HIGH PERFORMANCE GC DIAPHRAGM VALVE*

THE ONLY ONE WITH AN EMBEDDED PATENTED PURGE SYSTEM

Diaphragm based chromatographic valves have been around for more than a half-century. Originally, they were in use in BTU analyzers and hydrocarbon measurement GC. With time, their size and built-in actuator feature made them attractive for other applications. Unfortunately, their sealing performance and problems associated with atmospheric diffusion through diaphragm have limited their usage. Users had no choice but to stick to conical rotary valve.

Now, this situation is behind us, thanks to all the innovative concepts we introduced in GC diaphragm valve technology. Indeed, we are providing an entirely new set of performance parameters, which is many times greater than those found in today’s market, with a sizable reduction in cost.

Indeed, the valves shown in the following section overcome all the problems of previous diaphragm valve designs. They perform better and longer than GC rotary valves. In fact, the new valves can be used instead of GC rotary valves for most applications, with the exception of a few specific cases.

The unique purging feature, actuator design and assembly procedures result in an outstanding level of performance. Choice of performance grade, multiple ports fitting configuration, choice of actuation, NeSSi™ platform (a world premier for GC valves) and the possibility of custom designs allow maximum flexibility to instrument manufacturers and integrators.

Finally, GC valves that allow your highly sensitive detectors to unleash their full potential.

FIVE SERIES: ELDV1 / ELDV2 / MDVG / DADV / CADV

ELDV1: Standard level of performance, optimized for cost sensitive applications.

ELDV2: High performance level, better leak performance and lifetime, at medium cost.

MDVG: Premium performance grade, low, medium and high temperature grade.

DADV: Double actuation diaphragm valve. This gives independent control of the N.C. and N.O. plungers.

CADV: Cam actuated diaphragm valve, allows upgrade of system based on rotary valve without changing existing actuators and related hardware. First Electrical Driven GC Diaphragm Valve.

*Covered by Pat# 7,931,043 - 8,104,506 - EP2331858 and (5) patents pending.
FEATURES AND BENEFITS

1) Eliminates permeation and diffusion for low level trace measurement.
2) Eliminates inboard/outboard contamination. There are no fugitive emission.
3) Creates an inert atmosphere underneath the diaphragm for hazardous application.
4) Allows vacuum operation by balancing pressure over and under the diaphragm.
5) Allows real-time monitoring of valve condition by verifying the purge outlet quality.

This unique purging feature makes GC instrument much more reliable.

SEE AN-04 FOR HOW TO GET MAXIMUM BENEFITS FROM THE PURGE FEATURE.

RELIEF PINS:
1) Eases the process of diaphragm replacement in the field by pulling down all plungers
2) Relief pins remove stress on diaphragm for long term storage.

DIAPHRAGM DESIGN:
1) Multi-layer diaphragm.
2) Optional coating / metallization.
3) Choice of material.

PLUNGER DESIGN
1) Precisely machined in metal.
2) Tight length tolerance.
3) Self aligned compressible (spring return), two-part plungers (Patent Pending Design).
4) Tied base plunger design.
5) Valve can be operated in any position.
   Plungers will not stick, and there is no friction.
   Low and equal pressure drop on all ports.
6) Force is applied to the total plunger surface area.
7) Uniforms sealing force on the diaphragm.
Mission critical applications demand the best available product, but not every system requires the Premium Grade MDVG series. This family of chromatographic diaphragm valves have been designed to fill the need for standard and high performance specifications are required.

The ELDV series will fill the need of most bench top laboratory GC while providing a high level of sealing performance and lifetime, better than the standard GC rotary valve generally available on the market and this at a lower cost and better offering value.

**Description:**
The user may choose only the configuration option he needs, contributing to a further cost reduction. The valve is available in two (2) configurations, ELDV 1 and ELDV 2. Add to this the XL option, i.e. extended life (1.5 million cycles), is available.

**ELDV Series Configuration:**
- Aluminum actuator body, SS-316L valve head
- Both configurations are purge, as per premium grade MDVG series. See purging description section to understand the purge concept and its benefits.

**Selection guideline:**
- ELDV1 (standard grade): Optimize for cost sensitive application.
- XL (extended life) option available for the LT grade.

Note: If your application requires fast temperature cycling, please see the MDVG series.

**MDVG - PREMIUM GRADE, GC DIAPHRAGM VALVE**

This series is the premium grade, all stainless steel purge valve. It allows higher pressure and temperature operation. It is also available with VCR 1/8” fittings. This is the choice for mission critical applications, process GC, fast temperature cycling and where a special coating is required. XL option, i.e. extended life (1.5 million cycles) available for the LT grade. Ideal for sensitive GC/MS vacuum application.

**ACTUATOR TYPE**

**ELDV/MDVG - STANDARD ACTUATOR TYPE I.E. PNEUMATIC, SINGLE ACTING**

This standard version is in use in most of the ELDV / MDVG-series valves. It’s based on a single acting pneumatic actuator, supplied by an only inlet actuation port. When pressure (60-65psig) is applied, the normally open piston and plungers will move up closing connections between ports, while the normally closed piston and plungers will go down opening new connections. The non-mixing time is determined by adjusting the compression of the Belleville washer stack. The non-mixing time is defined as the time that all plungers are up during the actuation process. This make sure that there is no cross-port flow contamination during actuation. Indeed all ports are isolate before to move to next position. This is true when actuating and de-actuating the valve.

Note: The valve could also be tune to allow very little mixing upon actuation. This could be a benefit for specific application like when the sample loop is very small and the sample is gas. This eliminates redundant peaks in value de-actuation.
**CADV - CAM ACTUATED DIAPHRAGM VALVE**

**THE FIRST ELECTRICAL DRIVEN GC DIAPHRAGM VALVE**

This is a cam actuated version of our ELDV or MDVG series diaphragm valves. This valve can be actuated manually with the help of a handle. The CADV allows a direct upgrade of the existing GC equipped with rotary valves and their related pneumatic actuators. The CADV could be installed on existing pneumatic actuators, allowing the system to benefit from the GC diaphragm valve features.

However the most important benefit of the Cam base actuator is the possibility to use an electrical actuator. This is the first time that a GC diaphragm valve is made available with such actuator. This eliminates the need of actuating gas, a real benefit for portable instrument like explosive and hazardous detection system for homeland security. Sequential sample injection could be easily done, resulting in the elimination of baseline upset upon injection. See AN01, app#8 for more detail about this specific application.

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**DADV - DOUBLE ACTUATION DIAPHRAGM VALVE ACTUATOR**

This actuator allow independent control of the normally opened (N.O.) and normally closed (N.C.) plungers. Different actuating pressure could be used, control of the non-mixing time, control of the actuation speed, etc... Belleville spring may be also added to allow a fail safe position or to pre-define plunger position i.e. N.C. or N.O.. Ideal for method and specific system development.

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**SEE APPLICATION NOTE AB-04 FOR APPLICATION IDEAS AND ACTUATOR MECHANISM VARIATION.**

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**CADV installed on a electrical rotary actuator.**

**CADV with base mounted handle actuation handmade.**

**CADV installed on a VICI© pneumatic rotary actuator, for older system upgrade.**
FLOW PATHS

CONVENTIONAL FLOW PATH

The conventional flow path is the most common one used in gas chromatography. The main benefit of this configuration is to never interrupt the fluid, upon normal operation. So, fluid is continuously flowing in all ports, whether the valve is actuated or not. This particularity comes from the fact that actuation plungers are stopping the flow between the ports, instead of acting directly on the port.
ISL - INTERNAL SAMPLING LOOP

The internal sampling loop is available in a variety of model i.e. ELDV / MDVG / CADV / DADV / NeSSI™ and the size of the sampling loop is available in 0.5μl, 1.0μl, 1.5μl, 2.0μl, 3.0μl, 5.0μl. There is also the double internal sampling loop diaphragm valve. It can be configured in two different modes i.e. alternate or simultaneous. The ADSL version (Alternate Double Sampling Loop) will inject the two samples on an alternate base. On the other end we also have the SDSL version (Simultaneous Double Sampling Loop) that will inject both samples simultaneously. We offer the possibility to have different size of sampling loop in the same valve in a range of 1.0μl to 5.0μl. It is also possible to have one internal sampling loop and one external on the same valve head. Useful when the instrument measuring range must be change in real time.

MDVG-4-ISL-SERIES
(INTERNAL SAMPLING LOOP)

OFF Mode
The sample is injected into the sampling loop

ON Mode
The sample is injected into the column

MDVG-10-ADSL-SERIES
(ALTERNATE DOUBLE SAMPLING LOOP)

OFF Mode
Sample #1 is injected into the column
Sample #2 is loaded into the sampling loop

ON Mode
Sample #1 is loaded into the sampling loop
Sample #2 is injected into the column

MDVG-10-SDSL-SERIES
(SIMULTANEOUS DOUBLE SAMPLING LOOP)

OFF Mode
Sample is loaded into the double sampling loop

ON Mode
Sample is injected into the column #1 and column #2
## GC diaphragm valves performance specifications

### FEATURES

<table>
<thead>
<tr>
<th>Standard Maximum Working Pressure (PSI / kPa)</th>
<th>LT</th>
<th>MT</th>
<th>HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 / 2068</td>
<td>100 / 212</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>300 / 2068</td>
<td>100 / 212</td>
<td>180 / 356</td>
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</tr>
<tr>
<td>500 / 3450</td>
<td>100 / 212</td>
<td>180 / 356</td>
<td>250 / 482</td>
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<table>
<thead>
<tr>
<th>Maximum Working Temperature (°C / °F)</th>
<th>LT</th>
<th>MT</th>
<th>HT</th>
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<tbody>
<tr>
<td>100 / 212</td>
<td>180 / 356</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>100 / 212</td>
<td>180 / 356</td>
<td>250 / 482</td>
<td>N/A</td>
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<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>9.0x10⁻⁹ Atm-cc/sec He</td>
<td>4.7x10⁻¹¹ Atm-cc/sec He</td>
<td>3.0x10⁻¹² Atm-cc/sec He</td>
<td></td>
</tr>
<tr>
<td>5.0x10⁻¹⁰ Atm-cc/sec He</td>
<td>9.4x10⁻¹² Atm-cc/sec He</td>
<td>6.0x10⁻¹³ Atm-cc/sec He</td>
<td></td>
</tr>
<tr>
<td>1.0x10⁻¹¹ Atm-cc/sec He</td>
<td>4.7x10⁻¹² Atm-cc/sec He</td>
<td>3.0x10⁻¹³ Atm-cc/sec He</td>
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<tr>
<th>Leak Rate</th>
<th>Cross ports (max pressure)</th>
<th>Cross ports (100 PSI)</th>
<th>In / Outboard</th>
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<tr>
<td>9.0x10⁻⁹ Atm-cc/sec He</td>
<td>4.7x10⁻¹¹ Atm-cc/sec He</td>
<td>3.0x10⁻¹² Atm-cc/sec He</td>
<td></td>
</tr>
<tr>
<td>5.0x10⁻¹⁰ Atm-cc/sec He</td>
<td>9.4x10⁻¹² Atm-cc/sec He</td>
<td>6.0x10⁻¹³ Atm-cc/sec He</td>
<td></td>
</tr>
<tr>
<td>1.0x10⁻¹¹ Atm-cc/sec He</td>
<td>4.7x10⁻¹² Atm-cc/sec He</td>
<td>3.0x10⁻¹³ Atm-cc/sec He</td>
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| Estimated Working Lifetime (Year) | 2 | 3 | 5 |

<table>
<thead>
<tr>
<th>Valve Cap</th>
<th>SS-316L</th>
<th>SS-316L</th>
<th>SS-316L</th>
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<table>
<thead>
<tr>
<th>Number of Ports (6/10)</th>
<th>6 / 10</th>
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<th>6 / 10</th>
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<table>
<thead>
<tr>
<th>Port Connection (”)</th>
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<th>1 / 16</th>
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<tr>
<th>Port Size (”)</th>
<th>.030</th>
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<th>.030</th>
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<table>
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<tr>
<th>Internal Dead Volume (6/10)</th>
<th>0.14 μl / 0.12 μl</th>
<th>0.14 μl / 0.12 μl</th>
<th>0.14 μl / 0.12 μl</th>
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<table>
<thead>
<tr>
<th>Actuator Type</th>
<th>Pneumatic single actuation (spring return) with relief pin</th>
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</table>

<table>
<thead>
<tr>
<th>Actuation Pressure (PSI / kPa)</th>
<th>65 / 450</th>
<th>65 / 450</th>
<th>65 / 450</th>
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<table>
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<th>Gas Consumption Per Actuation (6/10)</th>
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<th>.05 / .07</th>
<th>.05 / .07</th>
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<table>
<thead>
<tr>
<th>Cylinder Body Material</th>
<th>Special aluminium grade treated as per AFPM-3 method</th>
<th>Special aluminium grade treated as per AFPM-3 method</th>
<th>SS-316L</th>
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</table>

<table>
<thead>
<tr>
<th>Surface Treatment Procedure</th>
<th>AFPM-2</th>
<th>AFPM-2</th>
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<th>Surface Cleaning Procedure</th>
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<th>AFPC-2</th>
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<table>
<thead>
<tr>
<th>Typical Applications</th>
<th>GC / Standard performance / Low temperature</th>
<th>GC / High performance / Low and Medium temperature</th>
<th>GC / LC, Low / Medium / High performance</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Weight (6/10)</th>
<th>GR</th>
<th>285 / 365</th>
<th>285 / 365</th>
<th>440 / 565</th>
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</table>

<table>
<thead>
<tr>
<th>OZ</th>
<th>10 / 12.9</th>
<th>10 / 12.9</th>
<th>15.5 / 19.9</th>
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<table>
<thead>
<tr>
<th>Pricing</th>
<th>Valve head coating</th>
<th>Call</th>
<th>Call</th>
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<table>
<thead>
<tr>
<th>Pre-conditioning</th>
<th>+ $125</th>
<th>+ $125</th>
<th>+ $125</th>
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</table>

<table>
<thead>
<tr>
<th>Vacuum</th>
<th>+ $95</th>
<th>+ $95</th>
<th>+ $95</th>
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</table>

<table>
<thead>
<tr>
<th>XL (Extended Life)</th>
<th>+ $185</th>
<th>+ $185</th>
<th>+ $185</th>
</tr>
</thead>
</table>
NOTES

1. Working pressure of the internal sampling loop configuration is available up to 700PSI. Please see ISL section.

2. AFPD-1, AFPD-2 and AFPD-3 refer to the diaphragm type being use in the valve. AFP diaphragm could be multi-layer (metal coated). Special surface treatment is also involved. Be sure to always use your valve with the specified diaphragm type.

3. Leak rates are verified at maximum operation conditions. Please see engineering note EN-01 for more information. This note is available on our website. Leak rates are verified on a VARIAN™ helium leak mass spectrometer detector and on AFP® proprietary online leak detection system.

4. LT  i.e. 100°C, 1.0 million actuations  
   MT  i.e. 180°C, 700,000 actuations  
   HT  i.e. 250°C, 500,000 actuations  
   Based on a cycle time of 5 minutes, 24 hours, 365 days / year. (see note 14 for extended life version)

5. Standard material is SS 316L, Hastelloy, Monel, Zirconium, Titanium, Peek, Teflon and ceramic material are available. Other polymers material are available on request. High temperature grade, HT, have the valve head with special coating.

6. Standard port fitting are 1/32", 1/16", 1/8" VCR, welded tube are available. Any mix of the above is also available on the same valve heads.

7. Other port size are available like .010", .015" or .040".

8. Standard actuation is the pneumatic single acting (spring return) type, with a single actuation inlet port. Another actuator type is available i.e. double actuation and cam base. All actuator versions allow actuation with no flow mixing upon actuation. The cam base actuator allow the sequential injection mode.

9. See specific valve configuration (i.e. LT, MT, HT or vacuum) for proper actuation pressure.

10. AFPM-2, AFPM-3 are proprietary surface treatment procedures. AFPC-2 are AFP cleaning procedures, O2 compatible.

11. Valve head coating : (for example SilcoNert 2000™) : the ultimate passivation of treated surfaces. There is a required treatment for metal components when analyzing for parts-per-billion levels of organo-sulfur compounds & mercury. Greatly reduce moisture contamination, improve system performance and eliminates surface adsorption of active compounds on steel.  
   Note : Others coating are available on request.

12. Pre-conditioning : This option allows the elimination of atmospheric contaminants from the wetted internal surface. It speeds up the system’s start up. The valve is then ship with all it's port plugged. It is very useful when working with helium carrier gas and ionisation base detector.

13. The vacuum configuration has a special spring, and require different tuning during the assembly. Actuation pressure is also slightly higher. Please see specification sheet include with your valve.

14. The XL option, i.e. extended life, is available for all LT grade temperature with a rated actuation at 1.5 millions.  
   *The XL option not available yet at the time of the printing of this brochure for the MT and HT temperature grade.

15. Internal dead volume is measured between a plunger in closed position and one of the adjacent port.
**ELDV/MDVG/DADV/CADV SERIES CONFIGURATION**

### SPARE PARTS:

#### VALVE HEAD

<table>
<thead>
<tr>
<th># of port</th>
<th>Fitting</th>
<th>Temperature</th>
<th>Sampling</th>
<th>S.L. size</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>16= fitting 1/16&quot;</td>
<td>LT= 100ºC</td>
<td>0= N/A</td>
<td>0 = N/A</td>
<td>P - Backside of the diaphragm purged</td>
</tr>
<tr>
<td>6</td>
<td>LS16= Lip Seal 1/16&quot;**</td>
<td>MT= 180ºC</td>
<td>ISL</td>
<td>05= 0.5 µl</td>
<td>XL - Extended life</td>
</tr>
<tr>
<td>10</td>
<td>V8= VCR 1/8&quot;</td>
<td>HT= 250ºC</td>
<td>ADSL</td>
<td>10= 1.0 µl</td>
<td>S - SilcoNert2000™</td>
</tr>
</tbody>
</table>

*Lip Seal:* Lip Seal fitting is our new patent pending AFP fitting detail. This reduces the dead volume, eliminates the rotation of the ferrule and improves the sealing resulting in an improved connection for valve and fitting. This is very beneficial for any analytical high sensitivity instrumentation. Sealing integrity of a VCR fitting with the flexibility of a compression fitting. Please refer to Design Report 3 (DR-3) in the Analytical Flow Product Cookbook.

**Patent Pending**

#### REPLACEMENT DIAPHRAGM

<table>
<thead>
<tr>
<th># of port</th>
<th>Temperature</th>
<th>Sampling</th>
<th>S.L. size</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>LT= 100ºC</td>
<td>0= N/A</td>
<td>0 = N/A</td>
</tr>
<tr>
<td>6</td>
<td>MT= 180ºC</td>
<td>ISL</td>
<td>05= 0.5 µl</td>
</tr>
<tr>
<td>10</td>
<td>HT= 250ºC</td>
<td>ADSL</td>
<td>10= 1.0 µl</td>
</tr>
</tbody>
</table>

*Lip Seal:* Lip Seal fitting is our new patent pending AFP fitting detail. This reduces the dead volume, eliminates the rotation of the ferrule and improves the sealing resulting in an improved connection for valve and fitting. This is very beneficial for any analytical high sensitivity instrumentation. Sealing integrity of a VCR fitting with the flexibility of a compression fitting. Please refer to Design Report 3 (DR-3) in the Analytical Flow Product Cookbook.

**Patent Pending**

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Ex: MDVG-6-16MT-0-0

Mini Diaphragm Valve Grooved,

with purge, 6 ports of .030", Fitting 1/16", 180ºC, 500 psi, diaphragm AFPD-2, All SS-316L valve.

*Lip Seal:* Lip Seal fitting is our new patent pending AFP fitting detail. This reduces the dead volume, eliminates the rotation of the ferrule and improves the sealing resulting in an improved connection for valve and fitting. This is very beneficial for any analytical high sensitivity instrumentation. Sealing integrity of a VCR fitting with the flexibility of a compression fitting. Please refer to Design Report 3 (DR-3) in the Analytical Flow Product Cookbook.

**Patent Pending**

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VALVE ACTUATOR REPLACEMENT KIT

VARK -

<table>
<thead>
<tr>
<th>Valve type</th>
<th># of port</th>
<th>Temperature</th>
<th>Sampling</th>
<th>Option</th>
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<tbody>
<tr>
<td>E1 = ELDV-1</td>
<td>4</td>
<td>LT = 100°C</td>
<td>0 = N/A</td>
<td>V = Vacuum</td>
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<tr>
<td>E2 = ELDV-2</td>
<td>6</td>
<td>MT = 180°C</td>
<td>ISL</td>
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<tr>
<td>MG = MDVG</td>
<td>10</td>
<td>HT = 250°C</td>
<td>ADSL</td>
<td></td>
</tr>
<tr>
<td>CA = CADV</td>
<td></td>
<td></td>
<td>SDSL</td>
<td></td>
</tr>
<tr>
<td>DA = DADV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

COMPATIBLE MOUNTING POSITION

Top mounting screw: #6-32 x 1/2"
Side screw: 1/4" - 20 x 1/2"
Bottom mounting screw: 1/4" - 20 x 1/2"

HARDWARE SPARE PARTS
(Screws & Belleville Washers)

BWVC -

<table>
<thead>
<tr>
<th># of port</th>
<th>Temperature</th>
</tr>
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<tbody>
<tr>
<td>6</td>
<td>LT = 100°C</td>
</tr>
<tr>
<td>10</td>
<td>MT = 180°C</td>
</tr>
<tr>
<td></td>
<td>HT = 250°C</td>
</tr>
</tbody>
</table>

CLAMP RING

Part number: CR-MDV

TOOL KIT
(This include all the tools and spare relief pins to do the maintenance i.e. replacing a valve head, diaphragm, actuator)

Part number: TK-01

Option

- P = Purge option (included in MDVG series).
- XL = Extended life (for LT temperature grade only).
- S = SilcoNert 2000™ The ultimate passivation of treated surfaces. A required treatment for metal components when analyzing for parts-per-billion levels of organo-sulfur compounds & mercury. Greatly reduce moisture contamination, improve system performance and eliminates surface adsorption of active compounds on steel.
- D = Dursan™ is a coating designed to improve the inertness, hardness, and corrosion resistance of stainless steel. Ideal for sulfur, H2S, mercaptan, ammonia and mercury sampling.
- C = Pre-conditioning; this allows the elimination of atmospheric contaminants from the wetted internal surface.
- V = Vacuum operation configuration.
- HC = Valve head made of Hastelloy ®.
- MO = Valve head made of Monel ®.
- TI = Valve head made of Titanium.
- P10 = Valve head with .010" Ports Size.
- P15 = Valve head with .015" Ports Size.
- P40 = Valve head with .040" Ports Size.
- XX = Custom request.
Base on a specific valve configuration and working condition, warranty period and valve maintenance procedure, (i.e.) parts replacement are different. Please refer to Analytical Flow Products™ specific valve documentation for more information.

Is still the responsibility of the user to make sure that for the selected valve configuration is safe and reliable for his application.

Analytical Flow Products engineering team will do their best to help customers for any application that may require custom modification. Analytical flow products will be please to supply demonstration parts to qualified O.E.M.

*SEE WEBSITE FOR WARRANTY AND DISCLAIMER NOTICE. PRODUCT SPECIFICATION MAY CHANGE WITHOUT NOTICE, ASK FOR UPTODATE NOTIFICATION.
### OFFERING COMPARISON OF GC DIAPHRAGM VALVES

<table>
<thead>
<tr>
<th>FEATURES AND BENEFITS</th>
<th>AFP®</th>
<th>COMPETITORS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3 Choices of Performance level</strong></td>
<td>3</td>
<td>N/A</td>
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<tr>
<td>300 to 750 psig</td>
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<td></td>
</tr>
<tr>
<td>-20°C to 250°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal Sample Valve</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>-20°C to 250°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Standard Purge Design Concept</strong></td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>Valve can be used under vacuum</td>
<td>•</td>
<td>N/A</td>
</tr>
<tr>
<td>GC/MS application</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allows safe operation</td>
<td>•</td>
<td>N/A</td>
</tr>
<tr>
<td>with hazardous gases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allows real time</td>
<td>•</td>
<td>N/A</td>
</tr>
<tr>
<td>monitoring the valve’s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eliminates fugitive</td>
<td>•</td>
<td>N/A</td>
</tr>
<tr>
<td>emission and inboard/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>outboard contamination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eliminates permeation</td>
<td>•</td>
<td>N/A</td>
</tr>
<tr>
<td>/diffusion through the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>diaphragm</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Valve Head Configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/32”, 1/16” ports</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>AFP Lip Seal fitting</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td>1/16”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/8” VCR or welded tube</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td>NeSSI™ as per ANSI/ASI-76.00.02-2002</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td>(surface mounted)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polymer or Ceramic</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td>Dual internal sampling loop</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td>Choice of coating: Sulfinert, Gold, Tantalum</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Actuation Mechanism</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relief pins design</td>
<td>•</td>
<td>N/A</td>
</tr>
<tr>
<td>Tied plungers design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No flow mixing upon actuation (Mixing is tunable)</td>
<td>•</td>
<td>N/A</td>
</tr>
<tr>
<td>Single acting / Single inlet port</td>
<td>•</td>
<td>N/A</td>
</tr>
<tr>
<td>Double actuation mechanism</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td>Cam or Electric actuator</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Choices of Diaphragm to match Application</strong></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Can be coated with Teflon®, Gold, Nickel, Custom</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td>Keyed to fit only one way</td>
<td>•</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Manufacturing / Quality Assurance</strong></td>
<td>3</td>
<td>N/A</td>
</tr>
<tr>
<td>Internal parts traceability</td>
<td>•</td>
<td>EXTRA COST (175$)</td>
</tr>
<tr>
<td>100% helium leak test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve Pre-conditioning</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Hardware</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuts and ferrules</td>
<td>•</td>
<td></td>
</tr>
<tr>
<td>Pneumatic adaptor</td>
<td>•</td>
<td>EXTRA COST</td>
</tr>
<tr>
<td>Clamp ring</td>
<td>•</td>
<td>EXTRA COST</td>
</tr>
</tbody>
</table>

- : Standard
- A : Available
- N/A : Not Available
FEATURES OF AFP® DIAPHRAGM VALVES

1- Selected from 3 models to match your requirements.
   - Working lifetime ranges from 2 to 5 years.
   - Pressure ranges from 300 to 700psig.
   - Temperature ranges from -20°C to 250°C.
   - Specs guaranteed for 500,000 to 1,000,000 cycles (depends on model).
   - Gas or Liquid.

2- Unique Purging Design Concept: Unsurpassed Value added benefit for system designers and users.
   - Eliminates fugitive emission and inboard / outboard leaks.
   - Eliminates permeation / diffusion through the diaphragm.
     - No more negative peaks.
     - Ideal for low level impurities measurement.
   - Allows vacuum application for GC / MS systems and sub atmospheric sampling
   - Eliminates a bulky purge enclosure.
   - Allow safe operation with hazardous gases.
   - Built in purge flow restrictor option.
     - Eliminates the need to set up an external flow restrictor to fix the purge flow.
   - Allows real time monitoring the valve’s health.
     - Prevents unwanted and costly system shutdown.

3- Valve’s Head Configuration: Users flexibility, tailor to fit application !
   - Six or ten ports.
   - Single internal sampling loop: 0.5μl to 5.0μl.
   - Dual sampling loop:
     - Alternate or simultaneous injection.
     - Loop could be of different size on the same valve’s head.
     - One internal / one external, configuration available.
   - Material:
     - choice of polymers / SS-316L (Standard) / Hastelloy /Monel / Titanium /   Others and custom…
   - Choice of coating:
     - Sulfinert / Gold / Tantalum / Others…
     - 1/32”, 1/16”, 1/8” VCR or welded tube or a combination of, on the same valve head.
   - Unique to AFP® NeSSi® version as per ANSI / ISA-76.00.02-2002
     - Ideal for surface mounted petrochemical/chemical plant applications.

4- Choice of actuation mechanism for maximum user’s flexibility.

General Characteristic :
   - Absolutely no port flow mixing upon actuation (carrier mixing with the sample).
     - Eliminate unwanted artifacts upon actuation.
   - Unique relief pins design concept. (Patent Pending)
     - Allows simple and quick diaphragm replacement.
     - Allows long term storage with no diaphragm distortion.
A) Standard Actuator Body:

- Single acting, Single inlet port, Pneumatic actuation

B) Pneumatic double actuation:

- Double actuating mechanism:
  - Allow lower actuating pressure to be use.
  - Ex: Carrier pressure of 100 psi = 30 psi of actuation pressure
  - Carrier pressure of 300 psi = 50 psi of actuation pressure
  - Allow full control of switching time.
  - Choice of N.C and / or N.O configuration or a mix of them.

C) First electrical driven diaphragm valve, Cam Driven Actuator Body:

No actuation gas required for actuation!

- Available with different flow switching scheme:
  - load / isolate / inject
  - load / pressurize / inject
  - Custom flow switching sequence.
- Actuation could be done manually or by any rotary actuator.
- Allows electrical actuation.
- This will allow you to retro fit AFP® valves onto existing rotary pneumatic or electric actuators.

5- Diaphragm Design:

- Polyimide treated core.
- Can be coated with; Teflon / Gold / Nickel...
- Custom coated for custom applications.
- Keyed to fit only one way.
- Easy to change and return to factory specs. 100% guarantee.

6- Manufacturing / Quality:

- 100% helium leak tested.
- Internal parts traceability.
- Valve Pre-conditioning: this allows the elimination of atmospheric contaminants from the wetted internal surface.
SHORT TUTORIAL AND TECHNICAL NOTE ON THE ELDV/MDVG FAMILY
Diaphragm based valves have been a very attractive solution for many chromatographers, mainly due to the space saving and performance expectation. However these valves were plagued with a bad reputation that they deserved, since their analytical performance has been poor. This is the story from the past.

Same concept since more than a half century

- Replaces old fashion plate valves and former conical rotary valves
- Built in actuator (saves space over the rotary model)

NEW ERA

- Completely new plunger and actuator design
- Purging groove design
- Pressure adjusting screw
- Multi-layer diaphragm
- Tight Manufacturing & control procedure

* Covered by four (4) patents pending.
Free moving plungers
Unequal sealing force on the diaphragm (F1>F2), because the piston pushes only on the half portion of the plunger’s surface.
Friction

Welded tube, can break over the time
Prevent inboard /outboard leak but with o-ring

Flat diaphragm, no groove

PLUNGER DESIGN VARIATION

ORIGINALLY PHILLIPS PETROLEUM (1961) DESIGN NOW SIEMENS

EXISTING VALVE DESIGN OVERVIEW & RELATED PROBLEMS

SIEMENS SERIE 11
EXISTING VALVE DESIGN OVERVIEW & RELATED PROBLEMS

VALCO SERIE DV 22

- Polymer base plunger
- Large tolerance variation in length
- Free moving plungers
- Unequal sealing force on the diaphragm (F1>F2), because the piston pushes only on the half portion of the plunger's surface.

- Plunger middle section will bend to compensate for plunger length variation. This phenomenon accentuates the problem of unequal sealing force.
- Friction: particles generation

The purge ring will not prevent permeation through the diaphragm from the actuation gas.

The middle section of the diaphragm still exposed to air. High risk of inboard/outboard contamination and fugitive emission.

Optionnal Purge Ring
PLUNGER DESIGN
SPRING RETURN & SELF ALIGNED

1. Two parts plunger self aligned designed.

2. Plungers are fixed to the pistons with a sealed screw. The valve can be used in any position and under vibration condition.

3. Precisely machined in low friction alloy to avoid wearing and ensure a long lifetime.

4. Precisely machined in stainless steel, no friction with the valve’s cylinder.

5. Force is applied to the total surface area resulting in an equal sealing force on the diaphragm (F1 = F2)
ACTUATION MECHANISM DESIGN

STANDARD ACTUATION MECHANISM:

- Single acting (spring return)
- Tilt compensated design, based on steel ball single contact point load transfer
- Compensation for long term wearing

1. Swivel ball bearing design that compensate for any misalignment
2. Precise pre-load actuating pressure tuning mechanism
   - Single contact load transfer compensation for misalignment
   - Allow tuning of the non-mixing zone
   - Locking screw to keep the factory tuning
3. Various spring configuration:
   - Vacuum and standard

Ball bearing
Locking screw
Mixing dead band adjustment
4 Holding screws on the valve head to preserve the sealing integrity
   • It makes sure to maintain proper sealing alignment

2 Temperature compensation spring washer to avoid excessive compression of the diaphragm, at high temperature

3 4 Independent holding screws for the bottom cap, independent from the pressure adjusting screw

4 Relief pin:
   • Ease the replacement of the diaphragm
   • Ideal for long term storage

5 Vent hole in the bottom cap to prevent actuating pressure built-up
All these grooves are connected

- Eliminates fugitive emission and inboard / outboard leaks
- Eliminates permeation / diffusion through the diaphragm
  - No more peaks
  - Ideal for low level impurities measurement.
- Allows vacuum application for GC / MS systems and sub atmospheric sampling
- Allow safer operation with hazardous gases.
- Allows real time monitoring the valves health, self diagnostic.
  - Prevents unwanted and costly system shutdown
Fool proof design to fit the diaphragm only in one way.

3 choices of diaphragm:
- HT (High Temperature): Treated Polyimide
- MT (Medium Temperature): Treated Polyimide
- LT (Low Temperature): Polyimide with Teflon layer

Polyimide treated core.
Can be coated; Teflon / Gold / Nickel...

Custom coated for custom applications.
Can be coated; Teflon / Gold / Nickel...

Extra protection against diffusion or permeation.
Can also be metal coated.

Mechanical Strength

Teflon®

(Accts as a cushion)
SELF DIAGNOSTIC EXAMPLE

For more information please refer to application note AN-04
IMPROVED PERFORMANCE RESULT

Test done by third party lab

Has many advantages over the old design
**ELDV1 / ELDV2 / MDVG-SERIES**

*WITH PNEUMATIC ACTUATOR*

---

**ELDV-1**
- Optimized for cost
- Sensitive application
- Standard grade valve

**ELDV-2**
- Better leak performance and lifetime
- Medium cost,
- High performance grade valve

**MDVG**
- Premium grade valve
- Premium leak performance and lifetime
- Choice of VCR fitting

---

**Leak rates:**

- **Cross Ports:**
  - (Maximum pressure)
  - 9.0 x 10^{-9} Atm-cc/sec He
  - 5.0 x 10^{-10} Atm-cc/sec He
- **Cross Ports:**
  - (100 Psig)
  - 1.0 x 10^{-10} Atm-cc/sec He

Equivalent in years to fill a cube of 1 cc
At the 100 Psi working pressure

**63 years**

**3 370 years**

**52 800 years**

---

*Estimated working lifetime: [years]*
*(Based on a cycle time of 5 minutes, 24 hours, 365 days/year)*

- **2**
- **3**
- **5**
MDVG-4-ISL-SERIES
(INTERNAL SAMPLING LOOP)

OFF Mode
The sample is injected into the sampling loop

ON Mode
The sample is injected into the column

Available Internal Sampling Loop volume: 0.5µl, 1.0µl, 1.5µl, 2.0µl, 3.0µl, 5.0µl

MDVG-10-ADSL-SERIES
(ALTERNATE DOUBLE SAMPLING LOOP)

OFF Mode
Sample #1 is injected into the sampling loop
Sample #2 is loaded into the sampling loop

ON Mode
Sample #1 is loaded into the double sampling loop
Sample #2 is injected into the column

MDVG-10-SDSL-SERIES
(SIMULTANEOUS DOUBLE SAMPLING LOOP)

OFF Mode
Sample is loaded into the double sampling loop

ON Mode
Sample is injected into the column #1 and column #2
FIRST ELECTRICAL DRIVEN GC DIAPHRAGM VALVE

CADV-SERIES
(WITH CAM BASE ACTUATOR)

CADV:

- Allows a direct upgrade of the existing GC equipped with rotary valves, allowing the system to benefit from the GC diaphragm valve features.

- Can be used with the syringe adaptor for sample loop filling.

- Sequential injection mode available. Eliminate baseline upset upon injection.

- 3 positions: Load / Isolated / Inject.

CADV installed on a VIC® pneumatic rotary actuator.

CADV with base mounted handle.

CADV installed on an electric actuator.
Fully 100% inspected and tested using helium mass spectrometer, makes sure that each valve meets the specifications.

Parts traceability, long term follow up.

- Private label and licensing.
- Special surface treatment.
- Polymer head.
- VCR 1/8".
- Tube connection.
- Double actuation mechanism.

ELDV-MDVG-SERIES