

4-7 Restrictor Sizing

The restrictor assembly is a ranging device for the sensor portion of the controller. It creates a pressure drop which is linear with flow rate. This diverts a sample quantity of the process gas flow through the sensor. Each restrictor maintains the ratio of sensor flow to restrictor flow, however the total flow through each restrictor is different. Different restrictors (micron porosity and active area) have different pressure drops and produce controllers with different full scale flow rates. For a discussion of the interaction of the various parts of the controller, you are urged to review Section 3-1 (Theory of Operation).

If the restrictor assembly has been contaminated with foreign matter, the pressure drop vs. flow characteristics will be altered and it must be cleaned or replaced. It may also be necessary to replace the restrictor assembly when the mass flow controller is to be calibrated to a new flow rate.

Restrictor assembly replacement should be performed only by trained personnel. The tools required for the removal/replacement procedure are as follows:

Appropriate size wrench for the removal of the inlet process connection
Restrictor removal tool
(contained in service tool kit P/N S-778-D-017-AAA)
Restrictor O-ring, refer to the spare parts Section 5, for the correct part number.

Restrictors

The 5850 Series Mass Flow Controllers use two types of restrictor assemblies depending upon full scale flowrate.

1. Anti-Clog Laminar Flow Element (ACLFE). This type of restrictor assembly is used for air equivalent flow rates less than 3.4 slpm.
2. Sintered wire mesh for air equivalent flow rates above 3.5 slpm. These restrictor assemblies are made from a cylinder of sintered wire mesh and are easily cleaned if they become contaminated in service.

Sizing

All 5850 Series Restrictor Assemblies are factory adjusted to provide a 115 mm water column pressure drop for a specific flow rate. This corresponds to the desired full scale flow rate. A list of restrictor assemblies used in the 5850 Series Mass Flow Controllers is shown in Table 4-5.

Table 4-5 Model 5850i Standard Restrictors

Size	Range SCCM Air Equivalent Flow Low	High	Part Number ACLFE	Wire Mesh
D	8.022	11.36	S-110-Z-275-BMT	
E	11.23	15.90	S-110-Z-276-BMT	
F	15.72	22.26	S-110-Z-277-BMT	
G	22.01	31.17	S-110-Z-278-BMT	
H	30.82	43.64	S-110-Z-279-BMT	
J	43.14	61.09	S-110-Z-280-BMT	
K	60.40	85.53	S-110-Z-281-BMT	
L	84.56	119.7	S-110-Z-282-BMT	
M	118.4	167.6	S-110-Z-283-BMT	
N	165.7	234.7	S-110-Z-284-BMT	
P	232.0	328.6	S-110-Z-285-BMT	
Q	324.8	460.0	S-110-Z-286-BMT	
R	454.8	644.0	S-110-Z-287-BMT	
S	636.7	901.6	S-110-Z-288-BMT	
T	891.4	1262.	S-110-Z-289-BMT	
U	1248.	1767.	S-110-Z-290-BMT	
V	1747.	2474.	S-110-Z-291-BMT	
W	2446.	3464.	S-110-Z-292-BMT	
X	3424.	4849.		S-110-Z-319-BMA
Y	4794.	6789.		S-110-Z-321-BMA
1	6711.	9504.		S-110-Z-317-BMA
2	9396.	13310.		S-110-Z-228-BMA
3	13150.	18630.		S-110-Z-226-BMA
4	18420.	30000.		S-110-Z-224-BMA

Example:
The desired gas is Silane (SiH4).
The desired full scale flow rate is 200 sccm
Sensor conversion factor is 0.68 from Table 4-3.
Air equivalent flow = 200/0.68 = 294.1 sccm air.

In the example above, a size P restrictor would be selected.

NOTE: If the calculated flow rate is such that two different size restrictors could be used, always select the larger size.

If a mixture of two or more gases are being used, the restrictor selection must be based on the air equivalent flow rate of the mixture.

Example:
The desired gas is 20% Helium (He) and 80% Chlorine (Cl_2) by volume.
The desired full scale flow rate of the mixture is 20 slpm.

Sensor conversion factor for the mixture is:

$$\text{Mixture Factor} = \frac{100}{\frac{20}{1.39} + \frac{80}{.83}} = .903$$

Air equivalent flow = 20/.903 = 22.15 slpm air.

In this example, a size 4 wire mesh assembly would be selected.

Materials: BMT = 316 Stainless Steel (ACLFE only)
BMA = Sintered 316 Stainless Steel (wire mesh only)

NOTE: For flow rates less than 8 sccm use the low flow plug,

P/N 618K019BMT in place of a restrictor assembly and install a low flow filler ring P/N 724Z363BMT in the valve cavity after the orifice is installed.

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5-1 General

When ordering parts, please specify:

Brooks Serial Number
Model Number
Part Description
Part Number
Quantity

(Refer to Figure 5-1 and Tables 5-1 and 5-2).

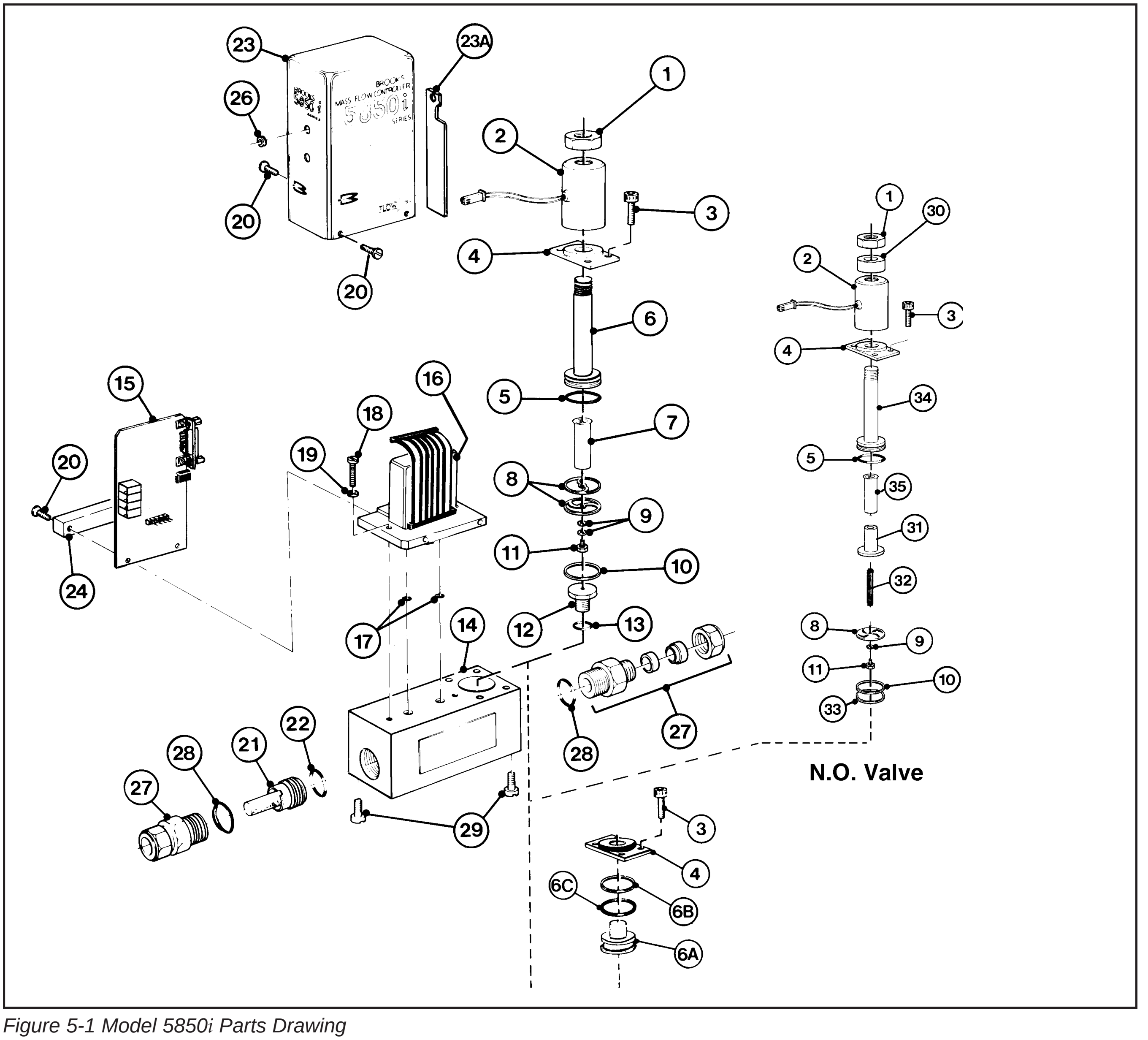

Figure 5-1 Model 5850i Parts Drawing

Table 5-1 Model 5850i Replacement Parts List

Item No.	Qty.	Description		Part Number
1	1	Jam Nut		573B027ACK
2	1	Coil Assembly		S185Z271AAA
3	4	Screw, Valve		751C322AWA
4	1	Retaining Plate		715Z169AH%
5	1	O-ring, Valve Stem, Size 016		375B016***
6	1	Valve Stem: Normally Closed Valve		949Z194QOT
		Valve Stem: Normally Open Valve		949Z215BMT
6A	1	Valve Plug		953Z068BMT
6B	1	Valve Ring		763Z064***
6C	1	Valve O-ring		375B016***
7	1	Valve Plunger Assy: Normally Closed Valve		S622Z165AAA
		Normally Open Valve		S622Z203QOT
31	1	Insert Sleeve Normally Open Valve		456Z071QOT
32	1	Plunger Extension Normally Open Valve		622Z200BMT
8	1	Lower Guide Spring,unit with NO ORIFICE		820Z109DR%
		Normally Closed Valve .001-.014 orifice		820Z109DR%
		Normally Closed Valve .020-.120 orifice		820Z110DR%
		Normally Open Valve all orifice sizes		820Z110DR%
9	AR	Small Valve Spacer, 0.005" Thick		810A362BMA
9	AR	Small Valve Spacer, 0.010" Thick		810A363BMA
10	AR	Large Valve Spacer, 0.005" Thick		810A368BMA
10	AR	Large Valve Spacer, 0.010" Thick		810A361BMA
33	1	Preload Spacer, Spring Normally Open valve		810A388BMT
		Valve Seat with Viton Insert		S715Z051AAG
11	1	Valve Seat with Buna Insert		S715Z050AAG
		Valve seat w/Kalrez insert (<or=200 psig)		S715Z297AAG
		Valve Seat with Kalrez Insert (>200 psig)		S715Z163AAA
		Valve Seat Solid 316 Stainless Steel		715Z181BNT
				Stainless
			ID 0.0013"	577Z375BMT
			ID 0.002"	577Z376BMT
			ID 0.003"	577Z377BMT
			ID 0.004"	577Z378BMT
			ID 0.007"	577Z381BMT
			ID 0.010"	577Z383BMT
12	1	Orifice	ID 0.014"	577Z385BMT
			ID 0.020"	577Z387BMT
			ID 0.032"	577Z391BMT
			ID 0.048"	577Z393BMT
			ID 0.062"	577Z395BMT
			ID 0.078"	577Z397BMT
		(Refer to Section 4-6	ID 0.093"	577Z398BMT
		for sizing)	ID 0.116"	577Z399BMT
			ID 0.120"	577Z400BMT
13	1	O-ring, Orifice, Size 008		375B008***
14	1	Controller Body		092Z768BI%
15	1	PC Board Assembly (D-Connector)		S097Y249AAA
16	1	Sensor Assembly		S774Z508AAA
17	2	O-ring, Sensor, Size 004		375B004***
18	2	Allen Nut, Sensor-Body		753B269AWA
19	2	Lock Washer, Sensor		962D006AWA
20	5	Screw, Sensor-PC Board-Cover		753L056AWZ
21	1	Restrictor Assembly and Components (Refer to Section 4-7 for sizing)		
22	1	O-ring, Restrictor, Size 109		375B109***
23	1	Electronics Cover Can (D-Connector)		219Z432EA%

****QTA=Viton, SUA=Buna, TTA=Kalrez, AR=As Required, NS=NS Not Shown*

Table 5-1 Model 5850i Replacement Parts List (continued)

Item No.	Quantity	Description		Part Number
NS	2	Fitting, 1/4" Compression, Swagelok		320B136BMA
		Fitting, 1/4" Male VCR, Cajon		315Z036BMA
		Fitting, 1/4" Male VCO, Cajon		315Z035BMA
		Fitting, 3/8" Compression		320B150BMA
		Fitting, 3/8" Male VCO (3/8" or 1/2" Tube)		315Z033BMA
		Fitting, 3/8" Male VCR (3/8" or 1/2" Tube)		315Z034BMA
27	2	O-Ring, Fitting, Size 906		375B906***
NS	2	O-Ring, VCO Gland, Size 010		375B010***
NS	1	O-Ring, End Block, Size 029		375B029***
NS	1	Interconnecting Cables	**Length**	**D-Connector**
		D-Connector on one end with no	5 Feet	S124Z361AAA
		termination on the other end	10 Feet	S124Z362AAA
			25 Feet	S124Z363AAA
			50 Feet	S124Z435AAA
NS	2	8-32 Mounting Screw		Customer Supplied
28	1	End Block with Integral Inlet Screen		S079Z200AAA
29	4	Screw, End Block		751Z105AAO

*** QTA = Viton, SUA = Buna, TTA = Kalrez
AR As required, NS Not Shown

Table 5-2 Tool and Spare Part Kits for 5850 Series

5850/5851 Series Service Tool Kit P/N S778D017AAA Permits the complete disassembly of the 5850*i* for servicing Contains: 1 — O-Ring Removal Tool 1 — Potentiometer Adjustment Tool 1 — Ball Point Allen Wrench 1 — Phillips Screw Driver 1 — Nut Driver for Orifice 1 — Restrictor Removal Tool 1 — Common Screw Driver	5851 Header Removal Tool P/N S817Z036AAA 0550/5851 Orifice Removal Tool P/N S908Z049AAA 5850/5851 Series Calibration Cover - "D" Connector P/N 909Z017EAD
5850/5851 Series Break Out Board Assembly(Not for S Series!) P/N S273Z668AAA Installs directly between mass flow controller and interconnecting cable. Allows convenient access to all signals for easy trouble-shooting of system. Contains: 1 — Break Out PC Board 1 — 5 Foot Extension Cable 1 — Terminal PC Board	5850/5851 Series Valve Shim Kit P/N S810A372BMA Contains: 1 — .010" Large Spacer 2 — .005" Large Spacers 1 — .010" Small Spacer 2 — .005" Small Spacers

*** QTA = Viton, SUA = Buna, TTA = Kalrez

NOTE: Additional publication available:
T-086 Mass Flow Controller Contamination Control

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Dansk

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Emne : Tillæg til instruktions manual.

Reference : CE mærkning af Masse Flow udstyr

Dato : Januar-1996.

Brooks Instrument har gennemført CE mærkning af elektronisk udstyr med succes, i henhold til regulativet om elektrisk støj (EMC direktivet 89/336/EEC).

Der skal dog gøres opmærksom på benyttelsen af signalkabler i forbindelse med CE mærkede udstyr.

<u>Kvaliteten af signal kabler og stik:</u>

Brooks lever kabler af høj kvalitet, der imødekommer specifikationerne til CE mærkning.

Hvis der anvendes andre kabel typer skal der benyttes et skærmet kabel med hel skærm med 100% dækning.

Forbindelses stikket type “D” eller “cirkulære”, skal være skærmet med metalhus og eventuelle PG-forskruninger skal enten være af metal eller metal skærmet.

Skærmen skal forbindes, i begge ender, til stikkets metalhus eller PG-forskruningen og have forbindelse over 360 grader.

Skærmen bør være forbundet til jord.

“Card Edge” stik er standard ikke af metal, der skal derfor ligeledes benyttes et skærmet kabel med hel skærm med 100% dækning.

Skærmen bør være forbundet til jord.

Forbindelse af stikket; venligst referer til vedlagte instruktions manual.

Med venlig hilsen,

Deutsch

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Subject : Nachtrag zur Bedienungsanleitung.

Referenz : CE Zertifizierung für Massedurchflußgeräte

Datum : Januar-1996.

Nach erfolgreichen Tests enstprechend den Vorschiften der Elektromagnetischen Verträglichkeit (EMC Richtlinie 89/336/EEC) erhalten die Brooks-Geräte (elektrische/elektronische Komponenten) das CE-Zeichen.

Bei der Auswahl der Verbindungskabel für CE-zertifizierte Geräte sind spezielle Anforderungen zu beachten.

<u>Qualität der Verbindungskabel, Anschlußstecker und der Kabeldurchführungen</u>

Die hochwertigen Qualitätskabel von Brooks entsprechen der Spezifikation der CE-Zertifizierung.

Bei Verwendung eigener Verbindungskabel sollten Sie darauf achten, daß eine

100 %igenSchirmababdeckung des Kabels gewährleistet ist.

“D” oder “Rund” -Verbindungsstecker sollten eine Abschirmung aus Metall besitzen.

Wenn möglich, sollten Kabeldurchführungen mit Anschlußmöglichkeiten für die Kabelabschrimung verwendet werden.

Die Abschirmung des Kabels ist auf beiden Seiten des Steckers oder der Kabeldurchführungen über den vollen Umfang von 360 ° anzuschließen.

Die Abschirmung ist mit dem Erdpotential zu verbinden.

Platinen-Steckverbindunger sind standardmäßige keine metallgeschirmten Verbindungen. Um die Anforderungen der CE-Zertifizierung zu erfüllen, sind Kabel mit einer 100 %igen Schirmababdeckung zu verwenden.

Die Abschirmung ist mit dem Erdpotential zu verbinden.

Die Belegung der Anschlußpins können Sie dem beigelegten Bedienungshandbuch entnehmen.

English

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Subject : Addendum to the Instruction Manual.

Reference : CE certification of Mass Flow Equipment

Date : January-1996.

The Brooks (electric/electronic) equipment bearing the CE mark has been successfully tested to the regulations of the Electro Magnetic Compatibility (EMC directive 89/336/EEC).

Special attention however is required when selecting the signal cable to be used with CE marked equipment.

<u>Quality of the signal cable, cable glands and connectors:</u>

Brooks supplies high quality cable(s) which meets the specifications for CE certification.

If you provide your own signal cable you should use a cable which is overall completely screened with a 100% shield.

“D” or “Circular” type connectors used should be shielded with a metal shield. If applicable, metal cable glands must be used providing cable screen clamping.

The cable screen should be connected to the metal shell or gland and shielded at both ends over 360 Degrees.

The shield should be terminated to a earth ground.

Card Edge Connectors are standard non-metallic. The cables used must be screened with 100% shield to comply with CE certification.

The shield should be terminated to a earth ground.

For pin configuration : Please refer to the enclosed Instruction Manual.

Español

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Asunto : Addendum al Manual de Instrucciones.

Referencia : Certificación CE de los Equipos de Caudal Másico

Fecha : Enero-1996.

Los equipos de Brooks (eléctricos/electrónicos) en relación con la marca CE han pasado satisfactoriamente las pruebas referentes a las regulaciones de Compatibilidad Electro magnética (EMC directiva 89/336/EEC).

Sin embargo se requiere una atención especial en el momento de seleccionar el cable de señal cuando se va a utilizar un equipo con marca CE

<u>Calidad del cable de señal, prensaestopas y conectores:</u>

Brooks suministra cable(s) de alta calidad, que cumple las especificaciones de la certificación CE .

Si usted adquiere su propio cable de señal, debería usar un cable que esté completamente protegido en su conjunto con un apantallamiento del 100%.

Cuando utilice conectores del tipo “D” ó “Circular” deberían estar protegidos con una pantalla metálica. Cuando sea posible, se deberán utilizar prensaestopas metálicos provistos de abrazadera para la pantalla del cable.

La pantalla del cable deberá ser conectada al casquillo metálico ó prensa y protegida en ambos extremos completamente en los 360 Grados.

La pantalla deberá conectarse a tierra.

Los conectores estandar de tipo tarjeta (Card Edge) no son metálicos, los cables utilizados deberán ser protegidos con un apantallamiento del 100% para cumplir con la certificación CE.

La pantalla deberá conectarse a tierra.

Para ver la configuración de los pines: Por favor, consultar Manual de Instrucciones adjunto.

Français

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Sujet : Annexe au Manuel d'Instructions.

Référence : Certification CE des Débitmètres Massiques à Effet Thermique.

Date : Janvier 1996.

Messieurs,

Les équipements Brooks (électriques/électroniques) portant le label CE ont été testés avec succès selon les règles de la Compatibilité Electromagnétique (directive CEM 89/336/EEC).

Cependant, la plus grande attention doit être apportée en ce qui concerne la sélection du câble utilisé pour véhiculer le signal d'un appareil portant le label CE.

<u>Qualité du câble, des presse-étoupes et des connecteurs:</u>

Brooks fournit des câbles de haute qualité répondant aux spécifications de la certification CE.

Si vous approvisionnez vous-même ce câble, vous devez utiliser un câble blindé à 100 %.

Les connecteurs « D » ou de type « circulaire » doivent être reliés à la terre.

Si des presse-étoupes sont nécessaires, ceux ci doivent être métalliques avec mise à la terre.

Le blindage doit être raccordé aux connecteurs métalliques ou aux presse-étoupes sur le pourtour complet du câble, et à chacune de ses extrémités.

Tous les blindages doivent être reliés à la terre.

Les connecteurs de type « card edge » sont non métalliques. Les câbles utilisés doivent être blindés à 100% pour satisfaire à la réglementation CE.

Tous les blindages doivent être reliés à la terre.

Se référer au manuel d'instruction pour le raccordement des contacts.

Greek

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Θέμα :Προσθήκη στο Εγχειρίδιο Οδηγιών.
Σχετικά :Πιστοποίηση CE των Οργάνων Μέτρησης Παροχής Μάζας.
Ημερομηνία :Ιανουάριος - 1996

1996

Κυρίες και Κύριοι,

Τα όργανα (ηλεκτρικά/ηλεκτρονικά) της Brooks τα οποία φέρουν το σήμα CE έχουν επιτυχώς ελεγχθεί σύμφωνα με τους κανονισμούς της Ηλεκτρο-Μαγνητικής Συμβατότητας (EMC ντιρεκτίβα 89/336/EEC).
Οπωσδήποτε χρειάζεται ειδική προσοχή κατά τήν επιλογή του καλωδίου μεταφοράς του σήματος το οποίο (καλώδιο) πρόκειται να χρησιμοποιηθεί με όργανα που φέρουν το σήμα CE.

<u>Ποιότητα του καλωδίου σήματος των στυπιοθλιπτών και των συνδέσμων .</u>

Η Brooks κατά κανόνα προμηθεύει υψηλής ποιότητας καλώδια τα οποία πληρούν τις προδιαγραφές για πιστοποίηση CE.
Εάν η επιλογή του καλωδίου σήματος γίνει από σας πρέπει να χρησιμοποιήσετε καλώδιο το οποίο να φέρει εξωτερικά πλήρες πλέγμα και να παρέχει θωράκιση 100%.

Οι σύνδεσμοι τύπου "D" ή "Κυκλικοί" των καλωδίων, πρέπει να θωρακίζονται με μεταλλική θωράκιση. Εάν είναι εφαρμόσιμο, πρέπει να χρησιμοποιούνται μεταλλικοί στυπιοθλίπτες καλωδίων που να διαθέτουν ακροδέκτη σύνδεσης του πλέγματος του καλωδίου.
Το πλέγμα του καλωδίου πρέπει να συνδέεται στο μεταλλικό περίβλημα ή στον στυπιοθλίπτη και να θωρακίζεται και στα δύο άκρα κατά 360 μοίρες.
Η θωράκιση πρέπει να καταλήγει σε κάποιο ακροδέκτη γείωσης.

Οι σύνδεσμοι καρτών είναι μη-μεταλλικοί, τα καλώδια που χρησιμοποιούνται πρέπει να φέρουν πλέγμα θωράκισης 100% για να υπακούουν στην πιστοποίηση CE.
Η θωράκιση πρέπει να καταλήγει σε κάποιο ακροδέκτη γείωσης.

Για την διάταξη των ακροδεκτών: Παρακαλούμε αναφερθείτε στο εσώκλειστο Εγχειρίδιο Οδηγιών.

Italiano

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Oggetto : Addendum al manuale di istruzioni.

Riferimento : Certificazione CE dei misuratori termici di portata in massa

Data : Gennaio 1996.

Questa strumentazione (elettrica ed elettronica) prodotta da Brooks Instrument, soggetta a marcatura CE, ha superato con successo le prove richieste dalla direttiva per la Compatibilità Elettomagnetica (Direttiva EMC 89/336/EEC).

E' richiesta comunque una speciale attenzione nella scelta dei cavi di segnale da usarsi con la strumentazione soggetta a marchio CE.

Qualità dei cavi di segnale e dei relativi connettori:

Brooks fornisce cavi di elevata qualità che soddisfano le specifiche richieste dalla certificazione CE. Se l'utente intende usare propri cavi, questi devono possedere una schermatura del 100%.

I connettori sia di tipo "D" che circolari devono possedere un guscio metallico. Se esiste un passacavo esso deve essere metallico e fornito di fissaggio per lo schermo del cavo.

Lo schermo del cavo deve essere collegato al guscio metallico in modo da schermarlo a 360° e questo vale per entrambe le estemità.

Lo schermo deve essere collegato ad un terminale di terra.

I connettori "Card Edge" sono normalmente non metallici. Il cavo impiegato deve comunque avere una schermatura del 100% per soddisfare la certificazione CE.

Lo schermo deve essere collegato ad un terminale di terra.

Per il corretto cablaggio dei terminali occorre fare riferimento agli schemi del manuale di istruzioni dello strumento.

Nederlands

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Onderwerp : Addendum voor Instructie Handboek

Referentie: CE certificering voor Mass Flow Meters & Controllers

Datum : Januari 1996

Dames en heren,

Alle CE gemarkeerde elektrische en elektronische produkten van Brooks Instrument zijn met succes getest en voldoen aan de wetgeving voor Electro Magnetische Compatibiliteit (EMC wetgeving volgens 89/336/EEC).

Speciale aandacht is echter vereist wanneer de signaalkabel gekozen wordt voor gebruik met CE gemarkeerde produkten.

Kwaliteit van de signaalkabel en kabelaansluitingen:

- Brooks levert standaard kabels met een hoge kwaliteit, welke voldoen aan de specificaties voor CE certificering.

  Indien men voorziet in een eigen signaalkabel, moet er gebruik gemaakt worden van een kabel die volledig is afgeschermd met een bedekkingsgraad van 100%.
- "D" of "ronde" kabelconnectoren moeten afgeschermd zijn met een metalen connector kap. Indien kabelwartels worden toegepast, moeten metalen kabelwartels worden gebruikt die het mogelijk maken het kabelscherm in te klemmen

  Het kabelscherm moet aan beide zijden over 360° met de metalen connectorkap, of wartel verbonden worden.

  Het scherm moet worden verbonden met aarde.
- "Card-edge" connectors zijn standaard niet-metallisch. De gebruikte kabels moeten volledig afgeschermd zijn met een bedekkingsgraad van 100% om te voldoen aan de CE certificering.

  Het scherm moet worden verbonden met aarde.

Voor pin-configuraties a.u.b. verwijzen wij naar het bijgesloten instruktie handboek.

Hoogachtend,

Norsk

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Vedrørende : Vedlegg til håndbok

Referanse : CE sertifisering av utstyr for massestrømsmåling og regulering

Dato : Januar 1996

Til den det angår

Brooks Instrument elektrisk og elektronisk utstyr påført CE-merket har gjennomgått og bestått prøver som beskrevet i EMC forskrift om elektromagnetisk immunitet, direktiv 89/336/EEC.

For å opprettholde denne klassifisering er det av stor viktighet at riktig kabel velges for tilkobling av det måletekniske utstyret.

Utførelse av signalkabel og tilhørende plugger:

- Brooks Instrument tilbyr levert med utstyret egnet kabel som møter de krav som stilles til CE-sertifisering.
- Dersom kunden selv velger kabel, må kabel med fullstendig, 100% skjerming av lederene benyttes.

"D" type og runde plugger og forbindelser må være utført med kappe i metall og kabelnipler må være utført i metall for jordet innfesting av skjermen. Skjermen i kabelen må tilknyttes metallet i pluggen eller nippelen i begge ender over 360°, tilkoblet elektrisk jord.

- Kort-kantkontakter er normalt utført i kunststoff. De tilhørende flatkabler må være utført med fullstendig, 100% skjerming som kobles til elektrisk jord på riktig pinne i pluggen, for å møte CE sertifiseringskrav.

For tilkobling av medleverte plugger, vennligst se håndboken som hører til utstyret.

Vennlig hilsen

Português

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Assunto : Adenda ao Manual de Instruções

Referência : Certificação CE do Equipamento de Fluxo de Massa

Data : Janeiro de 1996.

O equipamento (eléctrico/electrónico) Brooks com a marca CE foi testado com êxito nos termos do regulamento da Compatibilidade Electromagnética (directiva CEM 89/336/EEC).

Todavia, ao seleccionar-se o cabo de sinal a utilizar com equipamento contendo a marca CE, será necessário ter uma atenção especial.

<u>Qualidade do cabo de sinal, buchas de cabo e conectores:</u>

A Brooks fornece cabo(s) de qualidade superior que cumprem os requesitos da certificação CE.

Se fornecerem o vosso próprio cabo de sinal, devem utilizar um cabo que, na sua totalidade, seja isolado com uma blindagem de 100%.

Os conectores tipo "D" ou "Circulares" devem ser blindados com uma blindagem metálica. Se tal for necessário, deve utilizar-se buchas metálicas de cabo para o isolamento do aperto do cabo.

O isolamento do cabo deve ser ligado à blindagem ou bucha metálica em ambas as extremidades em 360º.

A blindagem deve terminar com a ligação à massa.

Os conectores "Card Edge" não são, em geral, metálicos e os cabos utilizados devem ter um isolamento com blindagem a 100% nos termos da Certificação CE..

A blindagem deve terminar com ligação à massa.

Relativamente à configuração da cavilha, queiram consultar o Manual de Instruções.

Suomi

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Asia : **Lisäys Käyttöohjeisiin**

Viite : **Massamäärämittareiden CE sertifiointi**

Päivämäärä : **Tammikuu 1996**

Brooksin CE merkillä varustetut sähköiset laitteet ovat läpäissyt EMC testit (direktiivi 89/336/EEC).

Erityistä huomiota on kuitenkin kiinnitettävä signaalikaapelin valintaan.

Signaalikaapelin, kaapelin läpiviennin ja liittimen laatu

Brooks toimittaa korkealaatuisia kaapeleita, jotka täyttävät CE sertifikaatin vaatimukset. Hankkiessaan signaalikaapelin itse, olisi hankittava 100%:sti suojattu kaapeli.

“D” tai “Circular” tyyppisen liitimen tulisi olla varustettu metallisuojalla. Mikälì mahdollista, tulisi käyttää metallisia kaapeliliittimiä kiinnitettäessä suojaa.

Kaapelin suoja tulisi olla liitetty metallisuojaan tai liittimeen molemmissa päissä 360°:n matkalta.

Suojan tulisi olla maadoitettu.

“Card Edge Connector”it ovat standarditoimituksina ei-metallisia. Kaapeleiden täytyy olla 100%: sesti suojattuja jotta ne olisivat CE sertifikaatin mukaisia.

Suoja on oltava maadoitettu.

Nastojen liittäminen; katso liitteenä oleva manuaali.

Ystävällisin terveisin,

Svensk

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Subject : **Addendum to the Instruction Manual**

Reference : **CE certification of Mass Flow Equipment**

Date : **January 1996**

Brooks (elektriska / elektronik) utrustning, som är CE-märkt, har testats och godkänts enligt gällande regler för elektromagnetisk kompabilitet (EMC direktiv 89/336/EEC).

Speciell hänsyn måste emellertid tas vid val av signalkabel som ska användas tillsammans med CE-märkt utrustning.

Kvalitet på signalkabel och anslutningskontakter:

Brooks levererar som standard, kablar av hög kvalitet som motsvarar de krav som ställs för CE-godkännande.

Om man använder en annan signalkabel ska kabeln i sin helhet vara skärmad till 100%. “D” eller “runda” typer av anslutningskontakter ska vara skärmade. Kabelgenomföringar ska vara av metall alternativt med metalliserad skärmning.

Kabelns skärm ska, i bada ändar, vara ansluten till kontakternas metallkåpor eller genomföringar med 360 graders skärmning.

Skärmen ska avslutas med en jordförbindelse.

Kortkontakter är som standard ej metalliserade, kablar som används måste vara 100% skarmade för att överensstämma med CE-certifieringen.

Skärmen ska avslutas med en jordförbindelse.

För elektrisk anslutning till kontaktstiften hänvisas till medföljande instruktionsmanual.

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LIMITED WARRANTY

Seller warrants that the Goods manufactured by Seller will be free from defects in materials or workmanship under normal use and service and that the Software will execute the programming instructions provided by Seller until the expiration of the earlier of twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller. Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer.
All replacements or repairs necessitated by inadequate preventive maintenance, or by normal wear and usage, or by fault of Buyer, or by unsuitable power sources or by attack or deterioration under unsuitable environmental conditions, or by abuse, accident, alteration, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense.
Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller.

BROOKS SERVICE AND SUPPORT

Brooks is committed to assuring all of our customers receive the ideal flow solution for their application, along with outstanding service and support to back it up. We operate first class repair facilities located around the world to provide rapid response and support. Each location utilizes primary standard calibration equipment to ensure accuracy and reliability for repairs and recalibration and is certified by our local Weights and Measures Authorities and traceable to the relevant International Standards.

Visit www.BrooksInstrument.com to locate the service location nearest to you.

START-UP SERVICE AND IN-SITU CALIBRATION

Brooks Instrument can provide start-up service prior to operation when required.
For some process applications, where ISO-9001 Quality Certification is important, it is mandatory to verify and/or (re)calibrate the products periodically. In many cases this service can be provided under in-situ conditions, and the results will be traceable to the relevant international quality standards.

CUSTOMER SEMINARS AND TRAINING

Brooks Instrument can provide customer seminars and dedicated training to engineers, end users and maintenance persons.

Please contact your nearest sales representative for more details.

HELP DESK

In case you need technical assistance:

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Asia	☎ +011-81-3-5633-7100	

Due to Brooks Instrument's commitment to continuous improvement of our products, all specifications are subject to change without notice.

TRADEMARKS

Brooks	Brooks Instrument, LLC
Freon TF	E. I. DuPont deNemours & Co.
Kalrez	DuPont Dow Elastomers
VCO	Cajon Company
VCR	Cajon Company
Viton	DuPont Performance Elastomers
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