

Model 5866RT Pressure Controller



Flow Controllers for Gas and Liquid Service

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

Flow Controllers for Gas and Liquid Service

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<u>Paragraph Number</u>	<u>Page Number</u>
Section 1 Introduction	
1-1 Purpose	1-1
1-2 Description	1-1
1-3 Principle of Operation	1-1
1-4 Specifications	1-7
Section 2 Installation	
2-1 General	2-1
2-2 Receipt of Equipment	2-1
2-3 Recommended Storage Practice	2-1
2-4 General	2-1
2-5 Gas Connections	2-2
2-6 Installation	2-2
2-7 In-Line Filter	2-3
2-8 Electrical Interface	2-3
2-9 Command Input	2-4
2-10 Valve Override	2-5
2-11 Precision 5V Reference	2-6
2-12 Remote Transducer Input	2-6
2-13 Valve Test Point	2-6
2-14 Remote Valve Return	2-6
Section 3 Operation	
3-1 Operation	3-1
3-2 Response Time Adjustment	3-1
Section 4 Maintenance	
4-1 General	4-1
Section 5 Troubleshooting	
5-1 System Checks	5-1
5-2 Bench Troubleshooting	5-1
5-3 Disassembly	5-3
5-4 Assembly	5-6
5-5 Adjusting the Control Valve	5-9
5-6 Orifice Sizing	5-14
Section 6 Calibration	
6-1 Flow Sensor Calibration Procedure	6-1
6-2 Flow Sensor Response Adjustment	6-3
6-3 Gas Conversion Factors	6-3
6-4 Restrictor Sizing	6-4
6-5 Control Circuit Bias Adjustments	6-8
Section 7 Parts List	
General	7-1
Appendix A CE Certification	
CE Certification for Mass Flow Equipment	A-1
Warranty, Local Sales/Service Contact Information	Back Cover

Model 5866RT

Figures

<u>Figure Number</u>	<u>Page Number</u>
1-1 Model 5866RT System Block Diagram	1-2
1-2 Model 5866RT Dimensions	1-3
1-3 Model 5866RT Upstream Controller	1-4
1-4 Model 5866RT Downstream Controller	1-4
1-5 Typical Application of Downstream Controller	1-5
1-6 Typical Application of Upstream Controller	1-5
1-7 Customer Connections and Settings	1-6
2-1 Connector Pin Arrangement	2-3
2-2 D-Connector to Card Edge Adapter	2-4
2-3 D-Connector to Card Edge Adapter (UPC - Series Replacement)	2-5
3-1 Response Dip Switch	3-2
5-1 Torque Sequence for the Valve Retainer Plate	5-7
5-2 Adjustment Test Setup	5-10
5-3 Valve Adjusting Spacer Locations, Normally Closed (N.C.) Elastomer Sealed Valve	5-11
5-4 Valve Adjusting Spacer Locations, Normally Open (N.O.) Elastomer Sealed Valve	5-13
5-5 Valve Adjusting Spacer Locations, Normally Closed (N.C.) Metal Sealed Valve	5-15
5-6 Valve Stem Spacer Orientation	5-15
5-7 Valve Adjusting Spacer Locations, Normally Open (N.O.) Metal Sealed Valve	5-16
5-8 Example Application of Orifice Sizing Procedure	5-18
7-1 Model 5866RT Parts Drawing with Elastomer Seal	7-2
7-2 Model 5866RT Parts Drawing with Metal Seals	7-4

Tables

<u>Table Number</u>	<u>Page Number</u>
5-1 Bench Troubleshooting	5-2
5-2 Flow Sensor Troubleshooting	5-3
5-3 Minimum Flow Values	5-14
5-4 Model 5866RT Orifice Selection	5-14
6-1 Gas Conversion Factors	6-5
6-2 Model 5866RT Standard Restrictors	6-9
7-1 Model 5866RT Elastomer Seal Parts List (with Normally Closed Valve)	7-3
7-2 Model 5866RT Metal Seal Parts List (with Normally Closed Valve)	7-5
7-3 Tool and Spare Part Kits for Model 5866RT with Elastomer Seals	7-6
7-4 Tool and Spare Part Kits for Model 5866RT with Metal Seals	7-6

1-1 Purpose

This instruction manual is intended to provide the user with all the information necessary to install, operate and maintain the Brooks® Model 5866RT Pressure Controller. This manual is organized into the following sections:

- Section 1 - Introduction
- Section 2 - Installation
- Section 3 - Operation
- Section 4 - Maintenance
- Section 5 - Troubleshooting and Repair
- Section 6 - Calibration
- Section 7 - Spare Parts
- Section A - CE Certification
- Back Cover - Warranty, Local Sales/Service Contact Information

It is recommended that this manual be read in its entirety before attempting to operate or repair the Model 5866RT.

1-2 Description

The Brooks Model 5866RT Pressure Controller controls upstream or downstream pressures and simultaneously measures the mass flow rate through the control valve. A user supplied pressure sensor, which may be located some distance from the controller, measures the pressure to be controlled. The integral control electronics compare the pressure signal to the setpoint and modulate the flow through the control valve to change or maintain the pressure. User adjustable dip switches allow for tuning the control loop to achieve optimum response times. An integral mass flow sensor measures the flow through the control valve to provide a 0-5 V signal proportional to mass flow.

1-3 Principle of Operation

A user supplied pressure sensor, with a full scale pressure as low as 10 mTorr or as high as several hundred psi and a full scale output signal of 5 or 10 Vdc, monitors the pressure in a vessel or a feed or exhaust line from the vessel. The control electronics in the Model 5866RT compare the pressure signal to a setpoint and act to regulate the flow through the integral solenoid control valve to stabilize the pressure at the setpoint. An integral mass flow sensor identical in design to the Brooks Model 5860E provides a 5 Vdc full scale signal proportional to the flow through the control valve. A system block diagram is shown in Figure 1-1.

The integration of mass flow sensor, control electronics and control valve into one unit results in a compact size. The mounting dimensions are comparable to a mass flow controller. Refer to Figure 1-2.

In the upstream pressure regulation mode shown in Figure 1-3, the pressure controller is placed at the outlet of the pressure vessel. The pressure in the process upstream of the controller will be constant independent of downstream variation. Pressure control takes place at the outlet side of the

Model 5866RT

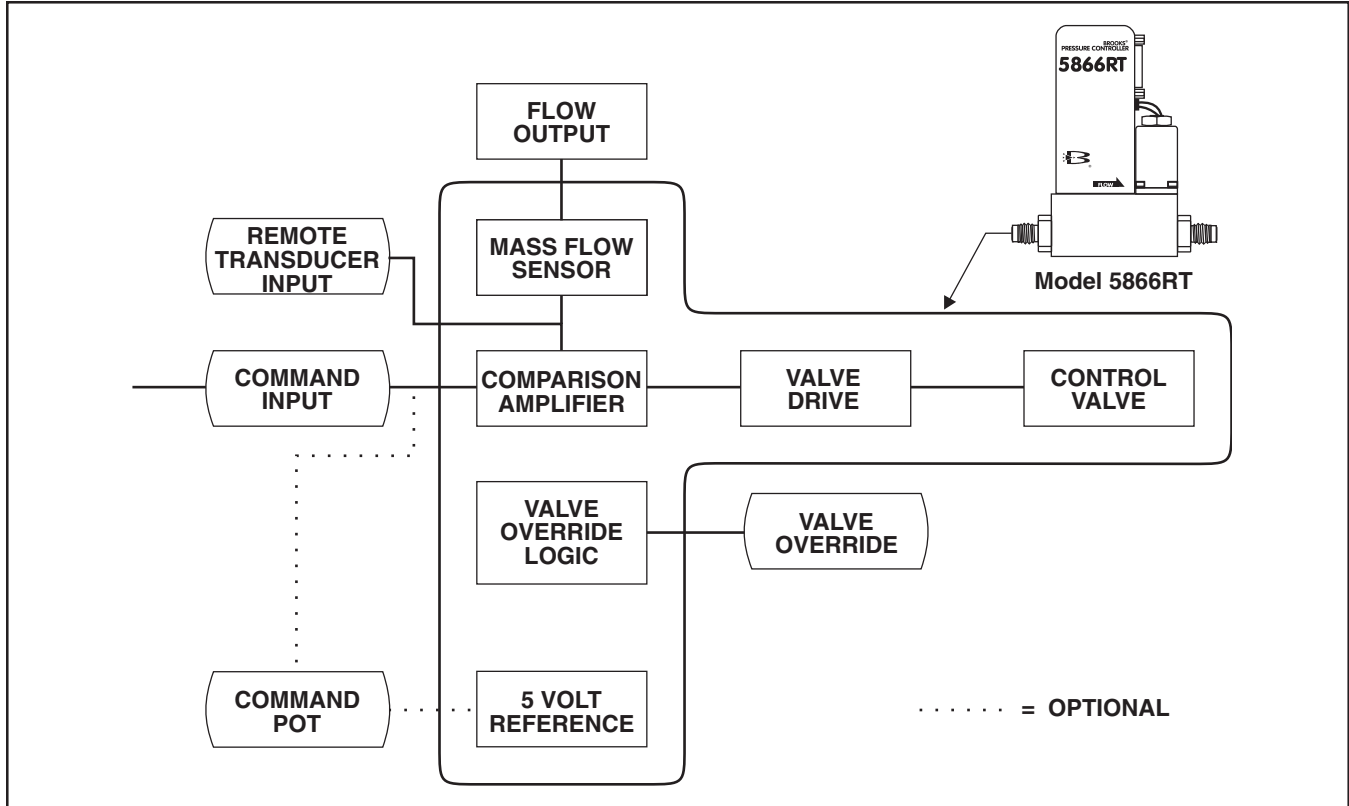


Figure 1-1 Model 5866RT System Block Diagram

pressure vessel.

When the pressure controller is used for downstream pressure regulation as shown in Figure 1-4, the pressure in the process vessel will be constant independent of upstream variation, provided the upstream pressure does not fall below the downstream setting. Pressure control takes place at the inlet side of the pressure vessel. In both applications, the mass flow through the control valve necessary to maintain the pressure at the desired value is measured.

The most common application of this type of instrument is in subatmospheric pressure control using an inert gas feed to maintain the pressure in a vacuum chamber instead of a high conductance butterfly valve in series with the vacuum pump (see Figure 1-5). Pressure changes can be made with greater speed, and the number of components exposed to the possibly corrosive or particulate laden process gas mixture is minimized. Figure 1-6 shows a typical application of the Model 5866RT in a system designed for upstream pressure control.

The physical characteristics of the piping system between the pressure sensor and the controller, the required flow rate, the piping conductance, the vessel capacity, the characteristics of the vacuum pumping system, and the characteristics of the PID control loop in the pressure controller will all have an effect on the response time of the system to changes in pressure setpoint. A set of easily accessible dip switches (see Figure 1-2) allow the response of the controller to be optimized for a particular system configuration by allowing independent adjustment of command signal rate of change, integration time, and derivative action.

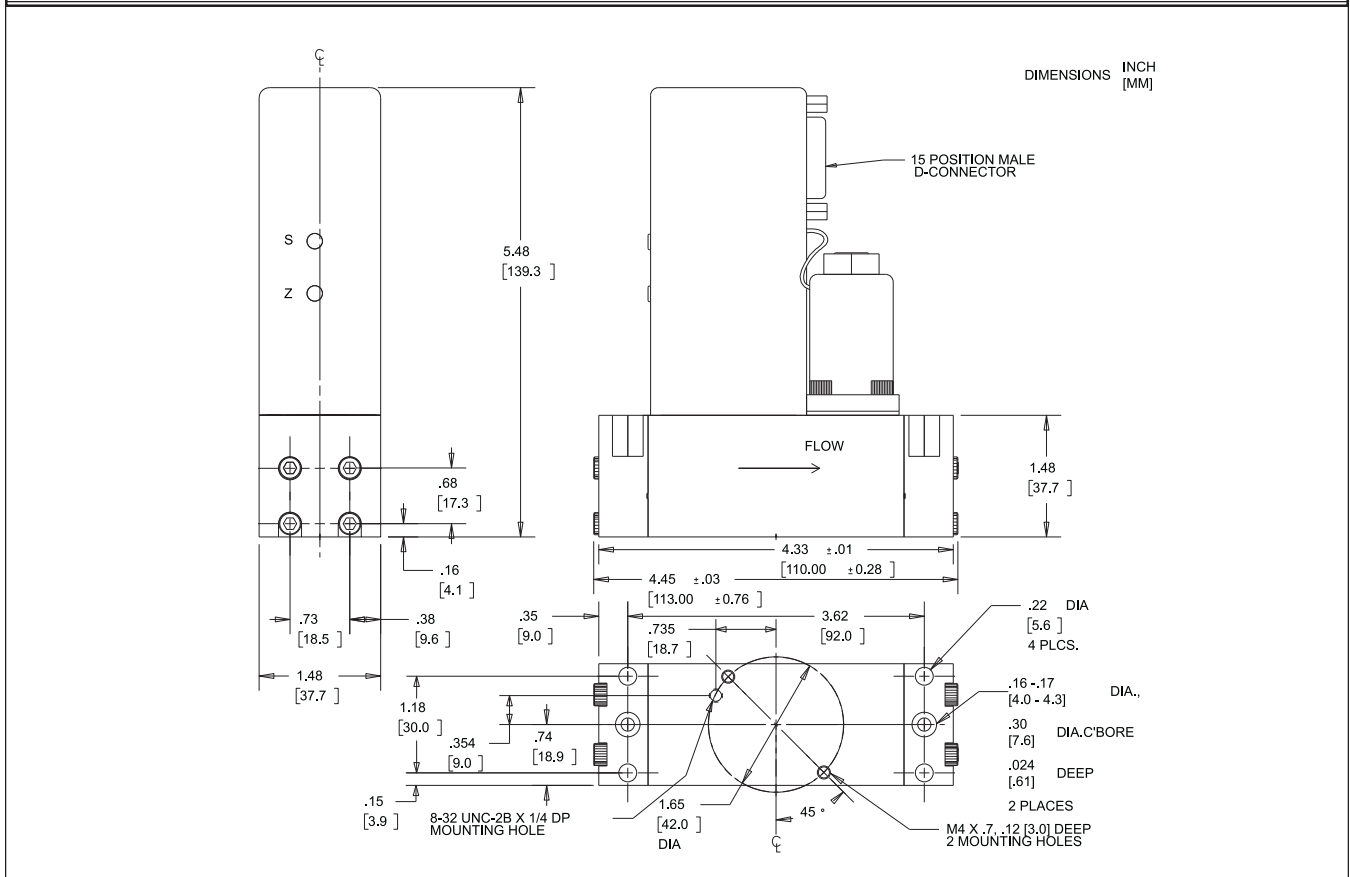
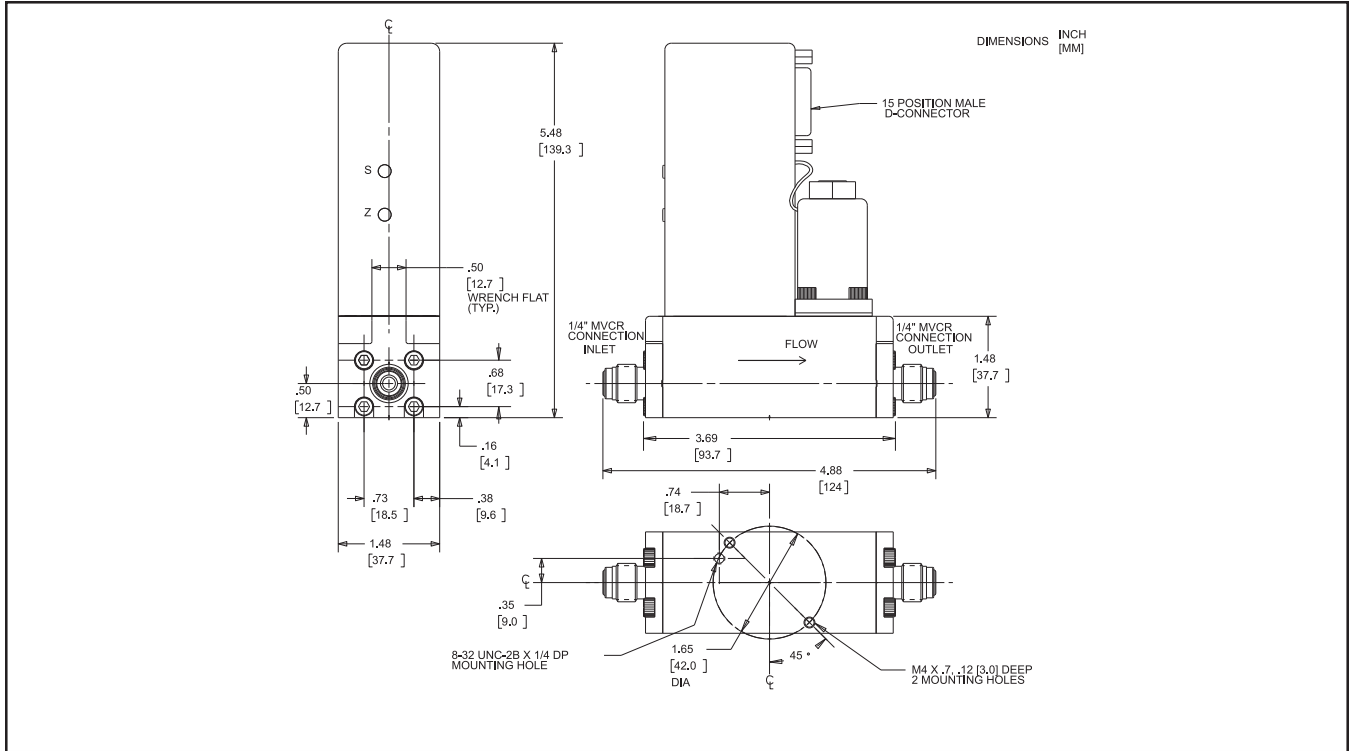


Figure 1-2 Model 5866RT Dimensions

Model 5866RT

Note: The Controller valve type (Normally Open or Normally Closed) is determined at the time of order. Mechanical parts must be changed to convert modes or valve types.

Upstream Controller Mode sets the controller to maintain the upstream process pressure constant, independent of downstream pressure or flow variations (Figure 1-3). For jumper positions on the PC board Figure 1-7.

Downstream Controller Mode sets the controller to maintain the downstream process pressure constant, independent of upstream pressure

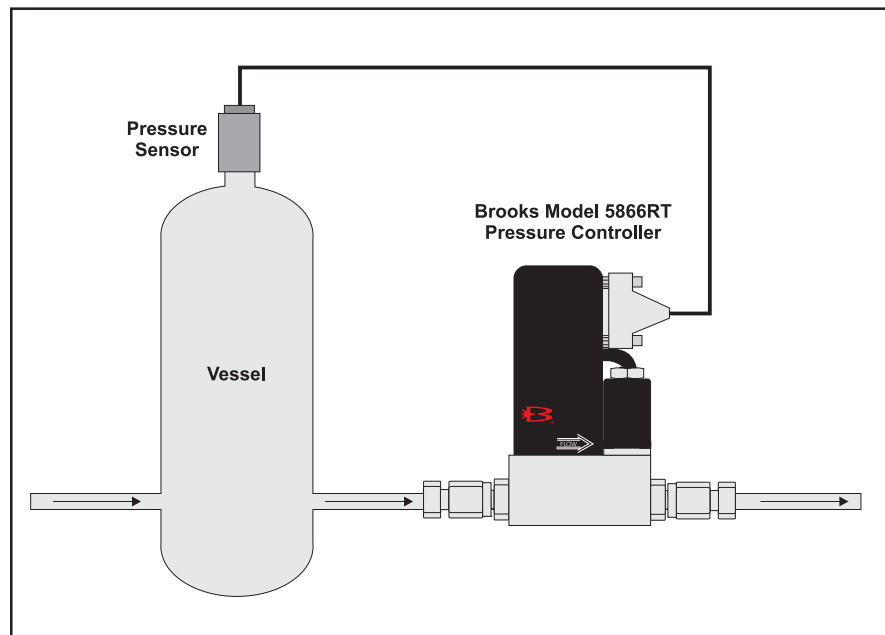


Figure 1-3 Model 5866RT Upstream Controller

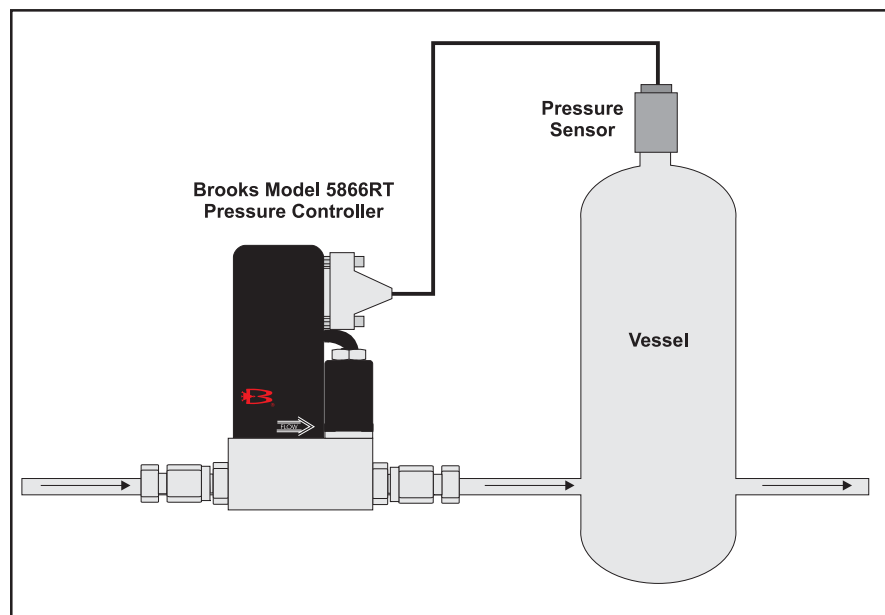


Figure 1-4 Model 5866RT Downstream Controller

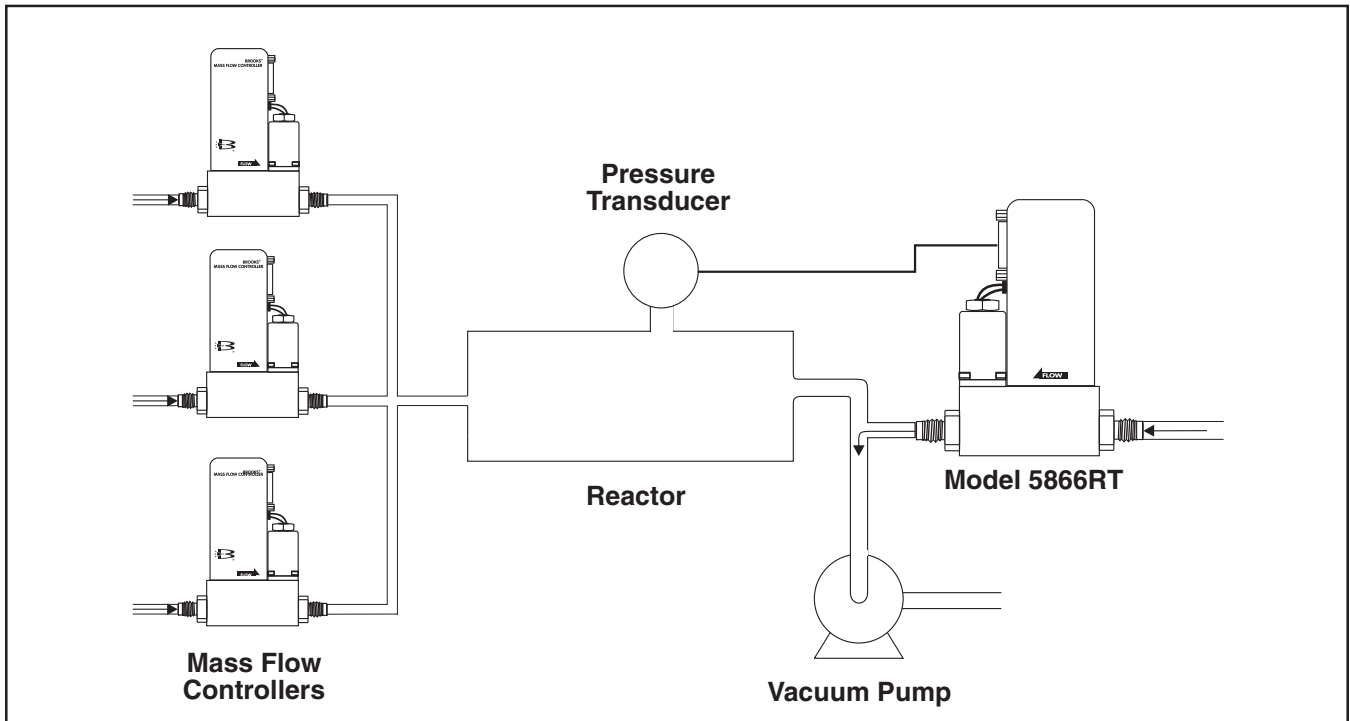


Figure 1-5 Typical Application of Downstream Controller

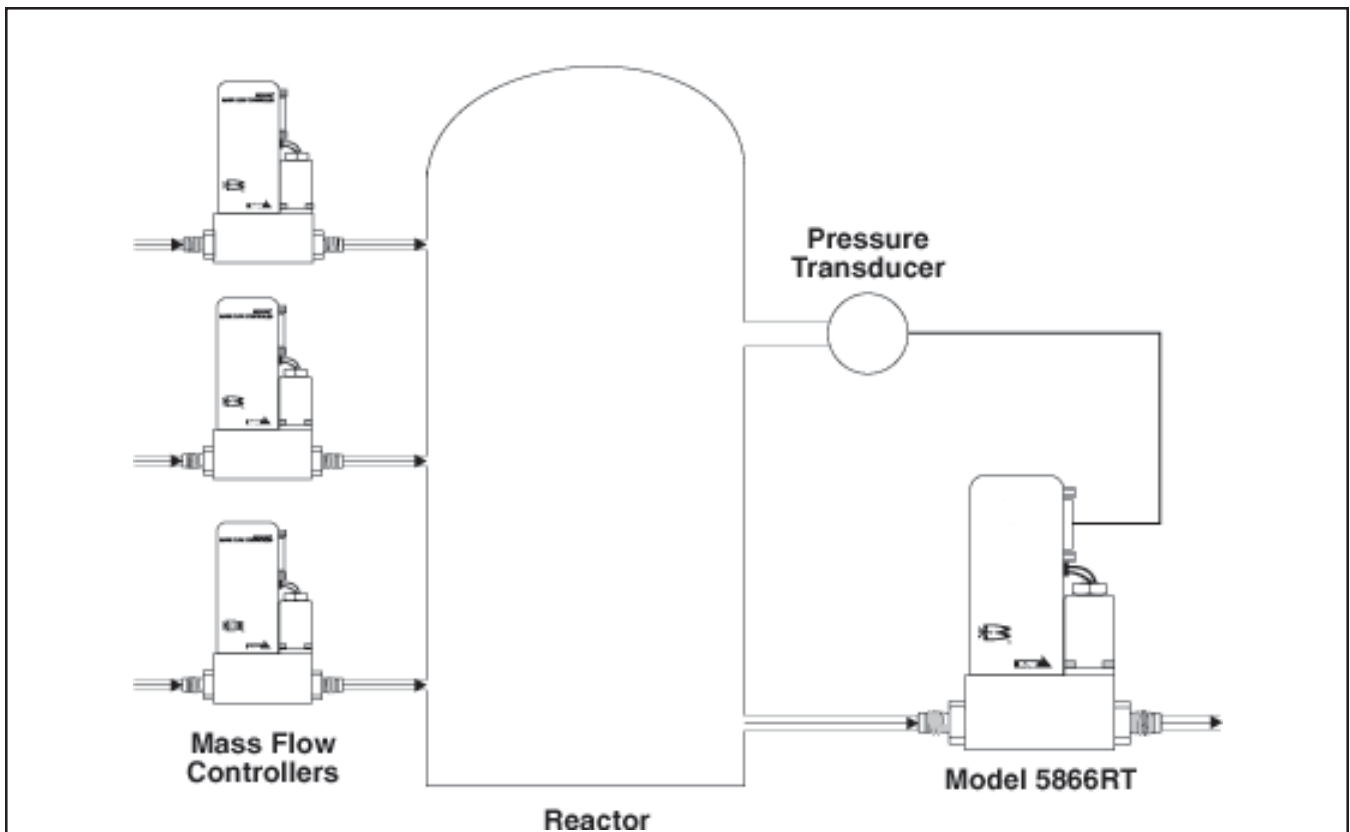


Figure 1-6 Typical Application of Upstream Controller

Model 5866RT

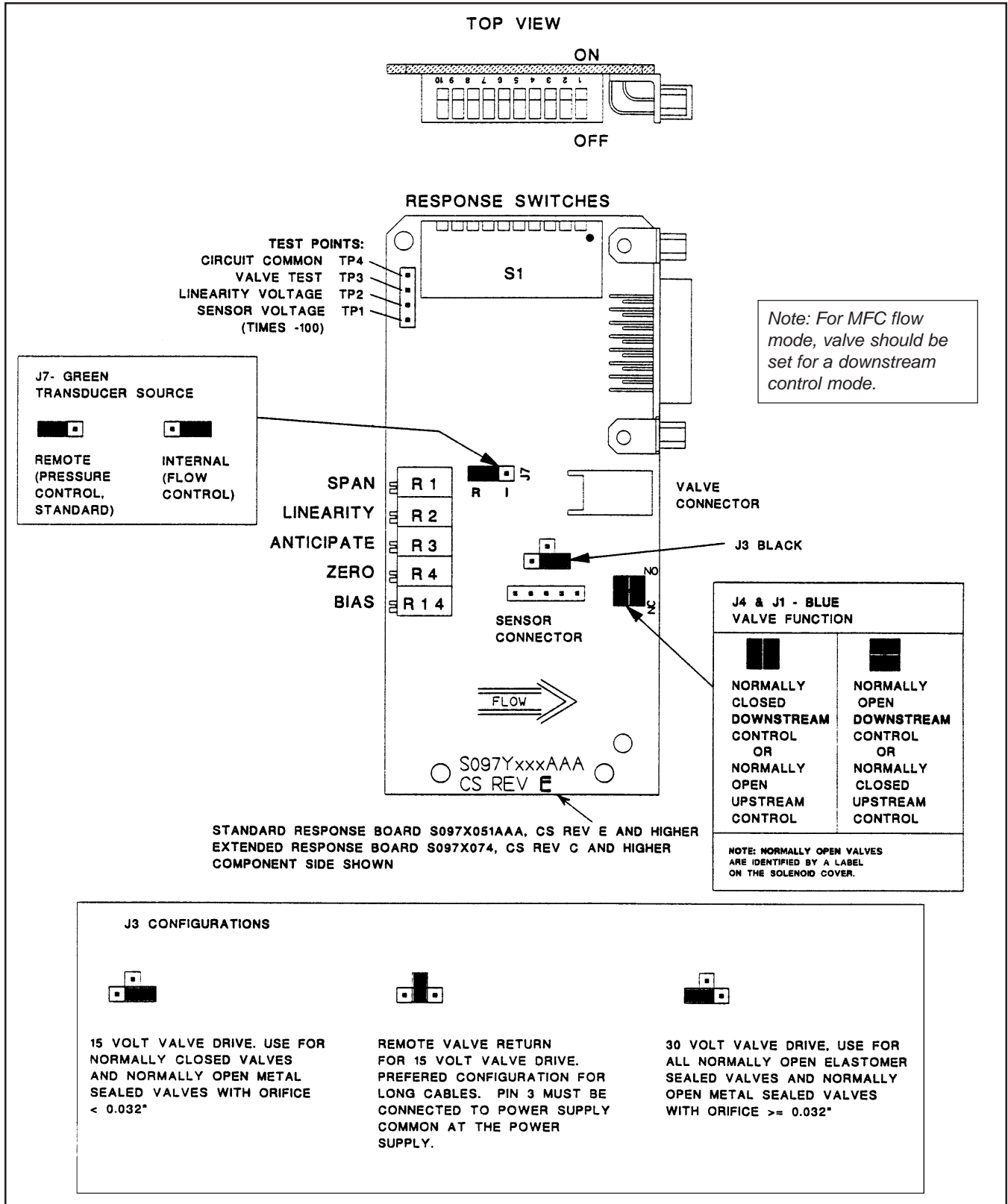


Figure 1-7 Customer Connections and Settings

or flow variations. For jumper positions on the PC board, Figure 1-7.

Normally Open/Normally Closed Control Valve - Both Normally Open (N.O.) and Normally Closed (N.C.) configurations are available. Normally Closed is the standard valve type. The Normally Open valve may be specified when safety, operation or process considerations warrant this type of valve.

Valve Override permits the user to open and close the valve independent of the command setting (refer to Section 2-9).

Precision +5 Volt Reference is provided to be used in conjunction with a user supplied command potentiometer to generate a 0-5 V command signal.

Mass Flow Rate measurement is provided by an internal flow sensor. Amplification and linearization circuitry provide a 0-5 Vdc output signal.

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.

Flow Ranges*

Any range from 0 to 3 sccm to 0 to 30,000 sccm N₂Eq.

*Standard pressure and temperature in accordance with SEMI (Semiconductor Equipment and Materials Institute) standard: 0°C and 101 kPa (760 torr).

Flow Output Signals

0-5 Vdc, max. load 1 k ohm

Flow Accuracy

±1.0% full scale including linearity at the calibration conditions. ±1.5% full scale for flow rates greater than 20 slpm.

Flow Repeatability

±0.25% of rate

Flow Temperature Coefficient

0.1% full scale/°C

Pressure Ranges

Dependent upon remote pressure transducer

Remote Pressure Sensor Input

Suitable for any pressure sensor with a 0-5 V or 0-10 V output signal.

Pressure Setpoint Signal

0-5 Vdc or 0-10 V. 5 Vdc reference output available for setpoint generation. 1 k ohm maximum load.

Pressure Ratings

Maximum pressure: 1500 psig

(PED) Pressure Equipment Directive 97/23/EC

Sound Engineering Practice (SEP)

Model 5866RT

Pressure Control Range

100:1 for a remote transducer with a 0-10 V output

Pressure Response Time

Less than 0.8 seconds typical for a 0-100% command step with less than 2% pressure overshoot. Actual pressure response depends on system design.

Temperature Range

32 to 150°F (0-65°C)

Input/Output Offset

0.2% full scale

Leak Integrity, Inboard to Outboard

1 x 10⁻⁹ atm cc/sec Helium max. (Elastomer Seal)

1 x 10⁻¹⁰ atm scc/sec Helium max. (Metal Seal)

Physical Characteristics:

Materials of Construction

Wetted Parts - Standard: 316L/316L VAR Stainless Steel

Valve Seat - Standard: Viton® fluoroelastomers or metal.

External/Internal Seals: fluoroelastomers or metal

Optional: Buna-N, Teflon® or Kalrez®

Mechanical Connections

Model 5866RT Standard: 1/8" or 1/4" Stainless Steel Compression Fittings.

Optional: 1/4" VCO™ or VCR™

Model 5866RT(M) 1/4" VCR.

Dimensions

See Figure 1-2

Electrical Characteristics:

Electrical Connections

15 Pin D-Connector (DA-15P)

Power Requirements

N.C. 3.5 watts; +15 Vdc (±5%) @ 35 mA, -15 Vdc (±5%) @ 180 mA

N.O. 10.5 watts; ±15 Vdc (±5%) @ 350 mA

EMC Directive 89/336/EEC EN 61326-1

2-1 General

This section contains the procedures for the receipt and installation of the instrument. Do not attempt to start the system until the instrument has been permanently installed. It is extremely 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

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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 31-318-549-300
Fax 31-318-549-309
E-mail: BrooksEu@BrooksInstrument.com

Brooks Instrument

1-4-4 Kitasuna Koto-Ku
Tokyo, 136-0073 Japan
Tel 011-81-3-5633-7100
Fax 011-81-3-5633-7101
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:

- a. Within the original shipping container.
- b. Stored in a sheltered area, preferably a warm, dry, heated warehouse.
- c. Ambient temperature of 70° F (21° C) nominal, 109° F (43° C) maximum, 45° F (7° C) minimum.
- d. Relative humidity 45% nominal, 60% maximum, 25% minimum.
Upon removal from storage a visual inspection should be conducted to verify the condition of equipment is "as received".

Model 5866RT

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 31-318-549-300
Fax 31-318-549-309
E-mail: BrooksEu@BrooksInstrument.com

Brooks Instrument

1-4-4 Kitasuna Koto-Ku
Tokyo, 136-0073 Japan
Tel 011-81-3-5633-7100
Fax 011-81-3-5633-7101
Email: BrooksAs@BrooksInstrument.com

Any instrument returned to Brooks requires completion of Form RPR003-1, Brooks Instrument Decontamination Statement, as well as, a Material Safety Data Sheet (MSDS) for the fluid(s) used in the instrument. This is required before any Brooks Personnel can begin processing. Copies of the form can be obtained from any Brooks Instrument location listed above.

2-5 Transit Precautions

To safeguard against damage during transit, transport the instrument to the installation site in the same container used for transportation from the factory if circumstances permit.

2-6 In-Line Filter

It is recommended that an in-line filter, such as the Brooks Model 5848 (for use with elastomer Model 5866RT), be installed upstream from the controller to prevent the possibility of any foreign material entering the meter. The filter porosity should be approximately ten times smaller than the orifice used in the installation, however, it is recommended that the minimum porosity that does not restrict the flow rate be used. The filtering element should be periodically replaced or cleaned.

2-7 Installation**⚠ CAUTION**

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

⚠ CAUTION

When installing the instrument, insure that no foreign materials enter the inlet or outlet of the meter. Do not remove the protective end caps until time of installation.

⚠ CAUTION

Any Brooks Instrument mass flow meter or flow controller with a 15-pin D-Connector PC Board bearing the “CE Mark” must use a 100% shielded cable and metal shell mating connectors. The shield is tied over 360 degrees to the shell at both ends. This is mandatory to be in compliance with the EMC Directive (89/336/EEC). Refer to Appendix A.

Recommended Installation Procedures

- a. The Model 5866RT should be located in a clean, dry atmosphere relatively free from shock and vibration.
- b. Leave sufficient room for access to the electrical connector and the dip switches.
- 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. See Brooks' Technical Sheet TS-086-TMF-ContaminationControl-eng for further information.

- d. The Model 5866RT pressure controller may be installed in any position. Note: The control valve in the Model 5866RT provides precision control and is not designed for positive shut-off. If positive shut-off is required, it is recommended that a separate shut-off valve be installed in-line.

⚠ CAUTION

Since the Model 5866RT Control Valve is not a positive shut-off, a separate solenoid valve may have been installed for that purpose. It should be noted that a small amount of gas may be trapped between the downstream side of the pressure controller and the solenoid, resulting in a surge upon opening of the solenoid valve. This surge can be reduced in a magnitude by locating the controller and solenoid valve upstream of the controller.

2-8 Electrical Interface

To insure proper operation, the Model 5866RT must be connected per Figure 2-1. As a minimum, the following connections must be made for new installations. The minimum electrical connections are shown in Figure 2-2 and in the list below.

Model 5866RT

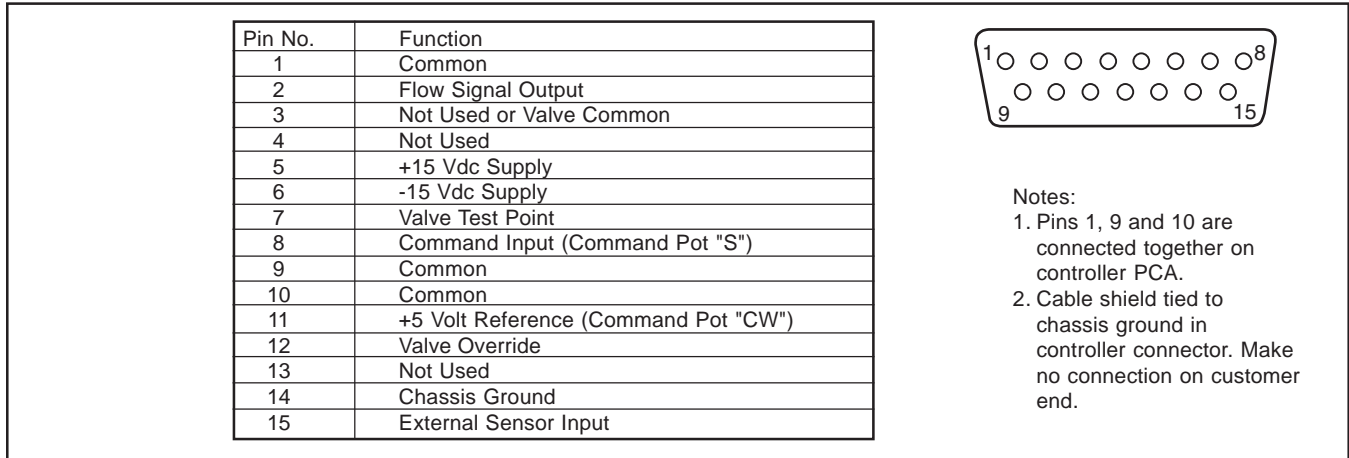


Figure 2-1 Connector Pin Arrangement

Note: Pins 1, 9 and 10 are connected together on the controller printed circuit assembly.

Pin Number	Description
1,9,10	Command, Signal, and Supply Common
5	+15 Vdc Supply
6	-15 Vdc Supply
8	Command Input
14	Chassis Ground
15	External Pressure Transducer Input

⚠ NOTICE

The adapter shown in Figure 2-3 should be used when using a Brooks Model 5866RT with a Card Edge system cable designed for a Unit Instruments UPC-Series pressure controller.

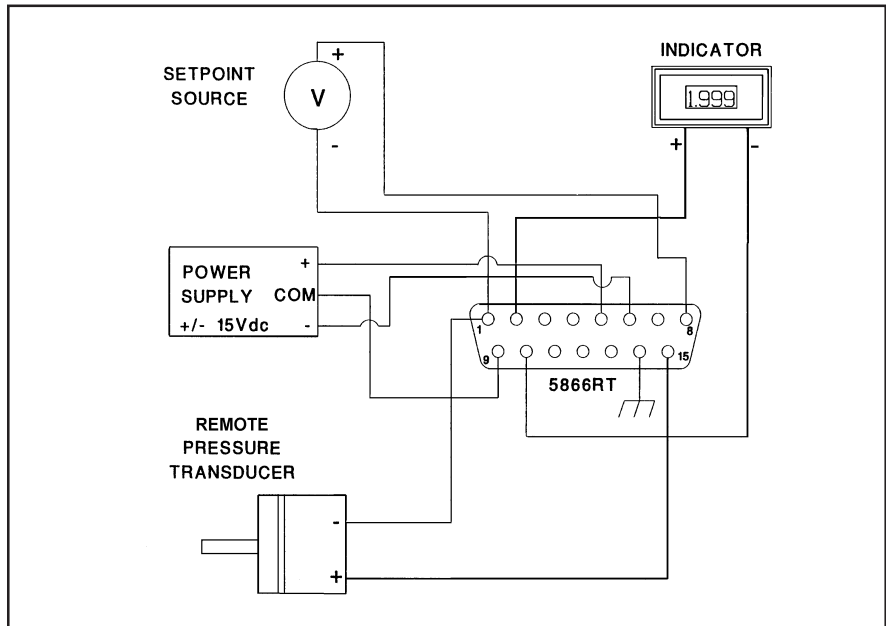


Figure 2-2 D-Connector to Card Edge Adapter

2-9 Command Input

If the pressure controller will be commanded by an external voltage, the command potentiometer is not used.

The command hookup is as follows:

- a. Connect the command signal to Terminal 8 and the command return to Terminal 1. Refer to Figures 1-7 and 2-1.

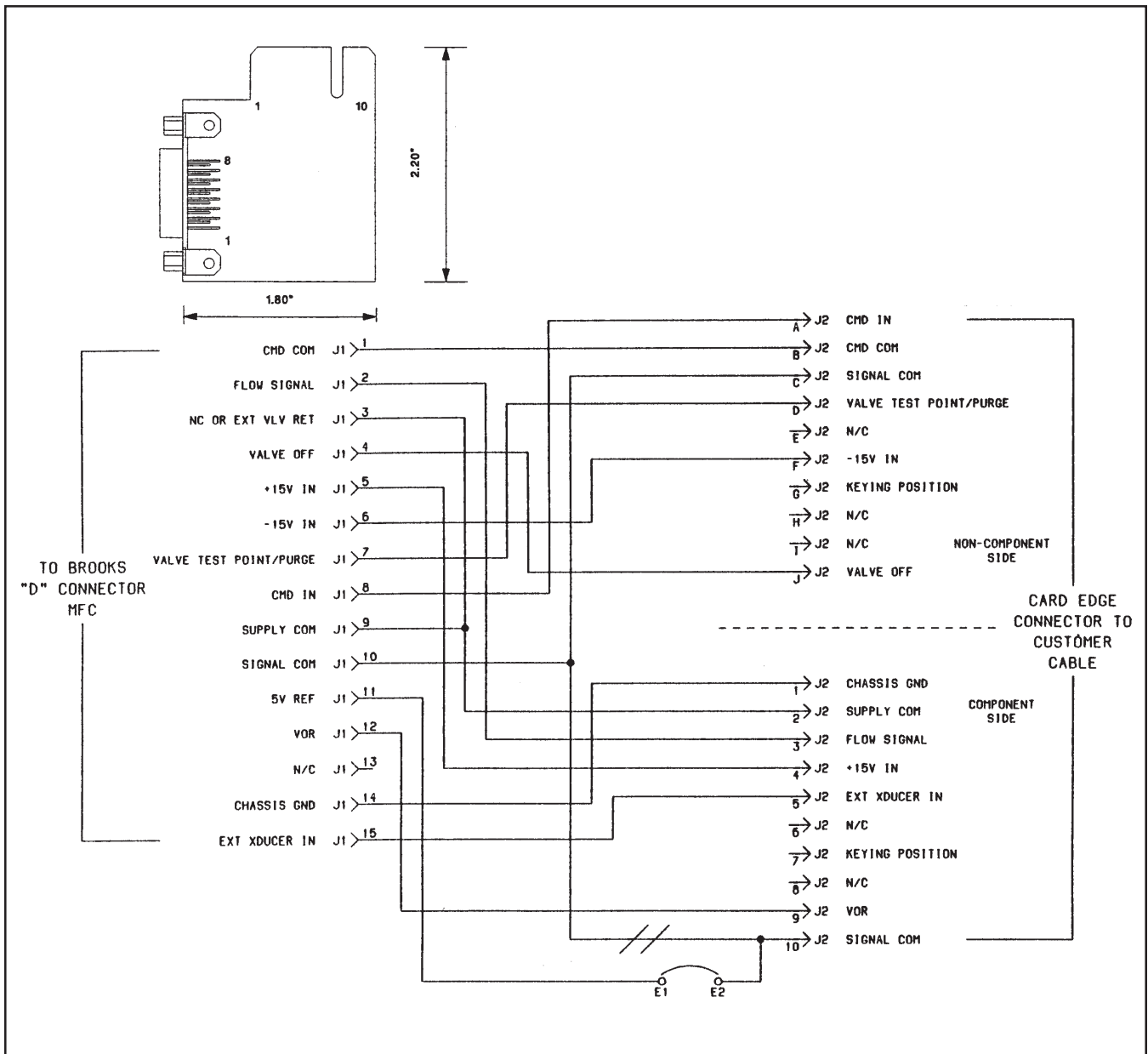


Figure 2-3 D-Connector to Card Edge Adapter (UPC - Series Replacement)

Model 5866RT

2-10 Valve Override

The valve override function allows full opening and closing of the valve independent of the command setting. The valve override for the pressure controller is as follows:

- a. To open the valve, apply +15 Vdc to the valve override terminal.
- b. To close the valve, apply -15 Vdc to the valve override terminal.

The valve override function is accessed from Terminal 12. Refer to Figures 1-7 and 2-1). Note: For normal operation, Terminal 12 may be left open (floating).

2-11 Precision 5V Reference

The Model 5866RT is equipped with a precision 5 Vdc reference. The reference is used internally and is also available as a buffered output for use in conjunction with a 1 to 10 k ohm potentiometer to provide 0-5 Vdc setpoint. The 5 Vdc reference is available at Terminal 11. Refer to Figures 1-7 and 2-1).

2-12 Remote Transducer Input

The Model 5866RT must be used with an external pressure transducer with a 0-5 or 0-10 Volt output signal, such as a capacitance manometer. The instrument is shipped with Jumper J7 set to the Remote (R) position. The external pressure sensor signal is connected to Terminals 15 and 10. Refer to Figures 1-7 and 2-1. If J7 is changed to the Internal (I) position, the internal flow sensor signal replaces the external pressure sensor signal as the controlled variable input to the controller circuit. This causes the instrument to function as an MFC. Both modes of operation may be used in some systems that are properly designed to make use of this feature.

2-13 Valve Test Point

The valve voltage may be monitored on Terminal 7 of the D-Connector.

2-14 Remote Valve Return

The Model 5866RT with a Normally Closed valve can be configured so the valve current can be returned to the power supply on a separate line. This is recommended if the power supply lines are longer than 10 feet. The feature is enabled by moving jumper J7 as shown in Figure 1-7.

3-1 Operation

- a. Purge the system with dry nitrogen for at least thirty minutes prior to start-up to prevent the formation of deposits if reactive gas is to be used.
- b. In unpressurized piping, apply power to the controller and allow approximately fifteen minutes for it to warm up and stabilize its temperature.
- c. Slowly apply gas pressure to the system.
- d. Set the command for the desired pressure to assume normal operation.

3-2 Response Time Adjustment

As with all closed control loops, the response of the pressure signal to changes in setpoint is determined by all the elements in the loop. These elements include the size, length, and configuration of piping connecting the pressure sensor and, if present, the vacuum pump to the Model 5866RT. Experimentation is necessary to optimize the response of the controller in the flow system. A strip chart recorder with a full scale pen response of at least 300 ms and a means of stepping the controller command to various setpoints is required to perform the optimization.

The 10 position dip switch on the top of the controller is divided into three sections. Each switch may be set ON (switch toggle toward number) or OFF (switch toggle away from number). Each section may be thought of as a binary word where 0=OFF and 1=ON. Switches 1-3 vary the command ramp time constant. The shortest time constant is enabled when these three switches are ON (111). The longest time constant is enabled when they are OFF (000). Thus a switch position of 100 represents a longer ramp time constant than a switch position of 101.

The other two switch sections function in a similar manner. Switches 4-7 vary the integration time. The shortest time constant is enabled with all four switches ON (1111). The longest time constant is enabled with the switches OFF (0000). Switches 8-10 vary the derivative action. Minimum derivative action occurs when the switches are ON (111). This information is summarized in Figure 3-1.

When optimizing the response, the following general guidelines apply:

1. Slower integration time or command ramp time will increase the dead time (the time delay between a command step from 0 to setpoint and the time that the pressure begins to rise to setpoint).
2. Faster integration time will increase the number and amplitude of transient overshoot/undershoot peaks. Oscillation will result if the integration time is made too fast.
3. Derivative action will not affect dead time. Increasing the derivative action will reduce the amplitude and number of transient peaks at low setpoints but may cause an increase in the transient peaks or oscillation at higher setpoints. Increasing the derivative action is most effective in systems with large volumes between the controller and the pressure sensor and in some extreme cases may be the only way to achieve a stable signal at setpoint.

Model 5866RT

4. If the response is optimum with the exception of a small transient overshoot peak with little accompanying undershoot, increase the command ramp time constant.

After installing the controller in the system and applying power and gas pressure, set Switch #4 OFF and all others ON. Record the response for a step change to the setpoint to be used. It is good practice to write the dip switch setting on the recording for reference. If the controller is to be used over a range of setpoints, record the response at the lowest and highest setpoint to be used.

If the dead time is too long or no transient overshoot/undershoot peaks are present, decrease the integration time and observe the transients which begin to develop. Try increasing the derivative action (by setting Switch #10 OFF) and observe if this improves the transient response or makes it worse.

If there is oscillation or significant ringing, increase the integration time (#4, 7 OFF) and record the response again. Continue to increase the integration time until the transients disappear or are visibly attenuated. Try increasing the derivative action and observe if this improves the transient response or makes it worse.

If a single overshoot peak occurs with little accompanying undershoot, increase the command ramp time constant (by setting Switch #3 OFF). Continue to increase the command ramp time until the peak is attenuated.

In some cases, when testing the response from a high to a low setpoint, an undershoot in the response will occur which will be impossible to eliminate. This may be due to an inability of the vacuum pump to reduce the pressure at the sensor quickly enough. To test for this, command a high setpoint and allow the controller to stabilize. Then step the command to 0 (which closes the pressure controller valve almost instantaneously) and observe the decay in the pressure signal. This represents the maximum rate of pressure decay for the system. Adjustments to the controller will not decrease this decay time.

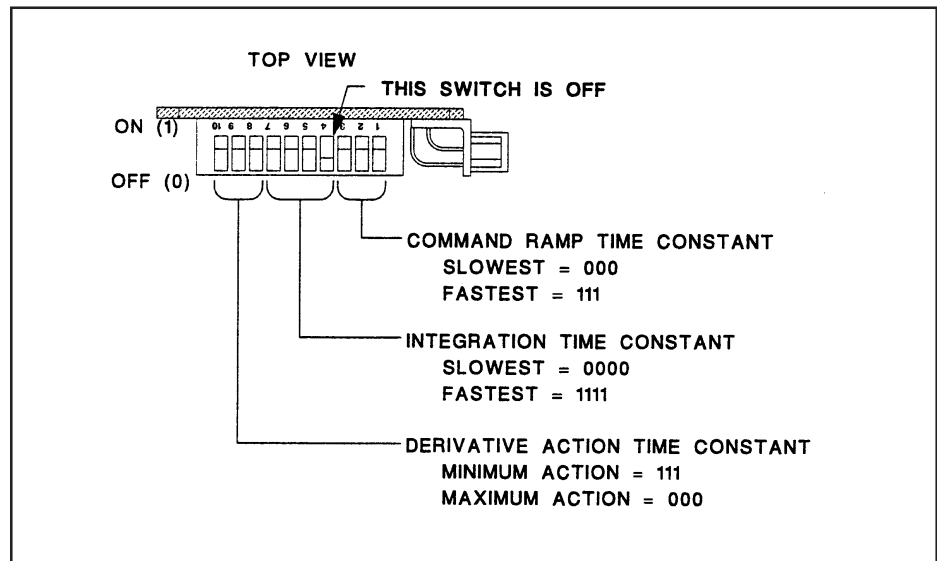


Figure 3-1 Response Dip Switch

4-1 General

No routine external cleaning is required for the Brooks thermal mass flow controller. If an in-line filter is used for the Model 5866RT, the filtering element should periodically be replaced or cleaned.

	⚠ WARNING
METER/CONTROLLER SEAL COMPATIBILITY	
<p>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.</p>	
<p>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.</p>	

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5-1 System Checks

⚠ CAUTION

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

The Model 5866RT 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 down time. If possible, make the following system checks before removing a suspected defective pressure controller for bench troubleshooting or return to the factory, especially if the system is new.

1. Verify a low resistance common connection and that the correct power supply Voltage and signals are reaching and leaving the controller. The Breakout Board (P/N S-273-Z-649-AAA) will make this job much easier.
2. Verify that the process gas connections have been correctly terminated and leak checked.
3. If the pressure 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 1-7).

If possible, select several setpoints (including 0 and 100%) and record the value of the pressure signal, flow signal, and valve test point for each setpoint. This will aid factory personnel in providing field support. If the instrument is achieving setpoint but the transient response is not acceptable, read Section 3-2 and attempt to adjust the response. If the response criteria cannot be achieved, a strip chart recording of the transient response will also

⚠ WARNING

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

5-2 Bench Troubleshooting (Refer to Table 5-1)

1. Connect the pressure controller to a ± 15 Vdc power supply, command Voltage source and connect an output signal readout device (a 4-1/2 digit voltmeter is recommended) to Terminals 2 and 10 (refer to Figure 2-1).

Model 5866RT

2. Apply power to the controller, close the valve using the valve override and allow it to warm up for fifteen minutes. Do not connect the controller to a gas source at this time.
3. Observe the flow sensor signal and, if necessary, perform the zero adjustment procedure.
4. If the flow sensor signal will not zero properly, troubleshoot the sensor using the procedures given in Table 5-1 below. If the sensor is electrically functional, the printed circuit board is defective and will require replacement.
5. Disconnect the cable to the device and remove the cover. The cover is secured by three screws. Move Jumper J7 to the Flow control (internal) position. If necessary, reconfigure J1 for UPSTREAM control mode. Record the response dip switch setting and then reconfigure the switches as follows:
 - a. Standard response board: #4 OFF, All others ON
 - b. Extended response board: #6 OFF, All others ON
6. Connect the device to a source of the calibration gas and reconnect power. Set VOR to "Open" and adjust the inlet pressure until the flow signal is approximately 6 V.
7. Set VOR to "Off" and the setpoint to zero. Wait one to two minutes and note the value of the flow signal to the nearest percent of full scale. Add 2 to this value to determine the minimum testable setpoint. Exercise the controller by varying the setpoint from the minimum testable value to 100% and verify that the instrument will stabilize at setpoint. The bias adjustment and response dip switches may be changed provided that they are reset to their original values before attempting to reinstall the instrument in the system. The bias voltage (See Section 3-2) may be measured by setting the command to any value above 2% and then setting VOR to "Closed". The voltage at the valve test point is now the bias voltage.

Table 5-1 Bench Troubleshooting

Trouble	Possible Cause	Check/Corrective Action
Flow output stays at zero Volts regardless of command and there is flow through the controller.	Defective Sensor	Replace sensor. Refer to Section 5-3 and Table 5-2.
Flow output stays at zero Volts regardless of command and there is no flow through the controller.	Clogged Control Valve -15 V applied to the valve override input. Defective printed circuit board. Valve voltage not returned properly.	Disassemble and repair the control valve. Refer to Sections 5-3 and 5-4. Check valve override input. Refer to Figure 1-7 for terminal assignments. Replace printed circuit board. Refer to Sections 5-3 and 5-4. Check jumper for external valve return. Refer to Figure 1-7.
Flow output signal stays above 6.8 V regardless of command and there is flow through the controller.	Valve stuck open or leaky. +15 Vdc applied to the valve override input. Defective printed circuit board.	Clean and/or adjust control valve. Refer to cleaning procedure and/or Section 5-5. Check the valve override terminal. Refer to Figure 1-7 for terminal assignments. Replaces printed circuit board. Refer to Sections 5-3 and 5-4.
Flow output signal follows setpoint at lower commands but does not reach full scale.	Insufficient inlet pressure or pressure drop. Partially clogged valve. Valve out of adjustment.	Adjust pressures, check calibration. Refer to Section 5-1. Disassemble and repair control valve. Refer to Sections 5-3 and 5-4. Adjust valve. Refer to Section 5-5.
Controller oscillates.	Pressure drop or inlet pressure excessive. Valve out of adjustment. Response adjustment not correct. Faulty pressure regulator. Defective printed circuit board	Adjust pressures. Adjust valve. Refer to Section 5-5. Refer to Section 5-2. Check regulator output. Replace printed circuit board. Refer to Sections 5-3 and 5-4.

Table 5-2 Flow Sensor Troubleshooting

SENSOR SCHEMATIC

WIRE COLOR	PIN NO.	FUNCTION
White	4	Sensor common
Yellow	1	Heater
Blue	5	Heater common
Red	2	Upstream temperature sensor (Su)
Black	3	Downstream temperature sensor (Sd)

Note: Sensors manufactured before 9/88 used a wire harness interconnect, newer sensors use a "Flex" cable.

Flex Circuit Wire Numbers

OHMMETER CONNECTION	RESULT IF ELECTRICALLY FUNCTIONAL
Yellow and white to body (ground) (Pin 1 or 4 to body)	Open circuit on ohmmeter. If either heater (yellow), or sensor common (white) are shorted, an ohmmeter reading will be obtained.
White to red (Pin 4 to Pin 2)	Nominal 1100 ohms reading.
White to black (Pin 4 to Pin 3)	Depending on temperature and ohmmeter current.
Blue to yellow (Pin 5 to Pin 1)	Nominal 1200 ohm reading.

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

5-3 Disassembly

⚠ WARNING

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

The Model 5866RT Pressure Controller may be disassembled in the field by the user for cleaning, re-ranging or servicing.

Note: The controller should be disassembled in a clean environment to prevent contamination.

⚠ CAUTION

Do not attempt to disassemble the controller until pressure has been removed and purging has been performed.

A. Disassembly Procedure for Elastomer Sealed Version [numbers in () refer to Figure 7-1]

The disassembly procedures below detail the upstream control version of the Model 5866RT with a Normally Closed control valve. The procedures for the upstream control version and the Normally Open control valve are substantially the same. Disassemble the controller as follows:

Model 5866RT

1. Remove the jam nut (8) on top of the valve assembly.
2. Unplug the valve connector from the electronics cover and remove the coil assembly (5).
3. Remove the hex socket screws (41) securing the valve retaining plate (36) attaching the valve stem assembly (40).

⚠ 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 (40).
5. Remove the plunger assembly (2, 3 and 4).
6. Remove and note the position of the valve spring spacers (17 & 18). Spacers may be used above and/or below the lower guide spring (3).
7. Unscrew the orifice (12) from the flow controller body (1).
8. Carefully unscrew the valve seat (4) from the plunger (7). Note the position and number of spacers (14-16) that are stacked on the threaded end of the valve seat.
9. Remove the three screws (10) attaching the electronics cover and loosen the upper jackpost on the D-Connector. Remove the electronics cover (21).
10. Unplug the sensor connector from the PC Board. Remove the two screws securing the bracket (9) and PC Board (11). Remove the bracket and PC Board.
11. Remove the two screws (53) and washers (54) securing the sensor assembly (51). Remove the sensor assembly.
Note: Do not attempt to disassemble the sensor assembly.
12. Remove the sensor assembly O-rings (52) from the flow controller body (1). Using the Brooks O-ring removal tool will help prevent scratching the sealing surface.

⚠ CAUTION

Do not scratch the O-ring sealing surface.

13. Remove the adapter fittings (6) from the flow controller body (1).
14. Remove the restrictor assembly (19) and O-ring (20) from the inlet side of the flow controller body (1) using the restrictor tool (part of service tool kit listed in Section 7, Table 7-3).

B. Disassembly Procedure for Metal Sealed Version [number in () refer to Figure 7-2]

The Model 5866RT Mass Flow Controller incorporates metal O-ring seals on the inlet and valve. The assembly procedures for metal O-rings are significantly different than the procedures used when assembling elastomeric O-rings.

⚠ CAUTION

Before attempting disassembly, read this section and be sure to have the proper tools and materials on-hand, i.e., mass spectrometer Helium leak detector, torque wrench and new O-rings. If the proper tools are not available, we recommend the flow controller be returned to the factory or service center for repair.

Metal O-rings affect a seal by plastically deforming during assembly to conform to the shape of mating parts. Because of this, the metal O-rings cannot be reused. The sealing surfaces of the mating parts also deform during assembly which makes a leak possible even if new O-rings are installed. For this reason, there is no guarantee that reassembled flow controllers will be leak-tight. Reassembled flow controllers must be checked for leaks prior to being returned to service. A mass spectrometer-type Helium leak detector must be used to assure the factory leak specifications have been achieved.

Note: The Model 5866RT Mass Flow Controller should be disassembled and assembled in a clean environment, using rubber gloves, to prevent particulate contamination.

⚠ CAUTION

When handling parts, be very careful. The highly polished O-ring sealing surface is easily damaged. One small scratch can cause the flow controller to leak when reassembled.

- Carefully remove the valve stem assembly (40) and valve spacer (36) by lifting straight up. Place the removed assembly on its side to prevent the polished sealing surface from contacting a hard surface or contamination which could cause a scratch.
- Remove the metal O-ring (34) from the body, making certain not to scratch the sealing surface. Discard the used metal O-ring.
- Using a spanner wrench or Brooks special tool P/N S-908-Z-048-AAA, remove the gland nut (39) from body.
- Remove the plunger assembly (2, 3 and 4) from the body taking note of the locations of the valve spring spacers (17, 18) which may be located below the lower guide spring (3).
- Unscrew the orifice (12) from flow controller body (1) using a 3/8 nut driver. Avoid touching the orifice hole with bare hands, as skin particles can clog the smaller size orifices. Carefully remove the sealing ring (13) from the orifice/valve cavity.
- Remove the three screws (10) attaching the electronics cover (2). Loosen the upper jackpost on the D-Connector and carefully remove the cover.
- Remove the sensor connector from the PC board. Remove the two screws (10) holding the bracket (9) and PC board (11) to the sensor base plate. Remove the bracket and PC board.

⚠ WARNING

The sensor on the Model 5866RT with the metal seals is not removable. Do not attempt to disassemble or remove the sensor from the body. Removing the two hold-down screws may cause irreparable damage to the sensor tube and leakage of the process gas.

Model 5866RT

10. Remove the socket head cap screws (42) from the inlet side of the flow controller. Remove the inlet plate (38) and inlet spacer (37). Be careful not to scratch the metal O-ring sealing surface or the fitting sealing surface.
11. Remove the metal O-ring (35) from the body, making certain not to scratch the sealing surface. Discard the used metal O-ring.
12. Remove the restrictor assembly (19) from the inlet cavity using the restrictor tool (part of service tool kit listed in Section 7, Table 7-3). Be careful, when inserting the tool into the body, not to contact the metal seal surface. Carefully remove the sealing ring (20) from the inlet cavity.

Once disassembled, the component parts of the Model 5866RT can be cleaned and serviced as detailed in Section 5-3C, Cleaning Procedures.

C. Cleaning Procedures

Should the Model 5866RT Pressure Controller require cleaning due to contamination with foreign material, use the following procedures:

1. Remove the unit from the system.
2. Refer to Section 5-3 to disassemble the controller.
3. 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.
4. Deposits of silicon dioxide may be removed by soaking the internal parts in a solution of 5% hydrofluoric acid (5 parts hydrofluoric (HF), 95 parts water (H₂O) followed by Freon TF™.
5. Blow all parts dry with dry nitrogen and reassemble. Refer to Section 5-4, Assembly Procedure.
6. Purge the assembled controller with dry nitrogen.
7. Perform calibration procedure in Section 6.
8. When the controller is reinstalled in the system, the connections should be leak-tested and the system should be purged with dry nitrogen or argon for thirty minutes prior to start-up to prevent the formation of deposits.

5-4 Assembly**A. Assembly Procedure for Elastomer Sealed Version [numbers in () refer to Fig. 7-1]**

The assembly procedures below detail the upstream control version of the Model 5866RT with a Normally Closed control valve. The procedures for the upstream control version and the Normally Open control valve are substantially the same.

⚠ CAUTION

Do not get grease on your hands. This is a special inert lubricant which is not easily removed.

Note: It is recommended that all O-rings be replaced during assembly. All O-rings should be lightly lubricated with Fomblin® YVAC3 lubricant prior to their installation.

Note: Gloves should be worn to reduce the possibility of contaminating the Model 5866RT or process.

1. Examine all parts for signs of wear or damage, replace as necessary.
2. Install the sensor O-rings (54) in the body (1).
3. Install the sensor securing it with two screws and washers (53, 54).
Note: The orifice can easily become clogged with skin or other foreign matter during assembly. Do not touch the orifice with the bare hand during installation. Use rubber gloves, finger cots or pliers to start the orifice in the body.
4. Install the orifice (12) and its O-ring (13) using a 3/8" nut driver. Insure that the orifice is fully seated but do not overtighten.
5. Insert the valve preload spacers (17, 18), if used, into the valve cavity in the controller body (1). Use care to preserve the correct order.
6. Install the valve plunger assembly (2, 3, 4, 14-16) on the preload spacers (10). Install air gap spacers, if used, on top of the valve spring (3).
7. Install the valve stem assembly (40), secure with the valve retaining plate (36) and four hex socket screws (41). When installing the screws, insure that the plate makes full contact all the way around the stem. Torque the screws securing the retaining plate in a diagonal pattern (refer to Figure 5-1) to 15 in-lbs.
8. Install the coil assembly (5) over the valve stem assembly (40) and secure with jam nut (8).
9. Install the printed circuit board (11), secure with the bracket (9) and two screws (10). Plug the connector from the sensor onto the printed circuit board.
10. Install the electronics cover (21) on the controller, secure with three screws (10) and the standoff. Plug the connector from the valve coil into the printed circuit board through the hole in the electronics cover.
11. Prior to installation, leak and pressure test the controller.

B. Assembly Procedure for Metal Sealed Valve

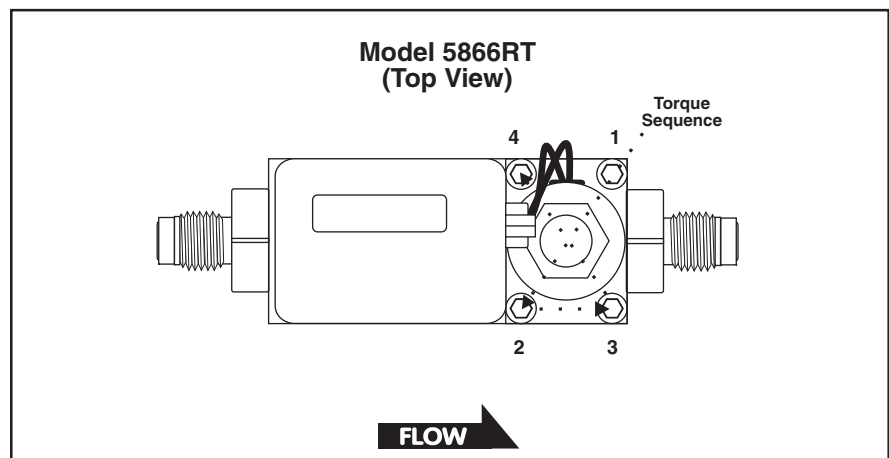


Figure 5-1 Torque Sequence for the Valve Retainer Plate

Model 5866RT

1. Normally Closed Control Valve

Note: All metal O-rings should be replaced during controller assembly.

- a. Examine all parts for signs of wear, damage or corrosion. Replace as necessary.

Note: Elastomer O-rings should be substituted for the metal O-rings when the flow controller must be repeatedly disassembled for testing, calibration or adjusting of the control valve. The inlet plate metal O-ring may be temporarily replaced with a .864 ID x .070 W (Size 020) elastomer O-ring. Do not expose the flow controller to hazardous gases when elastomeric O-rings are substituted for metal O-rings. Rupture or leakage may result.

⚠ CAUTION

The screws used to fasten the valve and inlet plates are made of high strength steel to produce the clamping force required by the metal O-rings. Do not use substitute screws.

- b. Place the restrictor sealing ring (20) on the restrictor assembly (19). Screw the restrictor assembly into the inlet side of the flow controller body using the restrictor tool and torque to 40-45 inch-pounds.
- c. Visually inspect the sealing surfaces on the inlet plate (37), body (1) and O-ring (35) for defects or contamination. Carefully remove any dust from these surfaces using a soft lens cleaning brush or clean compressed gas.

Note: The screws used to fasten the valve stem and inlet plate are lubricated at the factory with Dow Corning 577 silicone lubricant prior to assembly which helps minimize seizing and insures the proper clamping force when torqued. If these screws are replaced or the factory-applied lubricant has been washed away, reapply a suitable lubricant before assembling.

- d. Assemble the inlet plate, inlet spacer and O-ring using the four socket head cap screws (42). Evenly finger-tighten the screws. Using a suitable torque wrench, tighten all screws in a crisscross pattern to 20 inch-pounds torque. Then repeat the torquing process in 10 inch-pound increments to 65 inch-pounds. Several steps are required when tightening in order to insure that the metal O-ring is evenly crushed.
- e. Install the orifice (12) and its sealing ring (13) using a 3/8 nut driver. Do not touch orifice holes with bare hands, as skin particles can clog smaller size orifices. The use of rubber gloves is recommended. Insure that the orifice is fully seated and torque to 25 inch-pounds.
- f. If used, insert the valve preload spacers, carefully following proper order, in the valve cavity of the flow controller body.
- g. Install the plunger assembly (2, 3 and 4).
- h. Install the gland nut (39) over the plunger assembly and tighten using the special tool. Take care not to touch the metal sealing surface with the tool.
- i. Visually inspect the sealing surface of the valve stem body (40) and O-ring (31) for defects or contamination. Carefully remove any dust from these surfaces using a soft lens cleaning brush or clean compressed gas.
- j. Assemble the valve stem assembly (40), valve stem spacer (36) and O-ring (31) using the four socket head cap screws (41). The valve stem assembly must be oriented to the body properly since it is not a symmetrical part (see Figure 5-6). Evenly tighten the screws finger-tight. Using a suitable torque wrench, tighten all screws in a crisscross pattern

- to 20 inch-pounds torque. Then repeat the torquing process in 10 inch-pound increments to 65 inch-pounds. Several steps are required when tightening to insure that the metal O-ring is crushed evenly.
- k. Install the PC board (11) and bracket (9) to the sensor base plate using two flat head screws (10). Plug the connector from the sensor assembly into the PC board.
 - l. Install the electronics cover (21) on the controller by securing with the three remaining flat head screws (10). Plug the connector from the valve coil into the PC board through the hole in the electronics cover.
 - m. Prior to installation, leak and pressure test to any applicable pressure vessel codes. A suitable mass spectrometer Helium leak detector capable of measuring 1×10^{-10} atm/cc Helium should be used.

2. Normally Open Control Valve

The assembly procedure for the normally open valve instrument is essentially the same, however, the gland nut must be installed over the plunger extension before securing the plunger assembly to the extension (see Figure 7-2).

5-5 Adjusting the Control Valve

A. Elastomer Sealed Version [numbers in () refer to Figure 7-1]

The Model 5866RT control valve has been factory adjusted to insure

Normally Closed Valve	Normally Open Valve
Orifice (12)	Orifice (12)
Valve Stem (40)	Valve Stem (40)
Plunger (2)	Plunger (2)
Lower Guide Spring (3)	Lower Guide Spring (3)
Valve Seat (4)	Valve Seat (4)
	Plunger Extension (46)
	Spring Spacer (45)

proper operation. Adjustment is not normally required during the life of the instrument. Readjustment may be required if any of the following parts have been replaced:

The valve is adjusted in Brooks pressure controllers by changing spacers in the control valve to vary the initial position of the parts. The proper initial position is required so the valve will have the proper travel and force available to insure reliable control. Screw type adjustments are not used in Brooks' control valve since they can change with pressure and vibration. Screw type adjustments also introduce a dynamic seal that is a potential leak site and source for contamination.

The adjustment procedures below require the use of a variable voltage power supply, pressure regulator, pressure gage, voltmeter, flow meter and a supply of nitrogen. The test set up is shown in Figure 5-2. The power supply must be capable of delivering 400 mA at 30 V. If the proper equipment or facilities are not available to perform this procedure, please return the instrument to the factory or an authorized repair station. Refer to Figure 5-7 for the location of

Model 5866RT

⚠ WARNING

The procedure described below requires the disassembly of the control valve. Be certain to remove gas pressure prior to disassembly to prevent injury.

the parts. Please refer to the proper section for your valve type.

1. Adjustment procedure, Normally Closed (N.C.) control valve

Refer to Figure 5-3 for spacer locations and nomenclature for the Normally Closed (N.C.) control valve. Refer to Section 7, spare parts for the spacer part numbers and the spacer kit part number. The preload determines the initial force 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 when the valve is closed. If 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.

1. Make the bench testing set up as shown in Figure 5-2. Disconnect the valve connector from the side of the Model 5866RT and connect it to the variable power supply and voltmeter as shown. Polarity is not important.
2. Remove gas pressure. Disassemble the control valve following the procedure given in Section 5-3, above. Note the orifice size, which is marked on the orifice face. Referring to Figure 5-3, note the number, location and thickness of all spacers.
3. Decrease the preload of the valve by .005" by either removing a .005" small preload spacer or by adding a .005" large preload spacer.
4. Reassemble the control valve following the assembly procedure in Section 5-4.
5. Apply 10 psig to the inlet.
6. Apply zero Volts to the control valve and observe the flow.
7. If the valve leaks through, remove the gas pressure and increase the preload by .005" and go to Step 8. If the valve does not leak through repeat Steps 2 through 6.

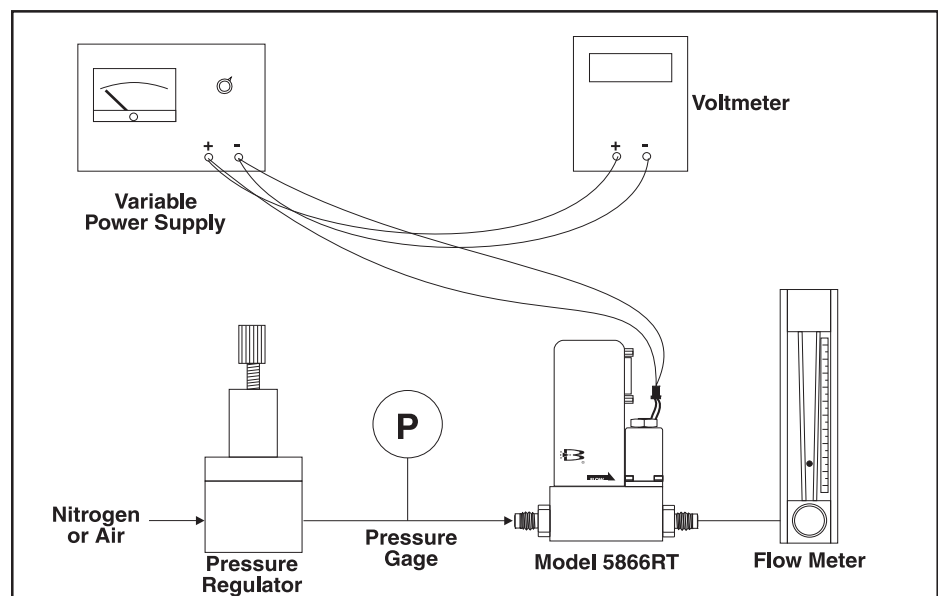


Figure 5-2 Adjustment Test Setup

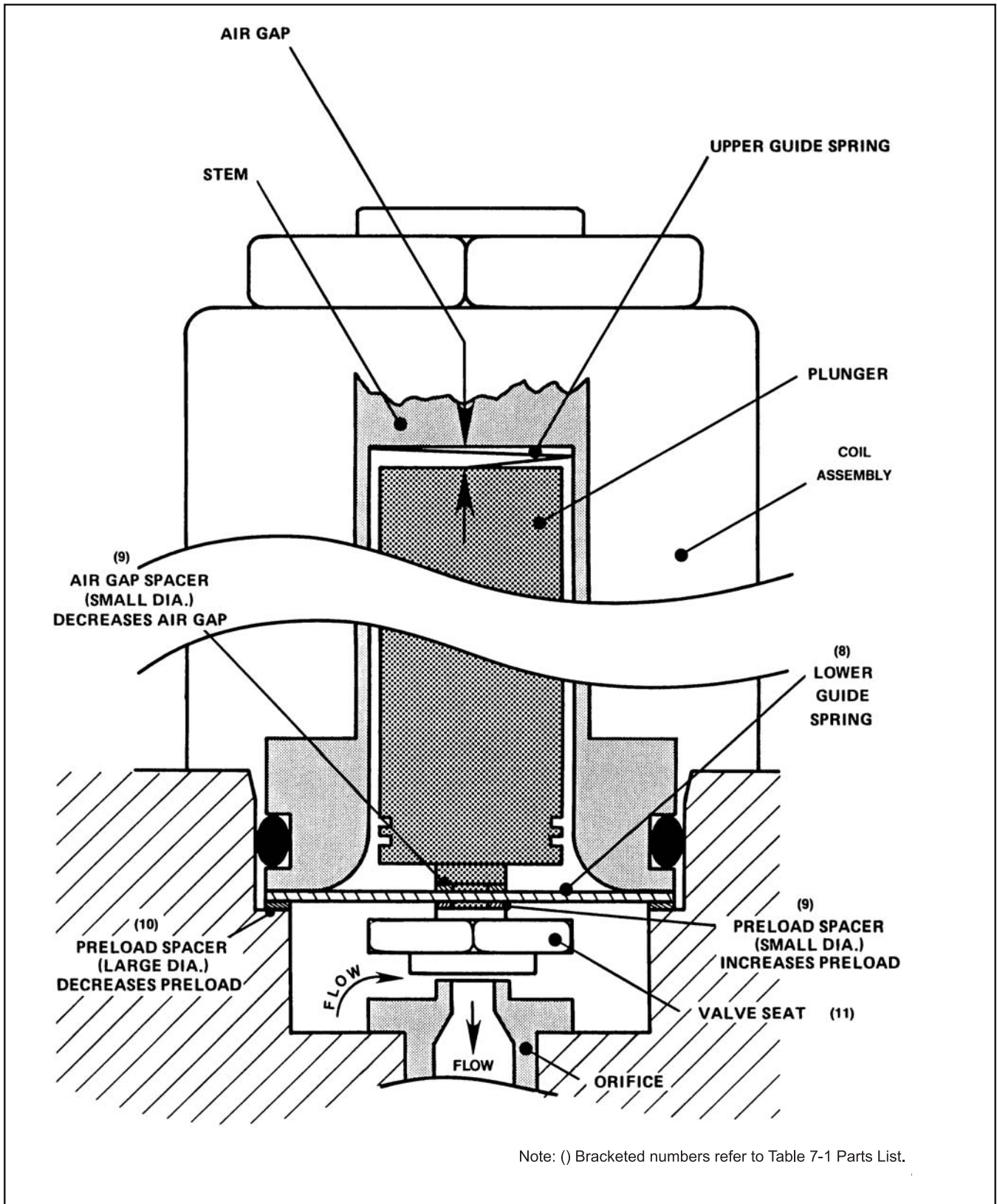


Figure 5-3 Valve Adjusting Spacer Locations, Normally Closed (N.C.) Elastomer Sealed Valve

Model 5866RT

8. Apply 10 psig to the inlet.
9. Apply 14.5 Volts to the valve using the variable power supply and observe the flow.
10. Compare the flow with the minimum flow listed in Table 5-3. The minimum flows have been listed with reference to both 0°C and 70°F reference for convenience. Be sure to use the column that is correct for the flow meter used in the set up. The outlet pressure at the controller must be less than 0.4 psig (10 inches of water).
11. If the observed flow is greater than the flow listed in Table 5-3 go to Step 13.
12. If the observed flow does not achieve the minimum flow, then increase the air gap by adding a large .005" air gap spacer to increase the valve travel. Repeat Steps 8, 9, 10 and 11.
13. Apply 11.5 Volts to the valve using the variable power supply. Observe the flow and compare it to the minimum flow values listed in Table 5-3.
14. If the observed flow is greater than the flow listed in Table 5-3 the valve adjustment is complete.
15. If the observed flow is less than the flow listed in Table 5-3 decrease the air gap by adding a small 0.005" air gap spacer. Repeat Steps 13 and 14.

2. Adjustment procedure, Normally Open (N.O.) Control Valve

Refer to Figure 5-4 for spacer locations and nomenclature for the Normally Open (N.O.) type control valve. Refer to Section 7, spare parts for the spacer part numbers and the spacer kit part number. The valve clearance determines the maximum space between the orifice (12) and the valve seat (4). If the valve clearance is too small the controller will not achieve full flow. If the valve clearance is too large, the control valve will not close properly.

The air gap is the space between the plunger (2) and insert (39) in the control valve. The air gap determines the magnetic force available to operate the valve. If the air gap is too large the magnetic force will be insufficient and the valve will not close. If the air gap is too small the valve will have insufficient travel and the valve will not close.

1. Make the bench testing set up as shown in Figure 5-2. Disconnect the valve connector from the side of the Model 5866RT and connect it to the variable power supply and voltmeter as shown. Polarity is not important.
2. Remove gas pressure. Disassemble the control valve following the procedure given in Section 5-3, above. Note the orifice size, which is marked on the orifice face. Referring to Figure 5-4, note the number, location and thickness of all spacers.
3. Reassemble the valve and set the variable voltage power supply to zero Volts.
4. Apply 5 psig to the inlet of the Model 5866RT if equipped with 0-1 bar transducer. Apply 10 psig for instruments equipped with other transducers.
5. Observe the flow and compare it to the values listed in Table 5-3.
6. If the observed flow is greater than the listed value for the orifice size that is installed then go to Step 8.
7. If the flow is less than the minimum flow increase the valve clearance by adding a large 0.005" spacer above the spring spacer (45) and repeat Steps 5 and 6.
8. Apply 18 Volts to the valve using the variable power supply and observe the flow.

Note: The maximum allowable leak through in controllers with an elastomer valve seat is 2% of the values listed in Table 5-3, (multiply by 0.02). The maximum allowable leak through for controllers with a metal or Teflon valve seat is 3% of the values listed in Table 5-3, (multiply by 0.03).

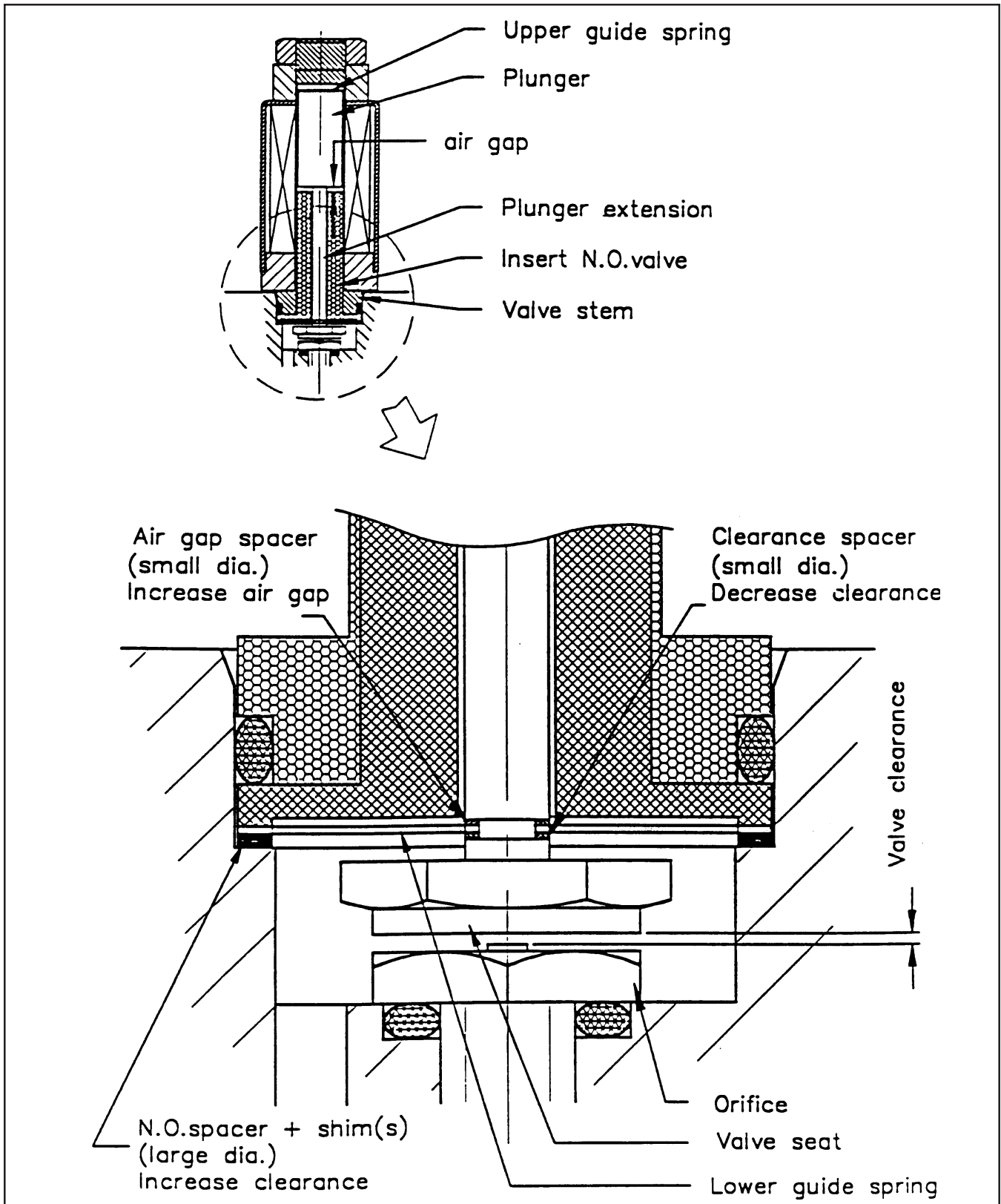


Figure 5-4 Valve Adjusting Spacer Locations, Normally Open (N.O.) Elastomer Sealed Valve

Model 5866RT

9. If the flow shuts off, or is less than the maximum allowable leak through for the type of valve seat installed the adjustment is complete.
10. If the leakage at 18 Volts is excessive add a large 0.005" spacer to decrease the air gap and repeat Steps 8 and 9.

B. Metal Sealed Valve

The adjustment procedure for metal sealed valves is essentially the same as for a elastomer sealed valves. However, the air gap cannot be changed by using large spacers beneath the gland nut. Refer to Figures 5-6, 5-7 and 7-2.

5-6 Orifice Sizing

The Model 5866RT Pressure Controller can be configured to control the pressure upstream of the instrument. This configuration is called an upstream controller. The Model 5866RT can also be configured to control the pressure downstream of the instrument. This configuration is called a downstream

Table 5-3 Minimum Flow Values

Orifice Size (inches)	Minimum Flow with 10 psig pressure	
	sccm (0°C)	sccm (70°F)
.001	5.3	5.7
.002	12.5	13.5
.003	39.2	42.2
.004	82.5	88.9
.007	374	403
.010	748	806
.014	1,364	1,470
.020	2,673	2,879
.032	6,490	7,000
.048	13,000	14,000
.062	22,000	23,700
.078	31,900	34,400
.093	42,500	45,800
.120	69,300	74,700

Table 5-4 Model 5866RT Orifice Selection

C_v	Orifice Size	Maximum Pressure Drop (psi)
5.0×10^{-6}	.001	1500
2.0×10^{-5}	.002	1500
5.0×10^{-5}	.003	1500
1.1×10^{-4}	.004	1500
4.0×10^{-4}	.007	1500
9.0×10^{-4}	.010	750
2.0×10^{-3}	.014	550
4.7×10^{-3}	.020	300
1.4×10^{-2}	.032	175
3.5×10^{-2}	.048	85
5.5×10^{-2}	.062	55
8.0×10^{-2}	.078	50
1.0×10^{-1}	.093	50
1.4×10^{-1}	.116	50
1.5×10^{-1}	.120	50

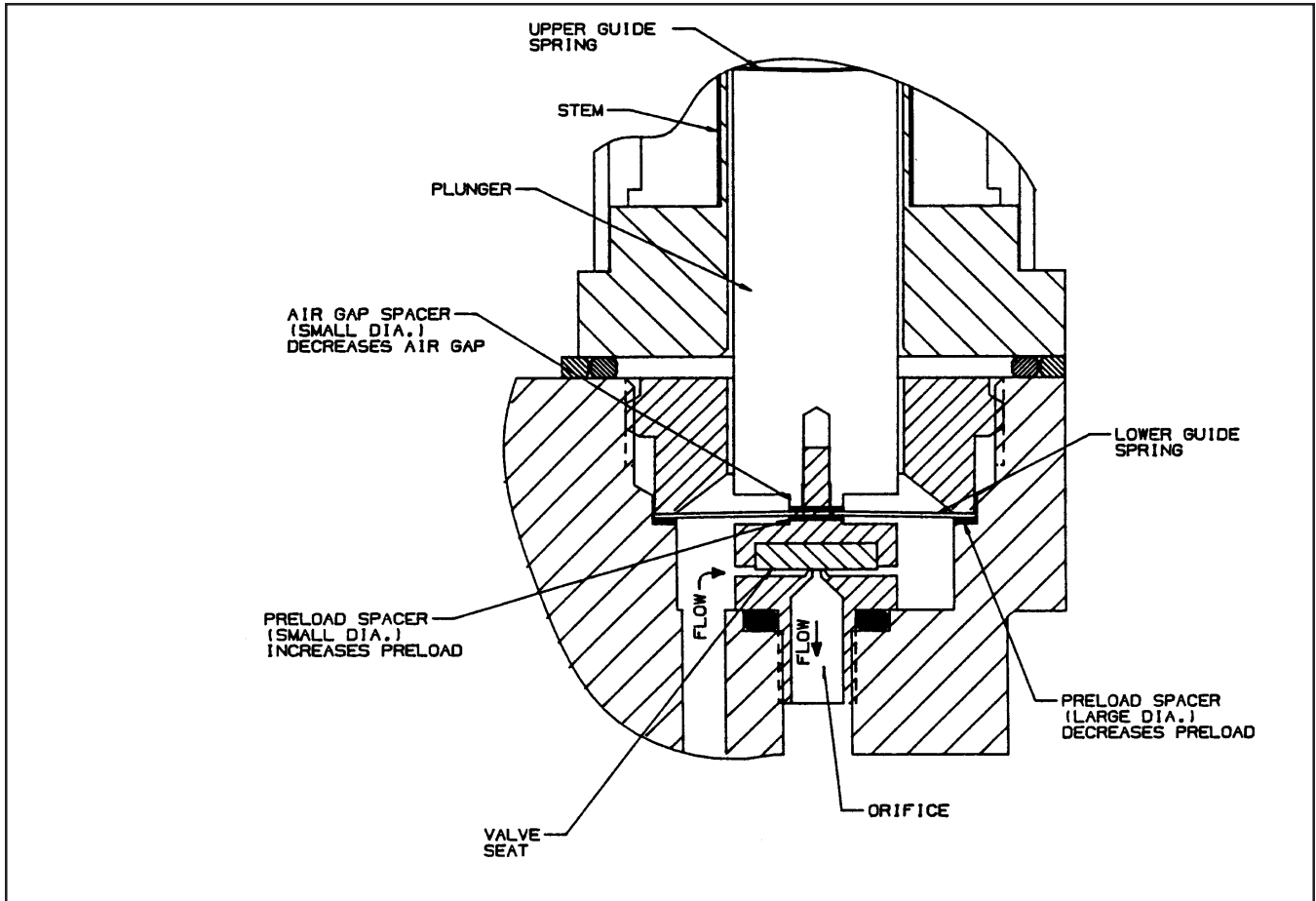


Figure 5-5 Valve Adjusting Spacer Locations, Normally Closed (N.C.) Metal Sealed Valve

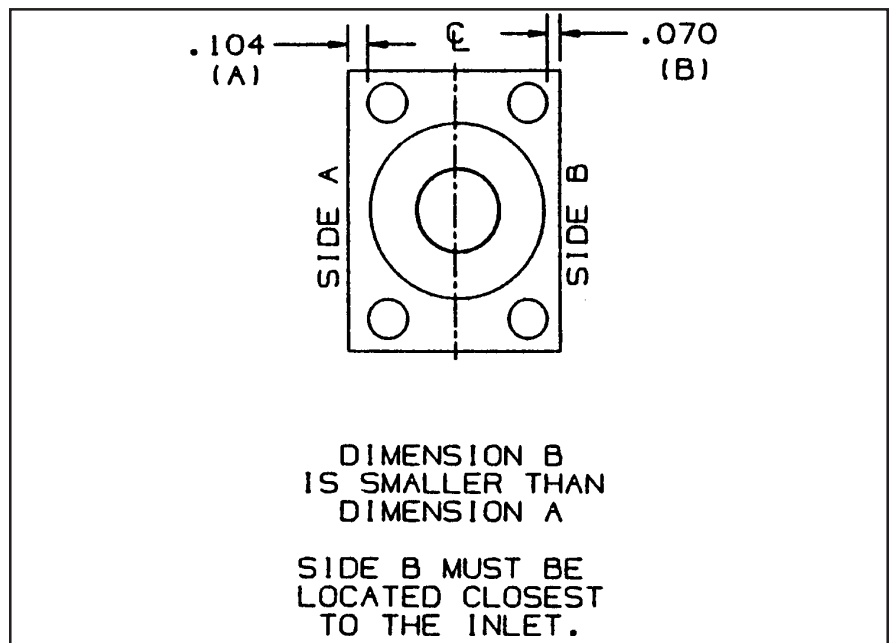


Figure 5-6 Valve Stem Spacer Orientation

Model 5866RT

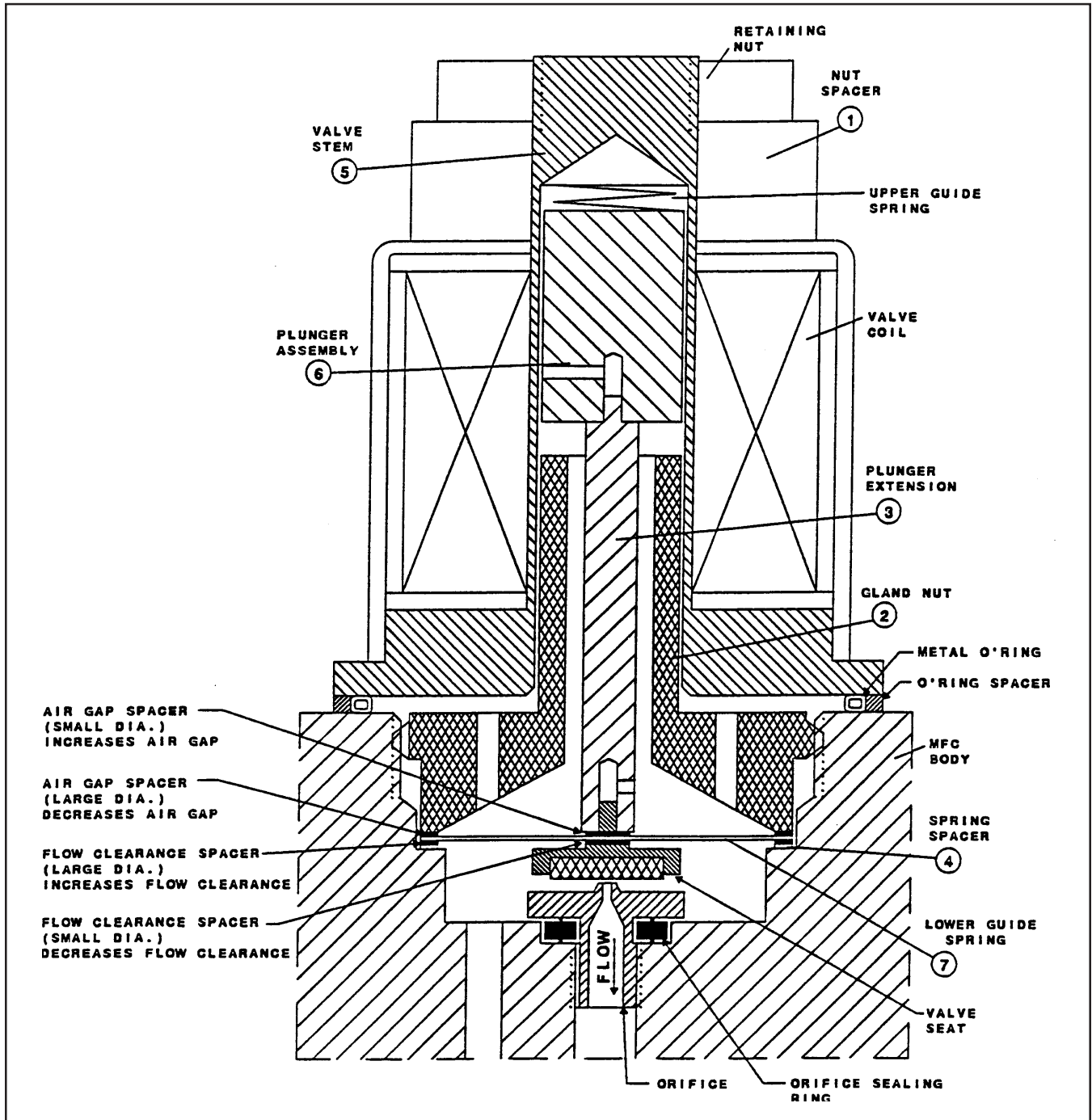


Figure 5-7 Valve Adjusting Spacer Locations, Normally Open (N.O.) Metal Sealed Valve

controller.

The sensed pressure is the pressure that is controlled. This is the upstream pressure for an upstream controller, downstream pressure for a downstream controller. The reference pressure is the pressure opposite the calibration pressure. The reference pressure would be the downstream pressure for an upstream controller and the upstream pressure for a downstream controller. The reference pressure is usually relatively constant. The calibration pressure is the pressure which produces a full scale signal from the pressure sensor.

Selection of the proper orifice can be easily performed using the Brooks Sizing Program MODEL, or it can be done manually. To properly size the control valve orifice in the Model 5866RT the following information must be known:

- Calibration Pressure, psia
- Reference Pressure, psia
- T = Gas Temperature (approximate) °R, (°R = °F + 460)
- Q_{max} = Max. Flow, sccm, 0°C reference temperature
- SG = Gas Specific Gravity, air @ 14.7 psia and 70°F = -1.0

1. Determine the minimum pressure drop across the pressure controller.
 - For an upstream controller this will be when the sensed (inlet) pressure is 2% of the calibration pressure, or 1.5 psi, whichever is larger.
 - For a downstream controller this will be the reference pressure minus the calibration pressure.
2. Determine the P1 and P2 in psia.
 - For an upstream controller P1 is the reference pressure plus the minimum pressure drop. P2 is the reference pressure.

$$P1 = P_{Ref} + \text{minimum pressure drop}$$

$$P2 = P_{Ref}$$

- For a downstream controller P1 is the reference pressure. P2 is the calibration pressure.

$$P1 = P_{Ref}$$

$$P2 = P_{Cal}$$

3. Determine the C_v for the application. The ratio between P1 and P2 will determine the calculation to use:

Equation #1

$$\text{If: } \frac{P2}{P1} > 0.5 \text{ use: } C_v = \frac{Q_{max}}{800,000} \sqrt{\frac{SG * T}{(P1 - P2) * P2}}$$

Equation #2

$$\text{If: } \frac{P2}{P1} \leq 0.5 \text{ use: } C_v = \frac{Q_{max}}{397,000 * P1} \sqrt{SG * T}$$

Model 5866RT

4. Select the orifice size from Table 5-4 that has a C_v just greater than the C_v determined in Step 3.
5. Check to see if the maximum pressure drop is greater than the maximum allowable pressure drop for the orifice size selected. If the pressure drop is too high for the orifice selected the instrument will not be able to function correctly. This situation can be corrected by reducing the pressure drop to the allowable level, or, reducing the maximum flow so a smaller orifice will be selected.

An example Model 5866RT application is shown in Figure 5-8 to illustrate the orifice sizing procedure.

Given:

Controller Type: Upstream

Gas: 5/8 Nitrogen, 3/8 Hydrogen

Temperature; 70°F (530°R)

Maximum Flow: 800 sccm

Calibration Pressure: 100 psig (114.7 psia)

Reference Pressure; 1 atmosphere (14.7 psia)

Max Flow: 10 slpm (0°C ref. temp.)

Calculations:

SG Mixture = $3/8 \times 0.070 + 5/8 \times 0.964 = .629$

Minimum Pressure Drop = $114.7 \times .05 = 5.7$ psi

Maximum Pressure Drop = $114.7 - 14.7 = 100$ psi

$P_1 = 14.7 + 5.7 = 20.4$ psia

$P_2 = 14.7$ psia

$P_2/P_1 = 14.7/20.4 = 0.721$ which is ≥ 0.5 therefore use equation #1

$$C_v = \frac{800}{800,000} \frac{0.629 \times 530}{(20.4 - 14.7) \times 14.7} = 2.0 \times 10^{-3}$$

Since the C_v calculated is the same as listed in Table 5-4 for the .014" orifice the .020" orifice should be selected. The last step is to check the maximum pressure drop for the application. The maximum pressure drop for the .020" orifice is 300 psi, this is greater than the 100 psi pressure drop required for the application so the .020" orifice is correct.

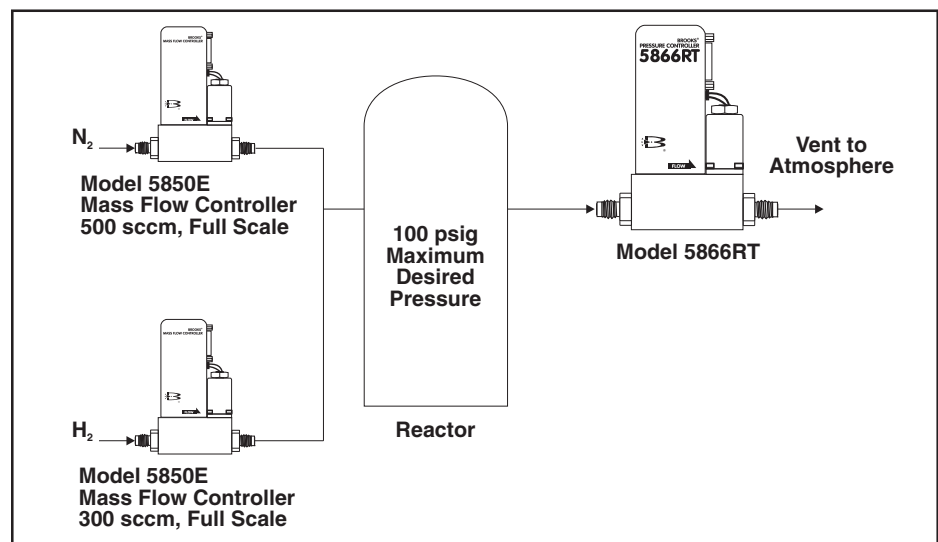


Figure 5-8 Example Application of Orifice Sizing Procedure

6-1 General

If the valve has been disassembled and any of the following parts have been replaced the control valve adjusting procedure must be performed before the Model 5866RT is calibrated.

- orifice
- valve stem
- plunger
- lower guide spring
- valve seat

Calibration of the Model 5866RT mass flow controller requires the use of a digital voltmeter (DVM) and a precision flow standard calibrator such as the Brooks Vol-U-Meter[®]. It is recommended that the calibration be performed only by trained and qualified service personnel.

If the controller is to be used on a gas other than the calibration gas, apply the appropriate sensor conversion factor. Size the orifice for actual operating conditions.

Before starting the flow sensor calibration, configure the controller for operation as an MFC in the upstream control mode (See Section 5-2).

- a. With the controller installed in an unpressurized gas line, apply power and allow approximately 45 minutes for warm-up. For Normally Closed valves, set the command to 0 Volts during warm-up. For Normally Open valves, set the command to 5 V.
- b. Adjust the anticipate potentiometer fully clockwise (20 turns). Then adjust the anticipate potentiometer 10 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 (Terminal 3 Card Edge, Pin 2 D-Connector) and the negative lead to signal common (TP4). Adjust the zero potentiometer for an output of 0 mV \pm 2 mV.
- d. Apply pressure to the system and insure that the zero signal repeats within 2 mV of the voltage set in Step c above. If the zero does not repeat, check for leakage.

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

- e. Set the command for 100% of flow (5.000 V). Connect the DVM positive lead to TP2 (linearity voltage) and the negative lead to TP4 (signal common). Adjust the linearity potentiometer for an output of 0.0 V (zero Volts).
- f. Connect the DVM positive lead to TP1 (-100x sensor voltage) and the negative lead to TP4 (circuit common). The command potentiometer should still be set at 100% flow (5.000 V). Measure the flow rate using suitable volumetric calibration equipment. To adjust the controller to the proper full scale flow, calculate a new TP1 voltage using the following equation:

Model 5866RT

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

Adjust the span potentiometer until the voltage at TP1 is equal to the value calculated above. Recheck the flow rate after the flow is stable (at least 2 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 the desired accuracy and/or signal stability may not be achieved. If one of the limits is reached check the orifice and restrictor sizing procedures.

- g. Set the command potentiometer for 0% of flow. Connect the DVM positive lead to flow signal output (Terminal 3 Card Edge, Pin 2 D-Connector) and the negative lead to TP4. Readjust the zero potentiometer for an output of 0 mV \pm 2 mV as necessary.
- h. Set the command potentiometer for 50% of flow (2.500 V) and measure the flow rate. Calculate the error as a percentage of full scale.

$$\text{full scale error} = 100\% \frac{\text{measured flow rate} - \text{desired flow rate}}{\text{full scale flow rate}}$$

Example:

What is the percent of full scale error when full scale is equal to 100 sccm?

Measured 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. Set the command potentiometer for 100% flow (5.000 V). 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.

- I. 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% set the command potentiometer for 100% (5.000 V). Connect the DVM positive lead to TP2 (linearity voltage) and the negative lead to TP4 (circuit common). Calculate a new TP2 voltage as follows:

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

Example:

Controller error = 0.7%

Measured TP2 voltage = -0.567 Volts

TP2 correction = $0.7 \times 0.450 = 0.315$ Volts

New TP2 correction = $0.314 + (-0.567) = -0.252$ 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.

6-2 Flow Sensor Response Adjustment

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

- a. Set the command potentiometer for 100% of flow (5.00 V) and wait about 45 seconds for the flow output signal to stabilize.
- b. Step the command signal to 0% or activate valve override closed to stop the flow. Observe the flow signal output as it decays.
- c. The behavior of the flow signal during this transition between 100% and 0% flow indicates the adjustment required of the anticipate potentiometer.
 1. If the flow signal decays to -.05 to -.5 V then rises to 0 V the anticipate potentiometer must be adjusted clockwise and Steps a and b repeated.
 2. If the flow signal decays rapidly and goes below -.05 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.

Model 5866RT

6-3 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 6-1. To change to a new gas, multiply the output reading by the ratio of the gas factor for the

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

desired gas by the gas factor for the calibration gas used.

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 $75 \times 0.773 = 57.98$ sccm

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

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

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

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

volume. The desired full scale flow rate of the mixture is 20 slpm. Sensor conversion factor for the mixture is:

Nitrogen equivalent flow = $20 / 0.945 = 21.16$ slpm Nitrogen

It is generally accepted that the mass flow rate derived from this equation is only accurate to $\pm 5\%$. The sensor conversion factors given in Table 6-1 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 6-1 Conversion Factors (Nitrogen Base)

GAS NAME	FORMULA	SENSOR FACTOR	ORIFICE FACTOR	DENSITY (KG/m ³) @0°C, 1 atm
Acetylene	C ₂ H ₂	0.615	0.970	1.173
Air	Mixture	0.998	1.018	1.293
Allene	C ₃ H 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 ₂ BrF ₃	0.326	2.397	7.165
Bromotrifluoromethane f-13B1	CBrF ₃	0.412	2.303	6.615
1,3-Butadiene	C ₄ H ₆	0.354	1.413	2.491
Butane	C ₄ H ₁₀	0.257	1.467	2.593
1-Butene	C ₄ H ₈	0.294	1.435	2.503
CIS-2-Butene	C ₄ H ₈	0.320	1.435	2.503
Trans-2-Butene	C ₄ H 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 ₄ H ₉ Cl	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 ₂ CLF ₅	0.243	2.397	7.165
Chlorotrifluoroethylene	C ₂ CLF 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 ₄ H ₈	0.387	1.413	2.491
Cyclopropane	C ₃ H ₆	0.505	1.224	1.877
Deuterium	D ₂	0.995	0.379	0.177
Diborane	B ₂ H ₆	0.448	1.000	1.235
Dibromodifluoromethane f-12B2	CBr ₂ F ₂	0.363	2.652	8.768
1,2-Dibromotetrafluoroethane f-114B2	C ₂ Br ₂ F ₄	0.215	2.905	10.53
Dichlorodifluoromethane f-12	CCL ₂ F ₂	0.390	2.099	5.492
Dichlorofluoromethane f-21	CHCL ₂ F	0.456	1.985	4.912
Dichlorosilane	SiH ₂ CL ₂	0.442	1.897	4.506
1,2-Dichloroethane	C ₂ H ₄ CL ₂	0.382	1.879	4.419
1,2-Dichlorotetrafluoroethane f-114	C ₂ CL ₂ F ₄	0.231	2.449	7.479
2,2 Dichloro	C ₂ HC ₁₂ F ₃	0.259	2.336	6.829
1,1-Difluoro-1-Chloroethane	C ₂ H ₃ CLF ₂	0.341	1.957	4.776
1,1-Difluoroethane	CH ₃ CHF ₂	0.415	1.536	2.940
1,1-Difluoroethylene	CH ₂ :CF ₂	0.458	1.512	2.860
Diethylsilane	C ₄ H ₁₂ Si	0.183	1.775	3.940
Difluoromethane f-32	CF ₂ H ₂	0.627	1.360	2.411
Dimethylamine	(CH ₃) ₂ NH	0.370	1.269	2.013
Dimethylether	(CH ₃) ₂ O	0.392	1.281	2.055
2,2-Dimethylpropane	C(CH ₃) ₄	0.247	1.613	3.244
Disilane	Si ₂ H ₆	0.332	1.493	2.779
Ethane	C ₂ H ₆	0.490	1.038	1.357
Ethanol	C ₂ H ₆ O	0.394	1.282	2.057
Ethylacetylene	C ₄ H ₆	0.365	1.384	2.388
Ethyl Chloride	C ₂ H ₅ CL	0.408	1.516	2.879

Section 6 Calibration

Table 6-1. Conversion Factors (Nitrogen Base) Continued.

Model 5866RT

Table 6-1 Conversion Factors (Nitrogen Base) Continued

GAS NAME	FORMULA	SENSOR FACTOR	ORIFICE FACTOR	DENSITY (KG/m ³) @0°C, 1 atm
Ethylene	C ₂ H ₄	0.619	1.000	1.261
Ethylene Oxide	C ₂ H ₄ O	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 ₂ HBrClF ₃	0.257	2.654	8.814
Helium	He	1.386	0.378	0.178
Hexafluoroacetone	F ₃ CCOCF ₃	0.219	2.434	7.414
Hexafluorobenzine	C ₆ F ₆	0.632	2.577	8.309
Hexafluoroethane f-116	C ₂ F ₆	0.255	2.219	6.139
Hexafluoropropylene (HFP)	C ₃ F ₆	0.249	2.312	6.663
Hexamethyldisilane (HMDS)	(CH ₃) ₆ Si ₂	0.139	2.404	7.208
Hexane	C ₆ H 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 ₂ Se	0.837	1.695	3.613
Hydrogen Sulfide	H ₂ S	0.850	1.108	1.539
Iodine Pentafluoride	IF ₅	0.283	2.819	9.907
Isobutane	C ₄ H ₁₀	0.260	1.440	2.593
Isobutene	C ₄ H ₈	0.289	1.435	2.503
Isopentane	C ₅ H 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 ₃ H ₄	0.473	1.196	1.782
Methyl Bromide	CH ₃ Br	0.646	1.834	4.236
3-Methyl-1-butene	C ₅ H ₁₀	0.252	1.584	3.127
Methyl Chloride	CH ₃ CL	0.687	1.347	2.308
Methyl Fluoride	CH ₃ F	0.761	1.102	1.518
Methyl Mercaptan	CH ₃ S	0.588	1.313	2.146
Methyl Silane	CH ₃ Si	0.393	1.283	2.061
Methyl Trichlorosilane (MTS)	CH ₃ Cl ₃ Si	0.267	2.310	6.675
Methyl Vinyl Ether	C ₃ H ₆ O	0.377	1.435	2.567
Monoethanolamine	C ₂ H ₇ NO	0.305	1.477	2.728
Monoethylamine	C ₂ HH ₅ NH ₂	0.359	1.269	2.013
Monomethylamine	CH ₃ NH 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 ₂ O ₃	0.443	1.649	3.389
Nitrosyl Chloride	NOCL	0.644	1.529	2.913
Nitrous Oxide	N ₂ O	0.752	1.259	1.964
Octofluorocyclobutane	C ₄ F 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 ₂ HF ₅	0.287	2.070	5.360
Pentane (n-Pentane)	C ₅ H ₁₂	0.212	1.605	3.222
Perchloryl Fluoride	CLO ₃ F	0.448	1.905	4.571
Perfluorobutane	C ₄ F ₁₀	0.738	2.918	10.61
Perfluoro-2-Butene	C ₄ F ₈	0.268	2.672	8.933
Perfluoromethyl-vinylether	PMVE	0.296	2.029	5.131

Table 6-1 Conversion Factors (Nitrogen Base) Continued

GAS NAME	FORMULA	SENSOR FACTOR	ORIFICE FACTOR	DENSITY (KG/m ³) @0°C, 1 atm
Perfluoropropane	C ₃ F ₈	0.179	2.591	8.396
Pentane (n-Pentane)	C ₅ H 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 ₃ CH ₂ CH ₃)	C ₃ H ₈	0.343	1.274	2.008
Propylene (Propene)	C ₃ H 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 ₂ F ₂	0.423	1.931	4.648
Tetrachloromethane	CCL ₄	0.344	2.345	6.858
Tetrafluoroethylene (TFE)	C ₂ F ₄	0.361	1.905	4.526
Tetrafluorohydrazine	N ₂ F ₄	0.367	1.926	4.624
Trichlorofluoromethane f-11	CCL ₃ F	0.374	2.244	6.281
Trichlorosilane	SiHCL ₃	0.329	2.201	6.038
Trimethoxyborane (TMB)	B(OCH ₃) ₃	0.300	1.929	4.638
1,1,2-Trichloro-1,1,2-Trifluoroet f-113	C ₂ CL ₃ F ₃	0.231	2.520	7.920
Trimethylamine	(CH ₃) ₃ N	0.316	1.467	2.639
Tungsten Hexafluoride	WF ₆	0.227	3.264	13.28
Uranium Hexafluoride	UF ₆	0.220	3.548	15.70
Vinyl Bromide	C ₂ H ₃ Br	0.524	1.985	4.772
Vinyl Chloride	C ₂ H ₃ CL	0.542	1.492	2.788
Vinyl Fluoride	C ₂ H ₃ F	0.576	1.281	2.046
Water Vapor	H ₂ O	0.861	0.802	0.804
Xenon	Xe	1.383	2.180	5.851

Ref. No. J-836D508 gasdata.doc Vsn. 8.6

6-4 Restrictor Sizing

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

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

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

Model 5866RT

- Appropriate size ball point allen wrench for the removal of the inlet block, spacer and O-ring. (For metal sealed instruments).
- Restrictor removal tool (contained in Service Tool Kit P/N S-778-D-017-AAA)
- Restrictor sealing ring, refer to the spare parts Section 5 for the correct part number.
- A replacement metal O-ring. (For metal sealed instruments)

The Model 5866RT Mass Flow Controller uses two types of restrictor assemblies depending on full scale flowrate and expected service conditions.

1. Wire mesh for Nitrogen equivalent flow rates above 3.5 slpm. These restrictor assemblies are made from a cylinder of wire mesh and are easily cleaned if they become contaminated in service.
2. Anti-Clog Laminar Flow Element (A.C.L.F.E.) — This type of restrictor assembly is used for Nitrogen equivalent flow rates less than 3.4 slpm. The A.C.L.F.E. is very tolerant to particulate contamination. This is especially important when handling semiconductor gases that tend to precipitate particles.

Sizing

All Model 5866RT Series Restrictor Assemblies are factory adjusted to provide a 115 mm water column pressure drop for a specific flow rate. This corresponds to the desired full scale flow rate. A list of restrictor assemblies used in the Model 5866RT Mass Flow Controller is shown in Table 6-2.

Example:

The desired gas is Silane (SiH_4).

The desired full scale flow rate is 200 sccm.

Sensor conversion factor is 0.625 from Table 6-1.

Nitrogen equivalent flow = $200/0.625 = 320$ sccm Nitrogen.

In the example above a Size P Restrictor would be selected.

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

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

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:

$$\text{Mixture Factor} = \frac{20}{1.386} + \frac{80}{.876} = .945$$

Table 6-2 Model 5866RT Standard Restrictors

Size	Range sccm Nitrogen Equivalent Flow*		Part Number	
	Low	High	A.C.L.F.E.	Wire Mesh
D	8.038	11.38	S-110-Z-275-BMG	
E	11.25	15.93	S-110-Z-276-BMG	
F	15.75	22.30	S-110-Z-277-BMG	
G	22.05	31.23	S-110-Z-278-BMG	
H	30.88	43.73	S-110-Z-279-BMG	
J	43.23	61.21	S-110-Z-280-BMG	
K	60.52	85.70	S-110-Z-281-BMG	
L	84.73	119.9	S-110-Z-282-BMG	
M	118.6	167.9	S-110-Z-283-BMG	
N	166.0	235.2	S-110-Z-284-BMG	
P	232.5	329.3	S-110-Z-285-BMG	
Q	325.4	460.9	S-110-Z-286-BMG	
R	455.7	645.3	S-110-Z-287-BMG	
S	638.0	903.4	S-110-Z-288-BMG	
T	893.2	1265.	S-110-Z-289-BMG	
U	1250.	1771.	S-110-Z-290-BMG	
V	1750.	2479.	S-110-Z-291-BMG	
W	2451.	3471.	S-110-Z-292-BMG	
X	3431.	4859.		S-110-Z-319-BMG
Y	4804.	6802.		S-110-Z-321-BMG
1	6724.	9523.		S-110-Z-317-BMG
2	9388.	13337.		S-110-Z-228-BMG
3	13176.	18667.		S-110-Z-226-BMG
4	18457.	30060.		S-110-Z-224-BMG

*Materials: BMG = 316 Stainless Steel Electropolished

- Notes:
- For flow rates less than 8 sccm, use the low flow plug, P/N 618-K-019-BMG in place of a restrictor assembly and install a low flow filler ring P/N 724-Z-363-BMG in the valve cavity after the orifice is installed.
 - If two sizes are allowed because of overlap, select the larger size.
 - Restrictor size not required to enter order.

Nitrogen equivalent flow = $20/.945 = 21.16$ slpm Nitrogen. In this example a Size 4 Wire Mesh Assembly would be selected.

6-5 Control Circuit Bias Adjustments

The bias potentiometer (R14) sets the voltage immediately applied to the control valve when a setpoint of 2% or greater is given. The integrating action of the control circuit then increases the valve voltage from this initial value. This allows for close control of the dead time in the controller when the command voltage is stepped from 0. The adjustment is factory preset. The adjustment process should be performed when a) the operating pressure conditions are changed considerably from those specified when the product was ordered or b) any internal valve parts which affect the mechanical preload are changed.

Exceedingly long dead time or inability to reduce pressure to setpoint are symptoms of a controller with an incorrect bias setting.

Bias adjustment is performed as follows:

1. Monitor the valve voltage with a DVM. The valve voltage is available at Pin

Model 5866RT

- 7 of the D-Connector or TP3 on the PCA.
- 2. Rotate the bias pot fully counterclockwise.
- 3. Set the command to between 50 and 100% and allow the pressure to settle at setpoint.
- 4. Set the command to 2% (elastomer valve seat) or 8% (metal or Teflon valve seat) and allow the controller to maintain setpoint for about 2 minutes.
- 5. Note the valve voltage.
- 6. Set VOR CLOSED by applying override voltage pin 12 (has to be +15 for upstream configuration, not 15 as in manual)...:OK. Valve Drive Voltage goes to -14.07 V.
- 7. Rotate the bias pot clockwise until:
 - a. Normally closed valve - the valve voltage is 2 Volts more negative than the value noted in Step 5.
 - b. Normally open valve - the valve voltage is 2 Volts more positive than the value noted in Step 5.

Note: Occasionally the desired valve voltage will be outside the range of the adjustment. The adjustment range for the three control valve types is shown below:

<u>Valve Type</u>	<u>Adjustment Range</u>
Norm. Closed	-14 to -8 Volts
Norm. Open	
Orifice<.032"	-.3 to -7.6 Volts
Orifice>=.032"	+13 to .5 Volts

7-1 General

Replacement parts for the Model 5866RT are readily available worldwide through the factories and customer service facilities. Parts can also be ordered through authorized repair stations and sales agents. When ordering replacement parts please specify: Brooks serial number, model number, part description, part number and quantity. Please refer to Tables and Figures 7-1 and 7-2. Tables 7-3 and 7-4 list tools and parts that are useful for troubleshooting and repair.

Model 5866RT

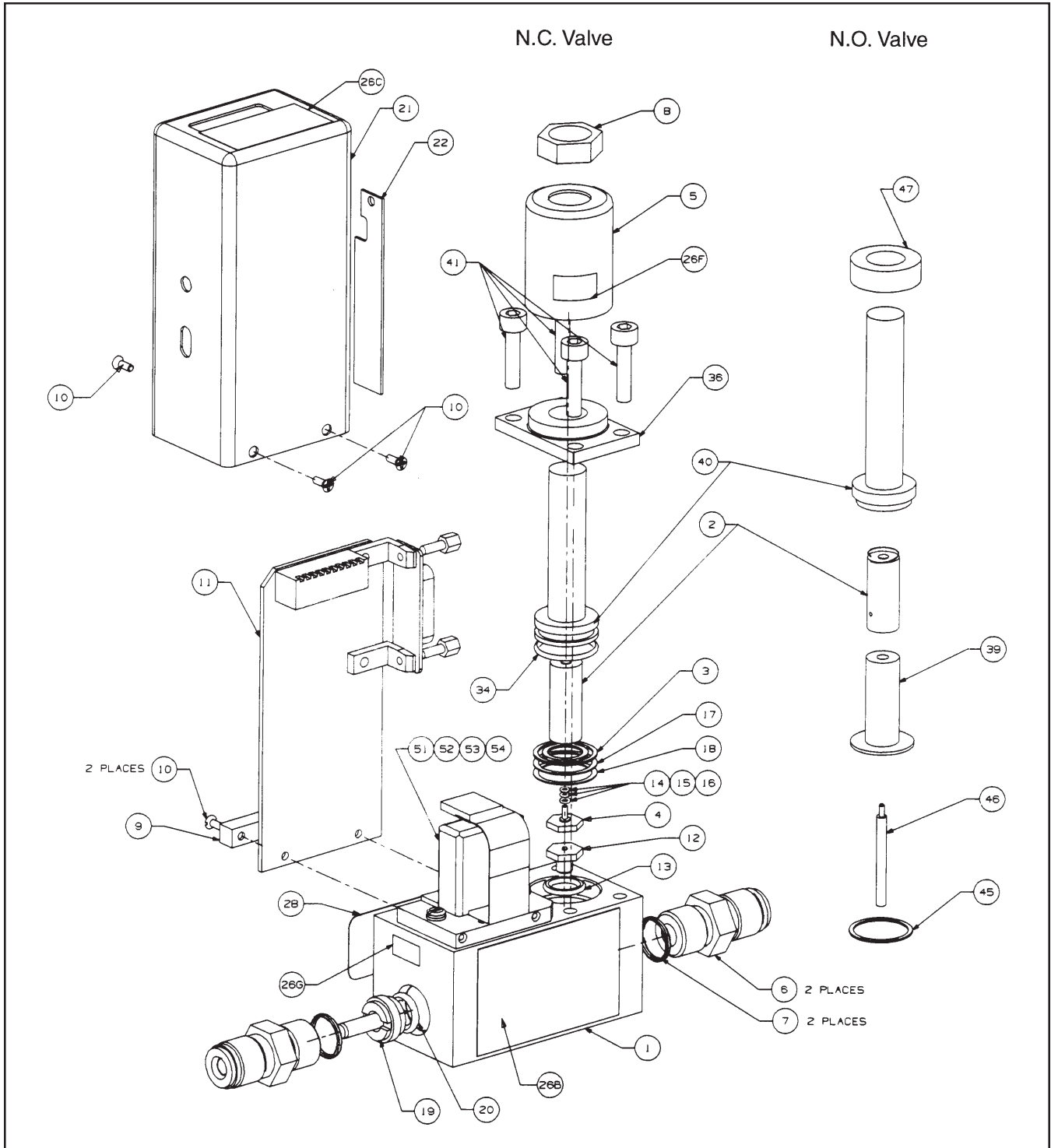


Figure 7-1 Model 5866RT Parts Drawing with Elastomer Seal

Table 7-1 Model 5866RT Elastomer Seal Parts List (With Normally Closed Valve)

Item No.	Qty.	Description	Part Number	
1	1	Controller Body	092Z768BM%	
2	1	Valve Plunger Assy, Corr. Resist.*	S622Z165AAA	
3	1	Lower Guide Spring	820Z083BMA	
4	1	Valve Seat w/Viton Insert	S715Z051AAA	
		Valve Seat w/Buna Insert	S715Z050AAA	
		Valve Seat w/Kalrez Insert	S715Z163AAA	
		Valve Seat, Stainless Steel	715Z181BNT	
5	1	Coil Assembly	S185Z271AAA	
6	2	Fittings:		
		1/4" Compression, Swagelok	320B136BMA	
		1/4" Male VCR, Cajon	315Z036BMA	
		1/4" Male VCO, Cajon	315Z035BMA	
7	2	O-ring, Fitting, Size 906	375B906***1	
8	1	Jam Nut	573B027ACK	
9	1	P.C. Board Mounting Bracket	079Z135EAA	
10	5	Screw PC Board Cover	753L056AWZ	
11	1	P.C. Board Asmbly (Std. Response)	S097X051AAA	
		(Ext. Response)	S097X074AAA	
12	1	Orifice	Stainless	Hastelloy™
		ID 0.0013"	577Z375BMT	577Z404CVA
		ID 0.002"	577Z376BMT	577Z405CVA
		ID 0.003"	577Z377BMT	577Z406CVA
		ID 0.004"	577Z378BMT	577Z407CVA
		ID 0.007"	577Z381BMT	577Z410CVA
		ID 0.010"	577Z383BMT	577Z412CVA
		ID 0.014"	577Z385BMT	577Z414CVA
		ID 0.020"	577Z387BMT	577Z416CVA
		ID 0.032"	577Z391BMT	577Z420CVA
		ID 0.048"	577Z393BMT	577Z422CVA
		ID 0.062"	577Z395BMT	577Z424CVA
		ID 0.078"	577Z397BMT	577Z426CVA
		ID 0.093"	577Z398BMT	577Z427CVA
ID 0.116"	577Z399BMT	577Z428CVA		
ID 0.120"	577Z400BMT	577Z429CVA		
13	1	O-ring, Orifice, Size 008	375B008***	
14	AR	Small Valve Spacer, .005" Thick	810A362BMA	
15	AR	Small Valve Spacer, .010" Thick	810A363BMA	
16	1	Small Valve Spacer, .002 Thick	810A374BMA	

Item No.	Qty.	Description	Part Number	
17	AR	Large Valve Spacer, .005" Thick	810A368BMA	
18	AR	Large Valve Spacer, .010" Thick	810A361BMA	
19	1	Restrictor Assembly, See Table 6-2		
20	1	O-ring, Restrictor, Size 109	375B109***	
21	1	Electronics Cover Can	219Z496EA%	
22	1	Cover Plate (D-Con. Version Only)	852Z209EA%	
34	1	O-ring, Valve Stem, Size 016	375B-016***	
36	1	Retaining Plate	715Z169CZ%	
40	1	Valve Stem, Corrosion Resistant*	949Z203QOA	
41	4	Valve/Screw	751-C-322-AWA	
51	1	Sensor Assembly	S774Z607AAA	
52	2	O-ring, Sensor, Size 004	375B004***	
53	2	Screw Sensor-Body	753B269AWA	
54	2	Lock Washer, Sensor	962D006AWA	
NS	2	O-ring, VCO Gland, Size 010	375B010***	
NS	1	Interconnecting Cables: Connector on one end with no termination on other end		
		Length	Card Edge	D-type
		5 feet	S124Z469AAA	S124Z361AAA
		10 feet	S124Z470AAA	S124Z362AAA
		25 feet	S124Z471AAA	S124Z363AAA
		50 feet	S124Z472AAA	S124Z442AAA
		Connector on one end with Connector for Model 0150 Series Secondary Electronics on other end		
		Length	Card Edge	D-type
		5 feet	S124Z669AAA	S124Z576AAA
		10 feet	S124Z539AAA	S124Z577AAA
25 feet	S124Z562AAA	S124Z578AAA		
50 feet	S124Z670AAA	S124Z579AAA		
NS	2	8-32 Mounting Screw	753A330AWA	

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

Normally Open Valve Parts

47	Extension Spacer	810A391CET
40	Valve Stem	949Z215BMT
2	Plunger	S622Z203QOG
39	Valve Insert	456Z071QOT
46	Plunger Extension	622Z200BMT
45	Valve Preload Spacer	810A388BMT

Parts not Shown

Low Flow Filler Ring	724Z363BMT
Valve Plug	953Z068BMT
Valve Plug Back-up Ring	763Z064QTA

Model 5866RT

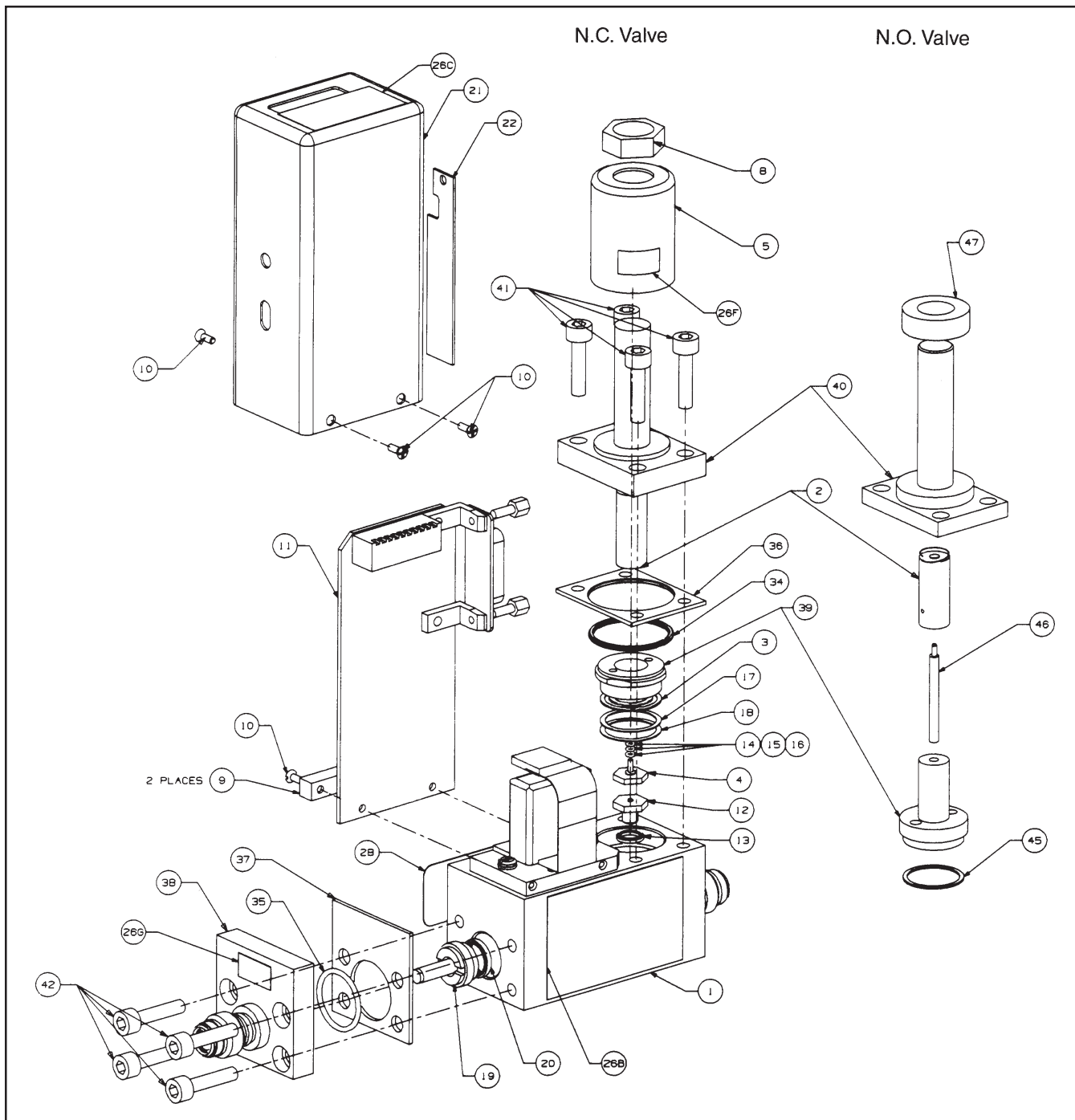


Figure 7-2 Model 5866RT Parts Drawing with Metal Seals

Table 7-2 Model 5866RT Metal Seal Parts List (With Normally Closed Valve)

Item No.	Qty.	Description	Part Number		
1	1	VCR Controller Body with Sensor	092Z809BIG*		
2	1	Valve Plunger Assembly	S622Z181QOG		
3	1	Lower Guide Spring	820Z083BMA		
4	1	Valve Seat with Viton Insert	S715Z051AAG		
		Valve Seat with Buna Insert	S715Z050AAG		
		Valve Seat with Kalrez Insert	S715Z163AA\$		
		Valve Seat with Teflon Insert	S715Z049AA\$		
		Valve Seat Solid 316 Stn. Stl.	715Z181BN\$		
5	1	Coil Assembly	S185Z280AAJ		
8	1	Jam Nut	573B027ACJ		
9	1	P.C. Board Mounting Bracket	079Z135EAA		
10	5	Screw, P.C. Board Cover	753L056AWZ		
11	1	P.C. Board Assembly (Std. Response)	S097Y944AAA		
		P.C. Board Assembly (Ext. Response)	S097Y827AAA		
12	1	Orifice			
			ID 0.0013"	577Z375BM\$	
			ID 0.002"	577Z376BM\$	
			ID 0.003"	577Z377BM\$	
			ID 0.004"	577Z378BM\$	
		(Refer to Section 5-6 for Sizing)		ID 0.007"	577Z381BM\$
				ID 0.010"	577Z383BM\$
				ID 0.014"	577Z385BM\$
				ID 0.020"	577Z387BM\$
				ID 0.032"	577Z391BM\$
				ID 0.048"	577Z393BM\$
				ID 0.062"	577Z395BM\$
				ID 0.078"	577Z397BM\$
			ID 0.093"	577Z398BM\$	
	ID 0.116"	577Z399BM\$			
	ID 0.120"	577Z400BM\$			

Item No.	Qty.	Description	Part Number
13	1	Sealing Ring, Orifice, Size 008	577Z488AA\$
14	AR	Small Valve Spacer, 0.005" Thick	810A362BMA
15	AR	Small Valve Spacer, 0.010" Thick	810A363BMA
16	1	Small Valve Spacer, .002	810A374BMA
17	AR	Large Valve Spacer, 0.005" Thick	810A368BMA
18	AR	Large Valve Spacer, 0.010" Thick	810A361BMA
19	1	Restrictor Assembly, See Table 6-2	
20	1	Sealing Ring, Restrictor, Size 109	110Z325AA\$
21	1	Electronics Cover	219Z437EAL
34	1	O-ring, Valve Stem, Size 016	375F098BMJ
35	1	Inlet Metal O-Ring	375F099BMJ
36	1	Valve Stem Spacer	810Z191BMT
37	1	Inlet Spacer	810Z190BMT
38	1	VCR Inlet Fitting Assembly*	S320Z087BIG*
39	1	Gland Nut	573Z264BMG
40	1	Valve Stem	949Z213QOG
41	4	Screw, Valve Stem, 5/8"	751Z111AAA
42	4	Screw, Inlet Plate, 1/2"	751Z103AA0

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

Normally Open Valve Parts

47	Extension Spacer	810A387CET
40	Valve Stem	949Z214BLG*
2	Plunger Assembly	S622Z203QOG
46	Plunger Extension	622Z200BML*
39	Gland Nut	573Z268QOG
45	Valve Preload Spacer	810A388BMG*

Parts Not Shown

Mounting Screws 753A330AWA

*Substitute T for G as last character for non-EP part

Model 5866RT

Table 7-3 Tool and Spare Part Kits for Model 5866RT with Elastomer Seals

<p>Service Tool Kit</p> <p>Permits the complete disassembly of the Model 5866RT (elastomer) for servicing</p> <p>Service Kit Contains:</p> <table border="0"> <tr> <td>1 — Tool Pouch</td> <td>1 — Tool Handle</td> </tr> <tr> <td>1 — Ball Point Allen Wrench, 1/8"</td> <td>1 — O-ring Tool</td> </tr> <tr> <td>1 — Ball Point Allen Wrench, 9/64"</td> <td></td> </tr> <tr> <td>1 — Potentiometer Adjustment Tool</td> <td></td> </tr> <tr> <td>1 — Phillips Screw Driver</td> <td></td> </tr> <tr> <td>1 — Common Screw Driver</td> <td></td> </tr> <tr> <td>1 — Nut Driver for Orifice, 3/8"</td> <td></td> </tr> </table>	1 — Tool Pouch	1 — Tool Handle	1 — Ball Point Allen Wrench, 1/8"	1 — O-ring Tool	1 — Ball Point Allen Wrench, 9/64"		1 — Potentiometer Adjustment Tool		1 — Phillips Screw Driver		1 — Common Screw Driver		1 — Nut Driver for Orifice, 3/8"		
1 — Tool Pouch	1 — Tool Handle														
1 — Ball Point Allen Wrench, 1/8"	1 — O-ring Tool														
1 — Ball Point Allen Wrench, 9/64"															
1 — Potentiometer Adjustment Tool															
1 — Phillips Screw Driver															
1 — Common Screw Driver															
1 — Nut Driver for Orifice, 3/8"															
<p>5866RT Break Out Board Assembly P/N S273Z649AAA Card Edge Version P/N S273Z668AAA D-Connector Version</p> <p>Installs directly between mass flow controller and interconnecting cable. Allows convenient access to all signals for easy troubleshooting of system.</p> <p>Contains:</p> <table border="0"> <tr> <td>1 — Break Out P.C. Board</td> </tr> <tr> <td>1 — 5 Foot Extension Cable</td> </tr> <tr> <td>1 — Terminal P.C. Board</td> </tr> </table>	1 — Break Out P.C. Board	1 — 5 Foot Extension Cable	1 — Terminal P.C. Board	<p>Valve Shim Kit P/N S810A372BMA</p> <p>Contains:</p> <table border="0"> <tr> <td>1 — .010" Large Spacer</td> </tr> <tr> <td>2 — .005" Large Spacers</td> </tr> <tr> <td>1 — .010" Small Spacer</td> </tr> <tr> <td>2 — .005" Small Spacers</td> </tr> </table> <p>Torque Wrench, required for assembly:</p> <table border="0"> <tr> <td>0 — 100 inch-pound Torque Wrench</td> </tr> <tr> <td>4" Extension Bar</td> </tr> <tr> <td>5/32" Allen-type Hex Wrench</td> </tr> </table>	1 — .010" Large Spacer	2 — .005" Large Spacers	1 — .010" Small Spacer	2 — .005" Small Spacers	0 — 100 inch-pound Torque Wrench	4" Extension Bar	5/32" Allen-type Hex Wrench				
1 — Break Out P.C. Board															
1 — 5 Foot Extension Cable															
1 — Terminal P.C. Board															
1 — .010" Large Spacer															
2 — .005" Large Spacers															
1 — .010" Small Spacer															
2 — .005" Small Spacers															
0 — 100 inch-pound Torque Wrench															
4" Extension Bar															
5/32" Allen-type Hex Wrench															

O-ring Kit: S375Z278-***

Table 7-4 Tool and Spare Part Kits for Model 5866RT with Metal Seals

<p>Service Tool Kit P/N S778D017AAA Gland Nut Tool and P/N S908Z048AAA 5/32" Allen Wrench P/N S908Z055ACA</p> <p>Permits the complete disassembly of the Model 5866RT (metal) for servicing</p> <p>Service Kit Contains:</p> <table border="0"> <tr> <td>1 — Tool Pouch</td> <td>1 — Tool Handle</td> </tr> <tr> <td>1 — Ball Point Allen Wrench, 1/8"</td> <td>1 — O-ring Tool</td> </tr> <tr> <td>1 — Ball Point Allen Wrench, 9/64"</td> <td></td> </tr> <tr> <td>1 — Potentiometer Adjustment Tool</td> <td></td> </tr> <tr> <td>1 — Phillips Screw Driver</td> <td></td> </tr> <tr> <td>1 — Common Screw Driver</td> <td></td> </tr> <tr> <td>1 — Nut Driver for Orifice, 3/8"</td> <td></td> </tr> </table>	1 — Tool Pouch	1 — Tool Handle	1 — Ball Point Allen Wrench, 1/8"	1 — O-ring Tool	1 — Ball Point Allen Wrench, 9/64"		1 — Potentiometer Adjustment Tool		1 — Phillips Screw Driver		1 — Common Screw Driver		1 — Nut Driver for Orifice, 3/8"		
1 — Tool Pouch	1 — Tool Handle														
1 — Ball Point Allen Wrench, 1/8"	1 — O-ring Tool														
1 — Ball Point Allen Wrench, 9/64"															
1 — Potentiometer Adjustment Tool															
1 — Phillips Screw Driver															
1 — Common Screw Driver															
1 — Nut Driver for Orifice, 3/8"															
<p>Break Out Board Assembly P/N S273Z649AAA Card Edge P/N S273Z668AAA D-Connector</p> <p>Installs directly between pressure controller and interconnecting cable. Allows convenient access to all signals for easy troubleshooting of system.</p> <p>Contains:</p> <table border="0"> <tr> <td>1 — Break Out P.C. Board</td> </tr> <tr> <td>1 — 5 Foot Extension Cable</td> </tr> <tr> <td>1 — Terminal P.C. Board</td> </tr> </table>	1 — Break Out P.C. Board	1 — 5 Foot Extension Cable	1 — Terminal P.C. Board	<p>Valve Shim Kit P/N S810A372BMA</p> <p>Contains:</p> <table border="0"> <tr> <td>1 — .010" Large Spacer</td> </tr> <tr> <td>2 — .005" Large Spacers</td> </tr> <tr> <td>1 — .010" Small Spacer</td> </tr> <tr> <td>2 — .005" Small Spacers</td> </tr> </table> <p>Torque Wrench, required for assembly:</p> <table border="0"> <tr> <td>0 — 100 inch-pound Torque Wrench</td> </tr> <tr> <td>4" Extension Bar</td> </tr> <tr> <td>5/32" Allen-type Hex Wrench</td> </tr> </table>	1 — .010" Large Spacer	2 — .005" Large Spacers	1 — .010" Small Spacer	2 — .005" Small Spacers	0 — 100 inch-pound Torque Wrench	4" Extension Bar	5/32" Allen-type Hex Wrench				
1 — Break Out P.C. Board															
1 — 5 Foot Extension Cable															
1 — Terminal P.C. Board															
1 — .010" Large Spacer															
2 — .005" Large Spacers															
1 — .010" Small Spacer															
2 — .005" Small Spacers															
0 — 100 inch-pound Torque Wrench															
4" Extension Bar															
5/32" Allen-type Hex Wrench															

O-ring Kit: S375F101AAA

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-2000.

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-forskrutninger skal enten være af metal eller metal skærmet.

Skærmen skal forbindes, i begge ender, til stikkets metalhus eller PG-forskrutningen 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-2000.

Nach erfolgreichen Tests entsprechend den Vorschriften 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 %igen Schirmabdeckung des Kabels gewährleistet ist.

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

Wenn möglich, sollten Kabeldurchführungen mit Anschlußmöglichkeiten für die Kabelabschirmung 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-Steckverbindungen 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.

Model 5866RT

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-2000.

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-2000.

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 2000.

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.
Εχετικά : Πιστοποίηση CE των Οργάνων Μέτρησης Παροχής Μάζας.
Ημερομηνία : Ιανουάριος - 1996

Κυρίες και Κύριοι,

Για όργανα (ηλεκτρικά/ηλεκτρονικά) της Brooks τα οποία φέρουν το σήμα CE έχουν πιστωχώς ελεγχθεί σύμφωνα με τους κανονισμούς της Ηλεκτρο-Μαγνητικής Συμβατότητας (EMC ντιρεκτίβα 89/336/EEC).

Πωσδήποτε χρειάζεται ειδική προσοχή κατά την επιλογή του καλωδίου μεταφοράς ου σήματος το οποίο (καλώδιο) πρόκειται να χρησιμοποιηθεί με όργανα που φέρουν ο σήμα CE.

Ιοιότητα του καλωδίου σήματος των τυποθλιπτών και των συνδέσμων .

Ι Brooks κατά κανόνα προμηθεύει υψηλής ποιότητας καλώδια τα οποία πληρούν τις ροδιαγραφές για πιστοποίηση CE.

ΐάν η επιλογή του καλωδίου σήματος γίνει από σας πρέπει να χρησιμοποιήσετε αλώδιο το οποίο να φέρει εξωτερικά πλήρες πλέγμα και να παρέχει θωράκιση 00%.

η σύνδεσμοι τύπου "D" ή "Κυκλικοί" των καλωδίων, πρέπει να θωρακίζονται με εταλλική θωράκιση. Εάν είναι εφαρμόσιμο, πρέπει να χρησιμοποιούνται μεταλλικοί τυποθλίπτες καλωδίων που να διαθέτουν ακροδέκτη σύνδεσης του πλέγματος του αλώδιου.

ο πλέγμα του καλωδίου πρέπει να συνδέεται στο μεταλλικό περιβλημα ή στον τυποθλίπτη και να θωρακίζεται και στα δύο άκρα κατά 360 μοίρες.

Ι θωράκιση πρέπει να καταλήγει σε κάποιο ακροδέκτη γείωσης.

ι σύνδεσμοι καρτών είναι μη-μεταλλικοί, τα καλώδια που χρησιμοποιούνται πρέπει ι φέρουν πλέγμα θωράκισης 100% για να υπακούουν στην πιστοποίηση CE.

θωράκιση πρέπει να καταλήγει σε κάποιο ακροδέκτη γείωσης.

ια την διάταξη των ακροδεκτών: Παρακαλούμε αναφερθείτε στο εσώκλειστο γχειρίδιο Οδηγιών.

Model 5866RT

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 2000.

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 Elettromagnetica (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 estremità.

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 2000.

Dames en heren,

Alle CE gemarkeerde elektrische en elektronische producten 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 producten.

Kwaliteit van de signaalkabel en kabelaan sluitingen:

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 instructie 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 2000.

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 lederne benyttes. "D" type og runde plugger og forbindelser må være utført med kappe i metall og kabelnipler må være utført i metall for jordnet innfesting av skjermen. Skjermen i kablen 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 2000.

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 requisitos 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 360°.

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.

Model 5866RT

Suomi

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

Asia : Lisäys Käyttöohjeisiin
Viite : Massamäärämittareiden CE sertifiointi
Päivämäärä : Tammikuu 2000

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 sertifiointivaatimukset. Hankkiessaan signaalikaapelin itse, olisi hankittava 100%:sti suojattu kaapeli.

”D” tai ”Circular” tyyppisen liittimen tulisi olla varustettu metallisuojaalla. Mikäli 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 sertifiointivaatimusten 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 2000

Brooks (elektriska / elektronik) utrustning, som är CE-märkt, har testats och godkänts enligt gällande regler för elektromagnetisk kompatibilitet (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 ändrar, 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% skärmade 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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Model 5866RT**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:

Americas	☎ 1-888-554-FLOW	
Europe	☎ +(31) 318 549 290	Within Netherlands ☎ 0318 549 290
Asia	☎ +011-81-3-5633-7100	

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

TRADEMARKS

Brooks	Brooks Instrument, LLC
Freon TF	E. I. DuPont de Nemours & Co.
Fomblin	Ausimont S.p.A.
Kalrez	DuPont Dow Elastomers
Teflon	E. I. DuPont de Nemours & Co.
VCO, VCR	Cajon Co.
Viton	DuPont Performance Elastomers
Vol-U-Meter	Brooks Instrument, LLC

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