



Vari-Q™ Throttling Valve

U.S. Patent No. 4,393,896

Owners Manual

Models VQ-SM & VQ-PA

MeiVac, Inc.
5830 Hellyer Avenue
San Jose, CA 95138, USA

Safety Procedures and Precautions

WARNING

Owners of MeiVac Vari-Q Throttle Valves *should not* open chamber/pump isolation valve unless the Vari-Q Valve is in the 100% open position.

Throttle valves not fully open when subjected to high pressure differential across the valve, could cause the vanes of the throttle valve to be pulled from the center hub and/or otherwise damaged. This will void the MeiVac warranty.

WARNING

Pneumatically actuated (PA) type valves with micrometer adjustment *must have exhaust restrictors* installed to control the speed of the valve movement thereby minimizing the potential for the valve to slam open or closed. Maximum air pressure to the pneumatic actuator is not to exceed 55 PSI.

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1. GENERAL DESCRIPTION

1.1 Introduction

This manual details the operation and maintenance of the Vari-Q pressure control system, a new dimension in pressure control technology manufactured by MeiVac Incorporated. Procedures are given for installation, use and maintenance of the various system elements. This manual should be carefully read prior to installation of the equipment or use of the system. And, the procedures described in this manual should be followed to maximize the system's unique capabilities.

1.2 VARI-Q Throttle Valve

The MeiVac Vari-Q throttle valve consists of a flange and a number of triangular vanes radially disposed around a central split hub. The number of vanes depends upon the flange diameter. For example, the VQ-6-ASA (6-inch valve) has 12 vanes while the VQ-10-ASA (10-inch valve) has 20 vanes.

Each vane has a rotating pin (shaft) brazed to the vane point end, and a pulley, with a spherical machined rear or outside surface, brazed to the vane wide end. Each pulley has a short shaft protruding from the center of the back surface, which acts as a rotational hinge point when installed in the flange body. The vanes are actuated by a narrow continuous stainless steel cable, which threads sequentially over and under each succeeding pulley. Both ends of the cable are secured to a driver vane assembly that incorporates the drive and vacuum shaft seal. All vane-pulley assemblies are physically attached to the stainless steel cable for precise alignment and to prevent vane slippage.

As the vanes open, the conductance changes linearly to modulate the pumping speed of the chamber. Vane shape and operation (counter rotation) provide very high OPEN pump-down throughput and linear control resolution during throttle operation.

The Vari-Q throttle valve has been used with most high vacuum pumps, including cryogenic, diffusion, conventional (ceramic) bearing turbo-molecular and mag-lev bearing turbo-molecular pumps.

1.3 Functional Description

Vari-Q Throttle Valves can be used with multiple actuator types and come in variety of flange styles, sizes and operating modes:

- Actuators
 - Pneumatic actuators (PA) stop valves at two positions, fully open or a fixed throttle position adjustable by a micrometer on the valve body. These actuators are typically used for upstream pressure control (see below).
 - Servo Motor (SM) actuators position the vanes anywhere between full open and full closed. This configuration is normally coupled with a controller, such

as an MKS 2252 or 651C. These actuators may be used for upstream or downstream pressure control (see below).

- Flange Styles, Materials and Sizes
 - MeiVac valves are available in a wide variety of sizes, materials and styles. Contact MeiVac or your local MeiVac sales representative for more details

1.4 Pressure Control Methods

In normal applications there are two forms of pressure control. MeiVac Vari-Q throttle valves are capable of handling one or both of these control methodologies.

Upstream Pressure Control

Upstream pressure control is control of the vacuum level in the chamber by varying process gas flow against a fixed pumping speed. A common configuration has an MFC (mass flow controller) operating closed loop with an external pressure set point and a pressure measurement device.

A PA model Vari-Q valve is designed specifically for this application. On actuation, the vanes are moved to a fixed throttle position. This position is mechanically adjustable, with a precision micrometer, external to the valve body.

PA Advantages:

- Lower cost,
- Ease of installation and configuration.

PA Disadvantages:

Operation:

- Only 2 positions, e.g. fully open or a single adjustable position.
- Adjustment to the throttle position must be made at the valve body.

Process:

- Poor response to residual gas events

In instances where a pressure burst of non-process gas occurs, such as initiation of plasma, upstream control can be problematic. Upstream's reaction to this occurrence is to REDUCE the flow of process gas to control pressure. The result of this action is the worsening of the process gas to contaminant ratio and a higher residual gas presence in the first critical layers of a process. Without increased pumping speed, the event lasts longer than Downstream.

SM driven valves may also be used for upstream pressure control. An advantage of SM over PA is the ability of the SM actuator to adjust valve position from its controller.

Downstream Pressure Control

Downstream pressure control is control of the vacuum level in the chamber by varying pumping speed (valve position in this case) against a fixed process gas flow. Common configurations would have one or more MFCs flowing a fixed rate and/or ratio of process gas(es). A motor driven throttle valve would have its

valve position drive motor controlled by a pressure controller that was monitoring vacuum level vs. set points.

SM and MK versions of the MeiVac Vari-Q throttle valve normally are used in these applications. Pressure controllers are available in standard commercially available rack mounted or valve mounted models.

SM Advantages:

- Flexibility in process control Ratios of gas flow and pumping speed can easily be changed prior to or during process steps.
- Potentially higher quality process results

In instances where a pressure burst of non-process gas occurs, such as initiation of plasma, process gas flow and pressure remain constant. The duration of the event is significantly reduced, compared to upstream pressure control, due to increasing pump throughput. Less process gas dilution and faster recovery time combine to improve deposited film quality. This is particularly true during the first few adhesion promoting monolayers.

1.5 Control Options

Three options are available for valve control.

- PA - Used for upstream pressure control.
- SM - Used in conjunction with a pressure controller such as an MKS 651.
- MK - An integrated servo motor and pressure controller that mounts on the valve body. The only such actuator currently available is the MKS 2153.

Pneumatically Actuated VQ Throttle Valve

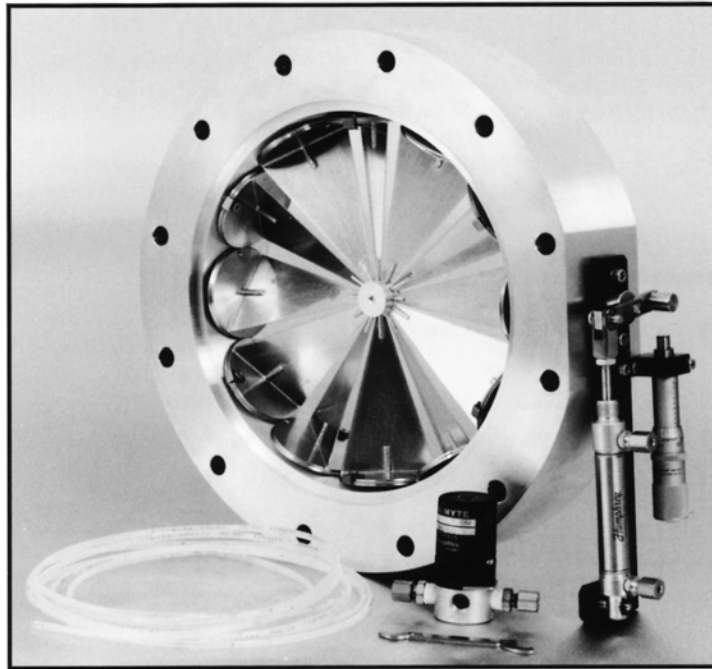


Figure 1

PA type valves with micrometer adjustment **must have exhaust restrictors** installed to control the speed of the valve movement thereby minimizing the potential for the valve to slam open or closed. Maximum air pressure to the pneumatic actuator is not to exceed 55 PSI.

Servo Motor Driven VQ Throttle Valve

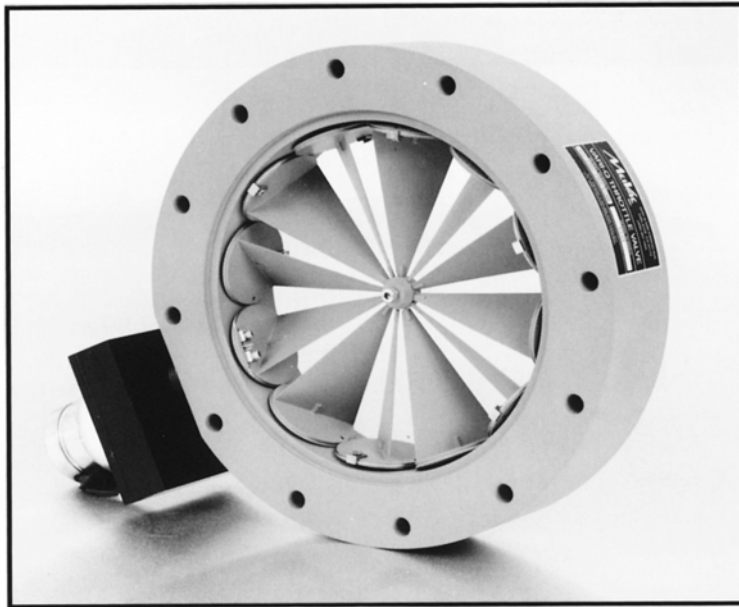


Figure 2

2. SPECIFICATIONS: VARI-Q VALVE

Dimensions:

See size diagram Figure 3 and Table 1. Other sizes may be available by special order.

Conductance:

Infinite adjustment from less than 20 l/sec to greater than 61,000 l/sec depending upon model. (See Table 2)

Size Diagram of VQ Throttle Valves

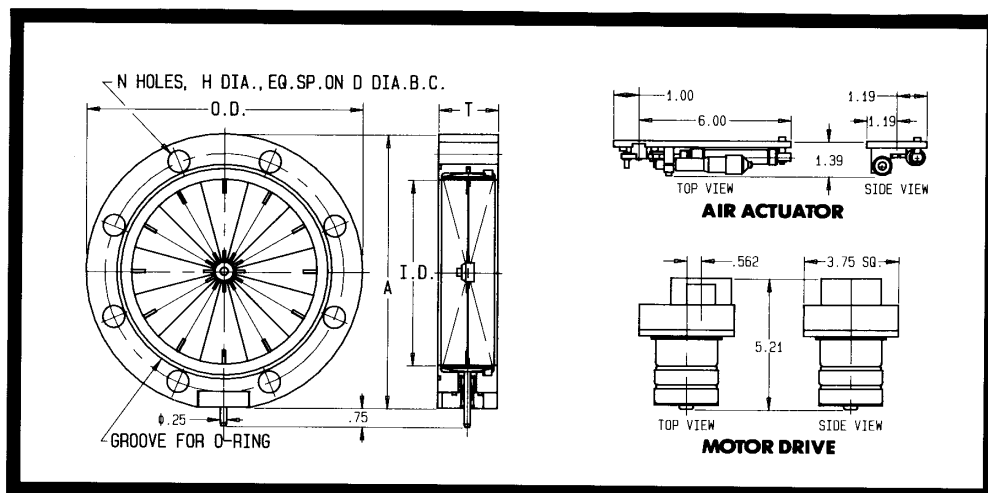


Figure 3,

DIMENSIONS OF VQ THROTTLE VALVE

Model	O.D.	I.D.	T	A	N	H	D	O-Ring
VQ-200-JIS-XX-0	11.811	7.376	2.375	11.30	8	0.593	10.603	225mm ID x 6mm C/S
VQ-250-JIS-XX-0	13.780	9.898	2.500	14.32	12	0.594	12.598	275mm ID x 6mm C/S
VQ-300-JIS-XX-0	15.748	11.875	2.375	15.67	12	0.594	14.567	325mm ID x 6mm C/S
VQ-400-JIS-XX-0	20.472	16.000	2.750	20.57	12	0.748	18.899	430mm ID x 6mm C/S
VQ-450-JIS-XX-0	22.638	18.000	2.750	22.81	16	0.750	21.063	480mm ID x 10mm C/S
VQ-100-ISO-XX-0	6.496	4.016	1.750	6.87	8	0.354	5.709	NA
VQ-160-ISO-XX-0	8.858	6.024	2.250	9.32	8	0.433	7.874	NA
VQ-200-ISO-XX-0	11.220	7.376	2.375	11.00	12	0.437	10.236	NA
VQ-250-ISO-XX-0	13.190	10.291	2.750	13.72	12	0.437	12.205	NA
VQ-320-ISO-XX-0	16.730	12.520	2.375	16.75	12	0.547	15.551	NA
VQ-400-ISO-XX-0	20.079	15.758	2.750	20.38	16	0.546	18.899	NA
VQ-6-CF-SS-0	5.97	3.699	1.000	6.16	16	0.330	5.130	Cu Gasket
VQ-8-CF-SS-0	7.97	5.702	0.870	8.30	20	0.332	7.128	Cu Gasket
VQ-10-CF-SS-0	9.997	6.438	0.970	10.35	24	0.332	9.128	Cu Gasket
VQ-12-CF-SS-0	12.000	9.868	2.500	12.51	32	0.344	11.181	Cu Gasket
VQ-4-ASA-XX-0	9.000	4.016	2.250	8.87	8	0.688	7.500	#2-431
VQ-6-ASA-XX-0	11.000	7.376	2.375	10.89	8	0.875	9.500	#2-267
VQ-8-ASA-XX-0	13.500	7.376	2.375	13.00	8	1.062	11.750	#2-272
VQ-10-ASA-XX-0	16.000	11.875	2.375	15.89	12	0.937	14.250	#5-905
VQ-16-ASA-XX-0	23.500	18.000	2.750	23.68	16	1.125	21.250	#2-466
VQ-20-ASA-XX-0	27.500	21.000	3.250	27.62	20	1.250	25.000	#2-471
VQ-32-ASA-XX-0	38.000	32.120	5.250	38.19	16	0.880	36.250	32.750 ID x .275 C/S
VQ-35-ASA-XX-0	41.750	35.000	5.250	41.68	14	1.625	38.500	35.000 ID x .275 C/S

MeiVac will custom design throttle valves to your specifications. Consult factory for details.

Table 1

TYPICAL CONDUCTANCE PERFORMANCE CHARACTERISTICS

Model	Minimum Conductance (l/s)	Maximum Conductance (l/s)
VQ-200-JIS	31	2443
VQ-250-JIS	56	4587
VQ-400-JIS	139	12168
VQ-450-JIS	158	12510
VQ-100-ISO	16	660
VQ-160-ISO	19	1591
VQ-200-ISO	31	2443
VQ-250-ISO	56	5085
VQ-320-ISO	88	7685
VQ-400-ISO	139	16356
VQ-6-CF	10	627
VQ-8-CF	28	1612
VQ-10-CF	26	2177
VQ-4-ASA	11	619
VQ-6-ASA	31	2443
VQ-8-ASA	31	2443
VQ-10-ASA	69	6884
VQ-16-ASA	158	16261
VQ-20-ASA	178	22023
VQ-32-ASA	273	51249
VQ-35-ASA	300	61685

Table 2

3. INSTALLATION AND OPERATION

3.1 PLEASE READ AND UNDERSTAND ALL INSTRUCTIONS BEFORE OPERATION.

1. Remove the equipment from the shipping containers. Save the containers and packing materials for possible future use.
2. Inspect the Vari-Q Valve and the Controller for any physical damage, which might have occurred in transit. If damage is visible, refer to the instructions under "Claims & Returns" in this manual.

3.2 PREPARATION FOR USE

- The shipment MAY contain the following items. Check your packing slip:
 - Vari-Q Valve with Pneumatic Actuator or with Servo Motor
 - *O-Rings
 - *Controller with AC Power Cord
 - *Interconnecting Cable with Connectors, Instruction Manual(s)

**Notes:*

- *Controller and interconnect cable are sold separately, not included in Valve part number.*
- *ASA and JIS models include flange o-ring.*
- *ISO flanges do NOT include a centering ring assembly.*
- *CFTM flanges do NOT include a metal gasket.*

If any of the items on the packing slip are missing, contact your local representative or MeiVac, Inc. Customer Support, 5830 Hellyer Avenue, San Jose, CA 95138, USA, Telephone: 1.408.362.1000.

3.3 PRELIMINARY OPERATION

The Vari-Q valve should be cycled prior to installation in the vacuum system to verify that all components are correctly adjusted and operating properly. Proceed as follows.

1. For valves with controllers, place the valve and controller (sold separately) on a bench. A source of 115 or 230 VAC will be required.
2. Install the interconnecting cable (sold separately).
3. Prior to connecting the controller to 115 VAC or 230 VAC, be sure that the voltage selector switch on the rear panel is in the proper position.
4. Put the valve controller in the Manual mode.

5. Have the valve controller command the valve to open. The orifice blades should move to the fully open position.

Note: The Vari-Q valve is designed so that the vanes are self-adjusting and always end up either fully open or fully closed. Over-driving the valve a small amount will have no effect on the vane orientation.

6. Have the valve controller command the valve to close. The orifice blades should move to the fully closed position.
7. The orifice blades should move freely through their entire range of travel. If any binding is evident, refer to Section 7.

3.4 SYSTEM DESIGN

Figure 4 shows the usual setup for standard downstream pressure control. The VQ-SM valve should be in series with an isolation high vacuum valve. The pressure transducer can be one of a number of units (See Table 3).

Connect the sensor to the vacuum chamber using the shortest possible tubing lengths with minimum restrictions. For ½ inch diameter tubing, lengths should be no longer than 6 inches. Never reduce the tubing diameter to less than that of the transducer. Fittings should be checked to make sure that they do not have restrictions (small passages). Antechambers off the main vacuum chamber or other small volumes should be kept to a minimum, as they can make system stabilization difficult or impossible to achieve. If the chamber is repeatedly opened to the atmosphere, an isolation valve should be installed to protect the transducer.

An important consideration is the peculiarity associated with diffusion pumps known as choking. If too much gas is introduced into the vacuum chamber at too high a pressure, the diffusion pump pumping speed changes radically and erratically. This behavior is easily recognized by lack of stability at set point, making control impossible at times. Closing down the inlet to the pump is the only solution. Note: Diffusion pumps should never be operated at inlet pressures above that at which the "top jet" will experience a pressure in excess of 5×10^{-4} Torr.

3.5 INSTALLATION OF THE VARI-Q VALVE

1. Follow normal procedures to bring the vacuum chamber to atmosphere.
2. Normally the Vari-Q valve will be installed in series with the vacuum chamber, the high-vacuum valve, a high-vacuum pump, a cryogenic trap (if used) and a roughing pump. Remove the appropriate nuts and bolts to create sufficient space above the high vacuum pump.
3. Lubricate the O-ring furnished with the Vari-Q valve.

4. Install the o-ring in the groove machined in the Vari-Q valve. *For an ISO flange, this is a centering ring (sold separately). For a CF flange, this is a metal gasket (sold separately).*
5. Place the Vari-Q valve in the open space between the high-vacuum pump and cryogenic trap (or vacuum valve if no cryo trap is used) and bolt it in place.
6. After completing the installation verify the system's vacuum integrity.

Caution!

Do not inject alcohol, acetone, or other solvents around the valve. Damage to the shaft seals may result.

7. If included, position the controller in a convenient location. It may be mounted in a standard 19-inch equipment rack or left free-standing, as desired.
8. Connect the appropriate cable between the Vari-Q valve and the rear panel of the controller.
10. Before plugging in the AC line cord, turn the power switch OFF and confirm that the voltage selector on the rear panel is in the proper position.
11. Connect the AC power cord from the rear panel of the controller to a source of main power.
12. Exercise the throttle valve as described above under **Preliminary Operation** (Section 3.3) and verify that all components continue to move freely.

3.6 PRESSURE CONTROLLER INTERFACE,

Refer to appropriate manufacturer's manual for controller set up. Links to selected controller manuals are provided here:

SM-651C CONTROLLER
SM-2153D CONTROLLER
SM-2252E CONTROLLER

3.7 PRESSURE TRANSDUCERS

Pressure transducer compatible with the pressure controller you select can be used as the feedback element of your pressure control loop. A number of pressure transducer options and their corresponding interconnecting cables are listed in Table 3.

Refer to appropriate manufacturer's manual for transducer set up.

Example Pressure Transducers

Transducer MKS	Recommended Pressure Ranges Available Torr	Interconnecting Cable	Output Voltage F.S. Volts
310/170M-6	1, 10, 100, 1000	CB-254-6	10
220 or 220B	1, 10, 100, 1000	CB-254-10	10
220A	10, 100, 1000	CB-254-4	10
221	10, 100, 1000	CB-254-1	10
222	10, 100, 1000	CB-254-2	10
227	1, 10, 100, 1000	CB-254-11	10

Table 3

Typical VQ-SM Control Loop

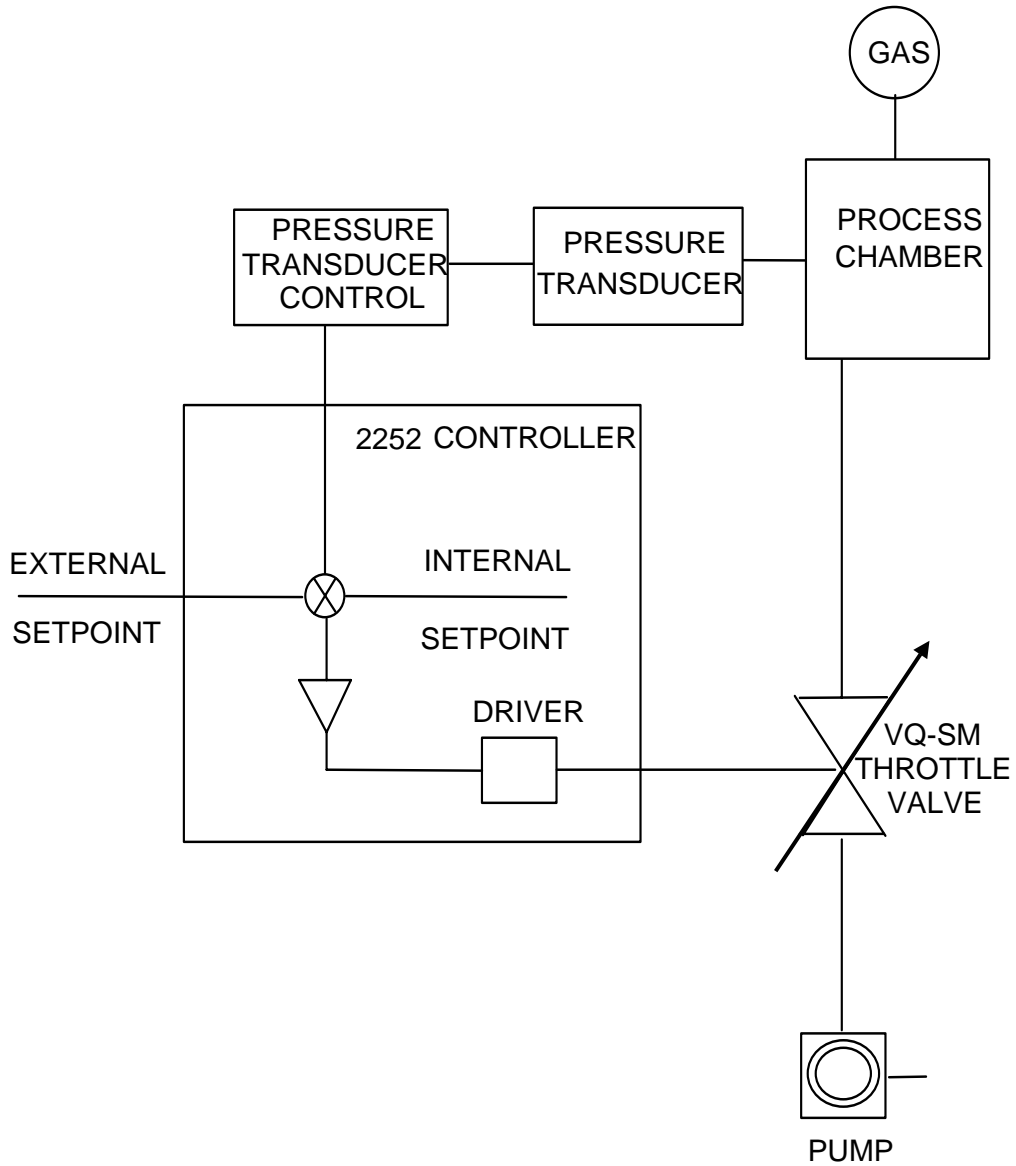


Figure 4

4. BASIC CONTROL THEORY, DOWNSTREAM PRESSURE CONTROL

The purpose of a pressure controller is to compare the desired pressure level (set point) with the actual pressure level (feedback input) and make appropriate corrections in pumping speed, via adjustments on the valve, until the actual pressure equals the desired pressure.

Figure 4 shows a simple pressure control loop consisting of a pressure transducer, controller, control valve, process chamber and pump. The pressure transducer converts pressure to an electrical signal, which is compared in the controller to the set point. Set points can originate from pressure controllers, system controllers or a precision potentiometer.

Any error between the feedback and set point signals is amplified by the controller and fed to the valve. For example, if the pressure is higher than the set point, the controller will open the valve allowing the pump to remove more gas than is entering, thereby reducing the pressure.

An additional capability of many controllers is to provide a stabilizing control. This control allows the operator to compensate for the different delays or lags, which occur in different systems. This capability is called "Phase Lead" in MKS controllers.

5. TROUBLESHOOTING SEQUENCE

1. Check for obvious problems such as power off, open fuse, defective line cord, input power failure, or loose connections.
2. Check all control settings. *Refer to appropriate control manuals*
3. If the trouble is traced to a MeiVac supplied Vari-Q valve or a pressure controller or other component that has been supplied by MeiVac, contact your local representative or MeiVac, Inc. Customer Support for problem disposition instructions. If it is necessary to return any part to MeiVac, Inc., follow the instructions for Authorized Returns found in the Claims & Returns section of this manual.

6. ALIGNMENT AND MAINTENANCE

Pressure control is a demanding process. It is highly recommended that if calibration or service is required on a Vari-Q valve that it is accomplished at the MeiVac factory or by a distributor using factory trained service personnel.

6.1 SERVICING OF THE VARI-Q VALVE

The O-ring, stainless steel cable, shaft seal and motor drive are the only items that are ever likely to need service. Maintenance procedures for these elements are listed below. The Vari-Q valve is pre-adjusted at the factory; no calibrations or further adjustments should be required under normal use.

6.2 VARI-Q VALVE DISASSEMBLY

To disassemble the Vari-Q valve, use the following procedure and refer to the items called out on Figure 5.

1. Remove motor assembly or pneumatic actuator assembly from driver shaft. Refer to Figure 6 or Figure 7 respectively.
2. Remove both driver cable clamps (1) and all pulley clamps.
3. Carefully unlace or pull out stainless steel cable (2).
4. Unscrew and remove split central hub (3).

CAUTION:

COMPLETE DISASSEMBLY WITH THE VALVE HORIZONTAL, OR ALL VANES WILL FALL OUT.

5. Remove all vanes (4).
6. Remove driver vane assembly (5).

NOTE:

IF THE VALVE IS KEPT FLAT ON A TABLE TOP THE SHAFT SEAL ELEMENTS MAY BE REMOVED AS DESCRIBED IN SECTION 6.6.

7. Reassemble in reverse order.

IMPORTANT: See NOTE in section 6.4

6.3 FREEPLAY ADJUSTMENT

Perform the following adjustments to assure that the Vari-Q vanes open and close smoothly.

1. With the stainless steel cable threaded and clamped at one end, pull on the other end with needle nose pliers.
2. While maintaining tension on the cable with the pliers, rotate the vanes back and forth until all vanes work uniformly.
3. Install clamp on free end of the cable.
4. Adjust all vanes to the closed position and clamp vanes to cable.

NOTE: Vanes are universal and may be clamped to the cable to allow left or right rotation. Select the correct rotation direction and then tighten the clamps.

VALVE COMPONENTS

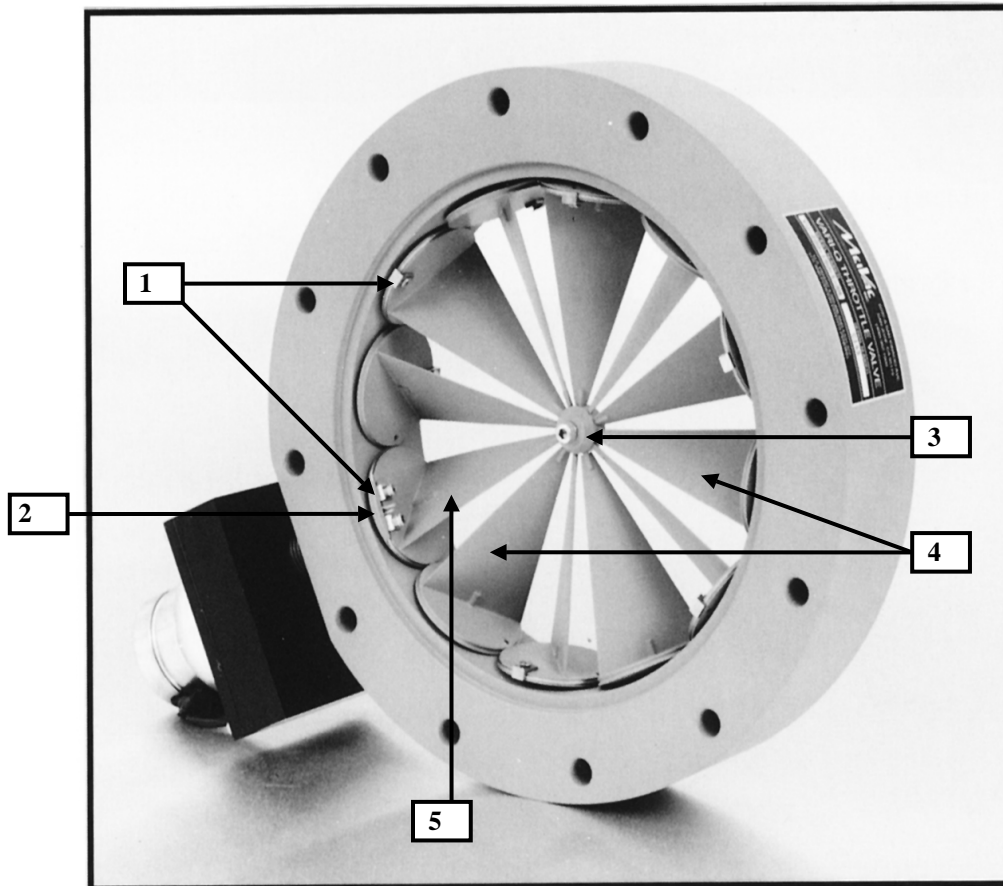


Figure 5

6.4 MOTOR DRIVE REMOVAL

Caution: Before starting the removal operation, connect the motor to the control power supply and close the throttle valve.

Refer to Motor drive assembly drawing Figure 6. The item numbers below are keyed to this drawing.

1. Loosen flexible shaft coupling (1) by unscrewing retaining screw, which is accessed through an opening in the locking plate (5).
2. Remove four socket head screws (2).
3. Remove motor plate (3) by pulling straight out away from the gear box (4).

Caution: Throttle valves manufactured after October 1, 1997 will have a 1/8" shaft key installed in the flexible coupler. Locate key and set aside for reuse later, when motor is reinstalled.

4. Remove two socket head screws holding the gear box (4), to the flange.
5. Remove gear box (4) and Locking Plate (5).
6. The shaft seal elements are now free to come out. Refer to Section 6.6.

NOTE:

Throttle valves manufactured before October 1997

Before replacing motor assembly, connect the motor to the control power supply and rotate the motor to the open and closed position, checking both limit switches. **Rotate the motor assembly and the throttle valve vanes to their closed position before installing.** After replacing motor assembly, tighten the shaft coupler screw to 30 in/lb. Use of a calibrated torque tool is required.

Throttle valves manufactured after October 1, 1997

Before replacing motor assembly, connect the motor to the control power supply and rotate the motor to the open and closed position, checking both limit switches. **Rotate the motor assembly and the throttle valve vanes to their closed position before installing.** Insert the 1/8" key in the shaft, then while holding motor plate assembly (3) slide the coupler into position. Replace the four screws (2), and then tighten setscrew on shaft coupler. If the vanes moved and are not in the fully closed position, (rotated cw or ccw), you will need to readjust the coupler position, reference to the stop limit switch. Refer to Figure 6A.

Remove the motor assembly plate (3), and connect the motor to the controller power supply. rotate the motor to the closed position. Check the alignment of the coupler slit. If the alignment not correct, loosen the cam (7), locking screw and jog the motor one way or the other until the coupler slit is parallel with the sides of the cover (3). With the coupler aligned, push the cam (7), tightly against the close limit switch and tighten the cam (7), clamping screw. Reassemble motor assembly plate (3) per instructions. Repeat cam adjustment until vanes remain closed with all screws tight.

Motor Drive Assembly

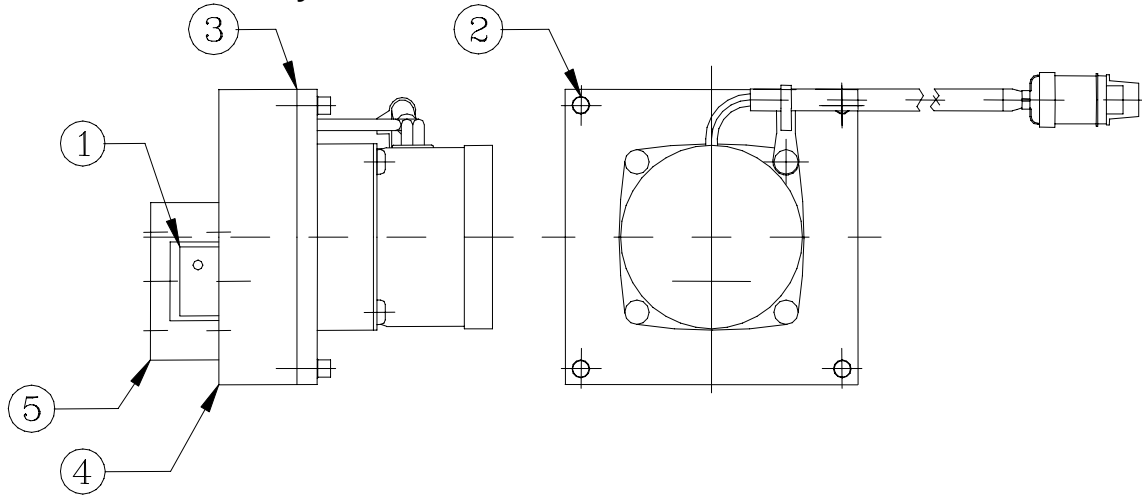


Figure 6, Motor Shown with Hex Connector

Motor Drive Inside View

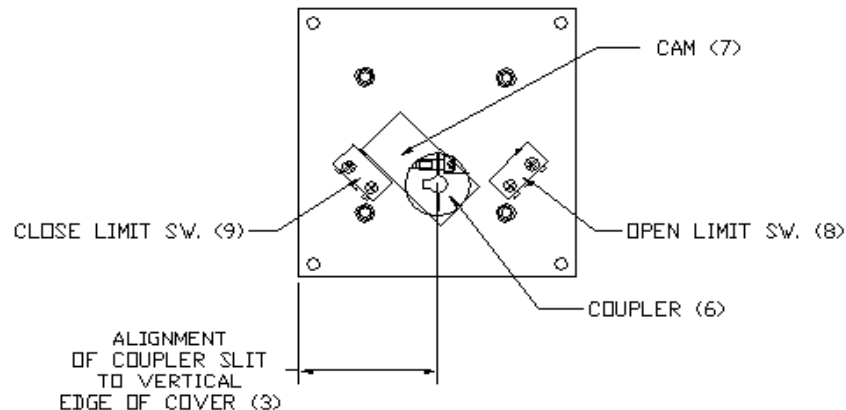


Figure 6 A

6.5 MANUAL ACTUATOR REMOVAL

Refer to drawing Figure 7. Note that when the pneumatic piston is all the way in, the vanes are in the fully open position.

1. Loosen the screw on the shaft clamp. (1)
2. Remove the two screws (2) holding the assembly to the valve and set aside.

NOTE: When reinstalling actuator assembly, adjust the driver shaft so that all vanes are in the fully open position, then tighten the clamp.

PA type valves with micrometer adjustment must have exhaust restrictors installed to control the speed of the valve movement thereby minimizing the potential for the valve to slam open or closed. Maximum air pressure to the pneumatic actuator is not to exceed 55 PSI.

Pneumatic Drive Assembly

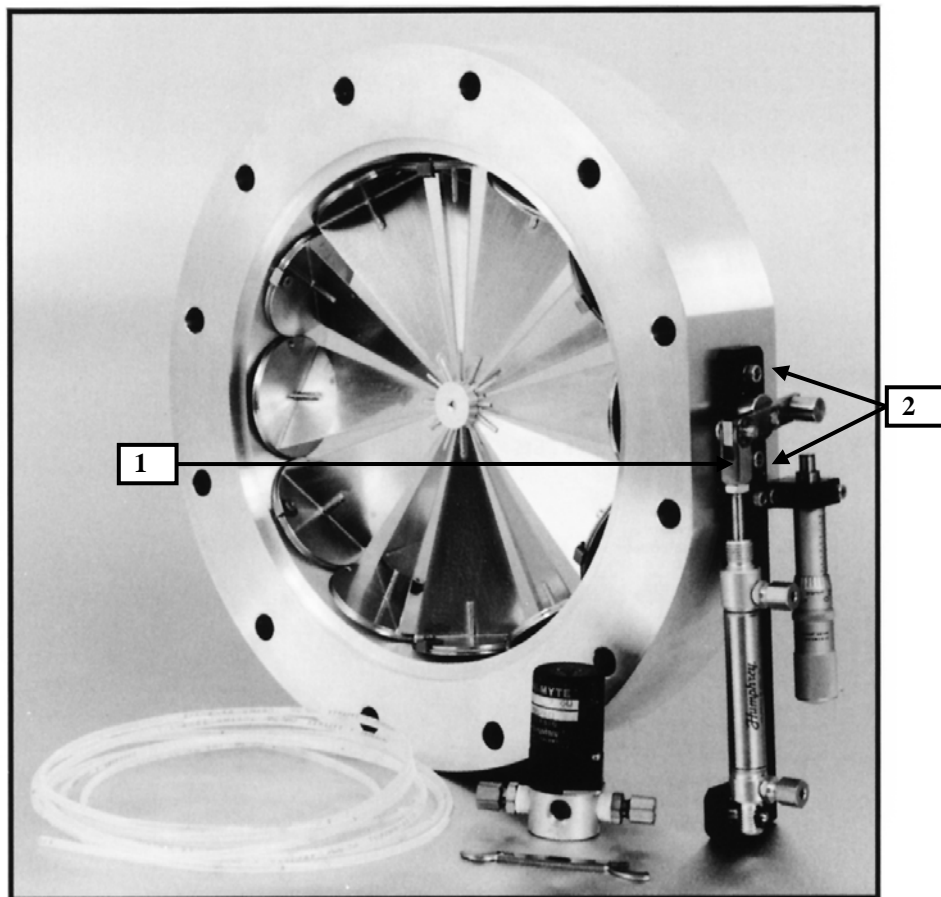


Figure 7

6.6 SHAFT SEAL DISASSEMBLY

The shaft seal has more than a dozen elements and should be disassembled only by an experienced vacuum technician. Refer to items listed on drawing, Figure 8.

1. To access shaft seal elements, go through Vari-Q valve disassembly, Section 6.2, and motor drive removal, Section 6.4, or manual actuator removal, Section 6.5, procedures.
2. With the vane-actuating shaft and locking plate removed, carefully remove the shaft seal elements.
3. Remove each seal element with care, being sure to note the following order of assembly.

Shaft Seal Parts List

Nomenclature	Item.	MeiVac Part #
Bearing spacer	(1)	1767-0806-3
Ball bearing	(2)	1995-0848-3
Bearing spacer	(1)	1767-0806-3
Precision washer	(3)	1765-0845-3
O-ring	(4)	2310-2202-2
Precision washer	(3)	1765-0845-3
Bellville washers	(5)	1770-0804-3
Precision washer	(3)	1765-0845-3
O-ring	(4)	2310-2202-2
Precision washer	(3)	1765-0845-3
Bearing spacer	(1)	1767-0806-3
Ball bearing	(2)	1995-0848-3
Locking plate	(6)	0100-0782-0

Table 4

4. Inspect each element for wear. Clean or replace as required. Lightly coat the O-rings with Apiezon "L" vacuum grease prior to installation.

SHAFT SEAL ASSEMBLY

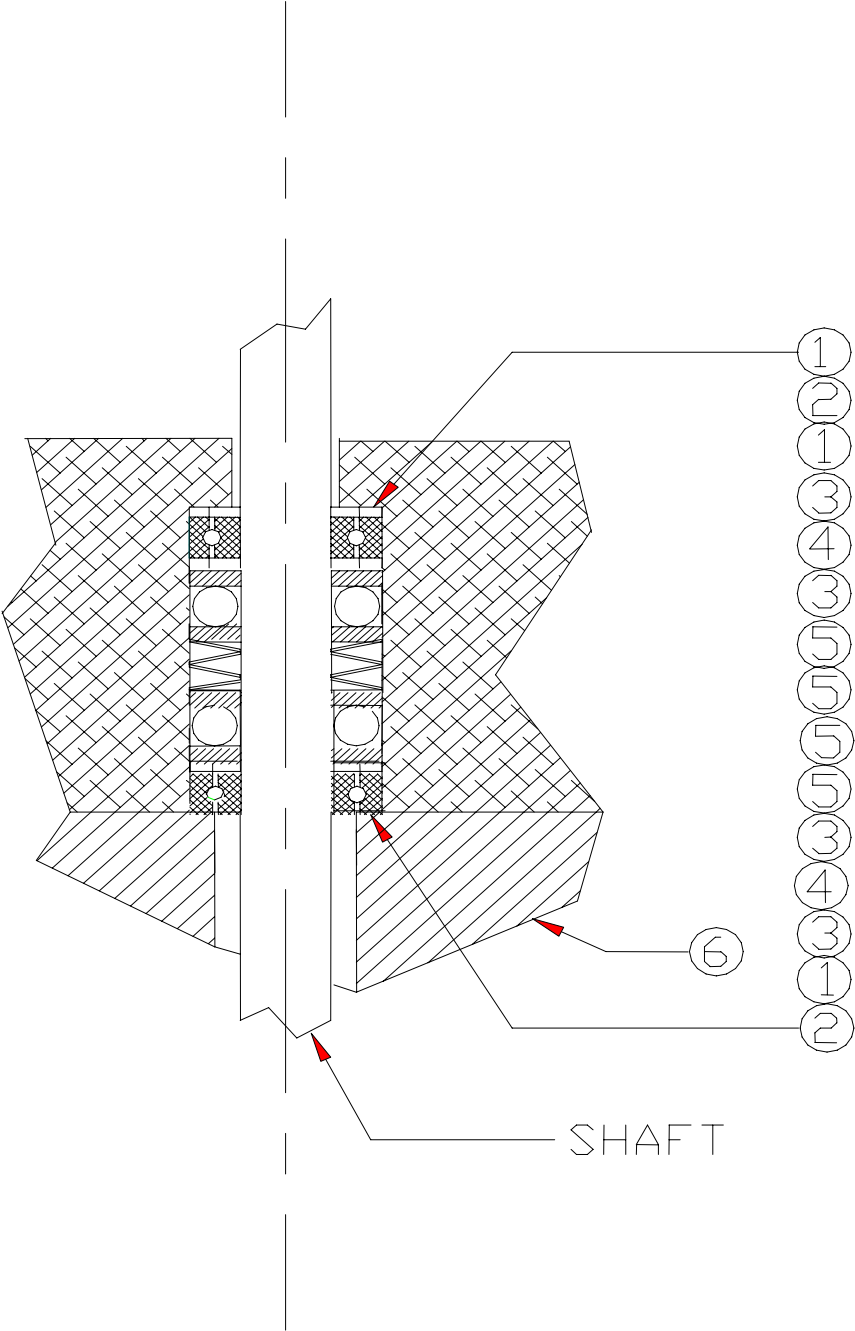


Figure 8

7. Claims & Returns

Shipping and Handling Claims

The Purchaser should inspect the product carefully as soon as it is received and test it in accordance with any instructions that may be provided. If damage is noted, or the product fails to operate properly as the result of transportation damage, a claim should be filed with the common carrier and a copy forwarded to MeiVac or MeiVac's local Distributor. MeiVac or its local Distributor will not recognize any claim for equipment damaged as a result of transportation damage if the claim is submitted more than thirty days after Purchaser's receipt of the product. Failing to report any damage within this thirty day period shall be considered an acknowledgement by Purchaser that the product was received undamaged.

Warranty Claims

For a warranty claim to be valid, it must:

- be made within the applicable warranty period,
- include the product serial number and a full description of the circumstances giving rise to the claim,
and if a material return is required,
- have been assigned an RMA number (see **Authorized Returns**) by MeiVac or its Distributor.

Purchaser's exclusive remedy and MeiVac's sole responsibility related to warranty claims shall be as set forth in the **MeiVac, Inc. Terms and Conditions of Sale** available from MeiVac, its Distributor or MeiVac's web site (www.meivac.com).

Purchaser is responsible for obtaining authorization to return any defective units, prepaying the freight costs, and ensuring that the units are returned to the location identified by MeiVac on the RMA (see **Authorized Returns**). Provided the work required on the unit is covered under the Warranty, MeiVac will replace the affected unit or repair it at no charge to Purchaser. On completion of said repair or replacement, the unit will be returned (freight prepaid) to the Purchaser. Whoever ships the unit (either Purchaser or MeiVac) will be responsible for properly packaging and adequate insurance.

Authorized Returns

Before returning any product for any reason, Purchaser shall call MeiVac or its Distributor to advise the serial number of the unit and discuss the reason for return. This consultation call shall be at no charge to the Purchaser and will allow MeiVac or its Distributor to determine if the unit must actually be returned. If it is determined that the unit needs to be returned a **Return Material Authorization (RMA)** number will be issued. This RMA number must be referenced on all paperwork associated with the return, and be prominently displayed on the outside of any packaging that the unit is being returned in.

Units that are returned without MeiVac's or its Distributor's authorization will be held by MeiVac or its Distributor until such time as Purchaser can identify the reason for the return, after which, action deemed appropriate by MeiVac or its Distributor (including return of the unit to Purchaser freight collect) shall be taken.

Terms governing all products sold by MeiVac, Inc. are the MeiVac Terms and Conditions of Sale. These can be found on the MeiVac, Inc. web site (www.meivac.com) or obtained from your local representative.

Please refer to the MeiVac Website for a
list of representatives in your area.

www.meivac.com

For operational or applications questions
regarding MeiVac products, contact:

support@meivac.com

QUALITY VACUUM PRODUCTS & SERVICES
5830 Hellyer Avenue, San Jose, CA 95138
Telephone: (408) 362-1000 Fax: (408) 362-1010