Installation and Operation Manual
X-TMF-Mf*i*-Mfx-MFC-eng
Part Number: 541B074AAG
August, 2009

NEMA 4X and IP66 Mass Flow Controllers and Meters

Mf*i* Series
Controllers: Mf50*i*, Mf51*i* and Mf53*i*
Meters: Mf60*i*, Mf61*i* and Mf63*i*

Mfx Series
Controllers: Mf50x, Mf51x and Mf53x
Meters: Mf60x, Mf61x and Mf63x

Mf61
Mass Flowmeter

Mf50
Mass Flow Controller

BROOKS® INSTRUMENT

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 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.

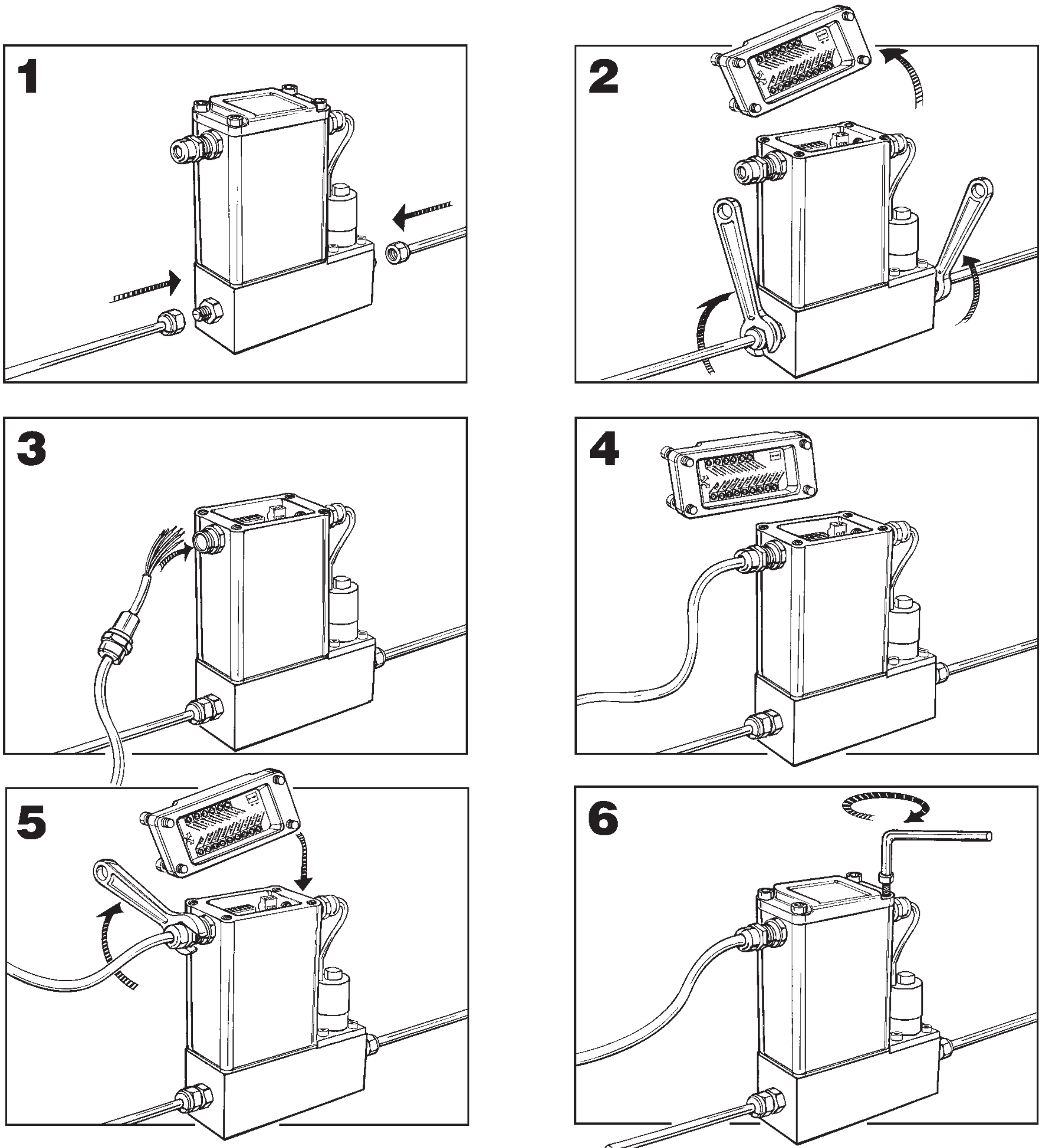
The Brooks product you have just received is of the highest quality available, offering superior performance, reliability and value to the user. It is designed with the ever changing process conditions, accuracy requirements and hostile process environments in mind to provide you with a lifetime of dependable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

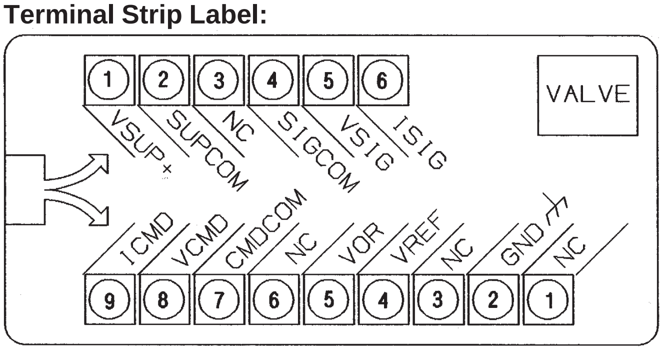
Yours sincerely,

Brooks Instrument

Mf Series Summary Installation Overview (shows cable gland option)



Terminal Strip Label:



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Tables

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1-1 Description

The Brooks® Mf™ Series mass flow controllers and meters are specifically designed to be used in an industrial environment. These controllers and meters offer high accuracy, control and measurement of industrial gases with the added integrity of NEMA 4X, IP66 industrial packaging. The heart of the controller and meter is the flow sensor which produces an electrical output signal linear with mass flow rate. This output can be used for indicating, recording and/or control purposes. The Brooks Mf Series Mass Flow Controller has an integral valve and accepts a remote setpoint which makes it a simple and easy to install flow control system. Many options are offered to provide a versatile system of mass flow control and measurement.

1-2 Design Features

- NEMA 4X, IP66 watertight construction
- UL and cUL listed and recognized for
  Class1 Division 2 hazardous locations (Mfx)
- Wide FS flow range for measurement and control for gases from 3 sccm to 1000 slpm N_2 (control) and 1000 slpm N_2 (measurement)
  - Flow control to 1000 slpm N_2
  - Flow metering to 1000 slpm N_2
- Sensor: Removable (Mfi) / Welded (Mfx)
- Insensitive to mounting attitude
- Selectable response time
- Electrically activated valve override
- Low command flow cutoff
- Corrosion resistant valve

1-3 Principle of Operation

The operating principle of the Brooks mass flow controller and meter is thermodynamic. A wire wound heating element directs heat to the midpoint of the bypass sensor tube. A predetermined portion of the total flow, flows through the bypass sensor tube. On the same tube, equidistant upstream and downstream of the heat input, are resistance temperature measuring elements.

With no flow, the heat reaching each temperature element is equal. With increasing flow the flow stream carries heat away from the upstream element, T1, and an increasing amount towards the downstream element, T2. An increasing temperature difference develops between the two elements and this difference is proportional to the amount of gas flowing or the mass flow rate. A bridge circuit interprets the temperature difference and positions the precision solenoid control valve. When the command signal is below 1% of full scale, the control valve is positioned to fully closed. The control valve can be latched fully open or closed by activating the valve override circuit.

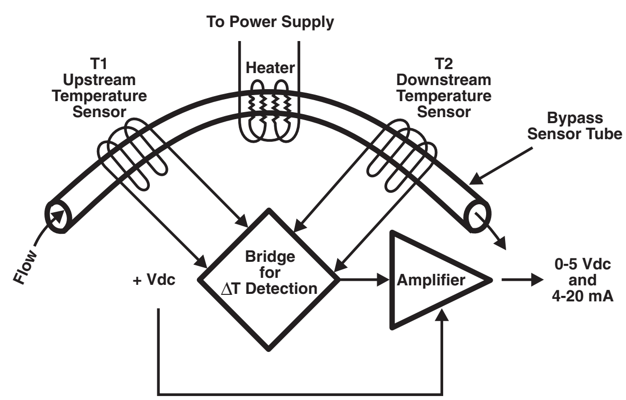


Figure 1-1 Principle of Operation.

1-4 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.

PERFORMANCE CHARACTERISTICS:

Table 1-1 Flow Ranges

Mass Flow Controller Model	Mass Flow Meter Model	Flow Ranges Nitrogen*			PED Module H
		Min. F. S.	Max. F. S. (slpm)	Max. Press. psi (Bar)	
Mf50	Mf60	0.003	30	1500 (100)	SEP
N/A	Mf61	0.003	30	4500 (300)	SEP
Mf51	Mf63	10	100	1000 (68)	SEP
Mf53	N/A	100	1000	1000 (68)	1 for all 150 lbs.Flanges

* Standard temperature and pressure equals 0°C and 101kPa (760 Torr). These mass flow controllers and meters can be calibrated to other conditions. Specify at time of ordering.

Control/Usable Range
50 to 1

Accuracy
±1% full scale including linearity at calibrated conditions
±1.5% full scale including linearity for Mf50 and Mf60 for flow ranges greater than 20 slpm

Repeatability
0.25% of rate

Sensitivity to Mounting Attitude
±0.5% full scale maximum deviation from specified accuracy after re-zeroing under 200 psig. Specify mounting attitude at time of order to insure optimum performance.

Temperature Sensitivity
Zero: Less than ±0.075% F.S. per degree C
Span: Less than ±1.0% F.S. shift from original calibration over 50°F to 122°F range (10°C to 50°C)

Pressure Sensitivity
±0.03% per psi up to 200 psig (N_2)

Ratings:
Operating Pressure
Refer to Table 1-1

Differential Pressure (Controllers)
Mf50: 5 to 50 psid pressure drop
Mf51: 10 to 50 psid pressure drop
Mf53: Standard high differential valve > 30 to 290 psid
Optional: Low differential valve 7.5 to 30 psid (<500 slpm)
11.8 to 30 psid (>500 slpm)

Response Time
Less than 6 seconds to within 2% of full scale of final value for a 0 to 100% command change. Refer to Figure 1-2, typical performance curve.

Temperature Ambient/Gas
41°F to 149°F (5°C to 65°C)
Leak Integrity, Outboard
1 x 10^{-9} atm cc/sec. He (excluding permeation)

PHYSICAL:

⚠ CAUTION

It is the user's responsibility to select and approve all materials of construction. Careful attention to metallurgy, engineered materials and elastomeric materials is critical to safe operation.

Materials of Construction
Standard wetted parts: Stainless steel with Viton® fluoroelastomers or Buna-N
Optional: Kalrez®

Dimensions
Controllers: Refer to Figures 1-6 through 1-9
Meters: Refer to Figures 1-10 through 1-12

Process Connections
Refer to the table at the bottom of each dimensional drawing for process connection sizes and options specific to each size controller and meter.

1-5 Electrical Specifications

Setpoint Command Requirements (Controllers)
4-20 mA (75 ohms input resistance). The 4-20mA setpoint signal must be supplied from the customers side(sourcing type).
The input load for this signal is 75 ohms.
For 0 to 5 Vdc (220 K ohms input resistance)

Output Signals
0/4-20 mA, loop resistance is power supply dependent, refer to Figure 1-2, or 0 to 5 Vdc into 2000 ohms, or greater load. Maximum ripple 3 mV.

Power Requirements
Refer to Table 1-2.

Electrical Connections
Wire hookup is through a Pg11 water tight cable gland suitable for cable diameters of .20 to .39 inches or 1/2" FNPT conduit fitting.
Wiring termination's are pluggable moving vise clamp with screw type terminations. Refer to Figure 1-3 for termination points and Table 1-3 for terminal identification and functions.

Typical Electrical Configuration
Figure 1-4 illustrates typical electrical hookup to Brooks 0151*i* Power Supply/Set Point Controller/Readout.

Table 1-2 Power Requirements

Mass Flow Controllers			Mass Flow Meters		
Model	**Voltage**	**Current**	**Model**	**Voltage**	**Current**
Mf50	15 to 28 Vdc	240 mA @ 15 Vdc	**Mf60**	15 to 28 Vdc	90 mA
		370 mA @ 28 Vdc			
Mf51**	15 to 28 Vdc	309 mA @ 22 Vdc	**Mf61**	15 to 28 Vdc	90 mA
		370 mA @ 28 Vdc			
Mf53	15 to 28 Vdc	240 mA @ 15 Vdc	**Mf63**	15 to 28 Vdc	90 mA
		370 mA @ 28 Vdc			

**** Note minimum voltage for Mf51 is 22 Vdc**

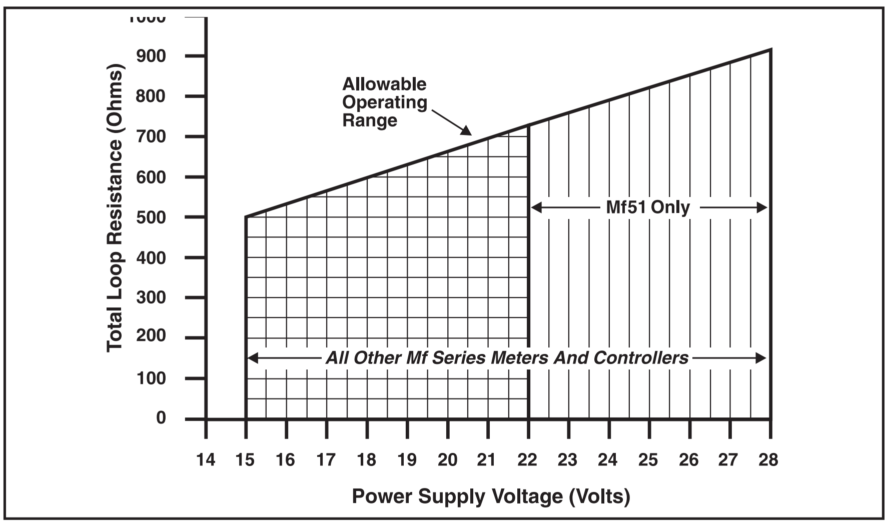


Figure 1-2 Maximum Allowable Output Loop Resistance

Table 1-3 Mf Series Controllers and Meters Terminal Strip Hookup

TB-1 Terminal 1-6	**Label Identification**	**Function**	**Color Code****
1	VSUP	Supply Voltage Plus (+) See Table 3	Orange
2	SUPCOM	Supply Voltage Common	Grn/Blk
3	NC	Not Used	Blue
4	SUPCOM	Signal Common	Org/Blk
5	VSIG	Voltage Signal Output	White
6	ISIG	Current Signal Output	Green
TB-2 Terminal 1-9	**Label Identification**	**Function**	**Color Code****
1	NC	Not Used	Blu/Wht
2	GND	Chasis Ground	Grn/Wht
3	NC	Not Used	Red
4	VREF	Reference Output +5 Vdc	Blu/Blk
5	VOR	Valve Override Input	Blk/Wht*
6	NC	Not Used	Red/Wht
7	CMDCOM	Command Common	Black*
8	VCMD	Voltage Command Input (Setpoint)	Red/Blk*
9	ICMD	Current Command Input (Setpoint)	Wht/Blk*
TB-3 Terminal 1 & 2	**Label Identification**	**Function**	**Color Code****
1	NONE	Valve Hookup	Orange*
2	NONE	Valve Hookup	Orange*

*These connections used only for controllers (Models Mf50, Mf51 and Mf53)
**Brooks reference

Certifications:
EMC Directive 89/336/EEC:
Per EN 61326
Hazardous Location Classification
Non-Incendive
Enclosure Type 4X 1/IP66
Ambient Temperature: 5^{0}C > Tamb < 65^{0}C (T3C) or
5^{0}C > Tamb < 55^{0}C (T4)

United States and Canada
UL Listed: E73889 Volume 1, Section 17
UL Recognized: E73889 Volume 3, Section 1

Class I, Division 2, Groups A, B, C and D;
Class II, Division 2, Groups F and G;
Suitable for Class III, Division 2

Per UL 1604 and CSA-213

Pressure Equipment Directive (97/23/EC)
See Table 1-1 for further information

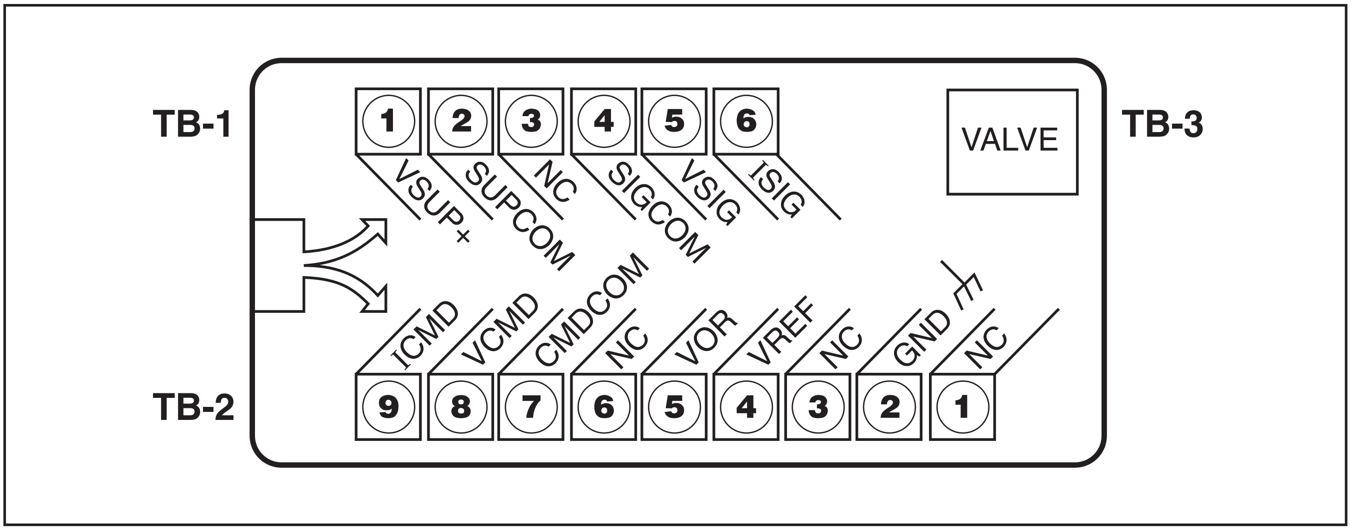


Figure 1-3 Terminal Strip Labeling

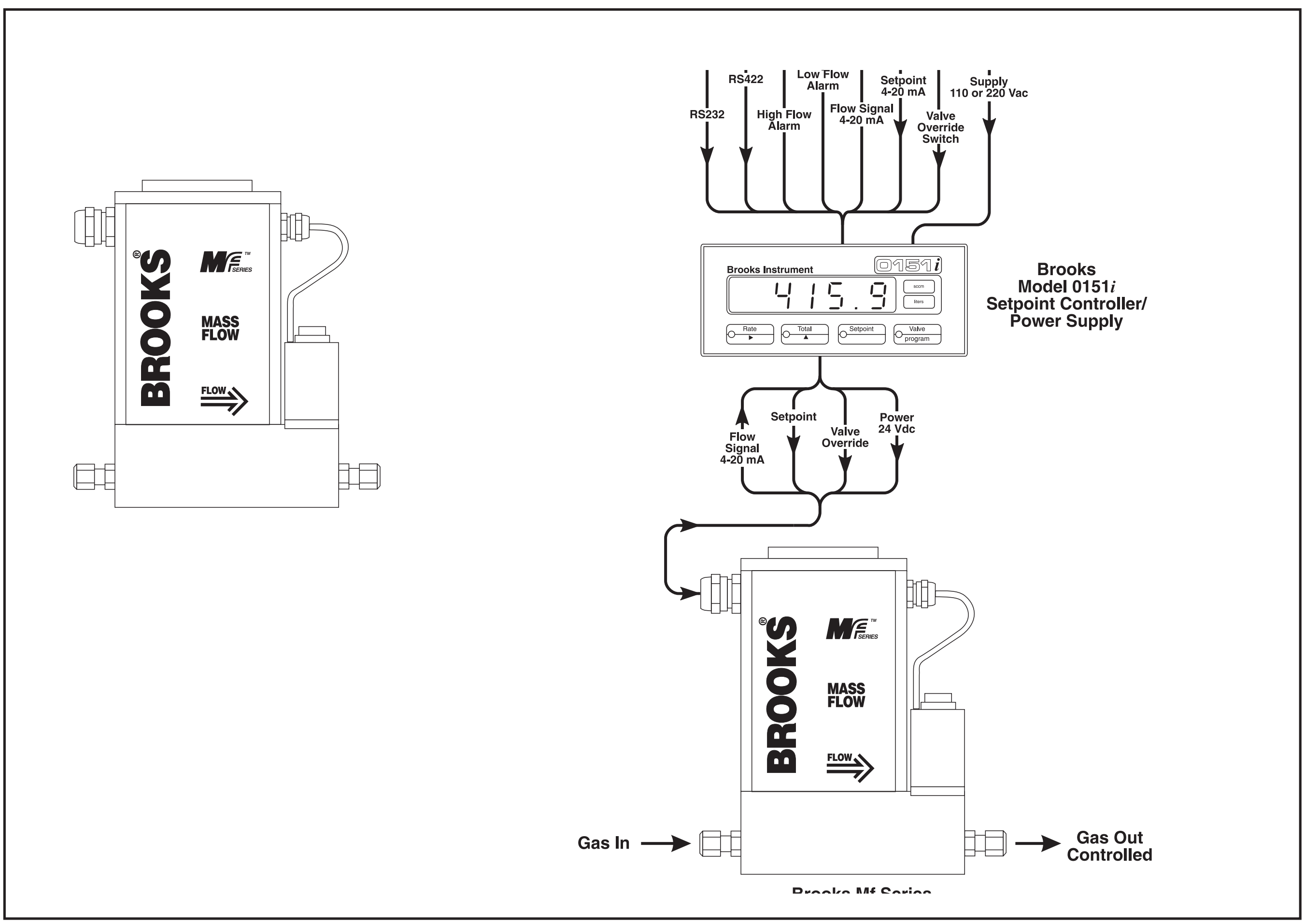
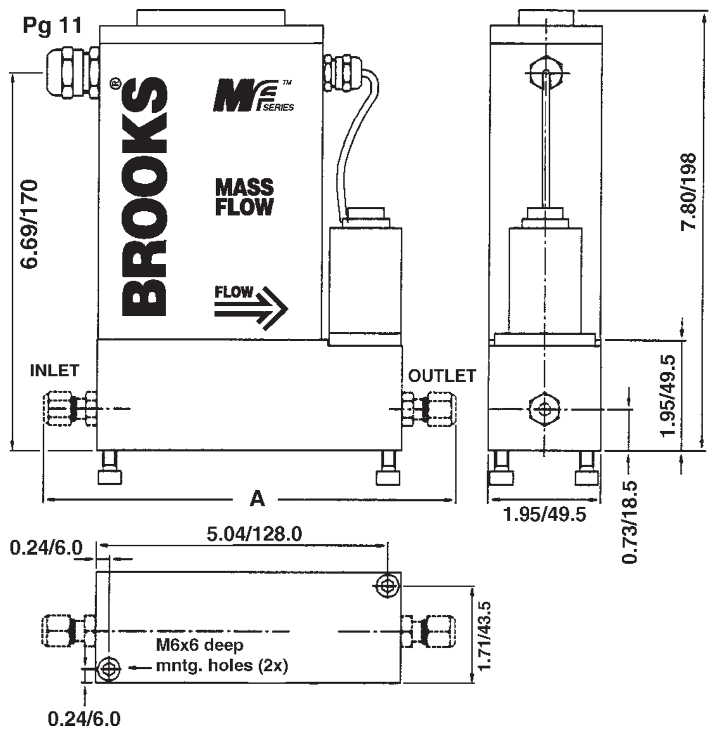


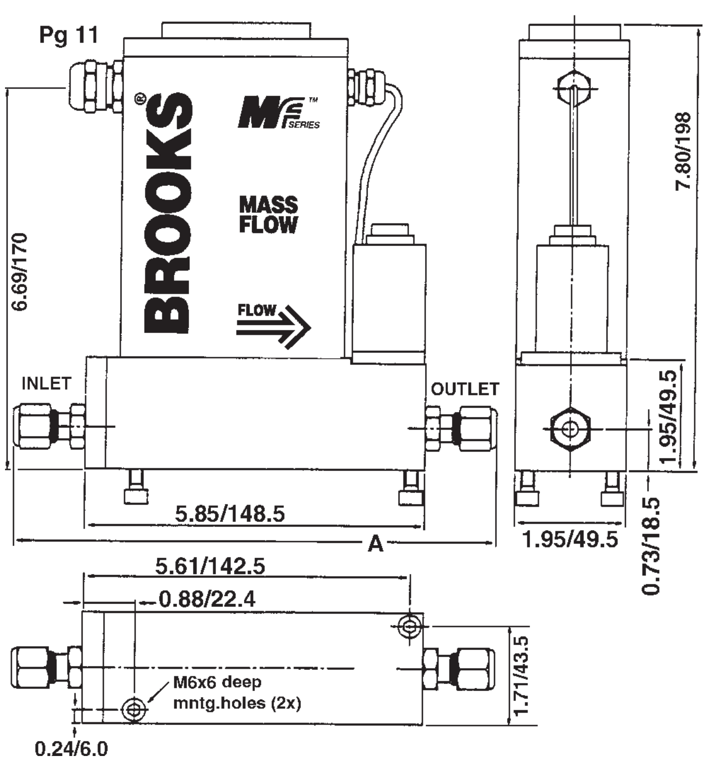
Figure 1-4 Mf Series Typical Hookup to Brooks 0151i Power Supply



Connections	"A" Dim.
9/16 -18 UNF	5.28/134
1/4" Tube Compr.	7.30/185
1/8" Tube Compr.	7.13/181
1/4" VCR™	7.17/182
1/4" VCO™	6.85/174
1/4" NPT	6.89/175
6mm Tube Compr.	7.32/186

Dimensions in inches/mm

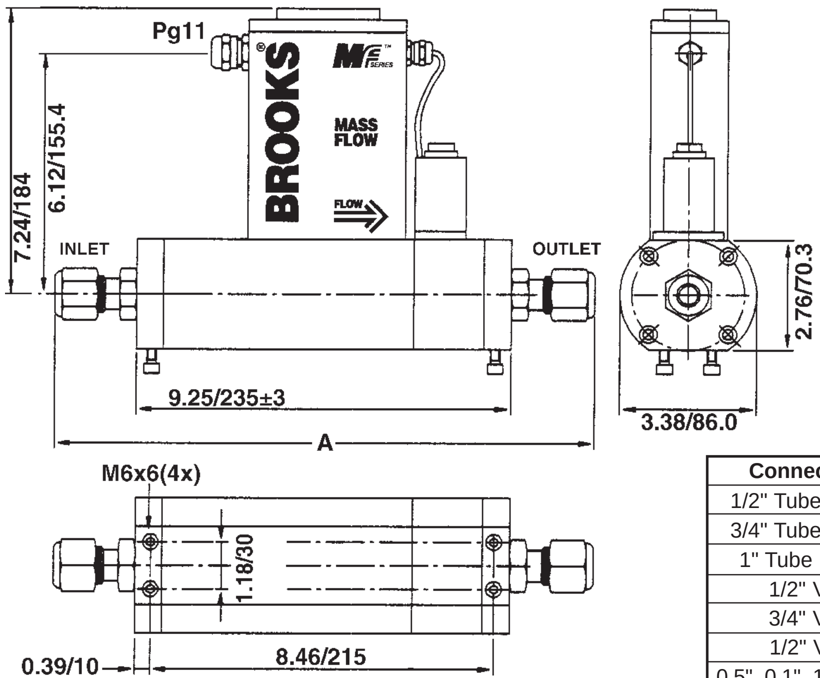
Figure 1-5 Model Mf50 Controller Dimensions



Connections	"A" Dim.
9/16 -18 UNF	5.85/148.5
1/4" Tube Compr.	7.87/199.9
3/8" Tube Compr.	7.99/203.0
1/4" VCR	7.74/196.5
1/4" VCO	7.42/188.5

Dimensions in inches/mm

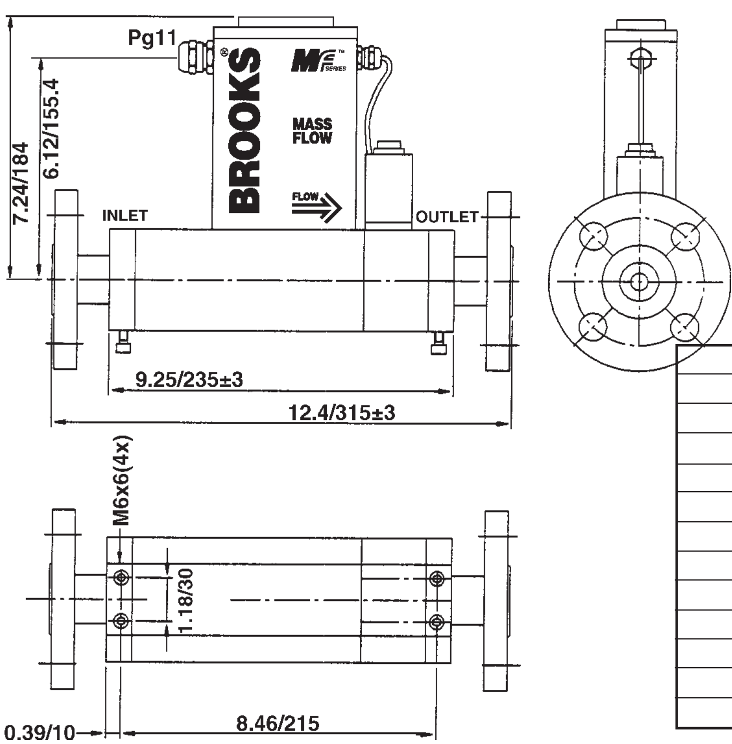
Figure 1-6 Model Mf51 Controller Dimensions



Connections	"A" Dim.
1/2" Tube Compr.	11.96/303.8
3/4" Tube Compr.	11.96/303.8
1" Tube Compr.	12.31/312.8
1/2" VCO	10.86/275.8
3/4" VCO	11.57/293.8
1/2" VCR	11.17/283.8
0.5", 0.1", 1.5" NPT or 1-1/16"-12	9.28/235.8

Dimensions in inches/mm

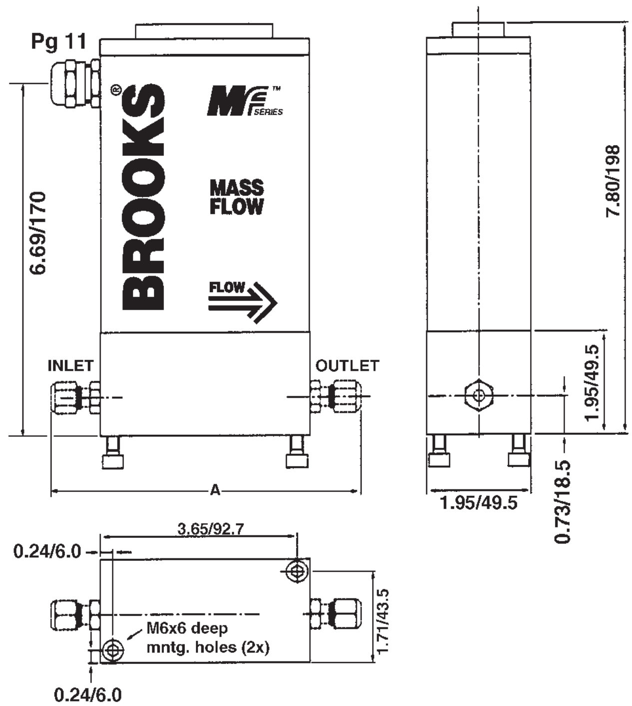
Figure 1-7 Model Mf53 Controller Dimensions



Flange	Class
DIN DN14	PN 40
DIN DN25	PN 40
DIN DN40	PN 40
DIN DN50	PN 40
ANSI 0.5"	150 LBS
ANSI 0.5"	300 LBS
ANSI 1"	150 LBS
ANSI 1"	300 LBS
ANSI 1.5"	150 LBS
ANSI 1.5"	300 LBS
ANSI 2"	150 LBS
ANSI 2"	300 LBS

Dimensions in inches/mm

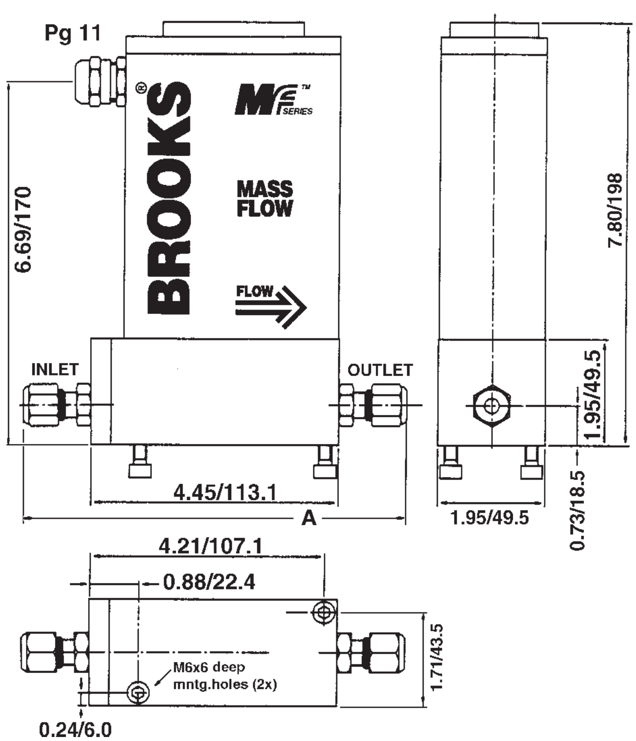
Figure 1-8 Model Mf53 Controller with Flange Dimensions



Connections	"A" Dim.
9/16 -18 UNF	3.89/98.7
1/4" Tube Compr.	5.93/150.7
1/8" Tube Compr.	5.74/145.7
1/4" VCR	5.78/146.7
1/4" VCO	5.46/138.7
1/4" NPT	5.50/139.7
6 mm Tube Compr.	5.93/150.7

Dimensions in inches/mm

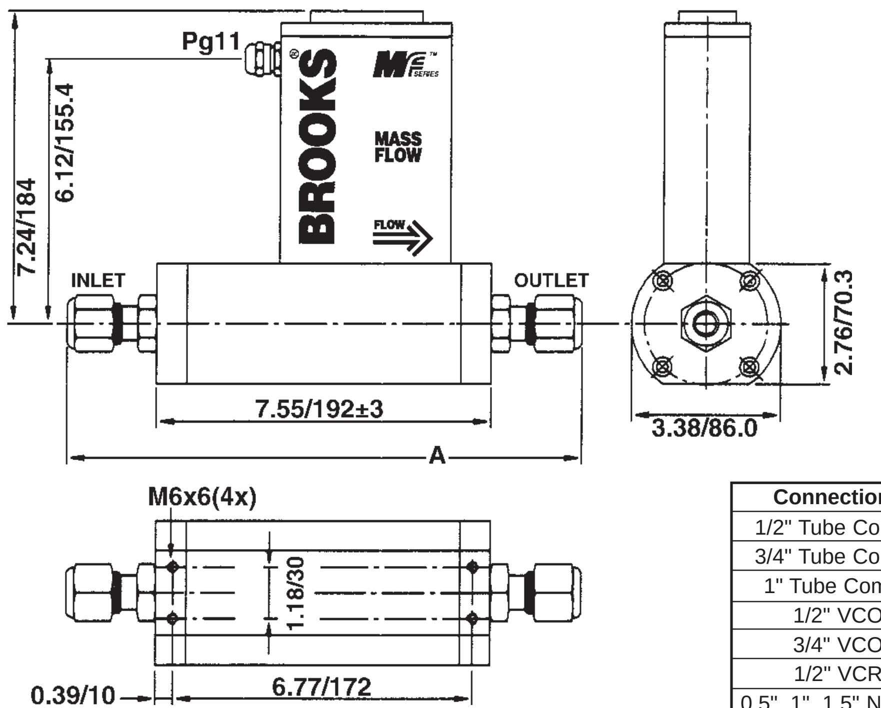
Figure 1-9 Model Mf60 Meter Dimensions



Connections	"A" Dim.
9/16 -18 UNF	4.45/113.1
1/4" Tube Compr.	6.48/164.5
3/8" Tube Compr.	6.60/167.6
1/4" VCR	6.34/161
1/4" VCO	6.02/152.8

Dimensions in inches/mm

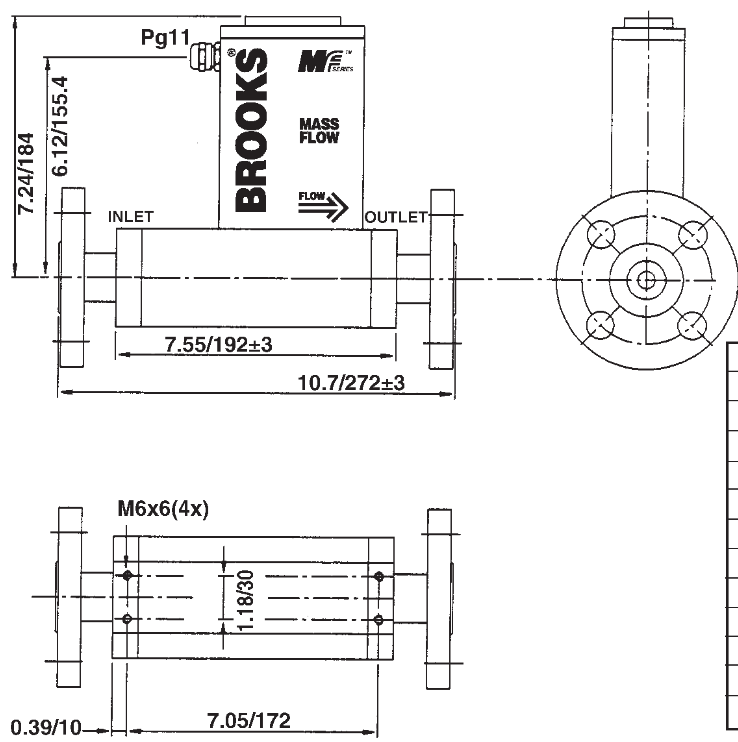
Figure 1-10 Model Mf61 Meter Dimensions



Connections	"A" Dim.
1/2" Tube Compr.	10.23/260
3/4" Tube Compr.	10.23/260
1" Tube Compr.	10.59/269
1/2" VCO	9.13/232
3/4" VCO	9.84/250
1/2" VCR	9.44/240
0.5", 1", 1.5" NPT or 1-1/16" - 12	7.55/192

Dimensions in inches/mm

Figure 1-11 Model Mf63 Meter Dimensions



Flange	Class
DIN DN15	PN 40
DIN DN25	PN 40
DIN DN40	PN 40
DIN DN50	PN 40
ANSI 0.5"	150 LBS
ANSI 0.5"	300 LBS
ANSI 1"	150 LBS
ANSI 1"	300 LBS
ANSI 1.5"	150 LBS
ANSI 1.5"	300 LBS
ANSI 2"	150 LBS
ANSI 2"	300 LBS

Dimensions in inches/mm

Figure 1-12 Model Mf63 Meter with Flange Dimensions

2-1 General

This section contains the procedures for the receipt and installation of the instrument. See Section 1 for dimensional and connection requirements. Do not attempt to start the system until the instrument has been permanently installed. It is important that the start-up procedures be followed in the exact sequence presented.

2-2 Receipt of Equipment

When the instrument 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 your nearest Product Service Department.

Brooks Instrument
407 W. Vine Street
P.O. Box 903
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Tel (215) 362 3700
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www.BrooksInstrument.com

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6718 WX Ede, Netherlands
P.O. Box 428
6710 BK Ede, Netherlands
Tel +31 (0) 318 549 300
Fax +31 (0) 318 549 309
E-mail: BrooksEu@BrooksInstrument.com

Brooks Instrument
1-4-4 Kitasuna Koto-Ku
Tokyo, 136-0073 Japan
Tel +81 (0) 3 5633 7100
Fax +81 (0) 3 5633 7101
Email: BrooksAs@BrooksInstrument.com

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

2-3 Recommended Storage Practice

If intermediate or long-term storage of equipment is required, it is recommended that the equipment be stored in accordance with the following conditions:

a. Within the original shipping container.

b. Stored in a sheltered area, preferably a warm, dry, heated warehouse.

c. Ambient temperature 21°C (70°F) nominal, 32°C (90°F) maximum, 7°C (45°F) minimum.

d. Relative humidity 45% nominal, 60% maximum, 25% minimum.

2-4 Return Shipment

Prior to returning any instrument to the factory, contact your nearest Brooks location for a Return Materials Authorization Number (RMA#). This can be obtained from one of the following locations:

Brooks Instrument
407 W. Vine Street
P.O. Box 903
Hatfield, PA 19440 USA
Toll Free (888) 554 FLOW (3569)
Tel (215) 362 3700
Fax (215) 362 3745
E-mail: BrooksAm@BrooksInstrument.com
www.BrooksInstrument.com

Brooks Instrument
Neonstraat 3
6718 WX Ede, Netherlands
P.O. Box 428
6710 BK Ede, Netherlands
Tel +31 (0) 318 549 300
Fax +31 (0) 318 549 309
E-mail: BrooksEu@BrooksInstrument.com

Brooks Instrument
1-4-4 Kitasuna Koto-Ku
Tokyo, 136-0073 Japan
Tel +81 (0) 3 5633 7100
Fax +81 (0) 3 5633 7101
Email: BrooksAs@BrooksInstrument.com

Instrument must have been purged in accordance with the following:

WARNING

Before returning the device purge thoroughly with a dry inert gas such as Nitrogen before disconnecting gas connections. Failure to correctly purge the instrument could result in fire, explosion or death. Corrosion or contamination may occur upon exposure to air.

All flow instruments returned to Brooks requires completion of Form RPR003-1, Brooks Instrument Decontamination Statement, along with a Material Safety Data Sheet (MSDS) for the fluid(s) used in the instrument. Failure to provide this information will delay processing by Brooks personnel. Copies of these forms can be downloaded from the Brooks website www.BrooksInstrument.com or are available from any Brooks Instrument location listed above.

2-5 Transit Precautions

To safeguard the instrument against transportation damage, it is recommended to keep the instrument in its factory container until ready for installation.

2-6 Removal from Storage

Upon removal of the instrument from storage, a visual inspection should be conducted to verify its "as-received" condition. If the instrument has been subject to storage conditions in excess of those recommended (See Section 2-3), it should be subjected to a pneumatic pressure test in accordance with applicable vessel codes.

2-7 Gas Connections

Refer to Tables 5-1 through 5-4 for the available process connection types and sizes. It is recommended that good tubing and piping practice be followed. It is also recommended that for very low flows in meter size Mf50's that tubing 1/4 or less be used and for flows over 10 slpm 3/8 tubing be applied. 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.

2-8 In-Line Filter

It is recommended that an Brooks in-line filter (refer to DS-5848 for appropriate models/flows) be installed upstream from the instrument to prevent the possibility of any foreign material entering the flow sensor or control valve. The filtering element should be periodically replaced or ultrasonically cleaned.

For Models Mf53/63, an in-line filter of 100 microns standard has been installed upstream from the meter or controller to prevent the possibility of any foreign material entering the flow sensor or control valve. The filtering element should be periodically replaced or ultrasonically cleaned.

Table 2-1 Recommended Filter Size

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

Note: The above lists the max. recommended porosity for each flow range. It is recommended that the minimum micron porosity that does not limit the full scale flow rate be used.

2-9 Installation (Refer to Table 1-4, Figure 1-4, 2-1 and Quick Start Instructions)

⚠ 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.

⚠ CAUTION

Any sudden change in system pressure may cause mechanical damage to elastomer materials. Damage can occur when there is a rapid expansion of fluid that has permeated elastomer materials. The user must take the necessary precautions to avoid such conditions.

Recommended installation procedures:

a. The Mf Series instrument should be located in an environment 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 dry Nitrogen before use.

d. The Mf Series controllers and meters can be installed in any position. However, mounting orientations other than the original factory calibration 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 Mf devices.

Note: The control valve in the Mf controller 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 Mf Series control valve is not a positive shut off, a separate shut off 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 shut off valve resulting in a surge upon acuation of the controller. This surge can be reduced in magnitude by locating the controller and shut off valve closer together or by moving the shut off valve upstream of the controller.

Special considerations to be taken when installing the Mf53 MFC:

The Model Mf53 has a valve design that is different from standard low flow Brooks TMFC's. The Mf53 consists of a dual stage, pilot operated valve. The pilot valve (located on top of the MFC) controls a differential pressure across the main valve which, in turn controls the flow through the device. The main valve is a pressure operated valve that utilizes a bellows spring and diaphragm to control flow. This bellows and diaphragm assembly can be susceptible to damage by pressure spikes or surges. For this reason, it is recommended that process line startups are handled with care.

The bellows spring is offered in two levels. A low force for low differential pressures (delta P < 30psig), and a high force (delta P >30 and <300 psig).

The selection of the bellows spring is mainly determined by the differential pressure as specified on the customer order. This should reflect your actual process conditions. The low force bellows consists of a softer bellows spring which is required to allow flow control at lower differential pressures.

During startup conditions, when a process line is being pressurized, the pressures and/or pressure differentials that the Mf53 is exposed to may be different from the final process conditions. For higher pressure applications, and especially those with the low force bellows, it is important to bring the pressure up in a controlled manner in order to prevent a possible pressure spike to the bellows spring and main valve diaphragm. A pressure spike could deform the bellows, damage the diaphragm or blow out the bellows O-ring seal. This typically results in a failure to shutoff (leakby at zero setpoint).

One method to assure successful startups is to set a 100% setpoint command or valve override open command and then gently ramp the pressure up to operating conditions. This will allow you to bring your process pressures up to normal operating conditions and the Mf53 will then function as specified.

Another method is to utilize a bypass valve to allow pressure around the device while ramping up pressure to proper operating conditions.

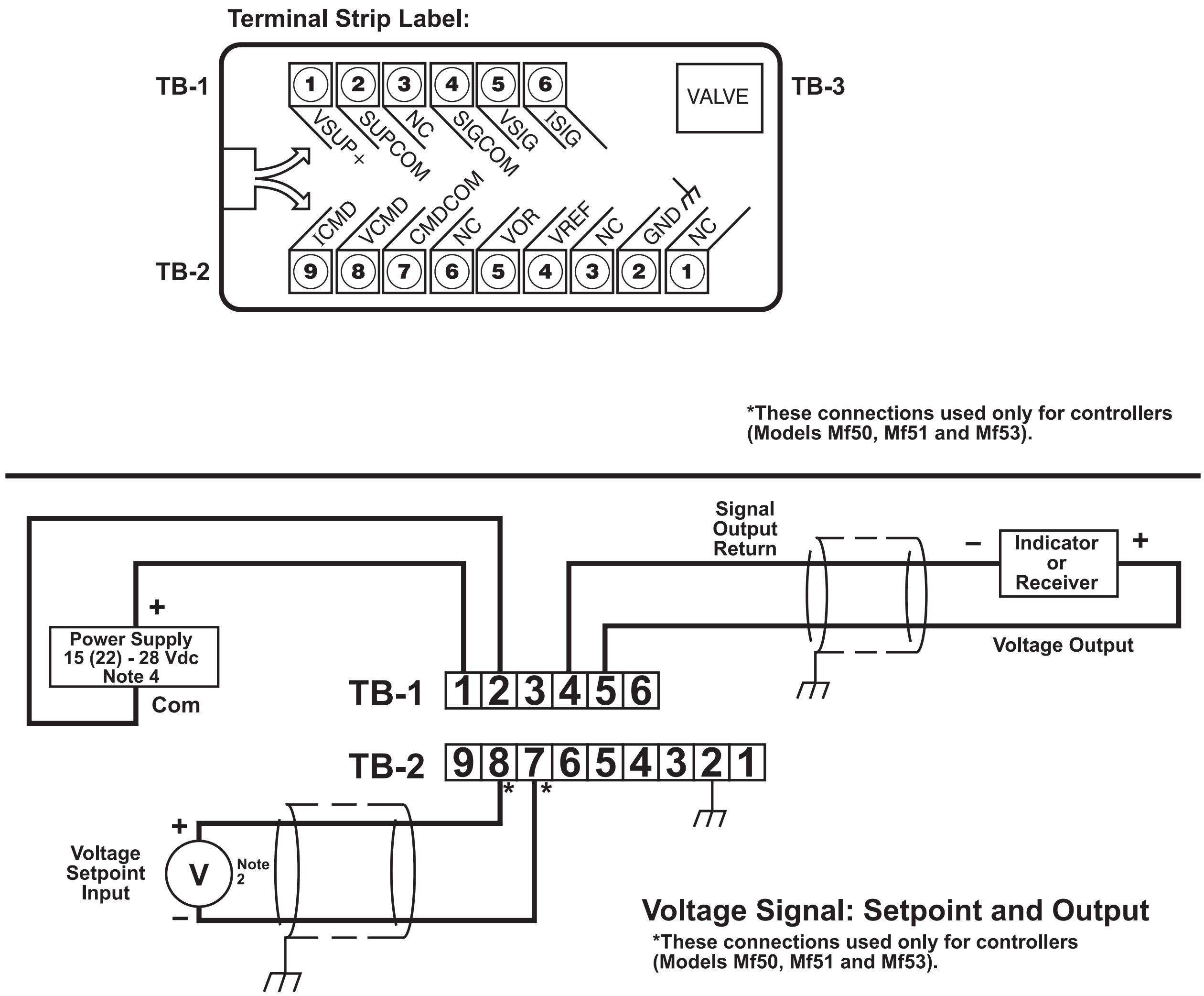
The main point is to not instantly open a ball valve and allow a high upstream pressure or high back pressure surge into the Mf53 main valve. Proper process line venting is also important. If operating at pressures greater than 50 psig, be sure to perform a controlled pressure release from inlet and back pressure simultaneously in order to prevent bellows damage from excessive back pressure.

Following careful startup and venting procedures will contribute to a long problem free life of your Mf53 controller.

Stable Operating Conditions:

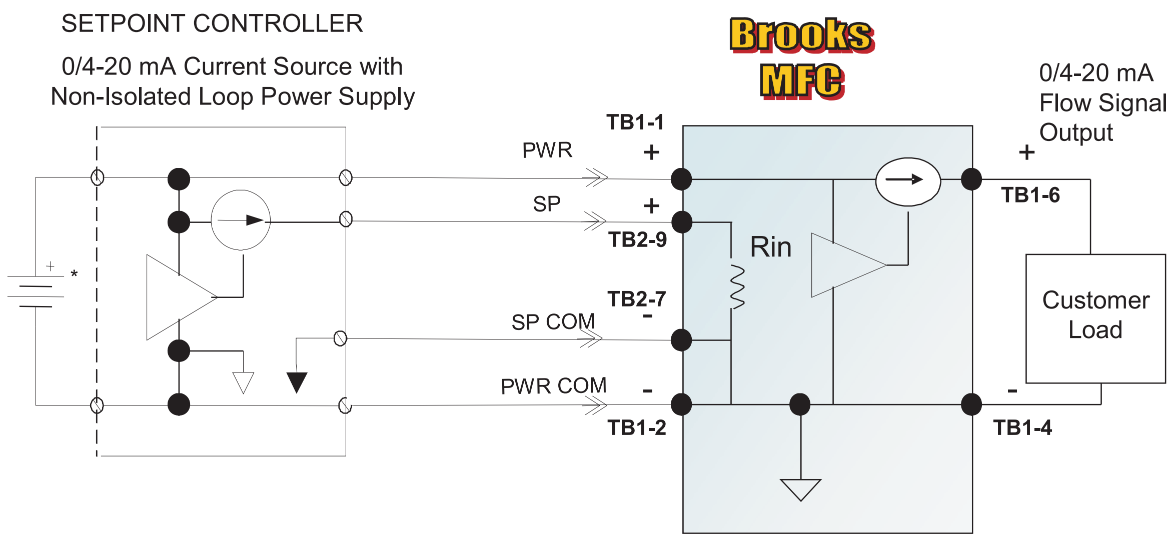
As stated above, the Mf53 model utilizes a pressure operated main valve. Valve performance is dependant on stable system pressures. Oscillating or unstable upstream or downstream pressures are likely to cause the device flow control to become unstable. For the best performance, it is important to create a stable pressure environment by utilizing quality inlet and back pressure regulators. In many cases, the addition of a back pressure regulator will isolate the Mf53 from the unstable downstream pressures inherent in many process designs.

For more information, please contact the Brooks Technical Service group.



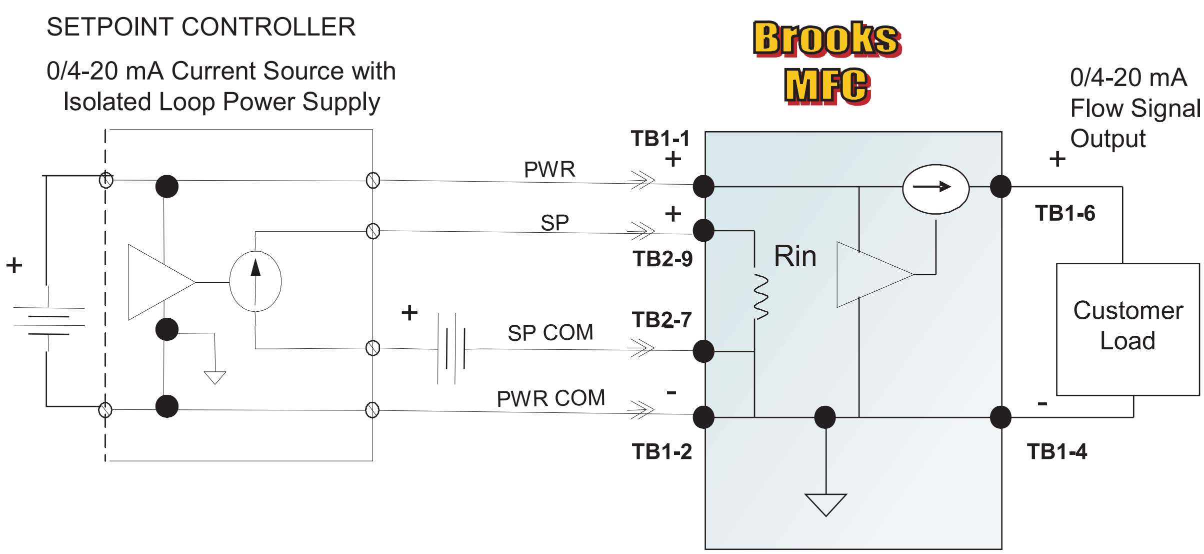
Notes:
1. The returns for the setpoint input and current output are not isolated from power supply common.
2. Tie cable shields to ground at one end only.
3. Current and voltage outputs may be used simultaneously.
4. Minimum power supply voltage for Mf51 is 22 Vdc.

Figure 2-1 Common Electrical Hookups



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 2-2 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 2-3 Recommended I/O Wiring Configuration for Current Signals (Isolated Power Supply)

2-10 Electrical Interfacing (Electrical Specifications Refer to Section 1-5)

To insure proper operation, the Mf device must be connected per Figures Figure 1-2 (Maximum Allowable Loop Resistance); Figure 1-3 and Table 1-3 (Terminal Strip Hookup); and Figures1-7 through 1-12 (Dimension Drawings). Configure in accordance to Section 2-9 and Figure 3-5. As a minimum, the following connections must be made for new installations:

Chassis Ground
Signal Output Common
Voltage or Current Signal Output
Plus (+) Vdc Supply
Supply Common
Voltage or Current Setpoint Input
Setpoint Common

Setpoint (Command) Input

The Mf Series 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 TB-2, Terminal 9, and the setpoint return (-) signal to TB-2, Terminal 7, and configure the PC board per Section 2-7. To use the voltage setpoint, connect the setpoint signal to TB-2, Terminal 8, and the voltage setpoint return to TB-2, Terminal 7, and configure the PC board per Section 2-7 and Figure 3-5.

(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 or a current simultaneously on two different positions of the Terminal Strip, TB-1, Terminal 5 indicates the flowrate with a 0-5 Vdc signal proportional to the mass flow rate. TB-1, Terminal 6 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 and Figure 3-5 for jumper positions). Both the current and voltage signals are returned on TB-1, Terminal 4.

(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 TB-1, Terminal 1 (+ Supply Voltage, Table 1-4) and TB-1, Terminal 2 (supply common) of the terminal strip connector. Refer to Section 1-3 for power requirements.
Note: The length of wire for the power supply connections (TB-1, Terminals 1 and 2) must be kept as short as possible to insure the minimum required voltage is available at the mass flow controller.

Chassis Ground
Connect earth ground to TB-2, Terminal 2.

Valve Override - Controller Only (connection optional)
The valve override function allows full opening and closing of the valve independent of the setpoint:

- To open the valve, apply voltage (15-24) Vdc to TB-2, Terminal 5.
- To close the valve, connection TB-2, Terminal 5 to power supply common.
- Floating TB-2, Terminal 5 (no connection) returns the controller to normal operation.

Note: For normal operation, TB-2, Terminal 5 should be left open (floating).

2-11 Configuring PC Board

Note: To obtain access to the jumpers, the electronics housing must be removed. Remove the cover from the electronics housing by loosening the four (4) self retained screws in the corner of the top cover. Disconnect power to the mass flow controller/meter, unplug Terminal Strips TB-1 and TB-2, and disconnect valve coil wire TB-3. Loosen the four (4) screws in the corner of the housing body using a long (6 inch) 3 mm hex wrench. Lift the housing off the circuit board. The can must be replaced before returning the unit to service.

Refer to Section 2-9 for the proper electrical hookup. 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 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 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 in the right-hand position (SS). To disable soft start, place jumper J2 in the left hand position (N).

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3-1 Theory of Operation

The thermal mass flow sensing technique used in the Mf Series works as follows:

A precision power supply provides a constant power heat input (P) to 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 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 controllers full scale flow.

In addition to the mass flow sensor, Mf Series mass flow controllers have an integral control valve and control circuit, as shown in Figure 3-2. The control circuit senses any difference between setpoint and flow sensor signal and adjusts the current in the modulating solenoid valve to increase or decrease flow.

The Mf Series 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.

- 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 2 K 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 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 to the controller/shut-off flow to the meter and observe the instrument's output signal. If the output is not zero mVdc ±.05 mAdc, check for leaks and if none are found, refer to the re-zeroing procedure in Section 3-3.
d. Set the command for the desired flow rate to assume normal controller operation. Open valve to allow flow to pass through the meter. Monitor the flow signal output.

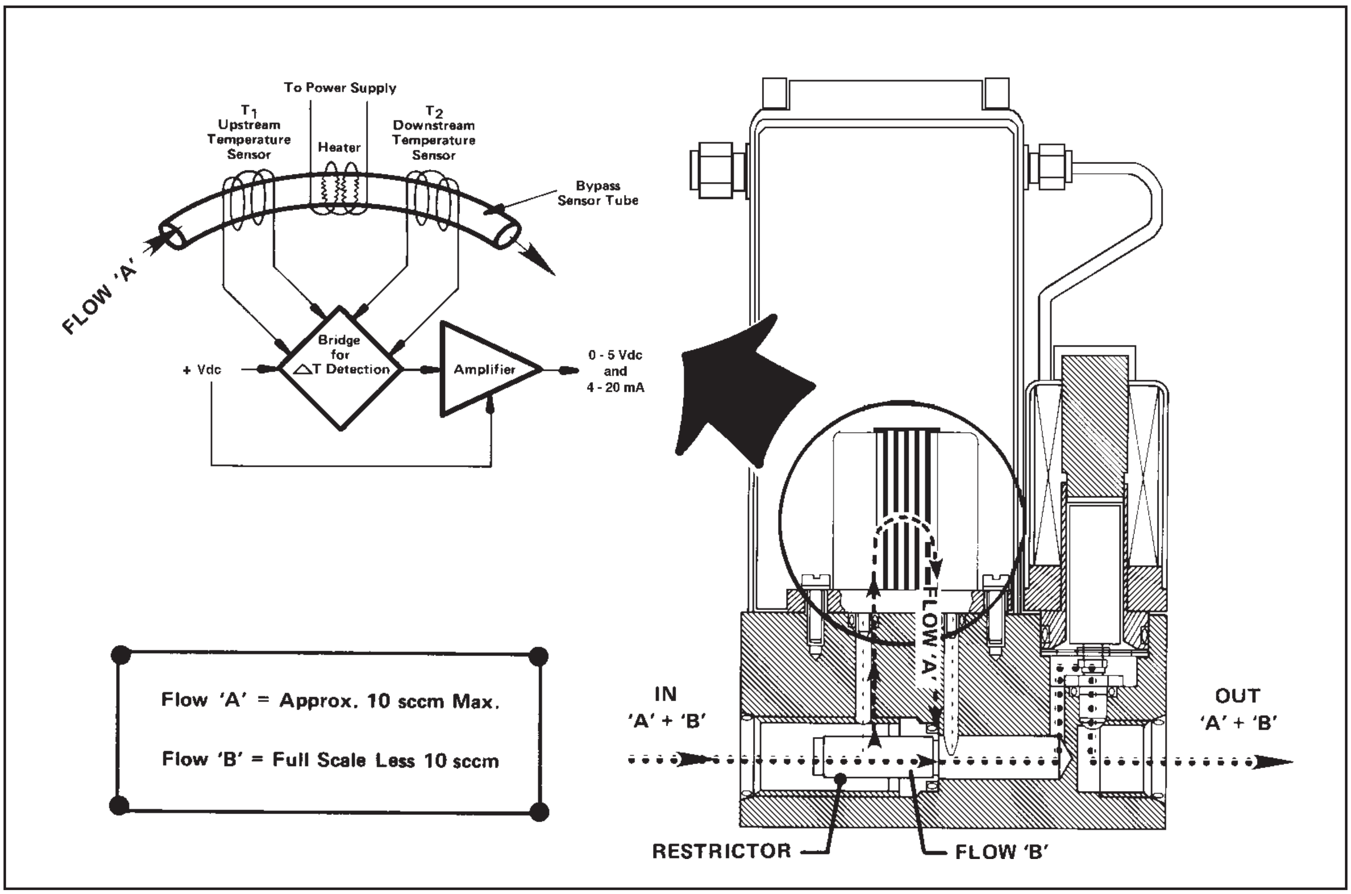

Figure 3-1 Flow Sensor Operational Diagram

3-3 Zero Adjustment

Each Mf Series controller and meter is factory adjusted to provide a zero ±10 mVdc signal or a 4 mAdc ±.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 of 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 inline pressure and mounting attitude.

To check zero, always mount the instrument in its final configuration and allow a minimum of forty minutes for the temperature of the instrument and its environment to stabilize. Using a suitable voltmeter or current meter, check the instrument output signal. If it differs from the factory setting, adjust it by removing the lower pot hole plug which is located closest to the instrument body. Adjust the zero potentiometer (refer to Figure 3-4) until the desired output signal is obtained.

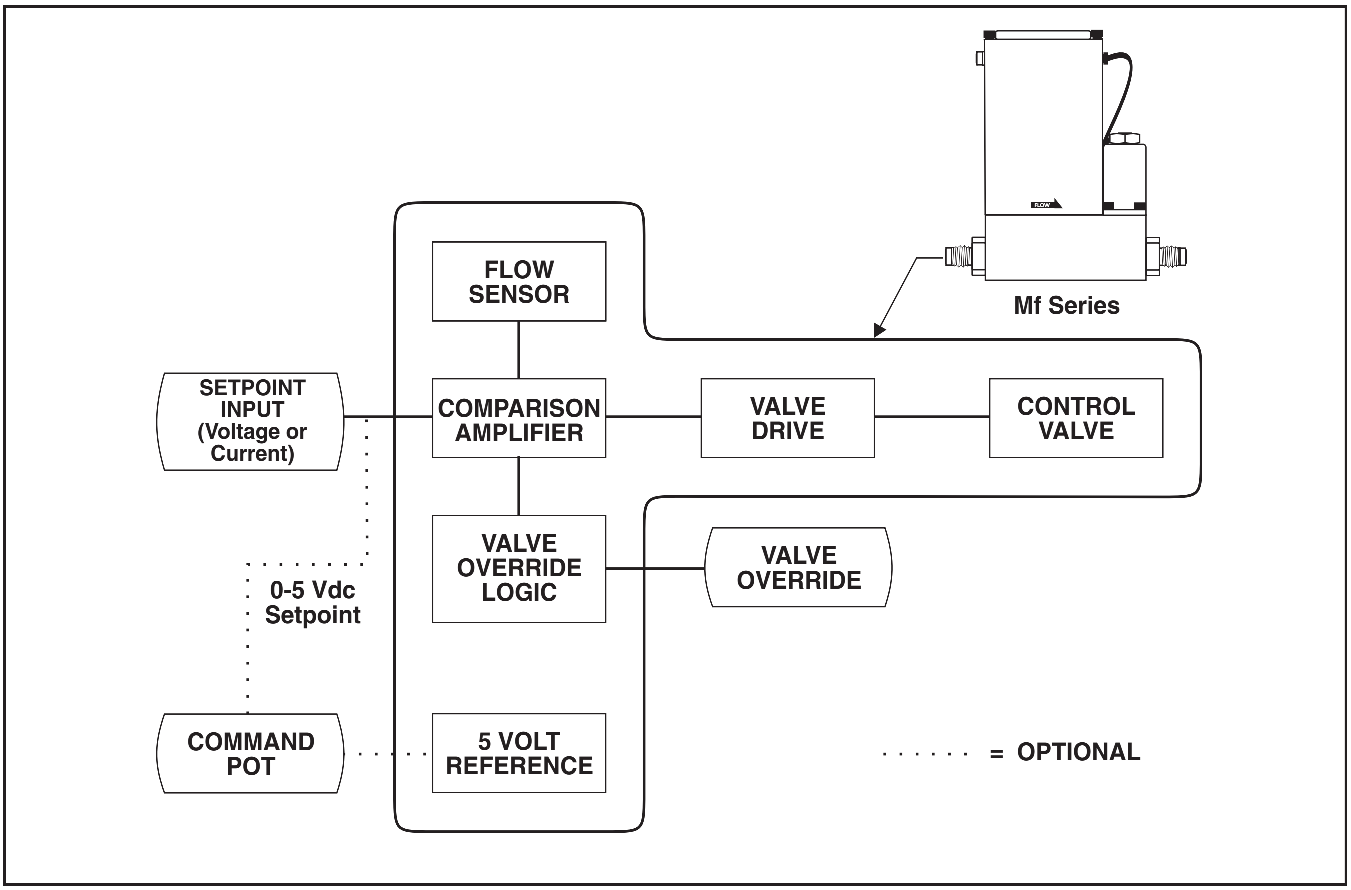

Figure 3-2 Flow Control System Block Diagram

3-4 Calibration Procedure

Note 1: If the valve has been disassembled and any of the following parts have been replaced, the control valve adjustment procedure in Section 4-4c must be performed before the Mf Series instrument is calibrated.

orifice
valve stem
plunger
lower guide spring
valve seat

Note 2: Calibration of the Mf Series Controller/Meter requires the use of a digital voltmeter (DVM) and a precision flow standard calibrator. It is recommended that the calibration be performed only by trained and qualified service personnel.

Note 3: If the mass flow controller/meter is to be used on a gas other than the calibration gas, apply the appropriate sensor conversion factor. For controllers size the orifice for actual operating conditions, refer to Section 4-6.

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 controller 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 0-5 V signal output TB-1, Terminal 5, and the negative lead to signal common (Terminal 4). Adjust the zero potentiometer for an output of 0 mV ±2mV (refer to Figures 3-4 and 3-5 for test point and potentiometer locations).
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.
e. Adjust the setpoint for 100% flow (5.000 V or 20.00 mAdc). Connect the DVM positive lead to TP2 (linearity voltage) and the negative lead to TP4 (circuit common). Adjust the linearity potentiometer for an output of 0.00 V (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 (5.000 V). Measure the flow rate using a 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 has

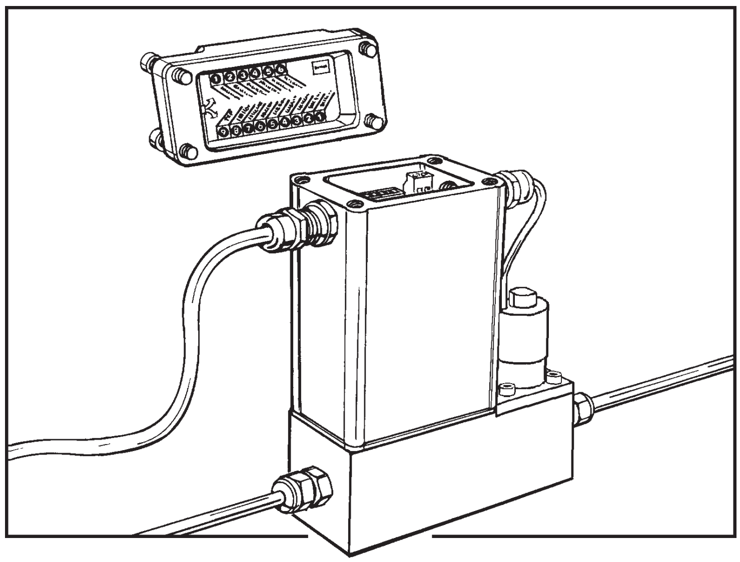

Figure 3-3 Mf Series Calibration Connections

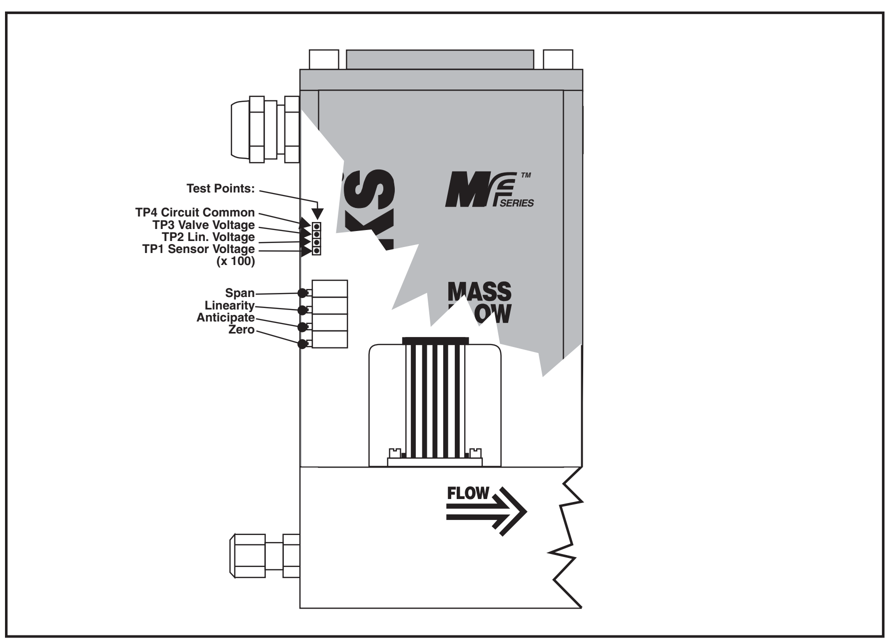

Figure 3-4 Adjustment Potentiometer Location

stabilized for 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 4-5 and 4-6 respectively.

g. Adjust the controller setpoint for 0% flow/shut-off the flow to the meter. Connect the DVM positive lead to 0-5 V signal output (TB-1, Terminal 5) and the negative lead to TP4. Readjust the zero potentiometer for an output of 0 mV ±2 mV as necessary.

h. Adjust the controller setpoint/adjust flow rate to the meter for 50% flow, and measure the flow rate. Calculate the error as a percentage of full scale.

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

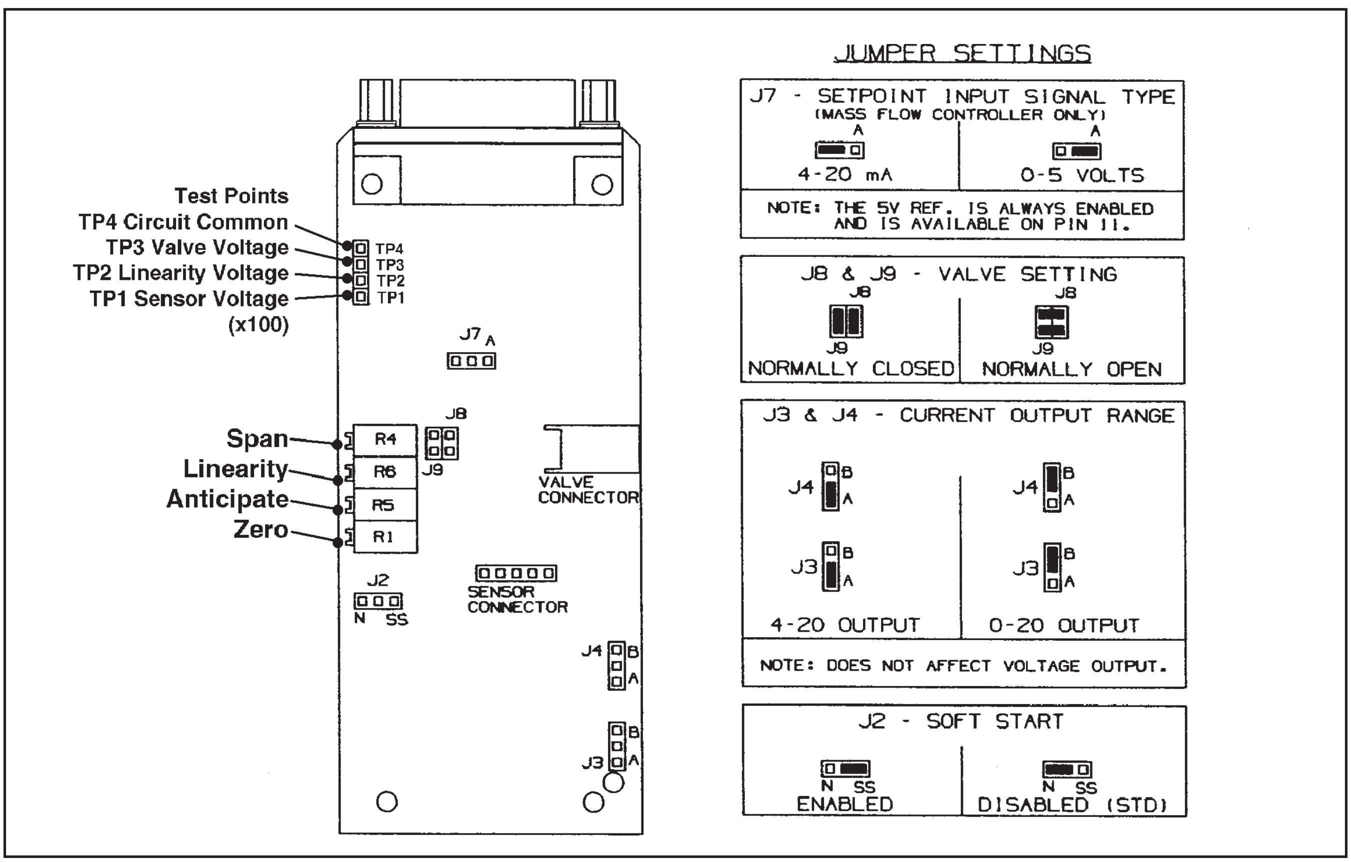

Figure 3-5 PC Board Jumper Location & Function

Example:
What is the percent of full scale error when full scale is equal to 100 sccm?
Measure flow rate = 48.5 sccm
Desired flow rate = 50.0 sccm

$$\text{Full Scale Error} = 100 \; \frac{(48.5 - 50)}{100} = -1.5\%$$

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. Adjust the setpoint for 100% flow. 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.
2. If the error is greater than 0.5% adjust the setpoint 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 Volts + (-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 4-5.

3-5 Response

Fast Response Adjustment (Controller)
Two methods of adjusting the step response of the Mf Series mass flow controllers can be used. Number 1 below, describes a method 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 Mfx Series 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 sample 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 setpoint 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% and 0% flow indicates the adjustment required of the anticipate potentiometer. Refer to Figure 3-6.
   1. If the flow signal measured on TB-1, Terminal 5, decays to -.05 to -.5 V, then rises to 0 V, the anticipate potentiometer is properly adjusted.
   2. If the flow signal decays rapidly and goes below -.5 V 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 -.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

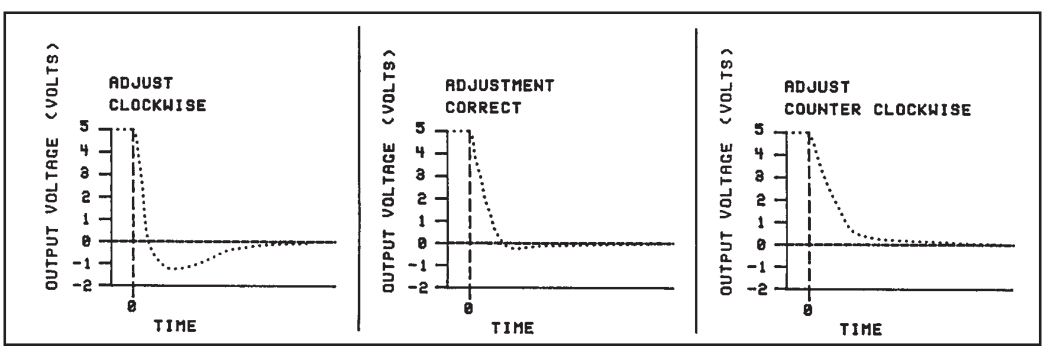

Figure 3-6 Fast Response Adjustment

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 Mf Series 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 three 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 above equipment, the anticipate potentiometer can be adjusted to give optimum response characteristics for any process.

Response (Flow Output Signal for Meter)

To achieve the proper response characteristics the response compensation circuit must be adjusted. This adjustment is performed by observing the output signal of the meter when the flow is suddenly stopped. Place a metering valve upstream of the Mf Meter to control the flow rate. A Brooks NRS™ precision metering valve is well suited for this application. Also place a fast acting shut-off valve immediately downstream of the flowmeter. A solenoid valve is ideal for this, but a manual toggle valve will do. Keep the length of interconnecting tubing as short as possible between the valves and the Mf Meter since the tubing can have a dampening effect on the flow and the gas may not stop flowing the instant the downstream valve is closed. Adjustment of the fast response circuit will not alter the steady state accuracy of the flowmeter as adjusted in Section 3-4.

Note: This procedure requires an oscilloscope chart recorder, or a DVM with a sampling speed of three samples per second or greater to monitor the rate of change of the output signal during the test. Monitor the output signal at TB1-5. TP1-4 may be used for circuit common.

a. With the shut-off valve open adjust the metering valve so that the output voltage of the Mf Meter is 4.0505 to 5.000 Vdc. Allow the output to stabilize at this setting.
b. Close the shut-off valve to stop the flow. Observe the output signal as it decays.
c. The behavior of the output signal during the transition between 100% and 0% flow indicates the adjustment required of the anticipate potentiometer. Refer to Figure 3-6.
    1. If the flow signal decays to -0.05 to -0.5 V then arises to 0.0 V, the anticipate potentiometer is properly adjusted.
    2. If the flow signal decays rapidly and goes below -0.5 V before rising to 0.0 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 aniticipate potentiometer must be adjusted counterclockwise and steps a and b repeated.

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4-1 General

⚠ WARNING

METER/CONTROLLER SEAL COMPATIBILITY

Products in this manual may contain metal or elastomeric seals, gaskets, O-rings or valve seats. It is the "user's" responsibility to select materials that are compatible with their process and process conditions. Using materials that are not compatible with the process or process conditions could result in the Meter or Controller leaking process fluid outside the pressure boundary of the device, resulting in personnel injury or death.

It is recommended that the user check the Meter or Controller on a regular schedule to ensure that it is leak free as both metal and elastomeric seals, gaskets, O-rings and valve seats may change with age, exposure to process fluid, temperature, and /or pressure.

⚠ WARNING

It becomes necessary to remove the instrument 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 disconnecting 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.

⚠ WARNING

If it becomes necessary to remove the instrument from the system, power to the device must be disconnected.

⚠ CAUTION

It is important that this MFC/MFM only be serviced by properly trained and qualified personnel.

This product contains elastomers that are used to seal the process gas and also to maintain a water tight and dust tight enclosure. Elastomers will deteriorate and fail over time. The elastomer seals used in this product have a maximum shelf life of five years, but severe service conditions may shorten their lifetime. It is recommended that these process seals and enviromental seals be inspected on a periodic basis and replaced anytime the instrument is serviced and more often under severe conditions.

No other routine maintenance is required on the Model Mf Series 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

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.

A. System Checks

The Mf Series instrument 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 common connections and that the correct power supply voltage and signals are reaching and leaving the controller.
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.

Table 4-1 Bench Troubleshooting

Trouble	Possible Cause	Check/Corrective Action
Actual flow overshoots controller setpoint by more than 5% full scale.*	Anticipate potentiometer out of adjustment	Adjust anticipate potentiometer. Refer to Section 3-5.
Output stays at zero and there is flow through instrument	Clogged sensor.	Clean sensor.Refer to cleaning, Section 4-2d.
Output stays at zero regardless of setpoint/ flow and there is no flow through the controller.	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 Section 4-4c.
	Valve override input is grounded.*	Check valve override input (TB-2, Terminal 5).
	Defective PC board.	Replace PC board. Refer to Section 4-4.
Output signal stays at +6.8 V or 26 mA regardless of setpoint and there is flow through the instrument.	Valve stuck open or leaky.*	Clean and/or adjust control valve. Refer to cleaning procedure and/or Section 4-4c.
	+15 V -28 Vdc applied to the valve override input.*	Check the valve override terminal (TB-2, Terminal 5).
	Defective PC board.	Replace PC board. Refer to Section 4-4.
Controller output signal follows setpoint at higher setpoints but will not go below 2% .*	Leaky control valve.	Disassemble and repair valve. Refer to Section 4-4c.
Controller output signal follows setpoint at lower setpoints but does not reach full scale.*	Insufficient inlet pressure or pressure drop.	Adjust pressures, inspect in-line 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).
Instrument grossly out of calibration. Flow is higher than desired.	Partially clogged sensor.	Clean sensor, refer to the cleaning procedure, Section 4-2d.
Instrument grossly out of calibration. Flow is lower than desired.	Partially clogged restrictor.	Replace restrictor. Refer to Section 4-4.
Instrument oscillates.	Pressure drop or inlet pressure excessive.*	Adjust pressures.
	Oversized orifice.*	Check orifice size. Refer to Section 4-5.
	Valve out of adjustment.*	Adjust valve. Refer to Section 4-4c.
	Anticipate potentiometer out of adjustment.	Adjust anticipate potentiometer. Refer to Section 3-4.
	Faulty pressure regulator.	Check regular capacity.
	Defective PC board.	Replace PC board. Refer to Section 4-4.

*For controller only (Models Mf50/51/53).

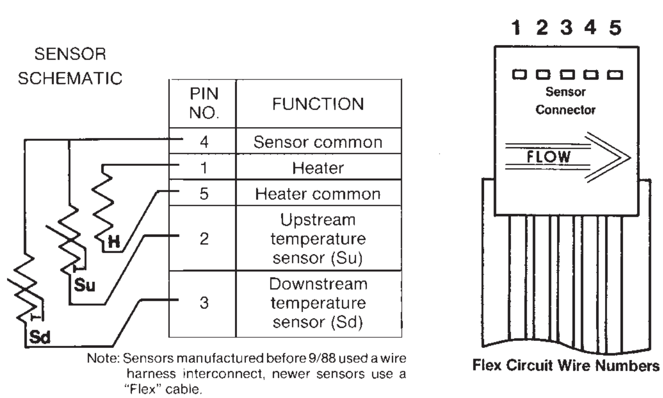
⚠ CAUTION

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 dry Nitrogen before use.

B. Bench Troubleshooting

1. Properly connect the mass flow instrument to a correct Vdc power supply, refer to Table 1-3, power requirements and setpoint source (controller). Connect an output signal readout device (4-1/2 digit voltmeter recommended) to TB-1, Terminals 5 and 4 (refer to Figure 1-4 and Table 1-4). Apply power, set the setpoint to zero (controller). Allow the instrument 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 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.

Table 4-2 Sensor Troubleshooting



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

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

2. Connect the instrument to a source of gas on which it was originally calibrated. Adjust the setpoint for 100% flow. Adjust flow to 100% indication (5.00 V) and adjust the inlet and outlet pressures to the calibration conditions. Verify that the output signal reaches and stabilizes at 5.00 Volts or 20 mA. Vary the setpoint/flow rate over the 2-to-100% range and verify that the output signal follows the setpoint/flow rate. For controller apply the correct voltage to the valve override input (TB-2, Terminal 5) and verify that the output exceeds 100%. Connect the valve override pin to power supply common and verify that the output signal falls below 2%. If possible, connect a flow measurement device in series with the mass flow instrument to observe actual flow behavior and verify accuracy of the mass flow instrument. If the mass flow instrument functions as described above, it is functioning properly and the problem may lie elsewhere.

   Tables 4-1 and 4-2 list possible malfunctions which may be encountered during bench troubleshooting.

C. 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.

D. Cleaning

No routine external cleaning is required for Brooks thermal mass flow controllers/meters. Should the Mf Series mass flow controller/meter 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.

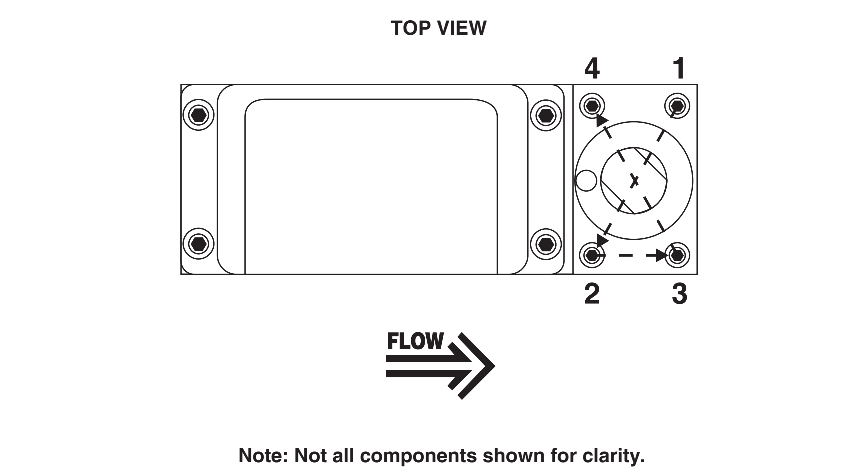


Figure 4-1 Torque Sequence for the Valve Retainer Plate (Controller)

⚠ CAUTION

Since the Mf series control valve is not a positive shut off, a separate shut off 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 shut off resulting in a surge upon actuation of the controller. This surge can be reduced in magnitude by locating the controller and shut off valve closer together or by moving the shut off valve upstream of the controller.

3. The Mfx Series sensor is not removable. The controller and meter should be disassembled following the instructions in Section 4-4. The sensor/body assembly can then be inspected for contamination and purged with clean, dry Nitrogen. The remaining component parts may be immersed in a deionized water bath using ultrasonic agitation to enhance cleaning.

   If it is determined the sensor is clogged, or the sensor/body assembly can not be cleaned using compressed Nitrogen, all parts should be returned to Brooks Instrument for service.

4. 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.

5. 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.
6. 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.
7. Restrictor elements can be cleaned in an ultrasonic bath. Refer to Section 4-5 for the correct restrictor to use.
8. Blow all parts dry with dry nitrogen and reassemble. Refer to Section 4-4B, assembly.
9. Purge the assembled instrument with dry nitrogen.
10. Perform the calibration procedure in Section 3-4.
11. When the instrument is reinstalled 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.

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 Mf*i* Series 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 Mf Series mass flow controller and meter may be disassembled in the field by the user for cleaning, re-ranging or servicing. Disassemble and assemble the controller as follows:

Note: The Mf Series mass flow controller and meter should be disassembled and assembled in a clean environment to prevent particulate contamination.

Note: Due to the complexity of the Mf53, Mf63 and Mf64 restrictor and bellows valve assemblies their disassembly and assembly procedures are not fully described. It is recommended that these instruments be serviced at the factory.

A. Disassembly (Mfx Series Sensor Assembly is Fixed)

The numbers in parentheses refer to the spare parts exploded view in Figures 5-1 through 5-3.

⚠ WARNING

Do not attempt to disassemble the Mass Flow Instrument 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 cap nut (20) on top of the valve assembly. Loosen dome nut on PG7 fitting (19) two turns counterclockwise. Remove PG7 fitting from housing assembly and slide it onto the tubing until it contacts the radius.
2. Disconnect the valve wires from the terminal (TB-3) and remove the coil assembly (21).
3. Remove the hex socket screws (22) securing the valve retaining plate (23) attaching the valve stem assembly (24).

⚠ 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 (24).
5. Remove the plunger assembly (26, 29, 28B and 32).
6. Remove and note the position of the valve spring spacers (28A) which may be located above and/or below the lower valve springs (29).
7. Unscrew the orifice (33) from the flow controller body.
8. Carefully unscrew the valve seat (32) from the plunger (26). Note the position and number of spacers (25A) and springs (29) that are stacked on the threaded end of the valve seat.
9. Remove the cover from the electronics housing by loosing the four (2) self retained screws in the corner of the cover.
10. Unplug signal wire terminal strip connectors TB-1 and TB-2.
11. Loosen the four screws (4) in the corner of the housing using a long (6 inch) 3 mm hex wrench. Lift the housing off the circuit board. Note: Signal wire assembly is still installed through housing gland or conduit fitting(5).

⚠ CAUTION

Be careful not to stress the sensor flex circuit cable when removing the sensor connector from the PC Board. If the sensor cable is stressed, an open in the sensor wire could result.

12. Unplug the sensor connector from the PC Board. Remove the screw and washer (42 and 43) securing the PC Board ground lug. Remove the two screws (17) and washers (16) securing the PC board (14). Remove the PC board.
13. Remove the two screws (37) and washers (38) securing the sensor assembly (18). Remove the sensor assembly. (Mf*i* Series only)

Note: Do not attempt to disassemble the sensor assembly.

⚠ 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 O-rings causing a leak.

14. Remove (Mf*i* Series only) sensor assembly O-rings (25B) from the flow controller body. Using the Brooks O-ring removal tool will help prevent scratching the sealing surface (Refer to Section 5, Table 5-5).
15. For Mf50/60, remove the adapter fittings from the flow controller body.
16. For Mf50/60, remove the restrictor assembly (40) from the inlet side of the flow controller body using the restrictor tool (part of service tool kit listed in Section 5, Table 5-5).

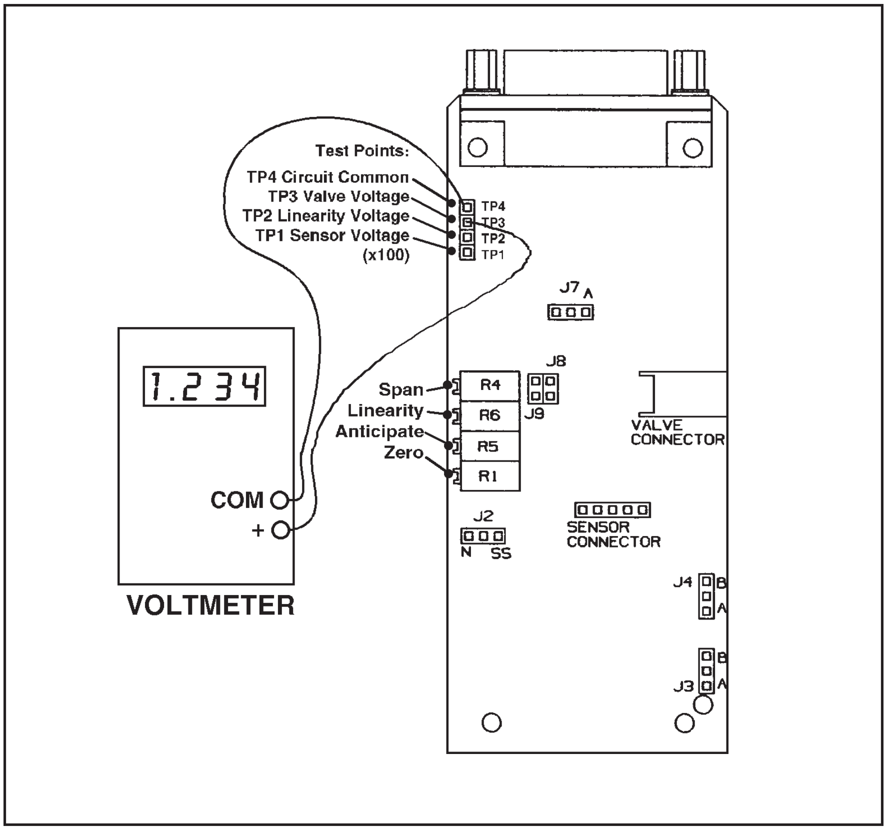


Figure 4-2 Voltmeter Connections for Valve Adjustment

17. For Mf51/61, remove the four screws from the end block and carefully remove the end block.

B. Assembly (Mfx Series sensor assembly is not removable)

⚠ CAUTION

For model Mf51 the end block screws and the valve screws(22) are not interchangable. The end block screws are stronger and are needed for the pressure rating.The end block screws are darker in color and can be attracted by a magnet.

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

Note: Torque valves for all critical fasteners are listed in Table 4-3.

1. Examine all parts for signs of wear or damage, replace as necessary.
2. Place the restrictor O-ring on the restrictor assembly. Screw the restrictor assembly 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 O-rings causing a leak.

3. For Mf51/61, place the end block O-ring in position and install the end block with the 4 hex socket screws.

⚠ CAUTION

For model Mf51 the end block screws and the valve screws(22) are not interchangable. The end block screws are stronger and are needed for the pressure rating.The end block screws are darker in color and can be attracted by a magnet.

4. (Mf*i* Series only), press the lubricated sensor O-rings (25B) into the flow controller body. Install the sensor assembly and secure with two screws (37) and washers (38) and tighten.
5. Install the orifice (33) and its O-ring (25A) using a 3/8 nut driver. Insure that the orifice is fully seated but do not overtighten.
6. Insert the valve preload spacers (28A), if used, into the valve cavity in the flow controller body. Use care to preserve the correct order.
7. Place the spacers (28B) and springs (29) on the valve seat (32) in the same order as noted in Step 8 of the disassembly. Screw the valve seat (32) into the plunger (26). Tighten the assembly until there is no looseness but do not overtighten.
8. Install the valve plunger assembly (26, 29, 28B and 32) on the preload spacers (28A). Install air gap spacers (28A), if used, on top of the valve springs.
9. Install the valve stem assembly (24), secure with the valve retaining plate (23) and four hex socket screws (22). Install O-ring (1) onto valve stem (24). 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 a diagonal pattern (refer to Figure 4-1) to 17 in/lbs

Table 4-3 Mf Series Torque Requirements

Model No.	End Block Screws	Valve Retaining Plate Screws	Sensor Screws	Electronics Housing Screws (M4)	Dome Nuts**	Electronics Housing Cover Screws
Mf50	N/A	17	15	25	1 1/2 Turns past finger tight	Tighten until cover contacts housing
Mf60	N/A	N/A	17	25		
Mf51	30	17	10	25		
Mf61	30	N/A	10	25		
Mf53	133	17	10	25	↓	↓
Mf63	133	N/A	10	25		

N/A = Not applicable

* The torque values listed should be used as a guide for assembly. The actual torque may need to be adjusted depending on the lubrication of the mating threads. It is recommended that the fasteners are used only one time. New fasteners can be obtained as spare parts from the factory (refer to Section 5).

** This should be used only as a guide. It is recommended that the actual number of turns, or torque, be determined empirically, using the actual cable.

10. Install the coil assembly (21) over the valve stem assembly (24) and secure with jam nut (20). Make sure O-rings (1) are installed on retaining plate (23) and jam nut (20).
11. Install the PC board (20) 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. Attach PC board ground lug to body with screw and washer (41, 42). Install the grounding spring (43) in the flat bottom hole on the body.
12. Install the electronics housing (6) on the controller, secure with four screws (4).
13. Connect the valve wires to terminal (TB-3). Tighten P67 fitting into eletronics housing and tighten dome nut. Plug in signal wire terminal. Strip connectors TB-1 and TB-2.
14. Install cover (3) and tighten four screws until cover touches electronics housing.
15. Prior to installation, leak and pressure test to any applicable pressure vessel codes.

C. Normally Closed Valve Adjustment

The Mf Series control valve has been factory adjusted to insure proper operation. Readjustment is only required if any of the following parts have been replaced: (Refer to Figure 4-3a).

orifice (33)
valve stem (24)
plunger (26)
lower guide springs (29)
valve seat (32)

The valve is adjusted in Brooks Mass Flow Controllers by adding spacers (28A and 28B) 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 4-3a) for spacer locations.

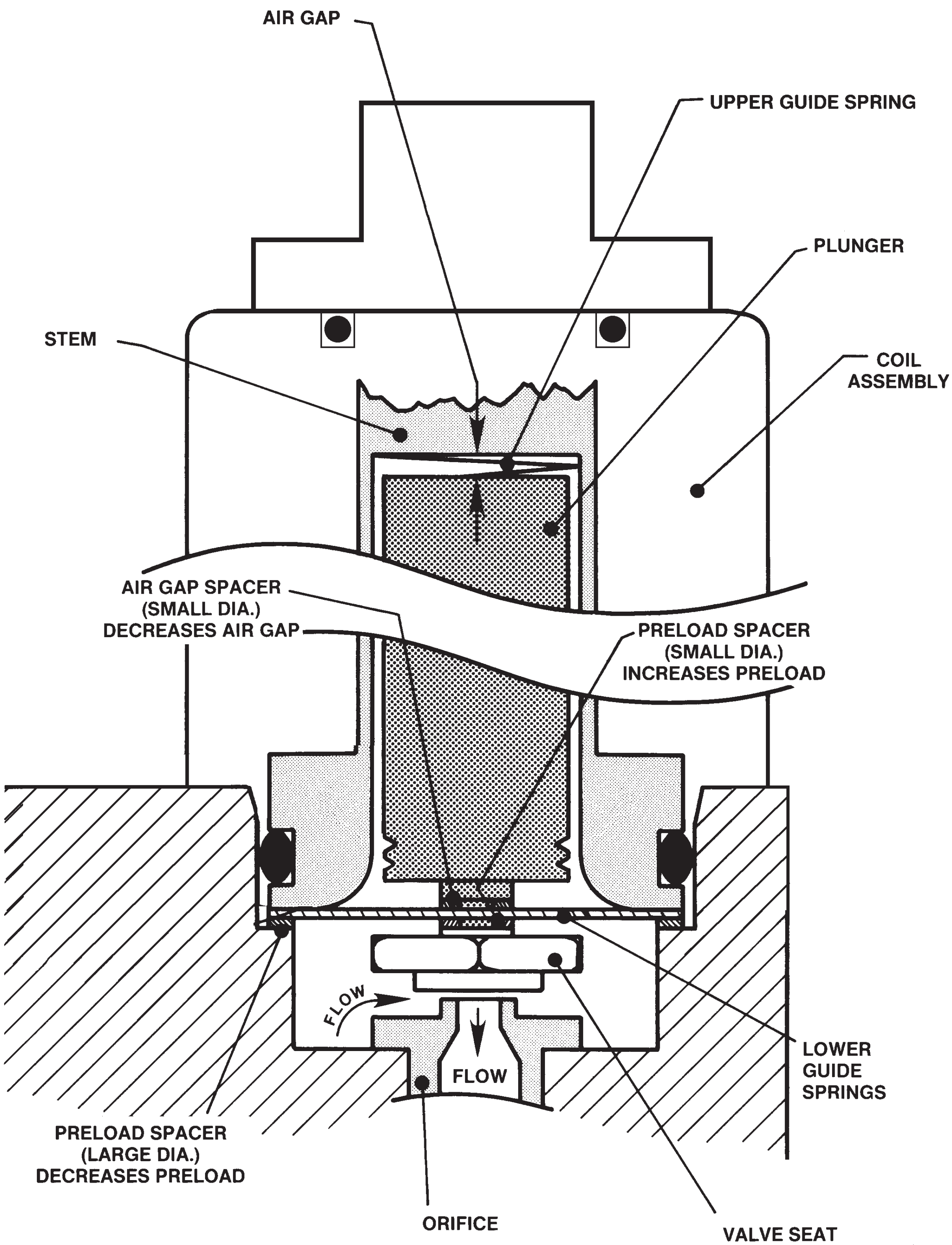


Figure 4-3a Valve Adjusting Spacer Locations (Normally Closed Valve)

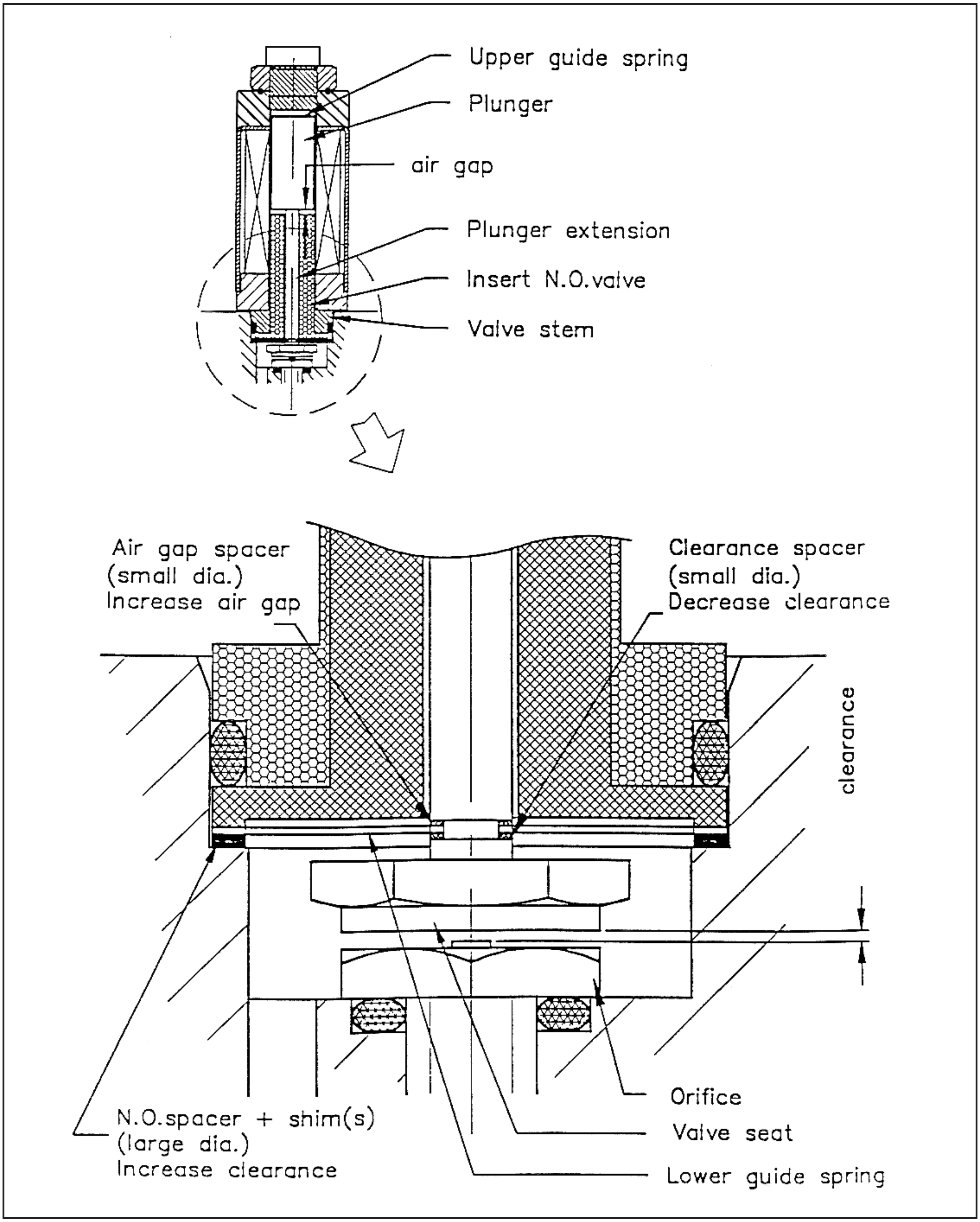


Figure 4-3b Valve Adjusting Spacer Locations (Normally Open Valve)

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.

Adjustment Procedure (Normally Closed Valve)
(Refer to Section 5, Spare Parts for Spacer/Shim Kit)

a. Remove the electronics housing (6) from the controller. Insure that the connector from the coil assembly (15) 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 (28A and 28B).
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 4-3a.
e. Reassemble the valve following the assembly procedure in Section 4-4B.
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 small.

k. Refer to Section 3-4, Calibration Procedure, if required.

Normally Open Valve Adjustment (Refer to Figure 4-3b)
Flow clearance determines the position of the valve in respect to orifice when valve coil is unpowered or under the valve override open condition. If the flow clearance is insufficient, the resistance to flow between orifice and valve seat will be great and full scale flow may not be able to obtain If the flow clearance is to large, the valve will not be able to close fully and will leak through excessively.

The air gap is the space between the top of insert and the bottom of plunger. The air gap determines the force between the plunger and insert 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 close the valve. In addition the the control range of the valve decreases which may cause flow instablity. If the air gap is too large, the magnetic force may not be able to lower thr plunger and the valve may not close.

Adjustment Procedure (Normally Open Valve)
Note: This procedure applies to the Mf50 and Mf51. Adjustments to the Mf53 should be done by the factory.

1. Install the flow controller in the test flow circuit.
2. Disconnect the valve connector from the customer terminal PC board. Connect the valve (nonpolarized) to power supply. It is not necessary to power the electronics.
3. Using clean dry Nitrogen, apply 10 psig to the controller inlet.

Note: the outlet of the controller must be kept below 10 inches of watercoloumn (0.4psi).

4. Apply 0 volts to the valve and measure and record flow rate. The measured flow rate must be greater than the flow given in Table 4-4 for the respective orifice.

Table 4-4 Orifice Capacities

Orifice Size (inches)	Minimum Flow Rate (sccm)	
	32°F (0°C)	70°F (21.1°C)
0.0013	5.3	(5.7)
0.002	12.5	(13.5)
0.003	39.2	(42.2)
0.004	82.5	(88.9)
0.0055	190	(205)
0.007	374	(403)
0.010	748	(806)
0.014	1364	(1469)
0.020	2673	(2879)
0.032	6490	(6991)
0.048	12980	(13980)
0.062	22000	(2879)
0.078	31900	(34400)
0.093	42500	(45800)
0.120	69300	(74700)
0.1405	95,500	(103,000)
0.1495	108,200	(116,600)

Inlet Pressure = 10 psig
Outlet Pressure = 10 inches of water (0.4 psig) or less
Note: Flow Rate based on Nitrogen

⚠WARNING

Do not disassemble the controller while it is under pressure. Serious personal injury or damage to the device can occur.

5. I f the measured flow exceeds the value shown in Table 4-4 proceed to step 7.
If the flow is less than expected, depressurize the controller and disassemble the valve following Disassembly, Section 4-4 and proceed to step 6.
Note: If the orifice size in use is unknown, it can be determined by:
Refering to Section 4-7, Orifice Sizing.Opening the control valve and inspecting the orifice. Refer to Section 4-4, Disassembly
Consulting the factory with the full model number which is printed on the front label of the controller and the order.

6.For orifice sizes 0.007" and greater add a 0.005" thick larger diameter flow clearance spacer.

For orifice sizes less than 0.007" add a larger diameter 0.005" thick large diameter flow clearance spacer and two 0.002" thick small diameter flow clearance spacers. Refer to Figure 4-3b for spacer placement.
If this does not provide adequate flow, remove one at a time, 0.002"thick small diameter spacers until the correct flow is achieved.

Assemble the valve following Assembly Section 4-4, utilizing the old socket head cap screws and the 020 elastomeric O-ring. Apply inlet pressure and zero volts to the valve.

⚠ CAUTION

Do not install the metal O-ring or new socket head screws until the entire adjustment procedure has been completed since the valve may have been reopened. The old socket head screws should be tightened, not torqued, so that there is no gap between the valve stem and the valve spacer plate.

If adding two 0.005" thick large diameter flow clearance spacers for controllers with 0.007" and greater orifices or removing both 0.002" thick small diameter flow clearance spacers for orifices less than 0.007" does not provide adequate flow, the orifice size should be checked. See Section 4-6, Orifice Sizing. If the size is correct inspect the orifice for clogging and clean as required following Section 4-2D, Cleaning. After cleaning, start the spacing procedure over using the initial spacer configuration.

7. After achieving adequate flow, apply 11 Volts to valves with orifices <.032" or 18 Volts to valves with orifices ≥ .032". Measure the flow. This voltage should provide less than 2% leak rate with elastomeric valve seats and less than 3% leak rate with metal valve seats. The leak rates given here are percentages of full scale for the gas on which the controller was calibrated. For all controllers calibrated for gases other than Nitrogen, the measured leak rate must be converted using the procedure in Section 4-6, Orifice Sizing where $Q_{Nitrogen}$ is the measured leak rate and Q_{gas} is to be determined.

Once Q_{gas} has been calculated it must meet the following:

$Q_{gas} \leq 0.02$ x Full Scale Flow of calibrated gas (elastomeric seat)

If the measured leak rate is greater than the respective allowable values, for all orifice sizes, add a 0.005" large diameter air gap spacer. Refer to Figure 4-3b for spacer placement. Continue to add a 0.005" thick large diameter air gap spacer until the leak rate is within the required specification for the valve seat in use. If adding two 0.005" large diameter air gap spacers does not yield the correct leak rate, the valve seat and orifice should be inspected for damage and replaced as necessary.

8. At this point the valve is properly adjusted. Replace the elastomeric O-ring with the new metal one and reassemble using the new socket head cap screws following Assembly, Section 4-4.
Note: Be sure to lubricate the screws to insure proper clamping force and prevent seizing when torqued.

4-5 Gas Conversion Factors

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 4-5. To change to a new gas, multiply the output reading by the ratio of the gas factor for the desired gas by the gas factor for the calibration gas.

$$\text{Actual Gas Flow Rate} = \text{Output Reading} \times \frac{\text{Factor of New Gas}}{\text{Factor of Calibration Gas}}$$

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 0.773 = 57.98 sccm

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

$$\text{Sensor Conversion Factor}_{\text{Mixture}} = \frac{100}{\dfrac{P_1}{\text{Sensor Conversion Factor}_1} + \dfrac{P_2}{\text{Sensor Conversion Factor}_2} + \dfrac{P_3}{\text{Sensor Conversion Factor}_3}}$$

Where,
P_1 = percentage (%) of gas 1 (by volume)
P_2 = percentage (%) of gas 2 (by volume)
P_n = 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:

$$\text{Mixture Factor} = \frac{100}{\dfrac{20}{1.386} + \dfrac{80}{0.876}} = 0.945$$

Nitrogen equivalent flow = 20/.945 = 21.16 slpm Nitrogen

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 4-4 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 pressure and/or temperature.

Table 4-5 Conversion Factors (Nitrogen Base)

GAS NAME	FORMULA	SENSOR FACTOR	ORIFICE FACTOR	DENSITY (kg/m^3)
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	$CH_2{:}CF_2$	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

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Table 4-5 Conversion Factors (Nitrogen Base) Continued

GAS NAME	FORMULA	SENSOR FACTOR	ORIFICE FACTOR	DENSITY (kg/m³)
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
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

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Table 4-5 Conversion Factors (Nitrogen Base) Continued

GAS NAME	FORMULA	SENSOR FACTOR	ORIFICE FACTOR	DENSITY (kg/m³)
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

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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:

$$\text{Mixture Factor} = \frac{100}{\dfrac{20}{1.386} + \dfrac{80}{0.876}} = 0.945$$

Nitrogen equivalent flow = 20/.945 = 21.16 slpm Nitrogen

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 4-5 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 pressure and/or temperature.

4-6 Restrictor Sizing

The restrictor assembly is a ranging device for the sensor portion of of the controller/meter. 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 rate of sensor flow to the restrictor flow, however, the total flow through each restrictor is different. Different restrictors (micron porosity and active area) have different pressure drops and produce instruments with different full scale flow rates. For a discussion of the interaction of the various parts of the instruments, 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 instrument is to be calibrated to a new flow rate.

Table 4-6 Model Mf50/60 Series Standard Restrictors

	Range sccm Air Equivalent Flow		Part Number	
Size	Low	High	ACLFE	Wire Mesh
D	8.022	11.36	S110Z275BMT	
E	11.23	15.90	S110Z276BMT	
F	15.72	22.26	S110Z277BMT	
G	22.01	31.17	S110Z278BMT	
H	30.82	43.64	S110Z279BMT	
J	43.14	61.09	S110Z280BMT	
K	60.40	85.53	S110Z281BMT	
L	84.56	119.7	S110Z282BMT	
M	118.4	167.6	S110Z283BMT	
N	165.7	234.7	S110Z284BMT	
P	232.0	328.6	S110Z285BMT	
Q	324.8	460.0	S110Z286BMT	
R	454.8	644.0	S110Z287BMT	
S	636.7	901.6	S110Z288BMT	
T	891.4	1262	S110Z289BMT	
U	1248	1767	S110Z290BMT	
V	1747	2474	S110Z291BMT	
W	2446	3464	S110Z292BMT	
X	3424	4849		S110Z319BMA
Y	4794	6789		S110Z321BMA
1	6711	9504		S110Z317BMA
2	9396	13310		S110Z228BMA
3	13150	18630		S110Z226BMA
4	18420	30000		S110Z224BMA

Materials: BMT = 316 stainless steel (ACLFE only)
BMA = Sintered 316 stainless steel (wire mesh only)

Note: For full scale 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.

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

1. Appropriate size wrench for the removal of the inlet process connection.
2. Restrictor removal tool (contained service tool kit P/N S778D017AAA)
3. Restrictor O-ring, Refer to Section 5, Spare Parts, for the correct kit part number.

Mf50/60 Restrictors
The model Mf51/Mf61 mass flow controller/meter utilizes porous metal restrictor assemblies depending upon full scale flow rates.

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.

Mf51/61 Restrictors
The model Mf51/Mf61 mass flow controller/meter utilies porous metal restrictor assembliesfor all full scale flow rates. Restrictor elements eith porosities of 40 and 60 microns are used in different combinations. Up to three restrictor elements can be placed in one assembly. These restrictors are assembled by pressing the porous metal elements into the header plate, Figure 4-4.

If a restrictor assembly is being replaced because the original has become contaminated, the original may be used as a guide to select the replacement assembly. the porosity of the original element or elements is marked on the calibration sheet which was shipped with the flow controller. The replacement assembly should be replaced in the same orientation as the original restrictor.

Mf53/63
Due to the complexity of the Mf53 restrictor assemblies it is recommended that these assemblie be sized at the factory.

Assembly Procedures
1. Select the proper restrictor element combination.
2. When handling restrictor elements, use care to ensure they are not contaminated with dirt, grease, oil, etc. The use of rubber gloves is recommended.
3. Put a lightly lubricated O-ring on the header plate. The restrictor assembly can then be installed in the mass flow controller body (restrictor element(S) go in first). It is important that the restrictor assembly is put into the body in the correct orientation (Refer to Figure 4-5). Push this assembly in with your fingers. Do not use an arbor press or hammer to install the restrictor assembly. The restrictor assembly should be pushed in until it bottoms out. Do not force it beyond this point.
4. Place the end block O-ring in position and install end block with the four hex socket screws. Tighten these screws to 30 inch/lbs. Do not overtighten.

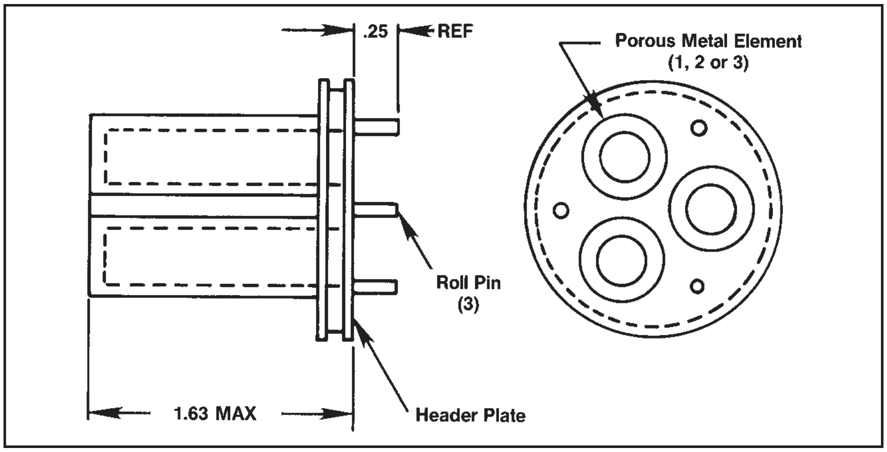

Figure 4-4 Model Mf51/61 Restrictor Element Assembly

5. Install the inlet adapter fitting and O-ring.
6. Recalibration of the controller or meter should be considered in order to maintain correct accuracy.

⚠WARNING

The end block screws and the valve screws are not interchangeable The end block scrws are stronger and are needed for the pressure rating. The end block screws are darker in color and can be attracted by a magnet..

Table 4-7 Model Mf51/61 Restrictor Selection Guide

Full Scale Range slpm Nitrogen Equivalent Flow*	Restrictor Element Combination	Part Number
4.6 to 15	1-40 micron (1 inch)	S613E604BMT
15 to 26	1-40 micron	S613E636BMT
26 to 42	2-40 micron	S613E523BMT
42 to 60	3-40 micron	S613E526BMT
60 to 79	2-40 micron/1-60 micron	S613E528BMT
79 to 93	1-40 micron/2-60 micron	S613E529BMT
93 to 130**	3-60 micron	S613E527BMT

*Based on 0°C Standard Reference Temperature
**For Hydrogen from 130 slpm to 200 slpm use 3-60 micron restrictor elements.
Note: If the nitrogen equivalent flow is between two sizes, select the larger size.

4-7 Orifice Sizing

Orifice sizes for all Mf controllers 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 Representative or through the Brooks Customer Service Department.

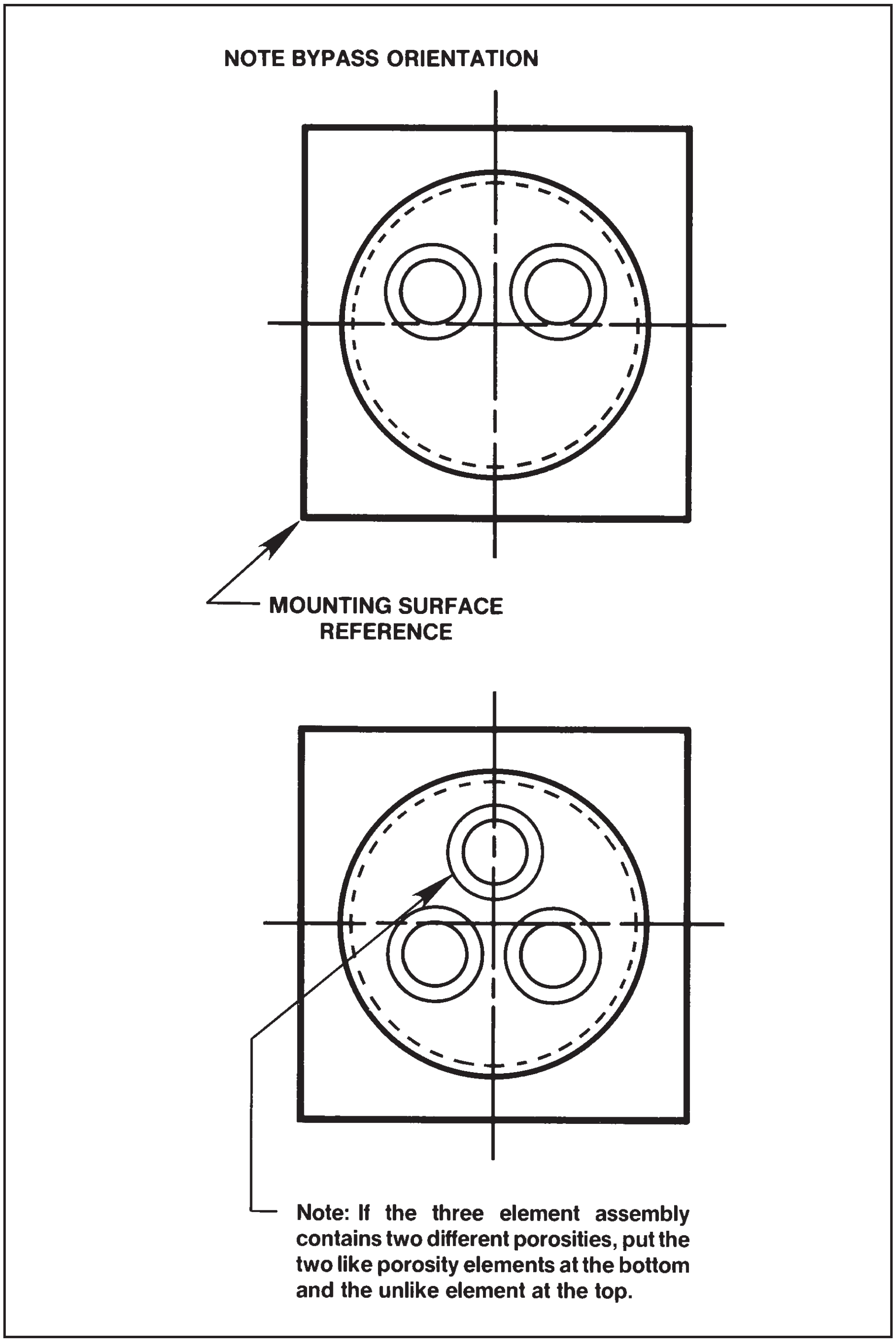

Figure 4-5 Model Mf51/61 Restrictor Element Orientation in Controller/Meter Body

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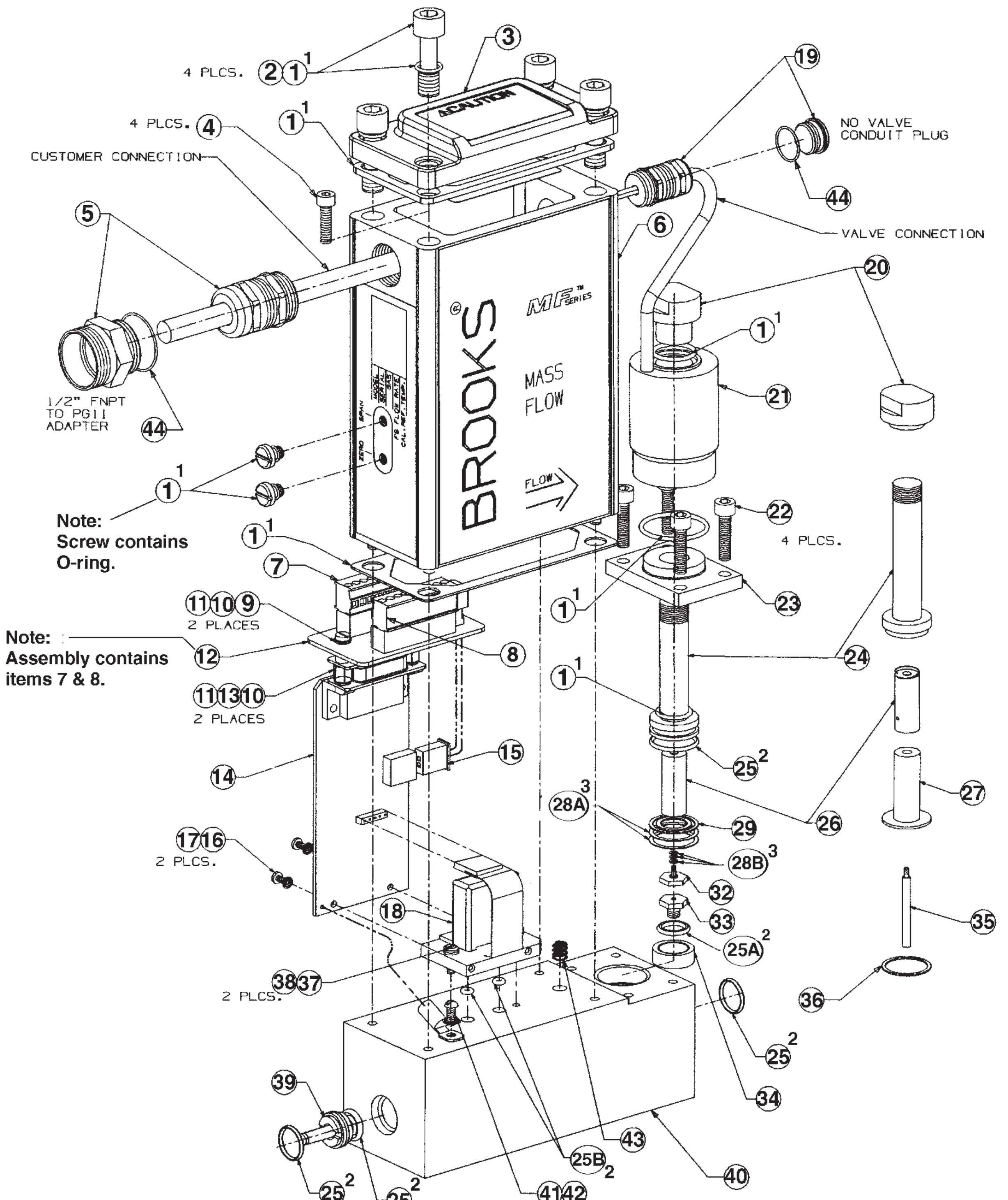
5-1 General

When ordering parts, please specify:

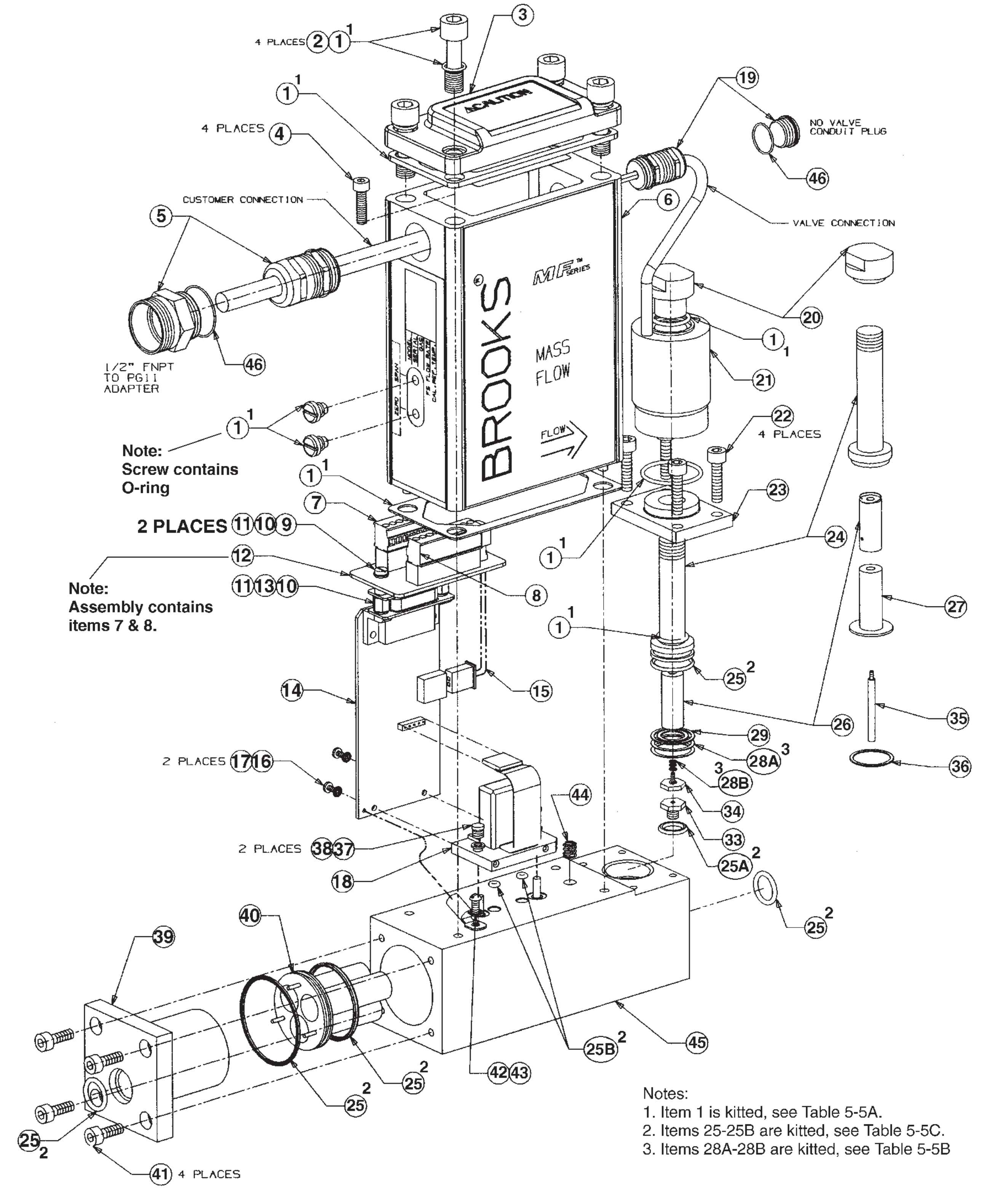
- Brooks Serial Number
- Model Number
- Part Description
- Part Number
- Quantity

Refer to Figures 5-1 through 5-3 for exploded parts drawings and Tables 5-1 through 5-4 for parts lists.



Notes:
1. 1 is kitted, see 5-5A.
2. Items 25-25B are kitted, seeTable 5-5C.
3. Items 28A-28B are kitted, see Table 5-5B.

Figure 5-1 Model Mf50/60 Parts Drawing



Notes:
1. Item 1 is kitted, see Table 5-5A.
2. Items 25-25B are kitted, see Table 5-5C.
3. Items 28A-28B are kitted, see Table 5-5B

Figure 5-2 Model Mf51/61 Parts Drawing

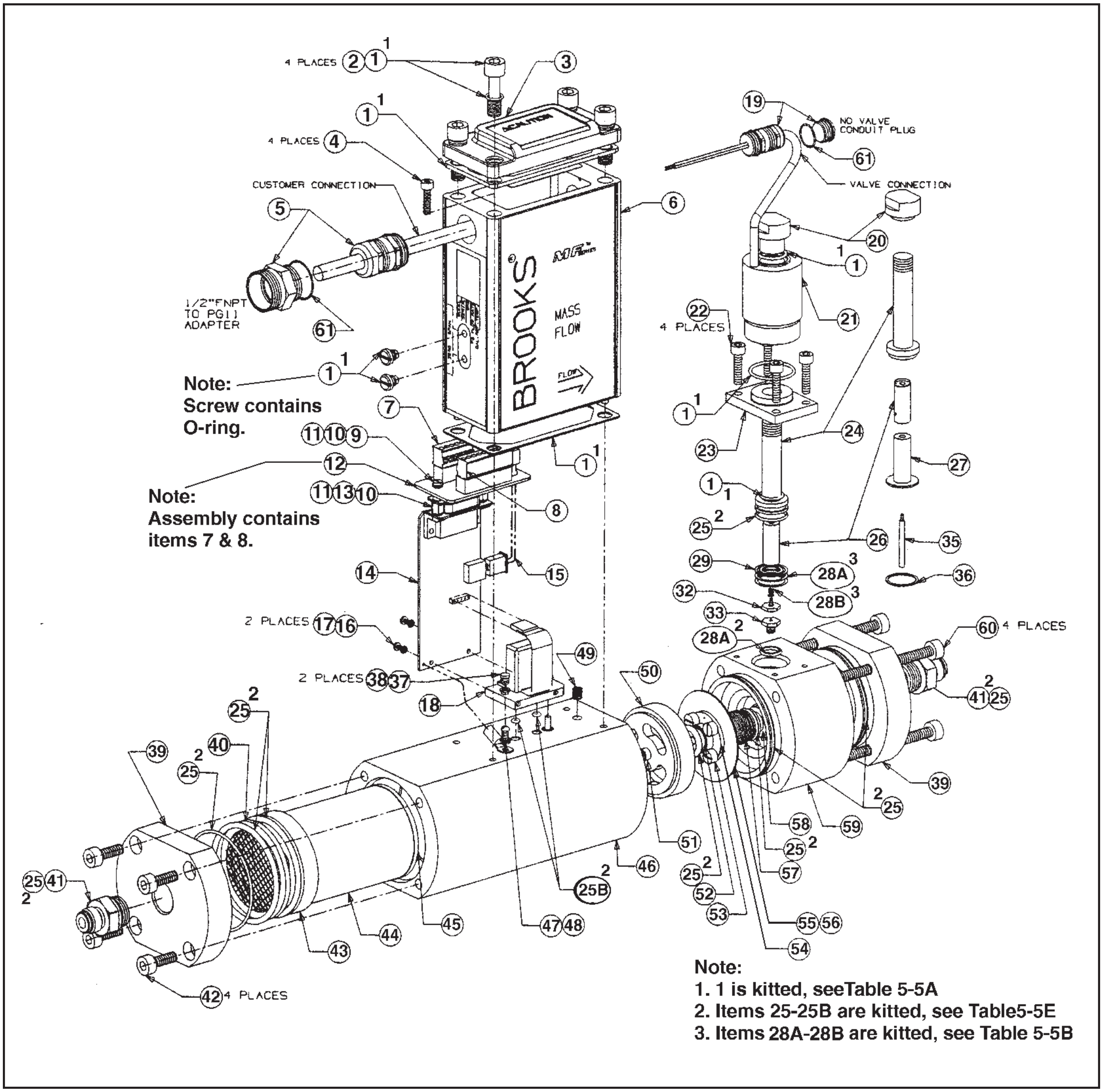


Figure 5-3 Model Mf53/63 Parts Drawing

Table 5-1 Mf Series Common Replacement Parts

Item No.	Description	Qty.	Part Number
2	Screw Cap Socket Head 5/16 x 1.25"	4	753Z197AWA
3	Top Cover	1	442C043EA%
4	Screw, Housing M4 x 12mm	4	758Z018AWA
5	Fitting PG11 Straight **(compression gland)**	1	326Z017GGJ
5	Fitting **1/2 FNPT** (1/2 FNPT to PG11)	1	014Z524GGJ
6	Housing Assembly **(Mfi Series)**	1	5 441Z479AAA
6	Housing Assembly **(Mfx Series)**	1	5 441Z486AAA
7	Terminal Strip Connector 6-position	1	883F053QRZ
8	Terminal Strip Connector 9-position	1	883J020QRZ
9	Screw Binding Head	2	753A166AWA
10	Flat Washer (for D-Connector)	4	962A004AWA
11	Lockwasher (for D-Connector)	4	962D004AWA
12	**P C Board Assembly** Terminal Board	1	097X224AAA
13	Standoff (for D-Connector)	2	830D332GGA
14	PC Board Assembly: **0-5V,** 4-20mA D-Connector	1	S097X220AAA
15*	Cable Assembly Valve Connector **(Mfi Series)**	1	S124Z977AAA
	No Valve		N.P.
16	Lockwasher Flat # 2	2	962C002BYA
17	Screw Round Head	2	753G056AWA
18	Removable Sensor Assembly **(Mfi Series)**	1	S774Z508BMA
19	Fitting Conduit-PG7 Plug with Buna No Valve	1	326Z018GGJ
	Fitting Conduit-PG7 Straight	1	326Z016GGJ
20*	Nut Normally Open	1	573Z290QOT
	Nut Normally Closed		573Z289QOT
21*	Coil Assembly (includes Coil)	1	S185Z290AAA
22*	Cap Screws	4	751C322AWA
23*	Valve Mounting Plate	1	715Z304QOT
24*	Valve Stem: Normally Closed Valve		949Z194QOT
	Valve Stem: Normally Open Valve		949Z215BMT
26*	Back-Up Ring - NO VALVE unit	1	763Z064QTA
	Plunger Assembly: Normally Open Valve		S622Z203QOT
	Plunger Assembly: Normally Closed Valve		S622Z165AAA
27*	Insert: Norm. Closed	--	N.P
29*	Lower Guide Spring	1	
	unit with NO ORIFICE		820Z109DR%
	N.C. Valve: .001 - .014 orifice		820Z109DR%
	.020 - .120 orifice		820Z110DR%
	N.O. Valve - all orifice sizes		820Z110DR%
32*	Valve Seat: Viton	1	S715Z051AAG
	Buna		S715Z050AAG
	Kalrez (< or = 200 psig)		S715Z297AAG
	Kalrez (> 200 psig)		S715Z163AAA
34*	Low Flow Filler Ring	1	
	for 'Plug' Type Restrictor		724Z363BMT
	other restrictors		N.P.
35*	Plunger Extension: Norm. Closed	--	N.P
	Plunger Extension: Norm.Open Valve	1	622Z200BMG
36*	Preload Spacer: Norm Closed Valve	--	N.P.
	Preload Spacer: Norm.Open Valve	1	810A388BMT

*These parts are used only for controllers (Models Mf50*i*/51*i*/53*i*)

Table 5-2 Mf50/60 Replacement Parts

Item No.	Description		Qty.	Part Number
		ID		Stainless
33*	Orifice	0.001	1	577Z375BMT
		0.002		577Z376BMT
		0.003		577Z377BMT
		0.004		577Z378BMT
		0.005		577Z379BMT
		0.007		577Z381BMT
		0.010		577Z383BMT
		0.014		577Z385BMT
		0.020		577Z387BMT
		0.032		577Z391BMT
		0.048		577Z393BMT
		0.052		577Z394BMT
		0.062		577Z395BMT
		0.078		577Z397BMT
	Refer to Section 4-5	0.093		577Z398BMT
	for Sizing	0.116		577Z399BMT
		0.120		577Z400BMT
37	Fillister Head Screw: Sensor/Body		2	753B269AWA
38	Spring Lockwasher: Sensor/Body		2	962D006AWA
39	Restrictor Assembly and Components (Refer to Section 4-5 for sizing)		1	
40	Body Mf50*i* Mf60*i*		1	092B183BMT 092B184BMT
40	Body and Sensor Assy. Mf50x Mf60x		1	5092Y065BMT 5092Y069BMT
41	Screw Round Head 6-32 X 3/16LG		1	753G263AWA
42	Lockwasher Internal #6		1	962C006BYA
43	Spring Compression .250 OD		1	820B417BBT
NS	M6 Mounting Screw		2	Customer Supplied
	Fittings:			
NS	1/8" Compression		2	320B182BMA
NS	1/4" Compression		2	320B136BMA
NS	3/8" Compression		2	320B150BMA
NS	1/4" VCR		2	315Z036BMA
NS	3/8" VCR (3/8" or 1/2" Tube)		2	315Z034BMA
NS	1/4" VCO		2	315Z035BMA
NS	3/8" VCO (3/8" or 1/2" Tube)		2	315Z033BMA

*These parts are used only for controller (Model Mf50)

Table 5-3 Mf51/61 Replacement Parts

Item No.	Description			Qty.	Part Number
33*	Orifice	ID .0040	(code B)	1	577Z275BMT
		.0067	(code C)		577Z277BMT
		.0091	(code D)		577Z280BMT
		.0120	(code E)		577Z283BMT
		.0160	(code F)		577Z286BMT
		.0210	(code G)		577Z289BMT
		.0260	(code H)		577Z293BMT
		.0310	(code J)		577Z296BMT
	BMT=	.0360	(code K)		577Z300BMT
	(Stainless)	.0410	(code L)		577Z305BMT
		.0465	(code M)		577Z308BMT
		.0550	(code N)		577Z310BMT
		.0635	(code P)		577Z312BMT
		.0700	(code Q)		577Z314BMT
		.0760	(code R)		577Z316BMT
		.0820	(code S)		577Z319BMT
		.0935	(code T)		577Z322BMT
		.1065	(code U)		577Z328BMT
		.1200	(code V)		577Z333BMT
		.1405	(code W)		577Z336BMT
		.1495	(code X)		577Z339BMT
37	Allenut (sensor to body)			2	573Q103ACZ
38	Lockspring Washer (sensor to body)			2	962D005AWA
39	End-block with integral inlet screen			1	S079Z240AAA
40	Restrictor Assembly and Components (Refer to Section 4-5 for sizing)			1	
41	Cap Screw (body to endblock)			4	751Z105AAO
42	Screw Round Head 6-32 x 3/16 (grounding)			1	753G263AWA
43	Lockwasher # 6 (grounding)			1	962C006BYA
44	Spring Compression .25" O.D.			1	820B417BBT
45	Body and Stud Weldment	Mf51*i*		1	092B185BMF
		Mf61*i*			092B186BMT
45	Body and Sensor Assy.	Mf51x		1	5092Y067BMT
		Mf61x			5092Y071BMT
NS	M6 Mounting Screw			2	Customer Supplied
	Fittings:				
NS	1/4" Compression				320B136BMA
NS	3/8" Compression				320B150BMA
NS	1/2" Compression				320B203BMA
NS	1/4" VCR				315Z036BMA
NS	3/8" VCR (3/8" or 1/2" Tube)				315Z034BMA
NS	1/4" VCO				315Z035BMA
NS	3/8" VCO (3/8" or 1/2" Tube)				315Z033BMA

*These parts are used only for controller (Model Mf51)

Table 5-4 Mf53/63 Replacement Parts

Item No.	Description		Qty.	Part Number
33*	Orifice	.020 Dia	1	577Z387BMT
	Orifice	.028 Dia		577Z389BMT
	Orifice	.032 Dia		577Z391BMT
	Orifice	.048 Dia		577Z393BMT
37	Allen Nut 5-40 UNC		2	573Q103ACZ
38	Lockwasher #5 Sensor		2	962D005AWA
39	End Plate	9/16"-18 UNF	2	613Z467BMT
	End Plate	1 1/16"-12		613Z463BMT
	End Plate	1/2" NPT		613Z464BMT
	End Plate	1" NPT		613Z465BMT
	End Plate	1 1/2" NPT		613Z466BMT
40	In-Line Filter Element		1	306Z142BMA
NS	M6 Mounting Screw		4	Customer Supplied
41	Fittings:			
	1 1/16-12 to 1/2" Tube		2	320B188BMA
	1 1/16-12 to 3/4" Tube			320B189BMA
	1 1/16-12 to 1" Tube			320B190BMA
	9/16 to 1/2" VCO			315Z033BMA
	1 1/16 to 3/4" VCO			315Z049BMA
	9/16 to 1/2" VCR			315Z034BMA
	1 1/16-12 to 1/2" VCR			320B204BMA
	Flanges:			
	ANSI 1/2" 150#RF			317Z076BMA
	ANSI 1/2" 300#RF			317Z077BMA
	ANSI 1" 150#RF			317Z078BMA
	ANSI 1" 300#RF			317Z079BMA
	ANSI 1 1/2" 150#RF			317Z080BMA
	ANSI 1 1/2" 300#RF			317Z081BMA
	ANSI 2" 150#RF			317Z082BMA
	ANSI 2" 300#RF			317Z083BMA
42	Screw Socket Head M6 x 20mm		4	758Z014AAA
43	Retainer Ring		1	724Z246QMA
44	Flow Restrictor		1	110Z243BFA
45	Restrictor Limiter	Up to 200 slpm	1	724Z249QMA
	Restrictor Limiter	201 to 450 slpm		724Z248QMA
	Restrictor Limiter	451 to 1000 slpm		724Z247QMA
46	Body and Stud Weldment (Mf53i/Mf63i)		1	092B181BMT
46	Body and Sensor Assy. (Mf53x/Mf63x)		1	5092Y073BMT
47	Lockwasher Internal #6 Grounding		1	962C006BYA
48	Screw Round Head 6-32 x 3/16LG Grounding		1	753G263AWA
49	Spring Compression .250 OD		1	820B417BBT
50	Seal Retainer Plate		1	613E457BMA
51	Screw Socket Head M4 x 6mm		1	760C102BMA
52	Seal Center		1	715Z113BMA
53	Screw Slot M3 x 8mm		4	760D081BMA
54	Main Orifice		1	577D059BMA
55	Diaphragm	Viton	1	237C096QTA
	Diaphragm	Teflon TFE		273C096QMA
56	Spacer	None:Viton Diaphragm		N.P.
	Spacer	For PTFE Diaphragm	1	810A331QMA
57	Bellow Assy		1	067Z018ZZZ
	Bellow Assy	Low Force		067Z019ZZZ
58	Bellows Spacer	Up to 450 slpm	1	810A329BFA
	Bellows Spacer	451 to 1000 slpm		810A330BFA
59*	Valve Body		1	092B182BMF
60	Screw Socket Head M6 x 70mm	Mf 53	4	758Z016AAA
	Screw Socket Head M6 x 20mm	Mf 63		758Z014AAA

*These parts are used only for controller (Model Mf53)

Table 5-5 Mf Series Tool and Spare Part Kits

Mf*i* Service Tool Kit
P/N S778D017AAA

Permits the complete disassembly of the Mf Series for servicing

Contains:

1 - O-ring Removal Tool
1 - Potentiometer Adjustment Tool
2 - Allen Wrench
1 - Phillips Screw Driver
2 - Hex Wrench
1 - Nut Driver for Orifice
1 - Restrictor Removal Tool
2 - Common Screw Driver

A. Mf Series NEMA 4 Gasket Kit
P/N S375Z383AAA

Contains:
1 - Cover Gasket
1 - Electronics Housing Gasket
1 - Valve Nut O-ring
1 - Coil Housing O-ring
1 - Coil Base O-ring
4 - Cover Screw O-ring
2 - Calibration Screws with O-ring

Model Mf51 Header Removal Tool
P/N S817Z036AAA

Model Mf51 Orifice Removal Tool
P/N S908Z049AAA

B. Mf*i* Series Valve Shim Kit
P/N S810A372BMA

Contains:
1 - .010" Large Spacer
2 - .005" Large Spacers
1 - .010" Small Spacer
2 - .005" Small Spacers

C. Model Mf50/60 O-ring Service Kit
P/N S375Z278***

Contains:
1 - Orifice O-ring
1 - Restrictor O-ring
1 - Valve O-ring
2 - Sensor O-rings (Mf*i* Series)
2 - Adaptor O-rings
1 - Syringe with Fomblin Grease
1 - Information Sheet

D. Model Mf51/61 O-ring Service Kit
P/N S375Z339***

Contains:
1 - Orifice O-ring
1 - Restrictor O-ring
1 - Valve O-ring
2 - Sensor O-rings (Mf*i* Series)
2 - Adaptor O-rings
1 - Endblock O-ring
1 - Syringe with Fumblin Grease
1 - Information Sheet

E. Model Mf53/63 O-ring Service Kit
P/N S375Z395***

Contains:
1 - Orifice O-ring
1 - Restrictor O-ring
1 - Valve O-ring
2 - Sensor O-rings (Mf*i* Series)
2 - Adaptor O-rings
3 - Endblock O-ring
1 - Filter O-rings
2 - Valve Plate O-ring
1 - Seal O-ring
1 - Syringe with Fomblin Grease
1 - Information Sheet

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

Note: Refer to Brooks publication DS-TMF-Mfi-Mfx-MFC-eng for additional accessories.

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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.

Kvaliteten af signal kabler og stik:

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.

Qualität der Verbindungskabel, Anschlußstecker und der Kabeldurchführungen

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

Bei Verwendung eigener Verbindungskabel sollten Sie darauf achten, daß eine

100 %igenSchirmabdeckung 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 Schirmabdeckung 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.

Quality of the signal cable, cable glands and connectors:

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

Calidad del cable de señal, prensaestopas y conectores:

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.

Qualité du câble, des presse-étoupes et des connecteurs:

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

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.

Ποιότητα του καλωδίου σήματος των στυπιοθλιπτών και των συνδέσμων .

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.

Qualidade do cabo de sinal, buchas de cabo e conectores:

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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