

# Diaphragm Valves for Atomic Layer Deposition



## Atomic Layer Deposition (ALD) Diaphragm Valves

- Ultrahigh cycle life with high-speed actuation
- $C_v$  range from 0.27 to 0.62
- Up to 392°F (200°C) capability with thermal actuators
- Electronic actuator position-sensing option
- Suitable for ultrahigh-purity applications with 316L VIM-VAR stainless steel body
- VCR®, tube butt weld, and modular surface-mount end connections

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## Features

- Normally closed and normally open pneumatic actuation
- Flow coefficients of 0.27 to 0.62 standard; custom flow coefficients available
- Two-port straight and elbow configurations
- Two-, three- and four-port multiport valves and multivalve manifolds
- Two- and three-port modular surface-mount valves in 1.125 in. (ALD3 series only) and 1.5 in. platforms
  - C-seal design (all valves)
  - W-seal design (ALD3 series only)
- VCR, “H” Type VCR, and tube butt weld end connections in 1/4, 3/8, and 1/2 in. and 6, 10, and 12 mm sizes



## Diaphragm

- Cobalt-based superalloy (UNS R30003) material for strength and corrosion resistance
- Optimized, patent-pending design for ultrahigh cycle life

## Seat

- Fully contained seat design
- High-purity grade PFA, fully fluorinated
- Ultrahigh cycle life
- Broad range of chemical compatibility
- Excellent resistance to swelling and contamination
- High-integrity seat seal performance

## Body

- Body seal provides ultrahigh cycle life
- 316L VIM-VAR stainless steel body material for ultrahigh-purity applications
- Fully swept flow path
  - minimizes entrapment areas
  - facilitates purging
  - maximizes flow capacity
- Optional body holes to accommodate heater cartridges

## Actuators

### Standard

- Pneumatic actuator for high-speed and repeatable actuation
- Capable of valve opening or closing time of less than 5 ms
- Factory-set flow adjusting mechanism ensures precise and consistent  $C_v$  from valve to valve
- Optional factory-set electronic actuator-position sensor verifies open position of pneumatically actuated valves
- Optional solenoid pilot valve for electronic control of high-speed actuation

### Thermal

Same performance and options as standard actuator with the following additional features:

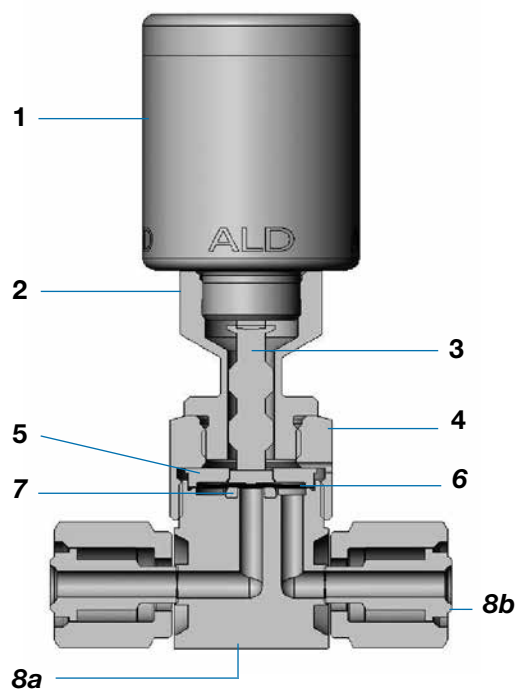
- Includes thermal isolation coupling for thermal applications
- Limits conductive heat transfer from the body to the actuator
- Provides a more uniform valve body temperature to reduce cold spots
- Significantly reduces electrical power required to heat the valve
- Extends the life of the actuator in applications where the body is heated

## Materials of Construction

Component	Material Grade/ASTM Specification
1 Pneumatic actuator assembly	—
Cylinder, cap	Aluminum
Pistons	Powdered metal 300 series SS—normally open; aluminum—normally open and normally closed
Base	Powdered metal 300 series SS—normally open; none—normally closed
Flow adjusting mechanism	316 SS/A479
O-rings	Fluorocarbon FKM
Springs	S17700
Button	316 SS/A479
Bushing	Carbon-filled PTFE
2 Thermal isolation coupling housing (thermal model only)	316 SS/A479
3 Thermal isolation coupling stem (thermal model only)	S17400
4 Bonnet nut	316 SS/A479
5 Bonnet	S17400
6 Diaphragm	Cobalt-based superalloy (UNS R30003)/AMS 5876
7 Seat	High-purity PFA Type II/D3307
8a Body	316L VIM-VAR SS/SEMI F20-0305 Ultrahigh-Purity <sup>①</sup>
8b Welded VCR end connections	316L VAR SS/SEMI F20-0305 High-Purity <sup>①</sup>
Lubricant	PTFE-based

Wetted components listed in *italics*.

① 20 % minimum elongation allowed.



Normally Closed Actuator Shown

## Process Specifications

See Swagelok® *Ultrahigh-Purity Process Specification (SC-01)* (MS-06-61) for details on processes, process controls, and process verification.

Cleaning	Assembly and Packaging	Wetted Surface Roughness ( $R_a$ )	Testing
Ultrahigh-purity cleaning with a continuously monitored, deionized water, ultrasonic cleaning system	Performed in ISO Class 4 work areas; valves are double bagged and vacuum sealed in cleanroom bags.	Electropolished and finished to an average of 5 $\mu\text{in.}$ (0.13 $\mu\text{m}$ )	ALD3 normally closed: Inboard helium leak tested to a rate of $1 \times 10^{-9}$ std $\text{cm}^3/\text{s}$ at the seat, envelope, and all seals. ALD3 and ALD6 normally open and ALD6 normally closed: Inboard helium leak tested to a rate of $1 \times 10^{-8}$ std $\text{cm}^3/\text{s}$ at the seat and to a rate of $1 \times 10^{-9}$ std $\text{cm}^3/\text{s}$ at the envelope and all other seals.

## Technical Data

Valve Series	Working Pressure psig (bar)		Temperature Rating °F (°C)			Flow Coefficient ( $C_v$ ) <sup>④</sup>	Orifice in. (mm)	Internal Volume <sup>⑤</sup> in. <sup>3</sup> (cm <sup>3</sup> )		Pneumatic Actuator <sup>⑤</sup>	
			Operating <sup>②③</sup>		Short-Term Bakeout			Tube Butt Weld Body	2-Port Surface-Mount	Actuation Pressure psig (bar)	Air Displacement in. <sup>3</sup> (cm <sup>3</sup> )
	Operating <sup>①</sup>	Burst	Standard Actuator	Thermal Actuator <sup>②</sup>							
<b>Normally Closed Actuation</b>											
ALD3	Vacuum to 145 (10.0)	>3200 (220)	32 to 248 (0 to 120)	32 to 392 (0 to 200)	392 (200) (valve open)	0.27	0.16 (4.1)	0.086 (1.4)	0.048 (0.79)	50 to 90 (3.5 to 6.2)	0.042 (0.69)
ALD6											0.075 (1.2)
<b>Normally Open Actuation</b>											
ALD3	Vacuum to 145 (10.0)	>3200 (220)	32 to 248 (0 to 120)	32 to 392 (0 to 200)	392 (200) (valve open)	0.27	0.16 (4.1)	0.086 (1.4)	0.048 (0.79)	70 to 90 (4.9 to 6.2)	0.027 (0.44)
ALD6											0.046 (0.75)

① Recommended operating pressure of less than 35 psig (2.4 bar) for optimal cycle life.

② Actuator temperature is limited to 248°F (120°C); valve body temperature is rated to 392°F (200°C).

③ See pages 6 and 8 for maximum operating temperatures for products with an electronic actuator-position sensor, solenoid pilot valve, or both.

④ Custom flow coefficients available; contact your authorized Swagelok representative for more information.

⑤ ALD3 series 1.125 in. platform surface-mount valve:

■ Internal volume for 2-port body: 0.078 in.<sup>3</sup> (1.3 cm<sup>3</sup>)

■ Actuation pressure: normally closed, 60 to 90 psig (4.2 to 6.2 bar); normally open, 70 to 90 psig (4.9 to 6.2 bar).

■ Air displacement: 0.03 in.<sup>3</sup> (0.49 cm<sup>3</sup>).

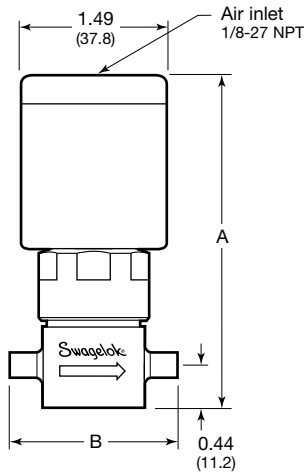
## Ordering Information and Dimensions

Dimensions, in inches (millimeters), are for reference only and are subject to change.

### Two-Port Valves

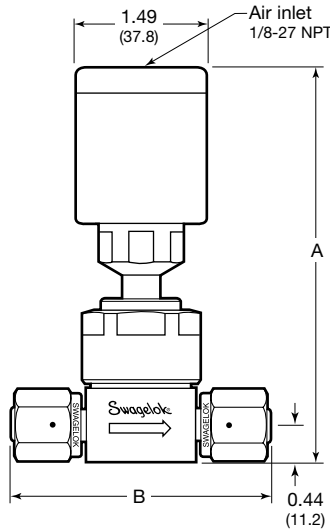
For a complete ordering number, add **C** for a normally closed actuator or **NO** for a normally open actuator.

**Normally Closed Standard Actuator**



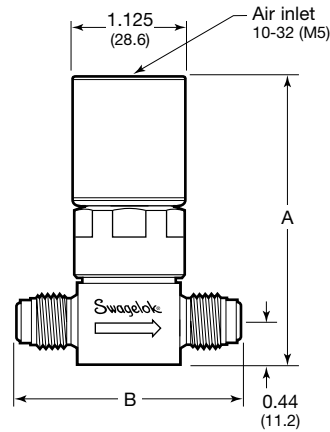
**Butt Weld End Connections**

**Normally Closed Thermal Actuator**



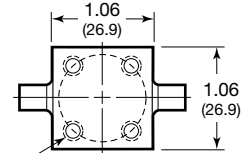
**Female VCR Fitting End Connections**

**Normally Open Standard Actuator**

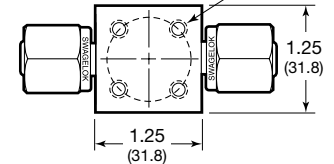


**Integral Male VCR Fitting End Connections**

**ALD3 Bottom**



Four mounting holes, M5 × 0.8-6H thread, 0.25 (6.4) deep, located 45° from center line, on a 1.00 (25.4) bolt circle. M5 × 0.8-6H holes are compatible with 10-32 mounting screws.



**ALD6 Bottom**

End Connections		Standard Actuator Ordering Number	Thermal Actuator Ordering Number	Dimensions, in. (mm)		
				A		B
Inlet/Outlet	Size		Normally Closed	Normally Open		
<b>ALD3 Series</b>						
Female VCR fitting	1/4 in.	6LVV-ALD3FR4-P-	6LVV-ALD3TFR4-P-	3.50 (88.9) (standard actuator)	3.22 (81.8) (standard actuator)	2.78 (70.6)
Integral male VCR fitting	1/4 in.	6LVV-ALD3VR4-P-	6LVV-ALD3TVR4-P-			2.30 (58.4)
Rotatable male VCR fitting	1/4 in.	6LVV-ALD3MR4-P-	6LVV-ALD3TMR4-P-			2.78 (70.6)
Tube butt weld, 0.30 in. long	1/4 × 0.035 in.	6LVV-ALD3BW4-P-	6LVV-ALD3TBW4-P-	4.50 (114) (thermal actuator)	4.22 (107) (thermal actuator)	1.74 (44.2)
Tube butt weld, 0.26 in. long	1/4 × 0.035 in.	6LVV-ALD3BW4S-P-	6LVV-ALD3TBW4S-P-			1.61 (40.9)
Tube butt weld, 7.6 mm long	6 × 1 mm	6LVV-ALD3BW6M-P-	6LVV-ALD3TBW6M-P-			1.74 (44.2)
<b>ALD6 Series</b>						
Female VCR fitting	1/2 in.	6LVV-ALD6FR8-P-	6LVV-ALD6TFR8-P-	3.76 (95.5) (standard actuator)	3.48 (88.4) (standard actuator)	4.16 (106)
Female "H" type VCR fitting	1/4 in.	6LVV-ALD6HFR4-P-	6LVV-ALD6THFR4-P-			2.78 (70.6)
Female/rotatable male "H" type VCR fitting	1/4 in.	6LVV-ALD6HFR4HMR4-P-	6LVV-ALD6THFR4HMR4-P-			2.96 (75.2)
Rotatable male VCR fitting	1/2 in.	6LVV-ALD6MR8-P-	6LVV-ALD6TMR8-P-			4.16 (106)
Rotatable male "H" type VCR fitting	1/4 in.	6LVV-ALD6HMR4-P-	6LVV-ALD6THMR4-P-			2.96 (75.2)
Tube butt weld, 0.50 in. long	3/8 × 0.035 in.	6LVV-ALD6BW6-P-	6LVV-ALD6TBW6-P-			4.76 (121) (thermal actuator)
	1/2 × 0.049 in.	6LVV-ALD6BW8-P-	6LVV-ALD6TBW8-P-			
Tube butt weld, 12.7 mm long	10 × 1 mm	6LVV-ALD6BW10M-P-	6LVV-ALD6TBW10M-P-			
	12 × 1 mm	6LVV-ALD6BW12M-P-	6LVV-ALD6TBW12M-P-			

## Ordering Information and Dimensions

Dimensions, in inches (millimeters), are for reference only and are subject to change.

### Modular Surface-Mount Valves

#### C-Seal Design

For a complete ordering number, add **C** for a normally closed actuator or **NO** for a normally open actuator.

ALD series 1.5 in. platform modular surface-mount valves with C-seals are IGC® II compatible. For more information about IGC II integrated gas components, see the *IGC II Integrated Gas Components—Substrates, Manifolds, Mounting Components, and Assembly Hardware* catalog, MS-02-134.

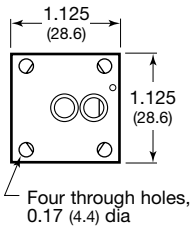
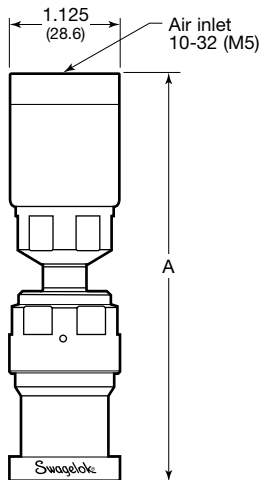
#### W-Seal Design

Insert **W** into an ALD3 series ordering number as shown.

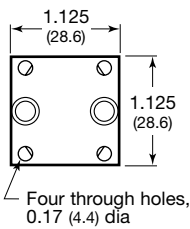
Examples:

- 6LVV-MSM-ALD3E-W2-P-C for a 1.125 in. 2-port valve with standard actuator
- 6LVV-MSM-ALD3T-W3-P-C for a 1.5 in. 3-port valve with thermal actuator

**Normally Closed Thermal Actuator, 1.125 in. Platform**

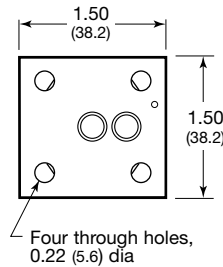
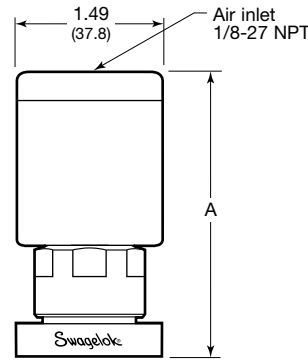


**1.125 in. C-Seal Platform Bottom**



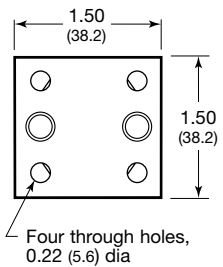
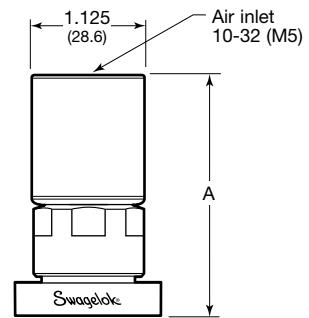
**1.125 in. W-Seal Platform Bottom**

**Normally Closed Standard Actuator 1.5 in. Platform**



**1.5 in. C-Seal Platform Bottom**

**Normally Open Standard Actuator 1.5 in. Platform**

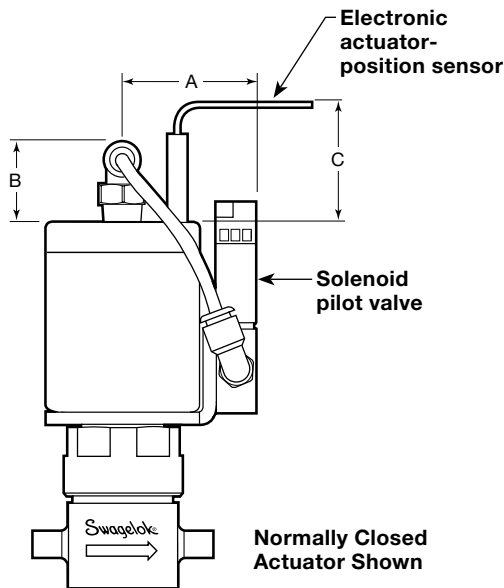


**1.5 in. W-Seal Platform Bottom**

Surface-Mount Platform	Ports	Standard Actuator Ordering Number	Thermal Actuator Ordering Number	A, in. (mm)			
				Normally Closed		Normally Open	
				C-Seal	W-Seal	C-Seal	W-Seal
<b>ALD3 Series</b>							
1.125 in.	2	6LVV-MSM-ALD3E-2-P-	6LVV-MSM-ALD3ET-2-P-	3.40 (86.4) (standard)	3.40 (86.4) (standard)	3.45 (87.6) (standard)	3.45 (87.6) (standard)
	3	6LVV-MSM-ALD3E-3-P-	6LVV-MSM-ALD3ET-3-P-	4.40 (112) (thermal)	4.40 (112) (thermal)	4.45 (113) (thermal)	4.45 (113) (thermal)
1.5 in.	2	6LVV-MSM-ALD3-2-P-	6LVV-MSM-ALD3T-2-P-	3.02 (76.7) (standard)	3.70 (94.0) (standard)	2.74 (69.6) (standard)	3.42 (86.9) (standard)
	3	6LVV-MSM-ALD3-3-P-	6LVV-MSM-ALD3T-3-P-	4.02 (102) (thermal)	4.70 (119) (thermal)	3.74 (95.0) (thermal)	4.42 (112) (thermal)
<b>ALD6 Series</b>							
1.5 in.	2	6LVV-MSM-ALD6-HF2-P-	6LVV-MSM-ALD6T-HF2-P-	3.15 (80.0) (standard)	—	2.87 (72.9) (standard)	—
	3	6LVV-MSM-ALD6-HF3-P-	6LVV-MSM-ALD6T-HF3-P-	4.15 (105) (thermal)	—	3.87 (98.3) (thermal)	—

## Options and Accessories

Valves with electronic actuator-position sensors (right), solenoid pilot valve assemblies, page 8, heater cartridge holes, page 8, and optical position sensors, page 7, are available.



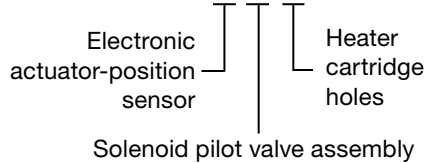
### Dimensions

Actuator	Dimensions, in. (mm)		
	A	B	C
Normally closed	1.32 (33.5)	0.70 (17.8)	1.18 (30.0)
Normally open	1.14 (29.0)	0.63 (16.0)	

### Ordering Information

To order one option, add a designator to the valve ordering number. To order two or more options, add the designators in

**6LVV – ALD3BW4-P-C S V H**



the sequence shown below.

Examples:

6LVV-ALD3BW4-P-CH for a valve with heater cartridge holes

6LVV-ALD3BW4-P-CS for a valve with electronic actuator-position sensor with short pigtail electrical connector

6LVV-ALD3BW4-P-CSLH for a valve with electronic actuator-position sensor with long cable with flying leads electrical connector and heater cartridge holes

6LVV-A3T1V333P-AAV for a multivalve manifold with solenoid pilot valve assembly on valve 2

6LVV-A31V333P-ASVASV for a multivalve manifold with electronic actuator-position sensor with short pigtail electrical connector and solenoid pilot valve assembly on both valves

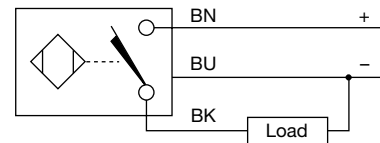
## Electronic Actuator-Position Sensors

Transmit a signal to an electrical device indicating the open position of pneumatically actuated valves. Sensors and electrical connectors described below are third-party products.

### Sensor Technical Information

<b>Output</b>	3-wire V (dc) – transistor (current-sourcing)
<b>Output Function</b>	Normally open
<b>Voltage</b>	10 to 30 V (dc) polarity protected – pulsed SCP
<b>Operating Temperature</b>	–23 to 70°C (–10 to 158°F)

### Wiring Diagram



### Factory-Assembled Electronic Actuator-Position Sensors

Factory-assembled position sensors are set for optimum performance and sealed with a tamper-evident paste that provides visible evidence of disassembly or adjustment.

To order an electronic actuator-position sensor factory assembled to a valve, add a designator to the valve ordering number.

Examples:

6LVV-ALD3BW4-P-CS

6LVV-MSM-ALD6-HF2-P-CSL

Sensor Electrical Connector	Designator
Short pigtail <sup>①</sup>	S
Long cable with flying leads	SL

<sup>①</sup> A mating direct-current M8 3-wire push-on straight female connector is available.

Ordering number:  
**MS-CS-BALF-1**

## Options and Accessories

### Optical Position Sensors

#### Features

- Fast response times
- Compatible with high temperatures
- Unaffected by RF noise
- Transferable from one valve to another, without loss of factory settings

#### Optical Sensor Kits

Optical sensors detect the open position on normally closed pneumatically actuated valves. Optical sensor kits contain the hardware required to install the sensor onto an optical sensor ready valve and connect it to an amplifier.

Optical sensors kits are factory set to the correct depth and tested for proper functionality.

#### Sensor Kit Technical Information

<b>Fiber Unit</b>	FU-87
<b>Temperature Rating</b>	-76°F to 356°F (-60°C to 180°C)
<b>Max Ambient Temperature</b>	302°F (150°C)
<b>Fiber Length<sup>①</sup></b>	6.56 ft. (2 m)

① Every optical sensor kit includes a single use fiber cutting tool

#### Ordering Information

Optical Sensor Kit Ordering number:

MS-SOK-ALD-FU87

To order an Optical Sensor Kit with an amplifier add, **-AMP** to the ordering number.

MS-SOK-ALD-FU87-AMP

#### Optical Sensor Ready Valves

Optical sensor ready valves are designed to allow an optical sensor kit to be easily installed onto the actuator. The modifications from standard ALD valves include the following:

- A sensor target is included in the actuator.
- The actuator is 0.115 in. (2.9 mm) taller.
- The 1/8-27 NPT air inlet is replaced with a 10-32 (M5) connection.

#### Ordering Information

To order an optical sensor ready valve, add **SO** to the ordering number.

Example: 6LVV-ALD3BW4-P-LI-**CSO**

Note: Optical sensor is only available on normally closed valves. LI indicates “less indicator” as sensor kits are sold separately for field assembly.

### Optical Sensor Amplifiers

Optical sensor amplifiers transmit a signal to an electrical device which indicates the open position of pneumatically actuated valves. The amplifiers work in conjunction with an Optical Sensor Kit and an Optical Sensor Ready Valve.

#### Amplifier Technical Information

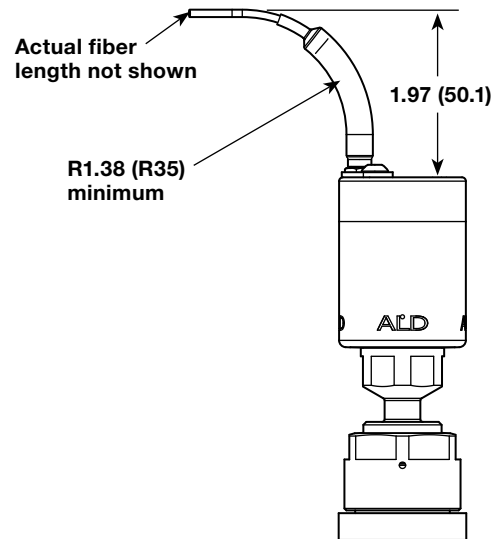
<b>Amplifier</b>	FS-N11CP
<b>Output</b>	PNP, M8 Connector
<b>Temperature Rating</b>	-4° to 131°F (-20° to 55°C)
<b>Power Requirement</b>	12-24V DC $\pm$ 10% Ripple (P-P) 10 % or Less

#### Factory Programmed Amplifiers

Factory programmed amplifiers are preset for optimum performance with Swagelok optical sensor ready valves and optical sensor kits. All factory programmed amplifiers are tested for proper functionality.

Optical Sensor Amplifier Ordering Number:

MS-SOK-ALD-AMP-M8

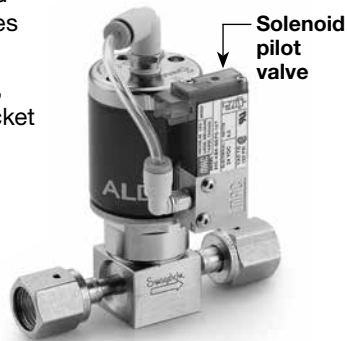


## Options and Accessories

### Solenoid Pilot Valve Assemblies

Fast-acting, high-flow solenoid pilot valve enhances ALD series valve response time.

- Includes tubing, connectors, and rotatable mounting bracket for installation versatility.
- See illustration on page 6 for assembly dimensions.
- See table below for technical information. For additional technical information, see MAC® valve part number 34C-ABA-GDFC-1KT.



### Solenoid Pilot Valve Technical Information

<b>Component</b>	MAC valve 34C-ABA
<b>Solenoid Pilot Valve</b>	24 V, 4 W
	Temperature rating: 50°C (122°F) maximum, continuous use
	Porting: M5 × 0.8-6H thread, compatible with 10-32 screws
<b>Push-to-Connect Fitting</b>	Material: C3604 brass, 304 SS, polybutylene terephthalate (PBT), polypropylene (PP), polyoxymethylene (POM), Nitrile rubber (NBR) (Buna N)
<b>Tubing</b>	Material: polyurethane
<b>Bracket</b>	Material: 316 SS
<b>O-Ring</b>	Material: Fluorocarbon FKM
<b>Washer</b>	Material: Nylon

### Factory-Assembled Solenoid Pilot Valves

To order a solenoid pilot valve factory assembled, add **V** to the ordering number.

Examples: 6LVV-ALD3BW4-P-CV  
6LVV-MSM-ALD6-2-P-CV

*In modular surface-mount systems, the solenoid pilot valve may interfere with adjacent components.*

### Solenoid Pilot Valves for Field Assembly

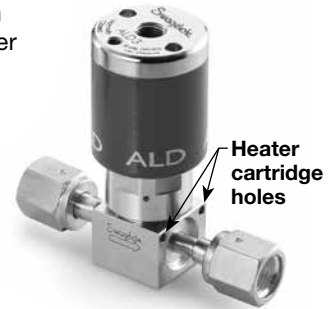
Ordering number for a solenoid pilot valve component only:

**MS-PVK-ALD-MAC34CA**

### Heater Cartridge Holes

Valves are available with holes in the body to accommodate heater cartridges.

- Hole size: 1/8 in. through holes for two-port, three-port, and elbow bodies; 1/8 by 1 in. deep holes for monoblock bodies.
- Two-port and monoblock bodies feature two body holes; three-port and elbow bodies feature one body hole. For more information, contact your authorized Swagelok representative.



### Ordering Information.

To order a valve with heater cartridge holes, add **H** to the ordering number.

Examples: 6LVV-ALD3BW4-P-CH  
6LVV-MSM-ALD6-2-P-CH

## Multiport and Elbow Valves and Monoblock Manifolds

ALD series valves are available in multiport and elbow configurations and monoblock manifolds; see the Swagelok *Bellows- and Diaphragm-Sealed Multiport and Elbow Valves and Monoblock Manifolds* catalog (MS-02-442).

**Caution: Do not mix or interchange parts with those of other manufacturers.**



## About this document

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### Safe Product Selection

**When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.**

## Warranty Information

Swagelok products are backed by The Swagelok Limited Lifetime Warranty. For a copy, visit your Swagelok Web site or contact your authorized Swagelok representative.

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