



OUR PRODUCTS DEVELOP TOMORROW'S TECHNOLOGIES™

DELTA-P™ VALVE (DPV)

Anti-Suckback and Vacuum System Isolation Valve

USER MANUAL



WARRANTY

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SAFETY

IMPORTANT SAFETY INFORMATION

Thank you for purchasing this equipment from Ideal Vacuum Products. We want you to operate it safely.



- **Read this manual and all associated equipment manuals before installing or operating this equipment. Failure to follow the warnings and instructions may result in serious injury or equipment damage.**
- **Keep this manual in a safe location for future reference.**
- **This equipment should only be installed and operated by trained, qualified personnel, wearing appropriate protective equipment.**
- **Follow all codes that regulate the installation and operation of this equipment.**

WARNING SYMBOLS AND DEFINITIONS



This is the universal safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.



Indicates an imminently hazardous situation that, if not avoided, will result in death or severe injury.



Indicates an imminently hazardous situation that, if not avoided, could result in death or severe injury.



Indicates a potentially hazardous situation that, if not avoided, could result in moderate or minor injury. It may also be used to alert against unsafe practices.



Indicates a potentially hazardous situation that, if not avoided, could result in equipment or property damage.



Indicates helpful tips and recommendations, as well as information for efficient, trouble-free operation.

Internationally recognized safety symbols may be used with safety warnings to specify the type of hazard or a safety protocol to follow. For example:



Indicates an electric shock hazard



Indicates safety glasses are required

1. GENERAL INFORMATION

1.1 INTRODUCTION

The Delta-P Valve (DPV) is an important component of any rough or high vacuum system. The DPV provides anti-suckback and vacuum system isolation from the mechanical backing pump during a power outage. It prevents backstreaming and the migration of contaminants (e.g., rotary pump oil or scroll pump tip seal particles) into the vacuum system. It also protects a high vacuum pump from damage.

The Delta-P Valve operates on the pressure difference (ΔP) between ambient atmosphere and the roughing/backing pump's vacuum level.

During a power failure, the DPV closes the roughing line to the vacuum system and vents the roughing pump inlet flange to atmosphere. This prevents major vacuum loss in the vacuum system and stops undesirable material from being swept into the system when the pump restarts.

The DPV is a compact, inline unit which mounts directly on the inlet side of the mechanical pump. It is available in four standard KF flanged sizes and with three solenoid voltage options.

DPV closure speed is approximately 25 ms, faster than other isolation valves. This is due to the reduced moving mass of our advanced piston design. Flow is unrestricted with flange sizes smaller than KF-50. A slight reduction in conductance may be experienced with pumps that have a high pumping speed and KF-50 inlet flange. The DPV can be mounted in any orientation; vertical, horizontal, or inverted.

All parts that make up the DPV have been carefully selected for vacuum system compatibility and longevity. All production, assembly, and testing is done in our manufacturing facility in Albuquerque, NM, U.S.A. Every valve is helium leak tested to ensure that it operates correctly before it ships.

Upon delivery, your Delta-P Valve is ready for immediate installation into a new or existing system.

The Delta-P Valve is intended for use with clean, dry air or inert gasses only. For processes that use or create corrosive or toxic gases, the valve's solenoid breather vent must be replaced with an exhaust line that exits to the facility exhaust.

1.2 QUICK START

! WARNING



To prevent serious injury, read the entire manual before use. Follow all safety warnings.

1. DISCONNECT the vacuum line at the mechanical pump's inlet port.
2. CONNECT the DPV outlet flange onto the inlet flange of the pump. The DPV flow arrow points towards the pump.
3. CONNECT the vacuum line to the DPV inlet.
4. CONNECT power to the solenoid. The solenoid and pump must be powered by the same circuit breaker. AC solenoids must be properly grounded (see [Section 2.2](#)).

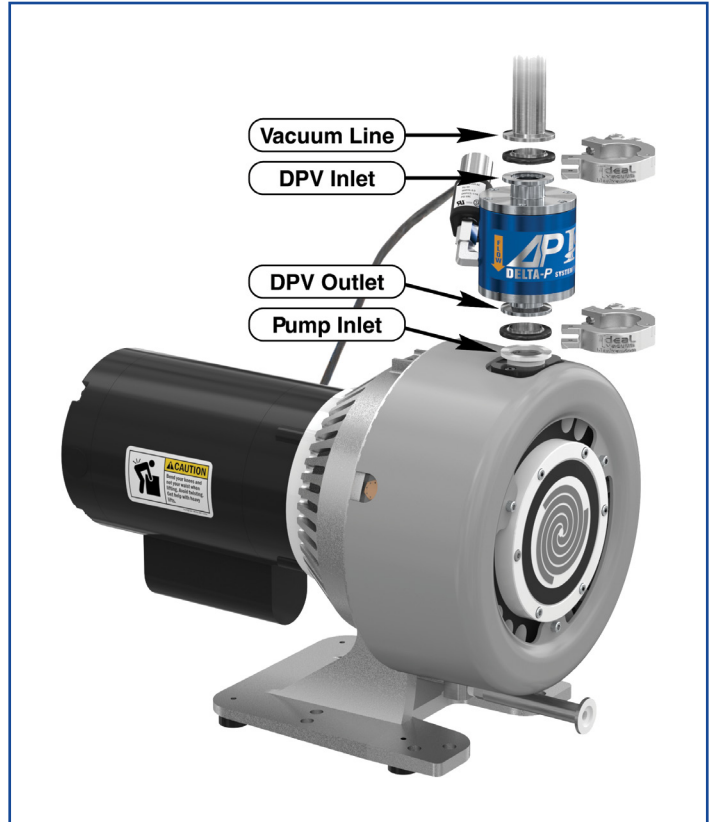


Figure 1 - Delta-P Valve Connection to the Mechanical Pump

1.3 FEATURES & FUNCTIONS

- Preserves chamber vacuum pressure during power outages
- Closes automatically upon loss of system power
- Operates on differential pressure between ambient atmosphere and roughing pump's vacuum level
- Isolates high vacuum pump and/or vacuum chamber system from mechanical pump
- Prevents backstreaming and migration of oil or particulate contaminants into the vacuum system
- Automatically re-opens when vacuum is restored
- Requires no additional power source or gases to operate
- Compact design - mounts directly on the inlet flange of the mechanical roughing pump
- Works in any orientation: vertical, horizontal, or inverted
- Four standard NW/KF flange connection sizes available: KF16, KF25, KF40, and KF50
- Three solenoid voltages available: 110 VAC, 220 VAC, and 24 VDC
- Non-restrictive flow for flange sizes smaller than KF-50
- Constructed entirely of vacuum compatible materials in the U.S.A.

1.4 SPECIFICATIONS

PARAMETER	MEASURE / TYPE
Geometry	Straight, Inline
Flanged End	KF-16, KF-25, KF-40, or KF-50
Solenoid Voltage	110 VAC, 220 VAC, or 24 VDC
Temperature Rating	0° to 100° C (valve) 0° to 50° C (solenoid)
Close Time	≈ 25 ms
Leak Rate	<1x10 ⁻⁸ atm cc/sec Helium
Service Life	>10,000 cycles
Part	Material
Valve Body	6061-T6 Aluminum
Flange Ends	6061-T6 Aluminum
Flange End O-Rings	Viton
Actuator Cup	6061-T6 Aluminum
Actuator Cup O-Ring	Viton
Actuator Slip Rings (bearings)	PTFE (Teflon), Bronze Impregnated
Tension Spring	302 Stainless Steel
Spring Stud Anchors	18-8 Stainless Steel
Assembly Hex Screws	18-8 Stainless Steel
Body	Dimensions
Outside Diameter	2.95 in. (75 mm)
Overall Length	4.2 in. (107 mm), KF-10 to KF-40 5.0 in. (127 mm), KF-50

Table 1 - Technical Specifications

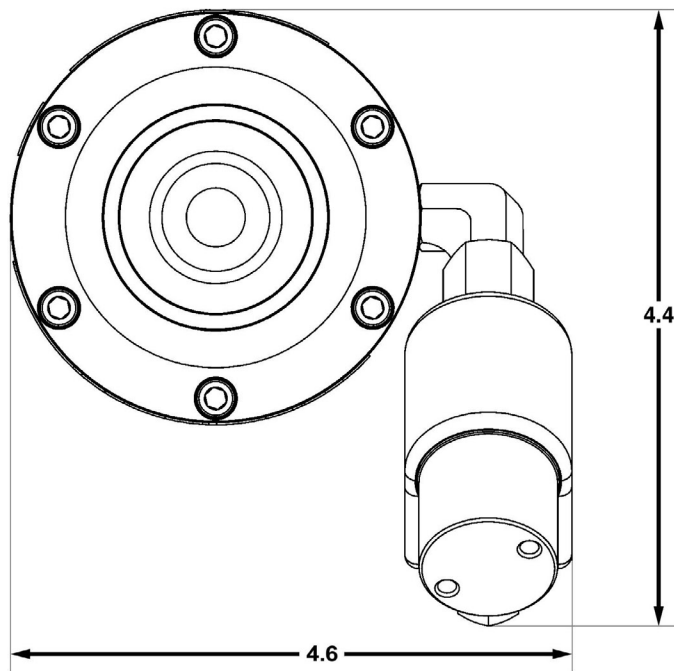
1.5 CONFIGURATIONS

The Delta-P Valve is available in four (4) standard KF flanged sizes (same flange on both ends), and with three (3) solenoid voltage options. Our part numbers for ordering standard DPV configurations are shown below in Table 2. Flange ends are interchangeable and can be purchased separately if two different flange sizes are needed (i.e., to adapt a KF-40 pump inlet flange to a KF-25 roughing or foreline). Replacement solenoids are also available (see [Appendix-Replacement Parts](#)).

FLANGE	SOLENOID VOLTAGE		
SIZE	110 VAC	220 VAC	24 VDC
KF-16	P1010136	P1010181	P1010186
KF-25	P1010137	P1010182	P1010187
KF-40	P1010138	P1010183	P1010188
KF-50	P1010139	P1010184	P1010189

Table 2 - Part Number Selector - Flange and Solenoid Voltage Options

1.6 DIMENSIONAL DRAWINGS



FLANGE SIZE	A	B
NW/KF-10	4.2 in. (107 mm)	3.0 in. (76 mm)
NW/KF-16	4.2 in. (107 mm)	3.0 in. (76 mm)
NW/KF-25	4.2 in. (107 mm)	3.0 in. (76 mm)
NW/KF-40	4.2 in. (107 mm)	3.0 in. (76 mm)
NW/KF-50	5.0 in. (127 mm)	3.0 in. (76 mm)

Table 3 - Dimensions

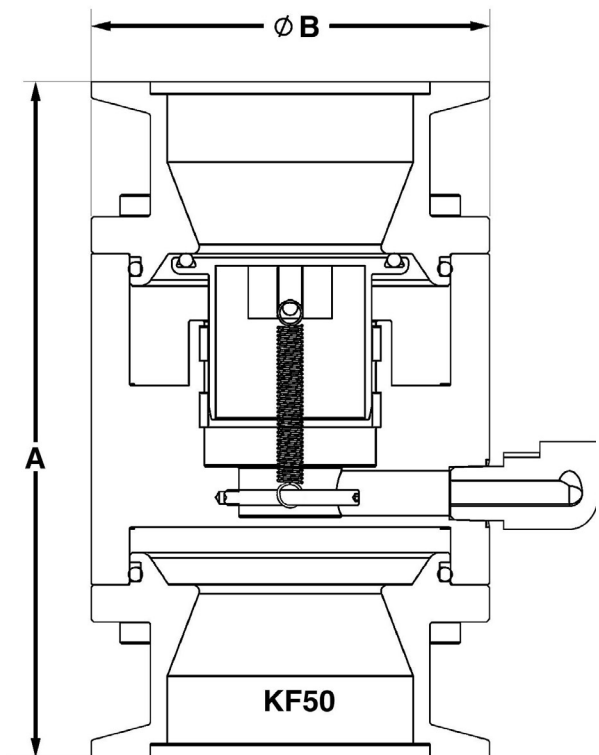
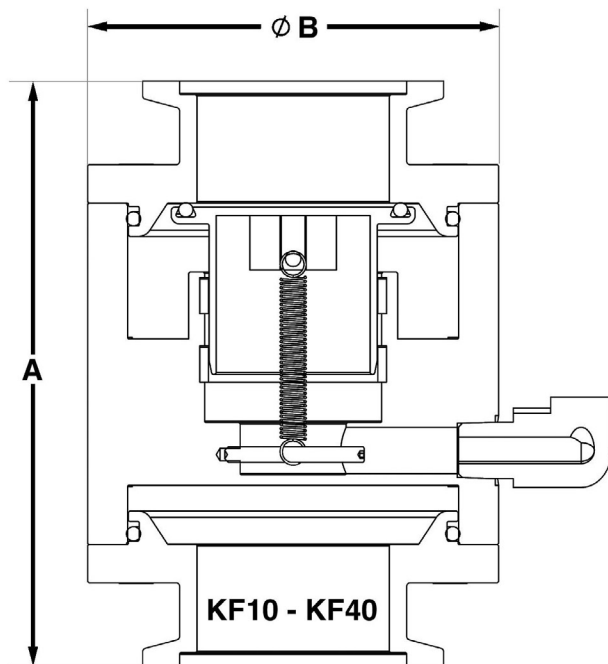
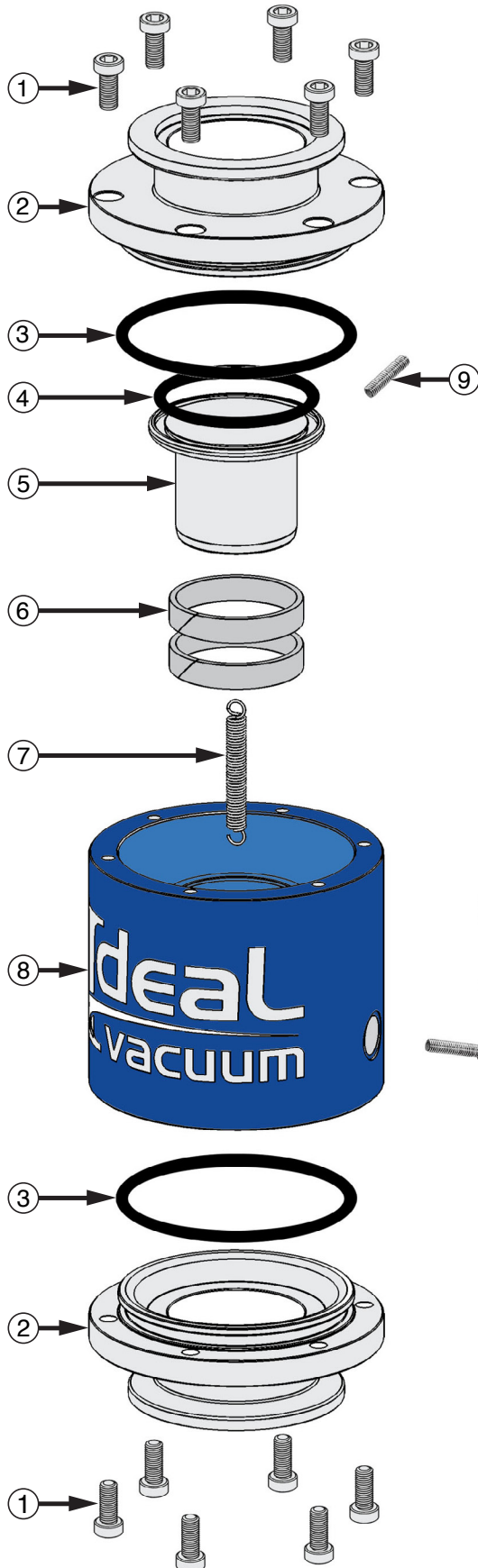


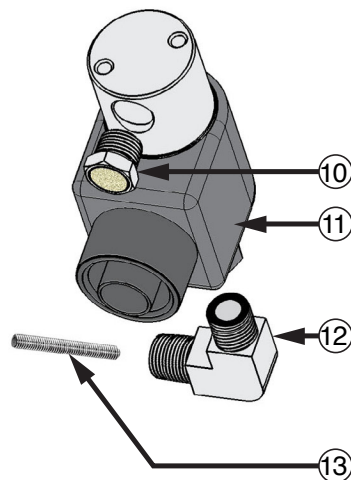
Figure 2 - Dimensional Drawings

1.7 ASSEMBLY DIAGRAM AND PARTS LIST



Item	DESCRIPTION	QTY.
1	Flange Socket Head Screw (8-32)	12
2	Flange End	2
3	Flange End Viton O-Ring	2
4	Actuator Cup Viton O-Ring	1
5	Actuator Cup	1
6	Slip Ring/Actuator Bearing	2
7	Tension Spring	1
8	Valve Body (Anodized)	1
9	Actuator Spring Retaining Screw	1
10	Solenoid Breather Vent (1/8" NPT)	1
11	Solenoid Valve	1
12	1/8" NPT Stainless Steel 90° Elbow	1
13	Valve Body Spring Retaining Screw (4-40)	1

Table 4 - Parts List



2. INSTALLATION

DANGER



Use with clean, dry air or inert gasses only.

Do not use with any process that uses explosive or pyrophoric gasses.

WARNING



For any process that uses or creates any corrosive or toxic gasses, the solenoid breather vent must be replaced with an exhaust line that exits to the facility exhaust. Evacuated vapors and gases could be vented into the personnel work area during a power outage.

CAUTION



Always wear protective equipment, including safety glasses and gloves.

Exercise care when working with vacuum equipment.

Figure 4 below illustrates the Delta-P Valve installed in a simplified high vacuum system. The system is comprised of a backing pump, the Delta-P Valve, a bellows hose, a turbo pump and a vacuum chamber (one of our modular [Ideal Vacuum Cubes](#)). In this example, both the turbo pump and chamber are protected during a power failure.

The DPV can also be used to safeguard a vacuum chamber in a roughing vacuum system (no high vacuum pump). Ideal Vacuum stocks everything shown in this example.



Figure 4 - High Vacuum Simplified System Example

2.1 MECHANICAL

NOTICE

The Delta-P Valve is a directional valve. It must be installed with its outlet connected to the inlet of the mechanical pump. The flow arrow points towards the mechanical (roughing) pump. Never install the Delta-P valve on the inlet of a high vacuum pump. Risk of pump damage if installed incorrectly.

To plumb the Delta-P Valve:

1. Disconnect the roughing or backing line (foreline) at the mechanical pump.
2. Examine the DPV to determine flow direction. The flow arrow points towards the mechanical pump's inlet.
3. Connect the DPV to the mechanical pump using an appropriately sized KF quick clamp and a properly sized centering ring with O-ring seal.
4. Connect the vacuum line to the inlet of the DPV.

2.2 ELECTRICAL

WARNING



Disconnect from power source and lockout/tagout before connecting equipment. Trained Service Personnel Only. Follow all applicable electrical codes for installation. AC solenoids must be properly grounded.

The DPV solenoid must be wired on the same circuit which powers the pump.

All solenoids have 3 wires.

AC solenoids use all 3 wires: Black (hot), White (neutral) and Green/Yellow (ground).

DC solenoids use 2 wires: Black (+) and white (-). The green ground wire is not used.

To wire the Delta-P Valve:

1. Disconnect power before making any electrical connections.
2. Install an appropriate plug on the solenoid's power cord (if necessary).
3. Make sure an AC solenoid is properly grounded.
4. Connect the solenoid. Wire it directly to the pump motor or to an AC outlet. For DC solenoids, use a 24VDC power supply. Make sure the positive and negative leads are connected correctly.
5. Do not restore power until all connections are made.

3. OPERATION

3.1 PRINCIPLE OF OPERATION

The Delta-P Valve operates on the differential pressure between ambient atmosphere and the roughing pump's vacuum level.

A normally open (NO) electric solenoid valve with an attached atmospheric breather vent is affixed to the DPV. When system power is on, the solenoid valve is held closed. Loss of system power causes the solenoid valve to open. Atmospheric air travels through the vent and enters the Delta-P Valve's body on the mechanical pump side of the Valve. The pressure difference (Delta P) between atmospheric pressure at the mechanical pump side and vacuum on the chamber side, causes the DPV to actuate and close very quickly (≈ 25 ms). This isolates the vacuum system from the mechanical pump and provides the force needed to keep the DPV closed.

When power is restored, the solenoid is re-energized and the atmospheric solenoid vent closes. The backing (mechanical) pump starts to pump down the roughing side of the Valve. When the backing pump's pressure approaches that of the static isolated vacuum chamber's pressure, the holding force on the DPV is significantly decreased, such that the DPV re-opens. Once open, vacuum pressure throughout the system equalizes and the system quickly returns to its normal operating pressure.

3.2 SEQUENCE OF OPERATION

Figure 5, on the following page, illustrates the four stages of DPV operation during a power loss and recovery cycle. The illustrations show how the internal mechanism of the Delta-P Valve functions and how the flow route changes at each of these stages.

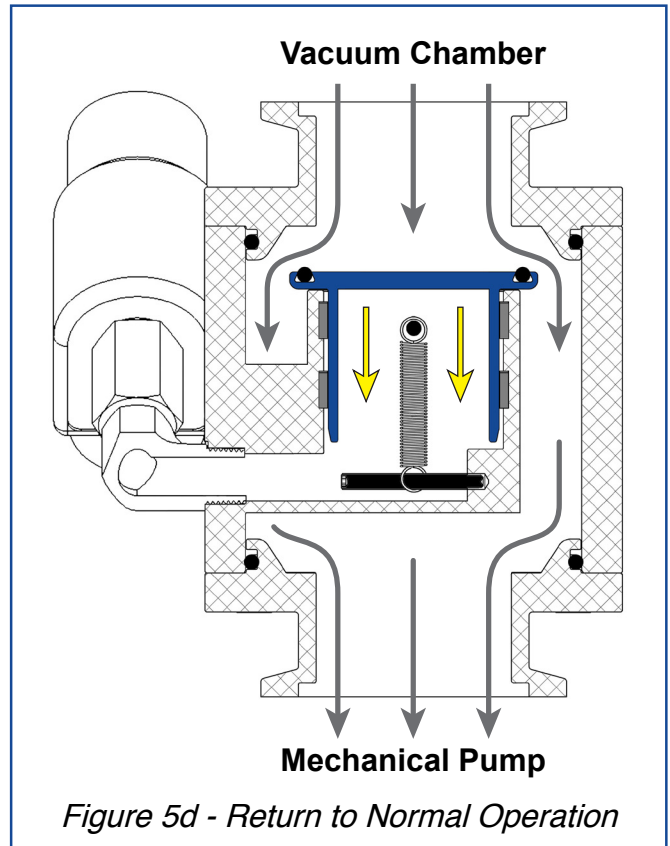
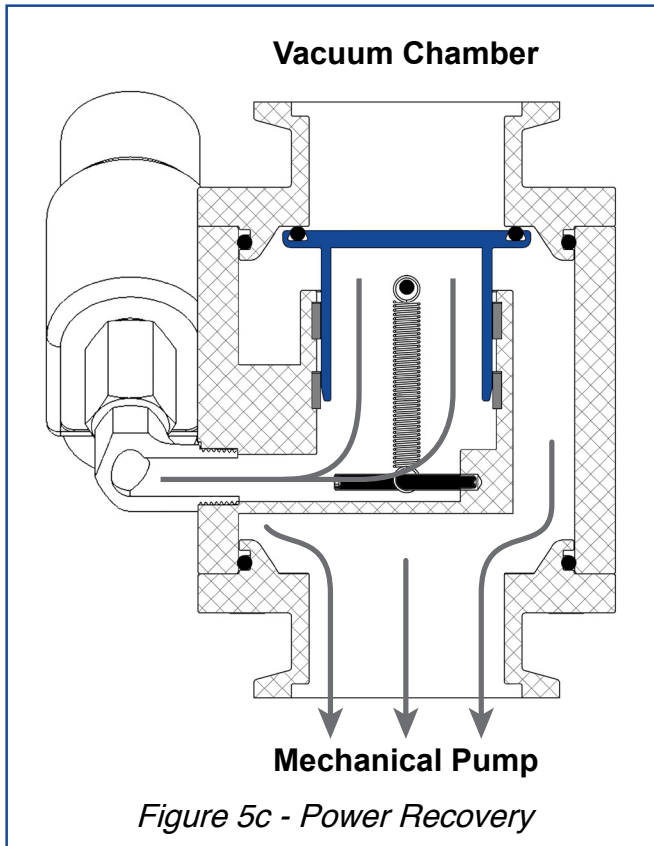
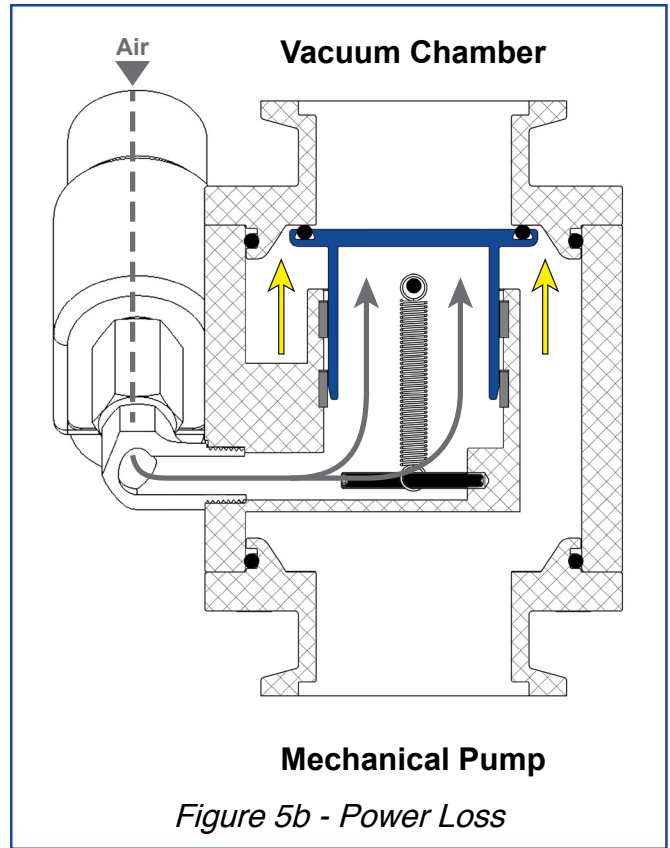
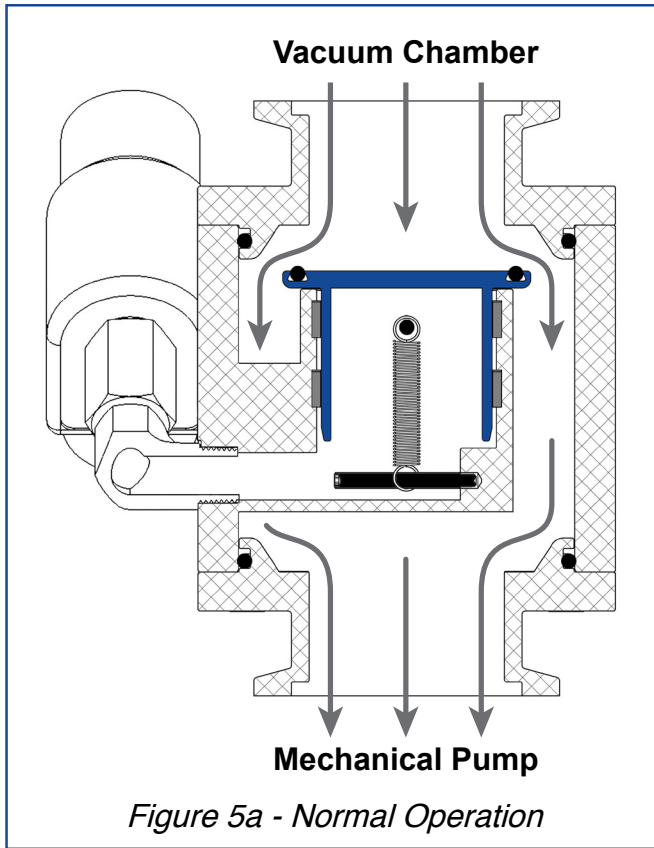


Figure 5 - Four Stages of DPV Operation

3.2.1 NORMAL OPERATION (Power On, DPV Open)

Figure 5a shows the DPV in its normal operating condition. System power is on and the primary (mechanical/backing) pump is producing vacuum. The Delta-P Valve is open allowing flow from the vacuum chamber into and through the pump. The Delta-P solenoid (vent) is closed. The mechanical pump, the roughing/backing line, and the Delta-P Valve are all at the same vacuum pressure.

3.2.2 POWER LOSS (Solenoid vents to Atmosphere, DPV Closes)

Figure 5b shows the action of the DPV when there is a power loss. If a power interruption occurs, the mechanical pump motor loses power and starts to spin down. The solenoid is de-energized and opens to atmosphere through its vent. Atmospheric air rushes through the solenoid vent, filling the Delta-P Valve's body on the mechanical vacuum pump's side of the valve, and into the piston chamber.

The pressure difference (Delta P) created between the higher ambient atmospheric pressure at the backing pump side and the lower pressure (vacuum) on the vacuum chamber side provides the force necessary to overcome the spring tension which holds the actuator cup (piston) in the open position (Figure 5b, yellow arrows). The actuator cup is forced rapidly towards the vacuum chamber side and closes against the flange end, sealed by the actuator cup O-ring seal. As the DPV closes, only the interior of the piston chamber is filled with air. Air cannot enter the vacuum chamber side.

Once closed, vacuum chamber pressure is preserved and the vacuum side is isolated from the backing pump side, safe from migrating contaminants. The backing pump side ultimately reaches atmospheric pressure and remains there until system power resumes.

3.2.3 POWER RECOVERY (Power On, Air Evacuated from Piston Chamber)

Figure 5c shows the DPV when power is restored. The solenoid is re-energized which closes its atmospheric vent. The backing pump begins to remove the atmospheric air contained between it and the closed Delta-P Valve. Air trapped in the piston chamber is evacuated through a small orifice in the DPV body as the backing pump generates more vacuum on its return to normal operation.

3.2.4 RETURN TO NORMAL OPERATION (Power On, DPV Opens)

Figure 5d shows the DPV as it returns to normal operation. While air is extracted from the DPV piston chamber, the backing pump's pressure rapidly decreases and begins to approach that of the static, isolated, vacuum chamber's pressure. The differential pressure force, which held the Delta-P Valve tightly closed (Figure 5b), is now significantly lessened.

When the differential holding force is reduced sufficiently, the tension spring pulls the actuator cup towards the mechanical/backing pump side. The DPV opens. Flow from the vacuum chamber through the DPV, is re-established. The vacuum and backing pressures equalize and pressure quickly reaches normal (pre-power loss) operating conditions.

3.3 CLOSURE TEST

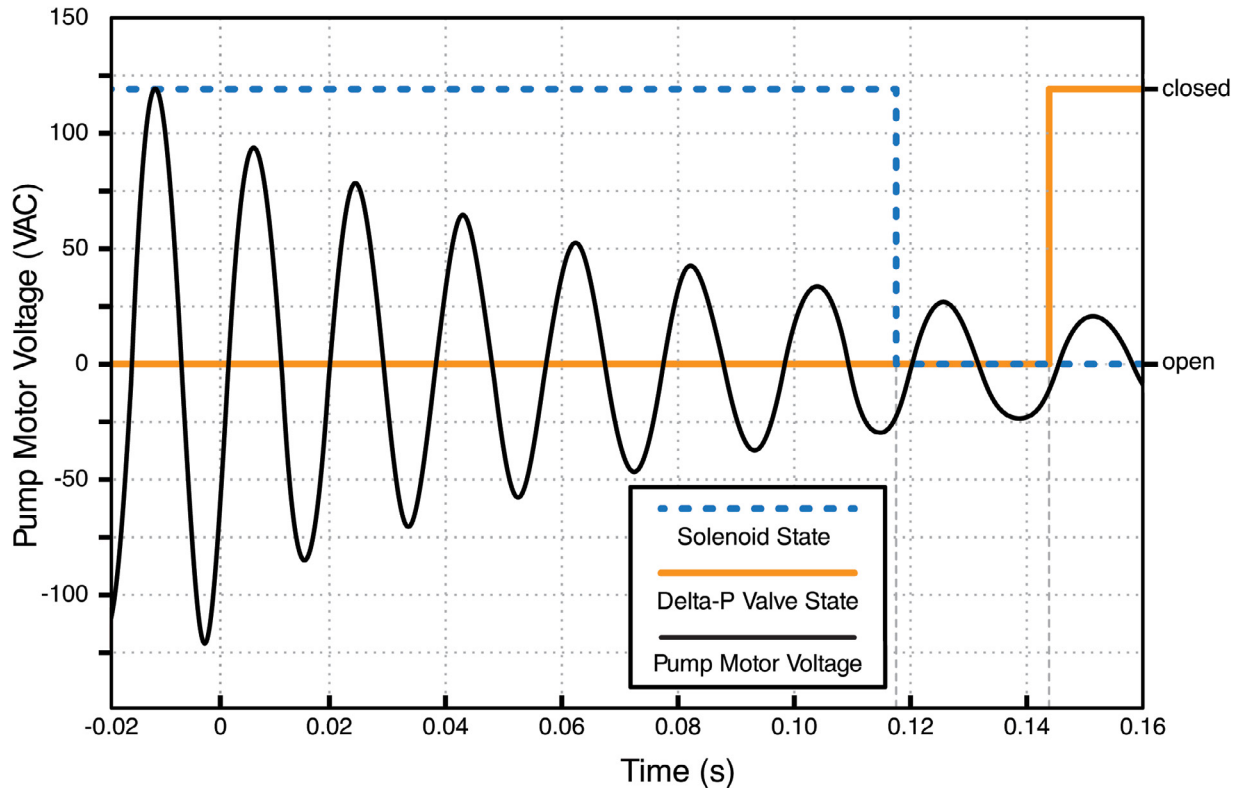


Figure 6 - Closure Test with Agilent Varian SH 110 Vacuum Pump

Delta-P valve closure and isolation is not instantaneous upon a power loss. There is always a delay. Actual closure time varies and depends on the time required for the backing pump to stop.

Figure 6 shows the results of an actual test using an Agilent Varian SH 110 dry scroll vacuum pump and the Delta-P Valve operating on standard 120 VAC power. The vacuum pump and solenoid are wired in parallel, powered from the same electrical circuit breaker. The pump motor's AC voltage is plotted as a function of time. The power is switched off at (0) seconds. The blue dashed line shows the state of the solenoid valve. The solid orange line represents the Delta-P Valve state.

This test result shows that the solenoid does not open, and the Delta-P Valve does not close, immediately upon the loss of power. Here, the DPV closes at approximately 143 ms.

When power is removed, the momentum of the pump's spinning rotor causes it to spin down, rather than to stop abruptly. The black sinusoidal curve shows that after power is removed, the pump's motor generates AC voltage, decaying as it slows. The AC voltage (and current) generated is fed back through the pump's electrical circuit.

Since it is on the same electrical circuit as the pump, the solenoid valve remains energized by the AC voltage being generated back through the circuit by the spinning pump motor. The solenoid opens when the AC voltage feedback drops below where it can no longer be held closed. In this test, the solenoid opens at approximately 118 ms.

Once the solenoid opens and atmospheric air is vented into the DPV, it requires only about 25 ms for the DPV to close.

4. MAINTENANCE AND SERVICE

CAUTION



Always wear protective equipment, including safety glasses and gloves. Exercise care when working with any vacuum component.

NOTICE

Before working on any vacuum system component, prepare a clean work area. Use only clean tools and recommended cleaning agents to perform maintenance, cleaning and service.

NOTE

If the DPV begins to close slowly, or does not seal completely, it is an indication that the Valve actuator cup seal requires cleaning.

The Delta-P Valve is designed to require very little maintenance. However, occasional cleaning of the DPV is beneficial to maintain good operation. Particulates and other contaminants can begin to accumulate inside the valve, resulting in poor sealing or conductance reduction. Service the DPV as part of scheduled system preventive maintenance. Most importantly, the O-rings should be checked, cleaned, and replaced if necessary. After service, test the DPV for correct operation.

4.1 CLEANING VALVE EXTERIOR

The Valve's exterior may be wiped down with IPA (isopropyl alcohol), soap and water, or another mild cleaning solution.

4.2 DISASSEMBLY

NOTICE

The piston chamber, made up of the PTFE bearings, aluminum actuator cup (piston), and the internal spring mechanism, is not user serviceable. **DO NOT DISASSEMBLE THE PISTON CHAMBER.** Disassembly of the valve's internal components may make it inoperable and will void the warranty.

Access the valve's interior and actuator cup (piston) seal for cleaning:

1. Remove the valve's inlet flange end (the flange end opposite the flow arrow).
2. Use a 7/64" hex key wrench to remove the six (6) hex screws that secure the flange end onto the valve body.
3. Hold the valve body firmly in one hand and the flange in the other.
4. Remove the flange end from the valve body. It may be tight due to the sealing O-ring.
5. The O-ring can be reused if it is still smooth, flexible, and undamaged.

4.3 CLEANING O-RINGS

To clean the actuator cup and flange end O-rings:

1. Dip a clean, lint-free cloth in IPA.
2. Wrap the dampened cloth around one finger and gently wipe the O-ring.
3. Repeat as necessary to remove all dirt. Use a clean spot on the cloth for each pass.
4. Similarly, wipe down the flange end O-ring and its interior sealing surface.



Figure 7 - Cleaning the Actuator Cup O-Ring

4.4 CLEANING VALVE BODY

NOTICE

Use only Isopropyl Alcohol on the valve's interior. Other cleaning agents or solvents are not recommended. Do not insert any tool inside the valve body. Do not use compressed air to blow out the valve after cleaning.

To clean the entire valve body, remove both flange ends according to the disassembly instructions in Section 4.2 (previous page). Use an IPA impregnated cloth to wipe the valve's interior surfaces. The valve body may be immersed in IPA if needed.

4.5 REPLACING O-RINGS

Should the actuator cup O-ring become too dirty to clean successfully, or if either of the flange end O-rings become damaged, replacement is required. All three O-rings should be replaced at the same time. See [Replacement Parts](#) in the Appendix for the O-ring Replacement Kit.

1. Carefully remove the O-ring from its groove. Use only a plastic O-ring/seal removal tool like the one shown in Figure 11. Avoid the use of metal tools which could scar the actuator cup or damage the O-ring groove.
2. Wipe O-ring grooves with IPA before installing new O-rings.
3. Apply a thin layer of vacuum grease on the two (2) flange end O-rings before reassembling the Valve. DO NOT use vacuum grease on the actuator cup O-ring.
4. Reassemble the Valve.



Figure 8 - Replacing the Actuator Cup O-Ring

4.6 REASSEMBLY

Before replacing the flange end, lightly lubricate its O-ring with vacuum grease.

1. Replace the flange end by pushing it into the valve body.
2. Use care not to catch or trap the O-ring between the flange end and valve body, as the O-ring could become damaged.
3. Do not over-tighten the flange end cap screws. A quarter or half turn past finger tight is sufficient.

4.7 TESTING

After performing any maintenance or service on the DPV and prior to reinstallation into the system, it is highly recommend that it be tested for proper functionality. The hardware setup and procedure described below will verify proper valve function.

The test setup includes a mechanical pump, the Delta-P valve, and a pressure sensor with controller, arranged as shown below in Figure 12.

1. Disconnect all power cables.
2. Connect the pump, DPV and pressure gauge with quick clamps and centering rings (as shown). Connect the sensor cable to the controller.
3. Connect power cables to the pump, valve solenoid and controller.
4. Turn on power.
5. The pump will start evacuating the air trapped between it and the pressure gauge. After the vacuum pressure is pumped down (typically less than one minute), cut power.
6. The controller should show an immediate, slight pressure increase. Pressure should quickly stabilize and remain constant for at least 10 minutes.



Figure 9 – Simple Test Apparatus

If the pressure remains constant, the valve is working. If the pressure increases, either the valve is not closing properly, or there may be a leak in another area of the test apparatus. See [Troubleshooting](#) on the following page.

4.8 TROUBLESHOOTING

ISSUE	POSSIBLE CAUSES	POSSIBLE SOLUTIONS
Solenoid gets hot	Normal operation	No action required
No flow	DPV installed in wrong direction	Reinstall DPV with flow arrow towards mechanical pump
Closes slowly	Dirty actuator cup O-ring	Clean O-ring
	Dirty Valve body	Clean valve body
	Solenoid vent clogged	Remove and clean solenoid vent with IPA
Leaks when closed	Dirty actuator cup O-ring	Clean O-ring
Leaks When Closed (after cleaning)	Damaged actuator Cup or flange end O-ring	Replace O-rings
	Bad solenoid valve seal	
Leaks after O-ring replacement	Bad centering ring seal	Replace centering ring
	Delta-P Valve damaged	Return to Ideal for repair service
Solenoid does not close	Solenoid not powered	Check power to solenoid
	Solenoid coil damaged	Replace solenoid valve

Table 5 - Troubleshooting

4.9 FACTORY REPAIR

If you have exhausted all troubleshooting suggestions, and the valve is still not functioning properly, it may need factory service or repair.

Please contact us prior to returning a malfunctioning valve, whether under warranty or outside the warranty period. Contact us by phone, M-F, 8 am - 5 pm, Mountain Time, at (505) 872-0037, or by email at: techsupport@idealvac.com. A technical support representative will try to resolve the problem. If the issue cannot be resolved quickly, we will issue an RMA number and provide product return instructions.

APPENDIX

A.1 REPLACEMENT PARTS

We offer a replacement O-ring kit, flange ends and solenoids for the Delta-P Valve. The O-ring kit consists of all three (3) O-rings in the Delta-P Valve. This includes two (2) flange end O-rings and one (1) actuator cup O-ring. Always replace all O-rings at once. Flange end replacement kits are available in four (4) NW/KF sizes and include a flange end O-ring and 6 cap screws. Use this kit to replace a damaged flange end, to match flange sizes between the DPV and a mechanical pump, or to avoid the use of a flange adapter between the DPV and the vacuum system line. We offer solenoids as replacement spares in three voltages (110-120 VAC, 200-240 VAC, and 24 VDC).

PART NUMBER	DESCRIPTION
P1010156	O-Ring Replacement Kit
P1010192	NW/KF-10 Flange End Kit
P1010193	NW/KF-16 Flange End Kit
P1010194	NW/KF-25 Flange End Kit
P1010195	NW/KF-40 Flange End Kit
P1010196	NW/KF-50 Flange End Kit
P108430	Solenoid Valve, 110VAC
P108431	Solenoid Valve, 220VAC
P1010132	Solenoid Valve, 24VDC

Table 6 - Replacement Parts

A.2 ACCESSORIES

To help speed the construction of your vacuum system, we suggest the accessories listed below. Visit idealvac.com for all your system needs.

PART NUMBER	DESCRIPTION
P1010547	O-Ring Removal Tool, Non Scratch Polycarbonate
P102545	Apiezon AP101 Anti Seize Vacuum Grease, 50 g Tube
P101198	NW/KF-16 Quick Clamp
P101199	NW/KF-25 Quick Clamp
P101200	NW/KF-40 Quick Clamp
P101201	NW/KF-50 Quick Clamp
P101242	NW/KF-16 Centering Ring w/Viton O-ring
P101243	NW/KF-25 Centering Ring w/Viton O-ring
P101244	NW/KF-40 Centering Ring w/Viton O-ring
P101245	NW/KF-50 Centering Ring w/Viton O-ring
P101246	NW/KF10 to KF16 Adaptive Centering Ring w/Viton O-ring

Table 7 - Recommended Accessories



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