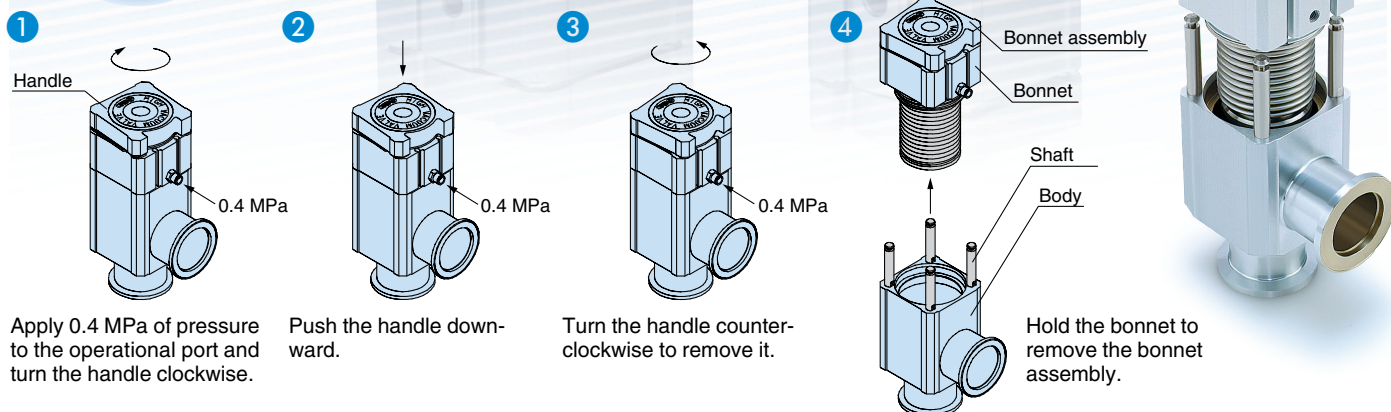


# Aluminum One-touch Connection and Release High Vacuum Angle Valves

Series *XLAQ/XLDQ*

**One-touch  
connection  
and release**  
(No tools are required.)

## Removal procedure

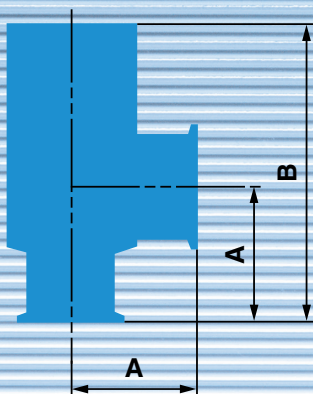




# Lightweight, Compact

Large conductance. Small body.

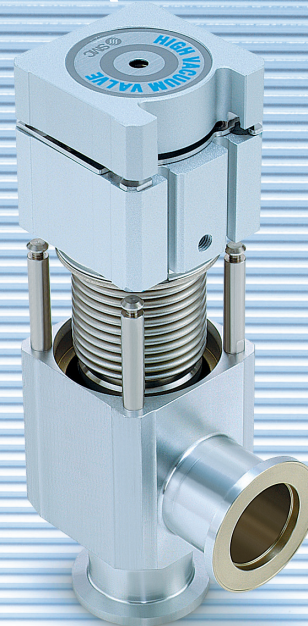
# One-touch Connection and Release (No tools are required.)



## XLAQ Series Case

| Model   | A*<br>(mm) | B<br>(mm) | Weight<br>(kg) | Conductance*<br>(ℓ/s) |
|---------|------------|-----------|----------------|-----------------------|
| XLAQ-16 | 40         | 120       | 0.33           | 5                     |
| XLAQ-25 | 50         | 133       | 0.6            | 14                    |
| XLAQ-40 | 65         | 178       | 1.3            | 45                    |
| XLAQ-50 | 70         | 190       | 2.0            | 80                    |

※: Common to the XLAQ/XLDQ series



## Variations

### Bellows seal, Single acting/**XLAQ**

- Particulate-free and clean room compatible bellows type
- The pressure-balance mechanism allows freedom in exhaust direction.

### 2-step control, Single acting/**XLDQ**

- Initial stage exhaust valve and main exhaust valve are combined. (flow rate 2-step control valve)
- Freedom in exhaust direction
- Designed for a compact system with reduced piping.
- Prevents particulate turbulence inside the chamber during exhaustion.
- Prevents a pumps from running overloaded.

| Actuation    | Applications                                                                  | Shaft seal system           | Model                                                                                              | Valve type           | Operating pressure<br>Pa                   | Flange size |    |    |    | Options |           |                        |
|--------------|-------------------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------|----------------------|--------------------------------------------|-------------|----|----|----|---------|-----------|------------------------|
|              |                                                                               |                             |                                                                                                    |                      |                                            | 16          | 25 | 40 | 50 | Switch  | Indicator | High temperature spec. |
| Air operated | Particle free                                                                 | Bellows seal                | <b>XLAQ</b><br> | Single acting (N.C.) | Atmospheric pressure to $1 \times 10^{-6}$ | ●           | ●  | ●  | ●  | ●       | ●         | ●                      |
|              | Prevents turbulence of particulates. Prevents a pump from running overloaded. | Bellows seal<br>O-ring seal | <b>XLDQ</b><br> |                      |                                            | —           | —  | ●  | ●  | ●       | Standard  | ●                      |

# Aluminum One-touch Connection and Release High Vacuum Angle Valve

## Series **XLAQ**

Normally Closed/Bellows Seal PAT.

### How to Order

**XLAQ** — **16** **□** **□** — **M9N** **A** — **□**

① ② ③ ④ ⑤ ⑥

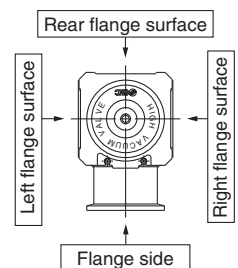


#### ① Flange size

| Size |
|------|
| 16   |
| 25   |
| 40   |
| 50   |

#### ② Indicator/Actuator port direction

| Symbol | Indicator         | Actuator port direction |
|--------|-------------------|-------------------------|
| -      | Without indicator | Flange side             |
| A      | With indicator    | Flange side             |
| F      |                   | Left flange surface     |
| G      |                   | Rear flange surface     |
| J      |                   | Right flange surface    |
| K      | Without indicator | Left flange surface     |
| L      |                   | Rear flange surface     |
| M      |                   | Right flange surface    |



#### ③ Temperature specifications/Heater

| Symbol | Temperature | Heater            | Applicable flange size |    |    |    |
|--------|-------------|-------------------|------------------------|----|----|----|
|        |             |                   | 16                     | 25 | 40 | 50 |
| —      | 5 to 60°C   | None              | ●                      | ●  | ●  | ●  |
| H0     | 5 to 150°C  | None              | ●                      | ●  | ●  | ●  |
| H4     |             | With 100°C heater | —                      | —  | ●  | ●  |
| H5     |             | With 120°C heater | —                      | ●  | ●  | ●  |

Note 1) Size 16 is not applicable for H4, H5, Size 25 not for H4.

Note 2) Heater cannot be retrofitted for the H0 type.

#### ⑤ Switch quantity/Mounting position

| Symbol | Quantity            | Mounting position |
|--------|---------------------|-------------------|
| -      | Without auto switch | —                 |
| A      | 2 pcs.              | Valve open/closed |
| B      | 1 pc.               | Valve open        |
| C      | 1 pc.               | Valve closed      |

#### ④ Auto switch type

| Symbol       | Auto switch part no. | Remarks                                        |
|--------------|----------------------|------------------------------------------------|
| -            | —                    | Without auto switch (Without built-in magnet)  |
| M9N(M)(L)(Z) | D-M9N(M)(L)(Z)       | Solid state switch                             |
| M9P(M)(L)(Z) | D-M9P(M)(L)(Z)       |                                                |
| M9B(M)(L)(Z) | D-M9B(M)(L)(Z)       |                                                |
| A90(L)       | D-A90(L)             | Reed switch (Not applicable to flange size 16) |
| A93(M)(L)(Z) | D-A93(M)(L)(Z)       | Without auto switch (With built-in magnet)     |
| M9//         | —                    |                                                |

Note 1) Auto switches are not applicable for high-temperature specifications (Temperature specifications H0, H4, H5). Standard lead wire length is 0.5 m. Add "L" to the end of the part number when 3 m is desired, "M" when 1 m, and "Z" when 5 m.  
Example) -M9NL

Note 2) A type with a pre-wired connector is also selectable. Example) -M9NSAPC

#### ⑥ Body surface treatment/Seal material and its changed part

##### • Body surface treatment

| Symbol | Surface treatment                                      |
|--------|--------------------------------------------------------|
| -      | External: Hard anodised Internal: Raw material         |
| A      | External: Hard anodised Internal: Oxalic acid anodised |

##### • Seal material

| Symbol | Seal material     | Compound no. |
|--------|-------------------|--------------|
| —      | FKM               | 1349-80*     |
| N1     | EPDM              | 2101-80*     |
| P1     | Barrel Perfluoro® | 70W          |
| Q1     | Kalrez®           | 4079         |
| R1     | Chemraz®          | SS592        |
| S1     | VMQ               | 1232-70*     |
| T1     | FKM for Plasma    | 3310-75*     |
| U1     | ULTIC ARMOR®      | UA4640       |
| F1     | FKM               | —**          |

\* Produced by Mitsubishi Cable Industries, Ltd.

\*\* Same specifications as the standard FKM type

##### • Part numbers for indicating the changed seal material and leakage

| Symbol | Changed part <sup>Note 2)</sup> | Leakage Pa•m <sup>3</sup> /s or less <sup>Note 1)</sup> |                               |
|--------|---------------------------------|---------------------------------------------------------|-------------------------------|
|        |                                 | Internal                                                | External                      |
| -      | None                            | 1.3 x 10 <sup>-10</sup> (FKM)                           | 1.3 x 10 <sup>-10</sup> (FKM) |
| A      | ②, ③                            | 1.3 x 10 <sup>-8</sup>                                  | 1.3 x 10 <sup>-8</sup>        |
| B      | ②                               | 1.3 x 10 <sup>-8</sup>                                  | 1.3 x 10 <sup>-10</sup> (FKM) |
| C      | ③                               | 1.3 x 10 <sup>-10</sup> (FKM)                           | 1.3 x 10 <sup>-8</sup>        |

Note 1) Values at ambient temperatures, excluding gas permeation.

Note 2) Refer to the part number in "Construction" on page 2 for the changed part. The number above indicates the part number from "Construction" accordingly.

Note 3) For option "F1," only "A" can be selected. The leakage amount is the same as that of "—" (standard FKM type).

To order something else than "—" (standard), list the symbols starting with "X", followed by the symbol for "seal material" and then the symbol for "changed parts" last.

Example) XLAQ-25-M9NA-XAN1A

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ULTIC ARMOR® is a registered trademark of VALQUA, LTD.

# Series XLAQ

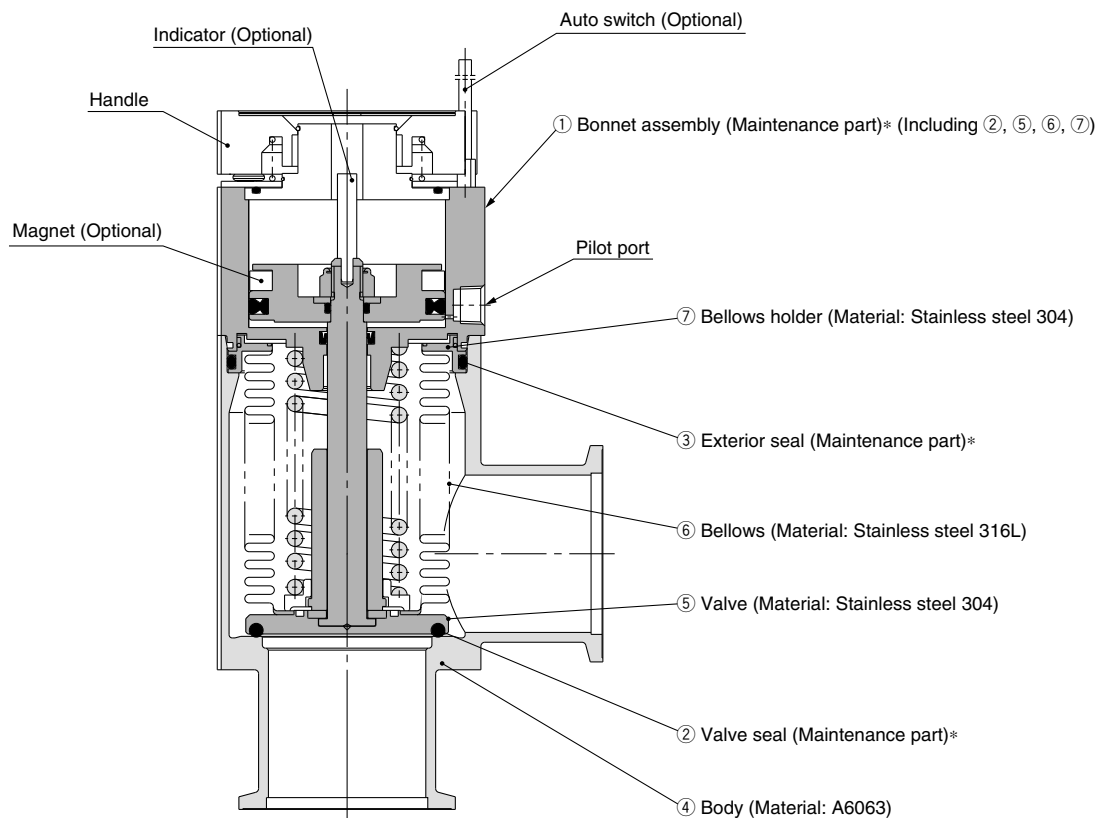
## Specifications

| Model                                |          | XLAQ-16                                                                                                                                   | XLAQ-25 | XLAQ-40 | XLAQ-50 |
|--------------------------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------|---------|---------|---------|
| Flange (valve) size                  |          | 16                                                                                                                                        | 25      | 40      | 50      |
| Valve type                           |          | Normally closed (Pressurise to open, Spring seal)                                                                                         |         |         |         |
| Fluid                                |          | Inert gas under vacuum                                                                                                                    |         |         |         |
| Operating temperature (°C)           |          | 5 to 60 (High-temperature type: 5 to 150)                                                                                                 |         |         |         |
| Operating pressure (Pa) (abs)        |          | Atmospheric pressure to 1 x 10 <sup>-6</sup>                                                                                              |         |         |         |
| Conductance (d/s) <sup>Note 1)</sup> |          | 5                                                                                                                                         | 14      | 45      | 80      |
| Leakage (Pa•m³/s)                    | Internal | 1.3 x 10 <sup>-10</sup> at normal temperatures (in case of standard material, FKM), excluding gas permeation                              |         |         |         |
|                                      | External |                                                                                                                                           |         |         |         |
| Flange type                          |          | KF (NW)                                                                                                                                   |         |         |         |
| Principal materials                  |          | Body: Aluminum alloy, Bellows: Stainless steel 316L, Bellows holder: Stainless steel 304, FKM (Standard seal material) <sup>Note 2)</sup> |         |         |         |
| Surface treatment                    |          | External: Hard anodized    Internal: Raw material                                                                                         |         |         |         |
| Pilot pressure (MPa) (G)             |          | 0.4 to 0.7                                                                                                                                |         |         |         |
| Pilot port size                      |          | M5                                                                                                                                        |         | Rc 1/8  |         |
| Weight (kg)                          |          | 0.33                                                                                                                                      | 0.6     | 1.3     | 2.0     |

Note 1) Conductance is the value for the “molecular flow” of an elbow with the same dimensions.

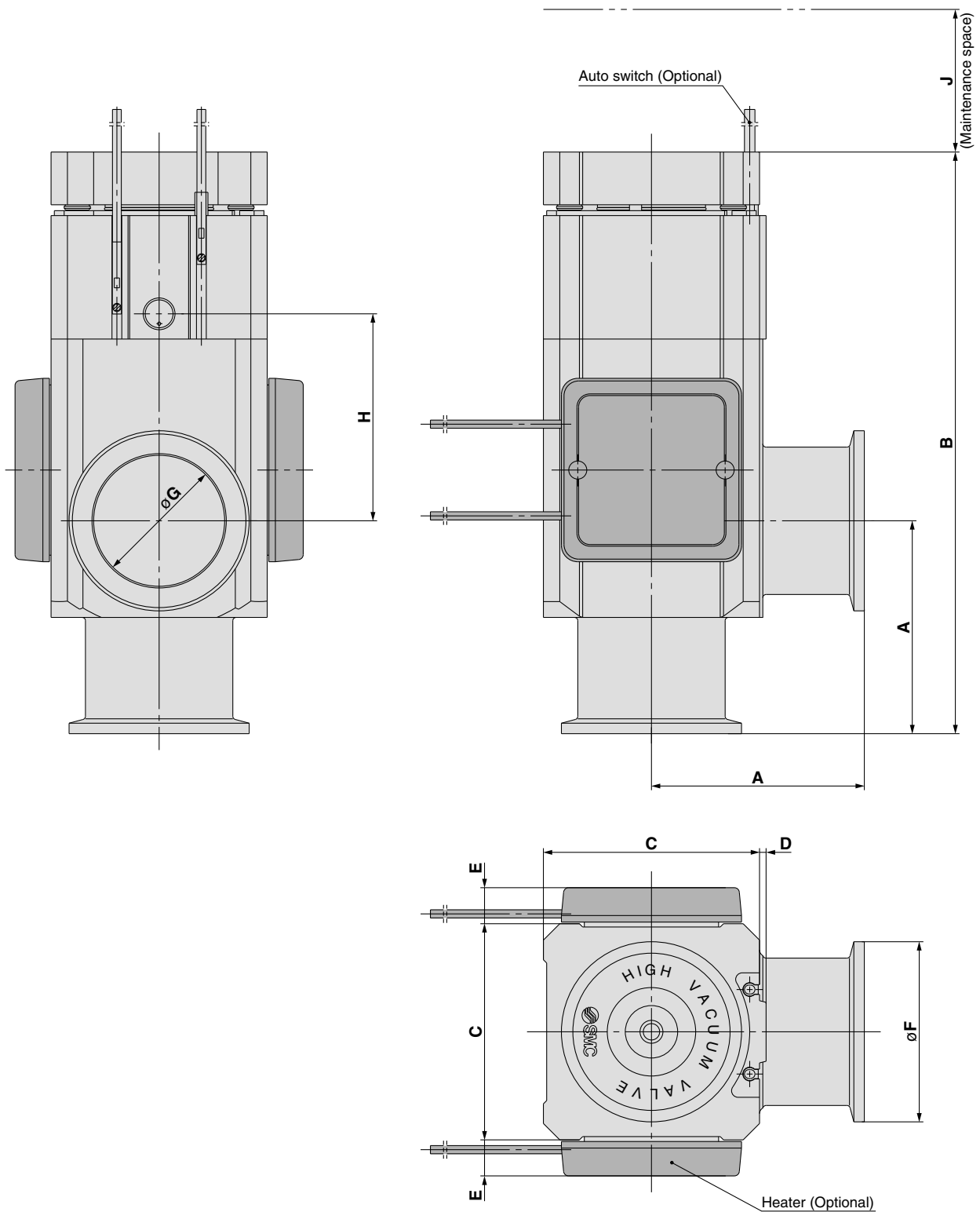
Note 2) Vacuum grease (Fluorine-based, Y-VAC2) is applied to the external seal of the vacuum components.

## Construction



\* Refer to back page 3 for the maintenance parts.

## Dimensions



(mm)

| Model          | A  | B   | C  | D | E  | F  | G  | H  | J   |
|----------------|----|-----|----|---|----|----|----|----|-----|
| <b>XLAQ-16</b> | 40 | 120 | 38 | 1 | —  | 30 | 17 | 40 | 87  |
| <b>XLAQ-25</b> | 50 | 133 | 48 | 1 | 12 | 40 | 26 | 39 | 91  |
| <b>XLAQ-40</b> | 65 | 178 | 66 | 2 | 11 | 55 | 41 | 63 | 129 |
| <b>XLAQ-50</b> | 70 | 190 | 79 | 2 | 11 | 75 | 52 | 68 | 142 |

Note) The heater (Optional) is not available with XLAQ-16.



# Aluminum One-touch Connection and Release High Vacuum Angle Valve

## Series **XLDQ**

2-step Control, Single Acting/Bellows Seal, O-ring Seal PAT.

### How to Order

**XLDQ** — **40** **□** **□** — **M9N** **A** — **□**

①      ②      ③                      ④      ⑤                      ⑥

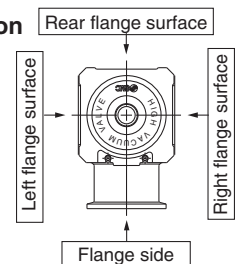


#### ① Flange size

| Size |
|------|
| 40   |
| 50   |

#### ② Indicator/Actuator port direction

| Symbol | Actuator port direction |
|--------|-------------------------|
| -      | Flange side             |
| K      | Left flange surface     |
| L      | Rear flange surface     |
| M      | Right flange surface    |



#### ③ Temperature specifications/Heater

| Symbol | Temperature | Heater            |
|--------|-------------|-------------------|
| -      | 5 to 60°C   | None              |
| H0     | 5 to 150°C  | None              |
| H4     |             | With 100°C heater |
| H5     |             | With 120°C heater |

Note 1) Heater cannot be retrofitted for the H0 type.

#### ⑤ Switch quantity/Mounting position

| Symbol | Quantity            | Mounting position |
|--------|---------------------|-------------------|
| -      | Without auto switch | —                 |
| A      | 2 pcs.              | Valve open/closed |
| B      | 1 pc.               | Valve open        |
| C      | 1 pc.               | Valve closed      |

#### ④ Auto switch type

| Symbol       | Auto switch part no. | Remarks                                       |
|--------------|----------------------|-----------------------------------------------|
| -            | —                    | Without auto switch (Without built-in magnet) |
| M9N(M)(L)(Z) | D-M9N(M)(L)(Z)       | Solid state switch                            |
| M9P(M)(L)(Z) | D-M9P(M)(L)(Z)       |                                               |
| M9B(M)(L)(Z) | D-M9B(M)(L)(Z)       |                                               |
| A90(L)       | D-A90(L)             | Reed switch                                   |
| A93(M)(L)(Z) | D-A93(M)(L)(Z)       |                                               |
| M9//         | —                    | Without auto switch (With built-in magnet)    |

Note 1) Auto switches are not applicable for high-temperature specifications (Temperature specifications H0, H4, H5). Standard lead wire length is 0.5 m. Add "L" to the end of the part number when 3 m is desired, "M" when 1 m, and "Z" when 5 m.

Example) -M9NL

Note 2) A type with a pre-wired connector is also selectable. Example) -M9NSAPC

#### ⑥ Body surface treatment/Seal material and its changed part

##### • Body surface treatment

| Symbol | Surface treatment                                      |
|--------|--------------------------------------------------------|
| -      | External: Hard anodised Internal: Raw material         |
| A      | External: Hard anodised Internal: Oxalic acid anodized |

##### • Seal material

| Symbol | Seal material     | Compound no. |
|--------|-------------------|--------------|
| -      | FKM               | 1349-80*     |
| N1     | EPDM              | 2101-80*     |
| P1     | Barrel Perfluoro® | 70W          |
| Q1     | FFKM              | 4079         |
| R1     | Chemraz®          | SS592        |
| S1     | VMQ               | 1232-70*     |
| T1     | FKM for Plasma    | 3310-75*     |
| U1     | ULTIC ARMOR®      | UA4640       |
| F1     | FKM               | —**          |

The material for the sliding parts of the S valve is FKM.

\* Produced by Mitsubishi Cable Industries, Ltd.

\*\* Same specifications as the standard FKM type

##### • Part numbers for indicating the changed seal material and leakage

| Symbol | Changed part <small>Note 2)</small> | Leakage Pa·m <sup>3</sup> /s or less <small>Note 1)</small> |                               |
|--------|-------------------------------------|-------------------------------------------------------------|-------------------------------|
|        |                                     | Internal                                                    | External                      |
| -      | None                                | 1.3 x 10 <sup>-10</sup> (FKM)                               | 1.3 x 10 <sup>-10</sup> (FKM) |
| A      | ②, ③, ④, ⑤                          | 1.3 x 10 <sup>-8</sup>                                      | 1.3 x 10 <sup>-8</sup>        |
| B      | ②, ④, ⑤                             | 1.3 x 10 <sup>-8</sup>                                      | 1.3 x 10 <sup>-10</sup> (FKM) |
| C      | ③                                   | 1.3 x 10 <sup>-10</sup> (FKM)                               | 1.3 x 10 <sup>-8</sup>        |

Note 1) Values at ambient temperatures, excluding gas permeation.

Note 2) Refer to the part number in "Construction" on page 5 for the changed part.

The number above indicates the part number from "Construction" accordingly.

Note 3) For option "F1," only "A" can be selected. The leakage amount is the same as that of "—" (standard FKM type).

To order something else than "—" (standard), list the symbols starting with "X", followed by the symbol for "seal material" and then the symbol for "changed parts" last.

Example) XLDQ-40K-M9NA-**XAN1A**

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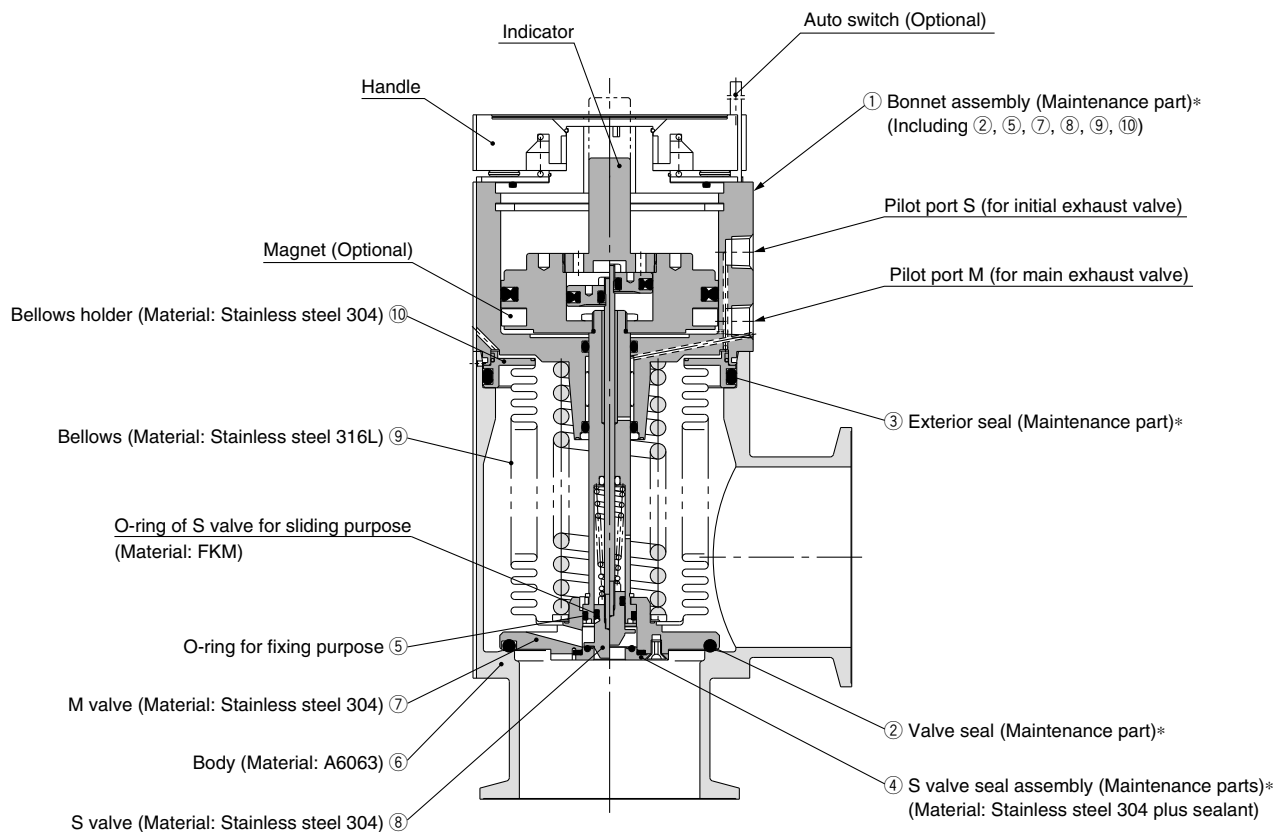
## Specifications

| Model                                       |                       | XLDQ-40                                                                                                                                      | XLDQ-50 |
|---------------------------------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Flange (valve) size                         |                       | 40                                                                                                                                           | 50      |
| Valve type                                  |                       | Normally closed (Pressurise to open, Spring seal) [both main & initial exhaust valves]                                                       |         |
| Fluid                                       |                       | Inert gas under vacuum                                                                                                                       |         |
| Operating temperature (°C)                  |                       | 5 to 60 (High-temperature type: 5 to 150)                                                                                                    |         |
| Operating pressure (Pa) (abs)               |                       | Atmospheric pressure to $1 \times 10^{-6}$                                                                                                   |         |
| Conductance <sup>Note 1)</sup><br>( $l/s$ ) | Main exhaust valve    | 45                                                                                                                                           | 80      |
|                                             | Initial exhaust valve | 8                                                                                                                                            | 11      |
| Leakage ( $Pa \cdot m^3/s$ )                | Internal              | $1.3 \times 10^{-10}$ at ordinary temperature (in case of standard material, FKM), excluding gas permeation                                  |         |
|                                             | External              |                                                                                                                                              |         |
| Flange type                                 |                       | KF (NW)                                                                                                                                      |         |
| Principal materials                         |                       | Body: Aluminum alloy, Bellows: Stainless steel 316L,<br>Bellows holder: Stainless steel 304, FKM (Standard seal material) <sup>Note 2)</sup> |         |
| Pilot pressure (MPa) (G)                    |                       | 0.4 to 0.7 [both main & initial exhaust valves]                                                                                              |         |
| Pilot port size                             |                       | Rc 1/8                                                                                                                                       |         |
| Weight (kg)                                 |                       | 1.5                                                                                                                                          | 2.2     |

Note 1) The main exhaust valve conductance is the valve for the "molecular flow" of an elbow with the same dimensions. The initial exhaust valve conductance is the value for the "viscous flow". Flow adjustment is not available for the initial exhaust valve.

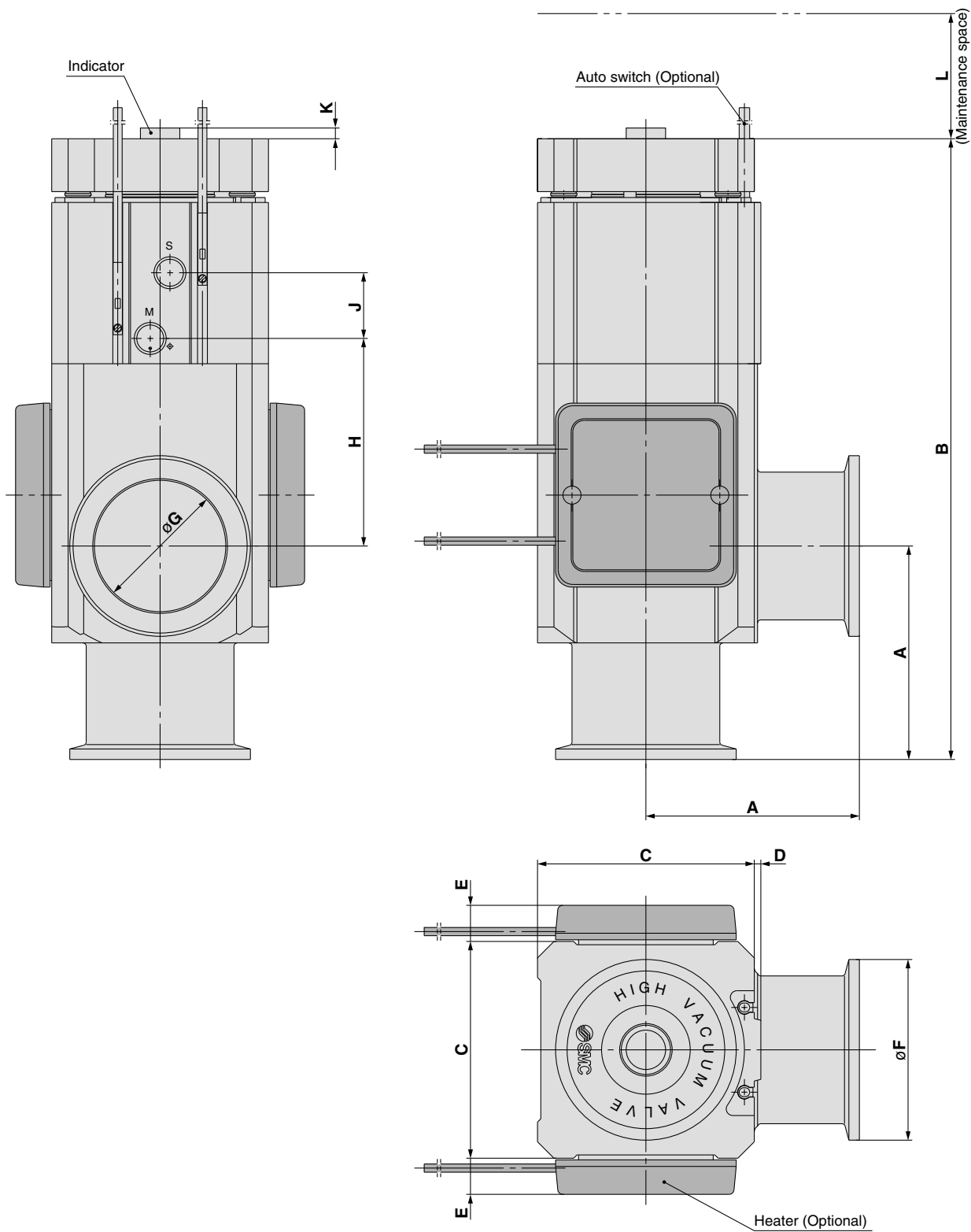
Note 2) Vacuum grease (Fluorine-based, Y-VAC2) is applied to the external seal of the vacuum components.

## Construction



\* Refer to back page 3 for the maintenance parts.

**Dimensions**



| (mm)    |    |     |    |   |    |    |    |    |    |        |     |
|---------|----|-----|----|---|----|----|----|----|----|--------|-----|
| Model   | A  | B   | C  | D | E  | F  | G  | H  | J  | K      | L   |
| XLDQ-40 | 65 | 189 | 66 | 2 | 11 | 55 | 41 | 63 | 20 | Max. 5 | 143 |
| XLDQ-50 | 70 | 198 | 79 | 2 | 11 | 75 | 52 | 68 | 20 | Max. 5 | 153 |



# Glossary of Terms

## 1 Seal Materials

Please note that the following are general features and subject to change depending on a processing condition. For details, please contact sealing component manufacturerers.

### FKM (Fluoro rubber)

With low outgassing, low permanent-setting and low gas permeation rates, this is the most popular seal material for high vacuums. Standard material used by SMC's high vacuum angle valve is Mitsubishi Cable Industries, Ltd. (Compound No. 1349-80).

It is advisable to choose a model depending on its application, because an improved material compound (3310-75) which reduces the weight reduction ratio with O<sub>2</sub> plasma is also available.

### FFKM

This material, perfluoroelastomer (FFKM), has excellent heat and chemical resistance, but its permanent-setting is large, and special caution is required. Variations are available with improved plasma (O<sub>2</sub>, CF<sub>4</sub>) and particulate resistance; therefore it is advisable to select types based upon the application.

Compound No. 4079: Standard FFKM, excellent in gas and heat resistance.

**Chemraz®** \* Chemraz® is a registered trademark of Greene, Tweed Technologies, Inc. This material, perfluoroelastomer (FFKM), has excellent chemical and plasma resistance and has slightly higher heat resistance than FKM. Several variations of Chemraz® are available and it is advisable to choose based upon the particular plasma being used and other conditions, etc.

Compound No. SS592: Excellent physical properties and especially effective for moving parts.

Compound No. SS630: Applicable to both fixed and moving parts and compatible with a wide variety of applications.

Compound No. SSE38: The cleanest material among Chemraz®, developed for high-density plasma instruments and its permanent-setting is

**Barrel Perfluoro®** \* Barrel Perfluoro® is a registered trademark of Matsumura Oil Co., Ltd. Compound No. 70W: Perfluoroelastomer (FFKM) which does not contain a metal filler. Resistant against NF<sub>3</sub>, NH<sub>3</sub>. Low particle generation under dry process conditions.

**ULTIC ARMOR®** \* ULTIC ARMOR® is a registered trademark of Nippon Valqua Industries, Ltd. Fluoro-based rubber which does not contain a metal filler. Seal material which is plasma-resistant and has low gas emittance and heat resistance.

### Silicone (Silicone rubber, VMQ)

This material is relatively inexpensive, has good plasma resistance, but its gas permeation rate is high.

Optional seal material used by SMC's high vacuum angle valve is Mitsubishi Cable Industries, Ltd. (Compound No. 1232-70, White)

It has a low weight-reduction ratio and low particle generation within O<sub>2</sub> plasma and NH<sub>3</sub> gas environments.

### EPDM (Ethylene propylene rubber)

Relatively lower priced and excellent in weatherability, chemical and heat resistance, but with no resistance at all to general mineral oil. Optional seal material used by SMC's high vacuum angle valve is Mitsubishi Cable Industries, Ltd. (Compound No. 2101-80)

Resistant to NH<sub>3</sub> gas, etc.

## 2 Shaft Sealing Method

### Bellows

Bellows offer cleaner sealing with reduced particle generation and less outgassing. The two major bellow types are: Formed-bellows and Welded-bellows. Formed-bellows produce less dust and offer higher dust resistance. Welded-bellows allow longer strokes, but generate more dust particles and offer less dust resistance. Please note, the endurance depends on the length and speed of the stroke.

## 3 Response Time/Operation Time

### Valve opening

The time from the application of voltage to the actuation solenoid valve until 90% of the valve stroke has been completed is the valve opening response time. Valve opening operation time indicates the time from the start of the stroke until 90% of movement has been completed. Both of these become faster as the operating pressure is increased.

### Valve closing

The time from the cut off of power to the actuation solenoid valve until 90% of the valve return stroke has been completed is the valve closing response time. Valve closing operation time indicates the time from valve opening until 90% of return movement has been completed. Both of these become slower as the operating pressure is increased.

# Glossary of Terms

## 4 Molecular Flow Conductance

### Orifice conductance

In the case of a  $\phi A$  (cm<sup>2</sup>) hole in an ultra-thin plate, conductance "C" results from "V", the average velocity of the gas; "R", the gas constant; "M", the molecular weight; and "T", the absolute temperature. From the formula  $C=11.6A$  (ℓ/sec), at an air temperature of 20°C.

### Cylinder conductance

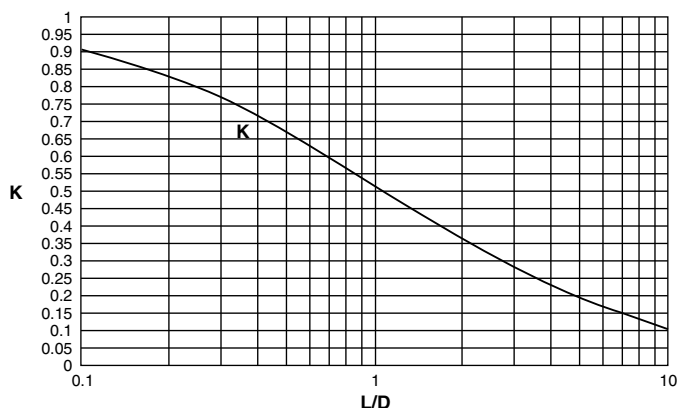
With length "L" (cm) and diameter "D" (cm) where  $L \gg D$ , from the formula  $C=(2\pi RT/M)^{0.5}D^3/6L$ , the conductance  $C=12.1D^3/L$  (ℓ/sec), at an air temperature of 20°C.

### Short pipe conductance

From Clausius's factor "K" and the hole conductance "C" in Graph 1. (Clausius's factor drawing), the short pipe conductance  $C_K$  is easily found as  $C_K=KC$ .

### Conductances combined

When each of the separate conductances are given as  $C_1$ ,  $C_2$ ,  $C_3$  and  $C_n$ , the composite conductance  $\Sigma C$  is expressed as:  $\Sigma C=1/(1/C_1+1/C_2+1/C_3 \dots 1/C_n)$  when in series, and  $\Sigma C=C_1+C_2+C_3 \dots C_n$ , when in parallel.



Graph 1. Clausius's factor

## 5 He Leakage

### Surface leakage

This leakage occurs between surfaces of the sealing and the seal material. In the case of elastic body seal (elastomer), leakage values are confirmed within minutes of operation. Leakage rate is measured at room temperature (20 to 30°C).

### Gas permeation

This is leakage caused by diffusion through the elastic body seal material. As temperature increases, the diffusion rate increases, and in many cases, becomes greater than surface leakage. The diffusion rate is proportional to the cross-sectional area (cm<sup>2</sup>) of the seal, and inversely proportional to the seal width (distance between the atmosphere and the vacuum side). In the case of metal gaskets, only hydrogen diffusion should be considered.

## 6 Outgassing

This is a phenomenon where gases adhered or adsorbed to the metallic surface or its inside parts are released from the surface and drawn into the vacuum according to the pressure decrease. The smoothness of the surface and closeness of the oxidized layer can effect (increase/decrease) this.

## 7 Ultimate Pressure

Ultimate pressure is  $P=Q/S$ , where the sum of mass flow rates for outgassing ( $Q_g$ ) and leakage ( $Q_l$ ) is  $Q$  (Pa·m<sup>3</sup>/s), and the exhaust speed is  $S$  (m<sup>3</sup>/s). The ultimate pressure is measured with  $Q_g$ ,  $Q_l$  and  $S$  shown as above, and the ultimate pressure of the pump itself. In the case of very low pressure, the exhaust characteristics of the actual pump can be the limiting factor. In particular, a deterioration of exhaust characteristics due to an unclean pump and invasion of the atmospheric moisture can be the major factor.

## 8 Exhaust Time (Low/Medium Vacuum)

The time ( $\Delta t$ ) required to exhaust a chamber at low vacuum with volume  $V$  (ℓ), from pressure  $P_1$  to  $P_2$ , using a pump with pumping speed  $S$  (ℓ/sec) is  $\Delta t=2.3(V/S)\log(P_1/P_2)$ . In high vacuum, this is subject to the ultimate pressure limit imposed by outgassing and leakage as characterised above.

## 9 Baking

Gases such as oxygen and nitrogen, which have a small adsorption activation energy ( $E$ ) and a short adsorption residence time ( $\tau$ ), are evacuated quickly. However, in the case of water, which has a high activation energy, evacuation does not progress quickly unless the temperature ( $T$ : absolute temperature) is raised to shorten residence time. This time is characterised as  $\tau=\tau_0 \exp(E/RT)$  where  $R$  is the ideal gas constant and  $\tau_0$ =(approx.)  $10^{-13}$  sec.

Residence time of water at 20°C is  $5.5 \times 10^{-6}$  sec, whereas at 150°C, it is  $2.8 \times 10^{-8}$  sec, or about 200 times shorter. The objective of baking is to exhaust water with long adsorption residence time more quickly.

# Auto Switch Specifications

## Auto Switch Common Specifications

| Type                  | Reed switch                                                        | Solid state switch                                    |
|-----------------------|--------------------------------------------------------------------|-------------------------------------------------------|
| Leakage current       | None                                                               | 3-wire: 100 $\mu$ A or less 2-wire: 0.8 mA or less    |
| Operating time        | 1.2 ms                                                             | 1 ms or less                                          |
| Impact resistance     | 300 m/s <sup>2</sup>                                               | 1000 m/s <sup>2</sup>                                 |
| Insulation resistance | 50 M $\Omega$ or more at 500 VDC Mega (between lead wire and case) |                                                       |
| Withstand voltage     | 1500 VAC for 1 minute<br>(between lead wire and case)              | 1000 VAC for 1 minute<br>(between lead wire and case) |
| Ambient temperature   | -10 to 60°C                                                        |                                                       |
| Enclosure             | IEC529 standard IP67, JIS C 0920 waterproof construction           |                                                       |

## Lead Wire Length

Lead wire length indication

(Example) D-M9P **L**

Lead wire length

|   |       |
|---|-------|
| - | 0.5 m |
| L | 3 m   |

## Contact Protection Boxes: CD-P11, CD-P12

### <Applicable switch model>

D-A9□/A9□V

The auto switches above do not have a built-in contact protection circuit. Therefore, please use a contact protection box with the switch for any of the following cases:

- ① Where the operation load is an inductive load.
- ② Where the wiring length to load is greater than 5 m.
- ③ Where the load voltage is 100 VAC, 200 VAC.

The contact life may be shortened. (Due to permanent energising conditions.)

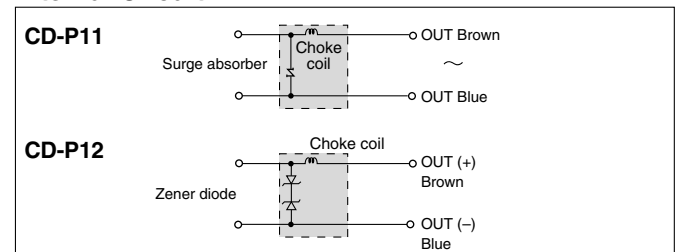
### Specifications

| Part no.             | CD-P11  |         | CD-P12 |
|----------------------|---------|---------|--------|
| Load voltage         | 100 VAC | 200 VAC | 24 VDC |
| Maximum load current | 25 mA   | 12.5 mA | 50 mA  |

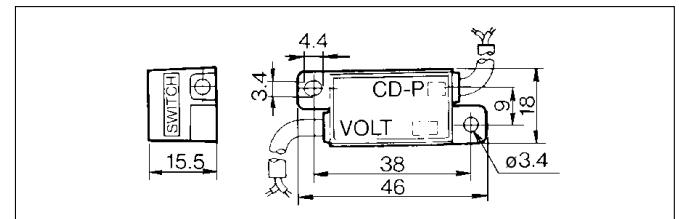
\* Lead wire length — Switch connection side 0.5 m  
Load connection side 0.5 m



### Internal Circuit



### Dimensions



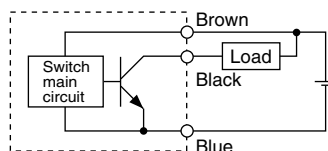
### Connection

To connect a switch unit to a contact protection box, connect the lead wire from the side of the contact protection box marked SWITCH to the lead wire coming out of the switch unit. Keep the switch as close as possible to the contact protection box, with a lead wire length of no more than 1 metre.

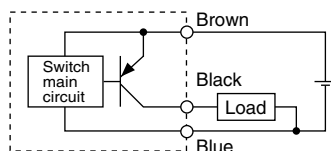
# Series XLAQ/XLDQ Auto Switch Connections and Examples

## Basic Wiring

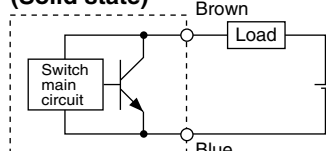
### Solid state 3-wire, NPN



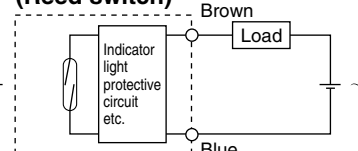
### Solid state 3-wire, PNP



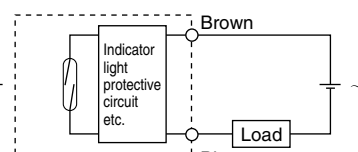
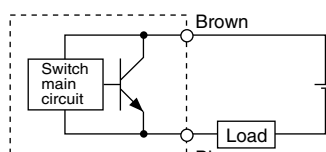
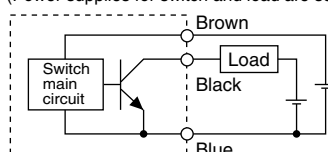
### 2-wire (Solid state)



### 2-wire (Reed switch)

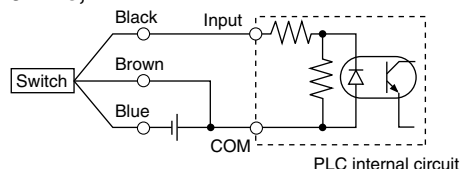


(Power supplies for switch and load are separate.)

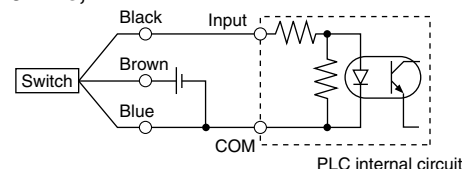


## Example of Connection to PLC (Programmable Logic Controller)

### • Sink input specifications 3-wire, NPN

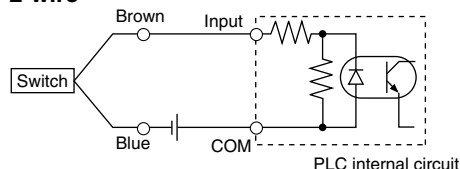


### • Source input specifications 3-wire, PNP

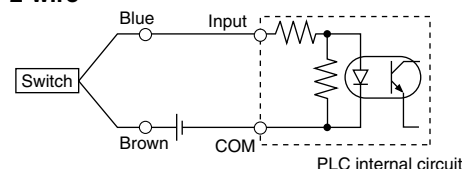


Connect according to the applicable PLC input specifications, since the connection method will vary depending on the PLC input specifications.

### 2-wire



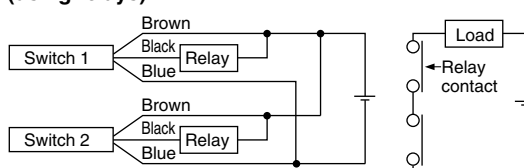
### 2-wire



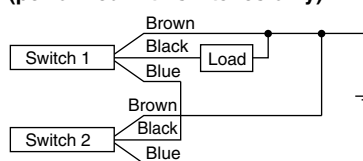
## Example of AND (Serial) and OR (Parallel) Connection

### • 3-wire

#### AND connection for NPN output (using relays)

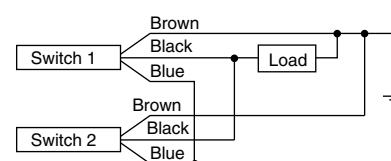


#### AND connection for NPN output (performed with switches only)

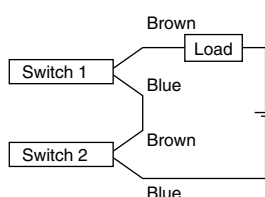


The indicator lights will illuminate when both switches are turned ON.

#### OR connection for NPN output



### 2-wire with 2-switch AND connection

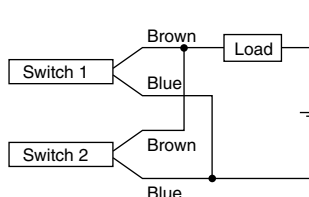


When two switches are connected in series, a load may malfunction because the load voltage will decrease when in the ON state. The indicator lights will illuminate if both of the switches are in the ON state.

$$\begin{aligned} \text{Load voltage at ON} &= \text{Power supply voltage} - \text{Internal voltage drop} \times 2 \text{ pcs.} \\ &= 24 \text{ V} - 4 \text{ V} \times 2 \text{ pcs.} \\ &= 16 \text{ V} \end{aligned}$$

Example: Power supply is 24 VDC.  
Internal voltage drop in switch is 4 V.

### 2-wire with 2-switch OR connection



#### (Solid state)

When two switches are connected in parallel, a malfunction may occur because the load voltage will increase when in the OFF state.

$$\begin{aligned} \text{Load voltage at OFF} &= \text{Leakage current} \times 2 \text{ pcs.} \\ &\quad \times \text{Load impedance} \\ &= 1 \text{ mA} \times 2 \text{ pcs.} \times 3 \text{ k}\Omega \\ &= 6 \text{ V} \end{aligned}$$

Example: Load impedance is 3 kΩ.  
Leakage current from switch is 1 mA.

#### (Reed switch)

Because there is no current leakage, the load voltage will not increase when turned OFF. However, depending on the number of switches in the ON state, the indicator lights may sometimes dim or not light because of the dispersion and reduction of the current flowing to the switches.



# Solid State Switch: Direct Mounting Style

## D-M9N/D-M9P/D-M9B



### Grommet

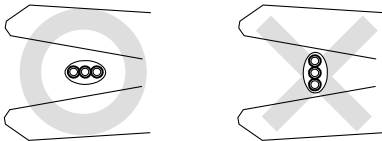
- 2-wire load current is reduced (2.5 to 40 mA)
- Lead free
- UL certified (style 2844) lead cable is used.



### Caution

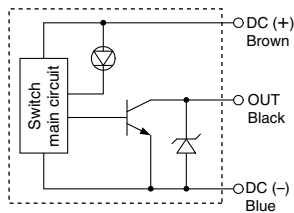
#### Operating Precautions

When the cable sheath is stripped, confirm the stripping direction. The insulator may be slit or damaged depending on the direction.

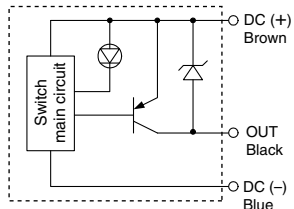


### Auto Switch Internal Circuit

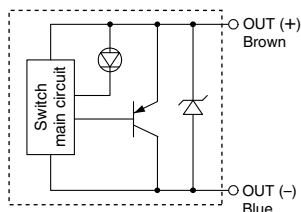
#### D-M9N



#### D-M9P



#### D-M9B



### Auto Switch Specifications



For details about certified products conforming to international standards, visit us at [www.smcworld.com](http://www.smcworld.com).

PLC: Programmable Logic Controller

| D-M9□ (With indicator light) |                              |       |                       |
|------------------------------|------------------------------|-------|-----------------------|
| Auto switch part no.         | D-M9N                        | D-M9P | D-M9B                 |
| Wiring type                  | 3-wire                       |       | 2-wire                |
| Output type                  | NPN                          | PNP   | —                     |
| Applicable load              | IC circuit, Relay, PLC       |       | 24 VDC relay, PLC     |
| Power supply voltage         | 5, 12, 24 VDC (4.5 to 28 V)  |       | —                     |
| Current consumption          | 10 mA or less                |       | —                     |
| Load voltage                 | 28 VDC or less               | —     | 24 VDC (10 to 28 VDC) |
| Load current                 | 40 mA or less                |       | 2.5 to 40 mA          |
| Internal voltage drop        | 0.8 V or less                |       | 4 V or less           |
| Leakage current              | 100 μA or less at 24 VDC     |       | 0.8 mA or less        |
| Indicator light              | Red LED illuminates when ON. |       |                       |

#### ● Lead wires

Oilproof heavy-duty vinyl cable:  $\phi 2.7 \times 3.2$  ellipse

D-M9B 0.15 mm<sup>2</sup> x 2 cores

D-M9N/D-M9P 0.15 mm<sup>2</sup> x 3 cores

Note 1) Refer to page 9 for solid state switch common specifications.

Note 2) Refer to page 9 for lead wire lengths.

### Weight

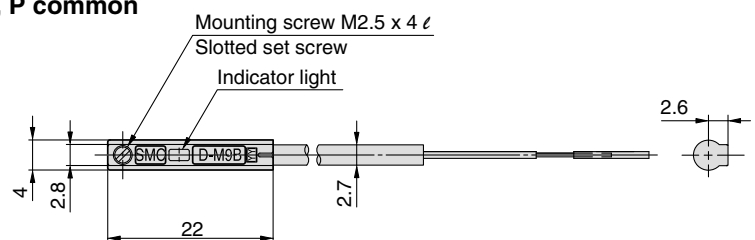
Unit: g

| Auto switch part no. | D-M9N | D-M9P | D-M9B |
|----------------------|-------|-------|-------|
| Lead wire length (m) | 0.5   | 8     | 7     |
|                      | 3     | 41    | 38    |

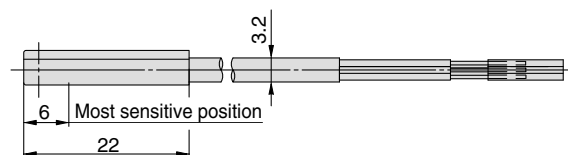
### Dimensions

#### D-M9□

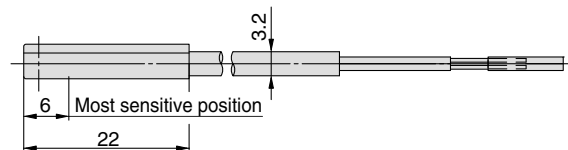
#### D-M9B, N, P common



#### D-M9N, P (3-wire)



#### D-M9B (2-wire)



# Reed Switch: Direct Mounting Style D-A90/D-A93



For details about certified products conforming to international standards, visit us at [www.smcworld.com](http://www.smcworld.com).

## Auto Switch Specifications

PLC: Programmable Logic Controller

| D-A90 (Without indicator light)          |                                                         |                    |                     |
|------------------------------------------|---------------------------------------------------------|--------------------|---------------------|
| Auto switch part no.                     | D-A90                                                   |                    |                     |
| Applicable load                          | IC circuit, Relay, PLC                                  |                    |                     |
| Load voltage                             | 24 V AC/DC or less                                      | 48 V AC/DC or less | 100 V AC/DC or less |
| Maximum load current                     | 50 mA                                                   | 40 mA              | 20 mA               |
| Contact protection circuit               | None                                                    |                    |                     |
| Internal resistance                      | 1 Ω or less (including lead wire length of 3 m)         |                    |                     |
| D-A93 (With indicator light)             |                                                         |                    |                     |
| Auto switch part no.                     | D-A93                                                   |                    |                     |
| Applicable load                          | Relay, PLC                                              |                    |                     |
| Load voltage                             | 24 VDC                                                  | 100 VAC            |                     |
| Load current range and max. load current | 5 to 40 mA                                              | 5 to 20 mA         |                     |
| Contact protection circuit               | None                                                    |                    |                     |
| Internal voltage drop                    | D-A93 — 2.4 V or less (to 20 mA)/3 V or less (to 40 mA) |                    |                     |
| Indicator light                          | Red LED illuminates when ON.                            |                    |                     |

### ● Lead wires

D-A90/D-A93 — Oilproof heavy-duty vinyl cable:  $\phi 2.7$ , 0.18 mm<sup>2</sup> x 2 cores (Brown, Blue), 0.5 m

Note 1) Refer to page 9 for reed switch common specifications.

Note 2) Refer to page 9 for lead wire lengths.

**Grommet**  
Electrical entry direction: In-line



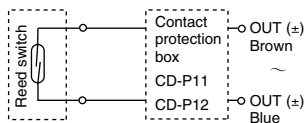
## ⚠ Caution

### Operating Precautions

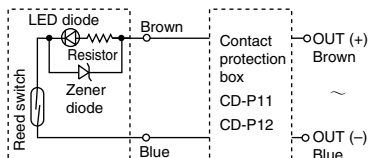
Fix the switch with the existing screw installed on the switch body. The switch may be damaged if a screw other than the one supplied, is used.

## Auto Switch Internal Circuit

### D-A90



### D-A93



- Note) ① In a case where the operation load is an inductive load.  
 ② In a case where the wiring load is greater than 5 m.  
 ③ In a case where the load voltage is 100 VAC.

Use the auto switch with a contact protection box in any of the above mentioned cases.

(For details about the contact protection box, refer to page 9.)

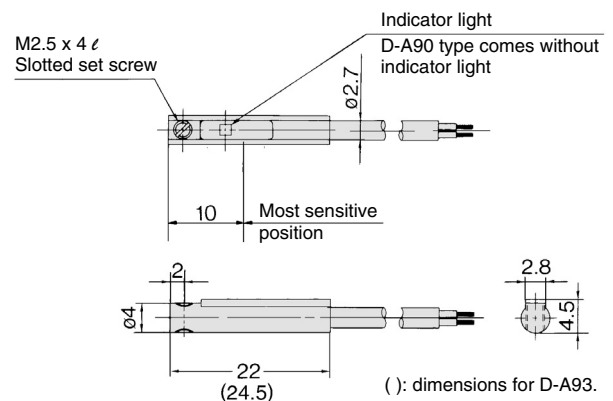
## Weight

Unit: g

| Auto switch part no.    | D-A90 | D-A93 |
|-------------------------|-------|-------|
| Lead wire length: 0.5 m | 6     | 6     |
| Lead wire length: 3 m   | 30    | 30    |

## Dimensions

### D-A90/D-A93





## Series XLAQ/XLDQ

# Specific Product Precautions 1

Be sure to read this before handling.

### Caution on Design

## Warning

#### • All models

1. The body material is aluminum alloy A6063, the bellows are stainless steel 316L, and other metal seal material is stainless steel 304. Standard seal material in the vacuum section is FKM that can be changed to the other materials (please refer to "How to Order"). Use fluids which are compatible with materials after confirming.
2. Select materials for the actuation pressure piping, and heat resistance for fittings that are suitable for the applicable operating temperatures.

#### • Model with auto switch

1. The switch section should be kept at a temperature no greater than 60°C.

#### • Model with heater

1. When using a model with a heater (thermistor), a device should be installed to prevent overheating.

### Selection

## Caution

#### • All models

1. When controlling valve responsiveness, take note of the size and length of piping, as well as the flow rate characteristics of the actuating solenoid valve.
2. Actuating pressure should be kept within the specified range. 0.4 to 0.5 MPa is recommended.
3. Use within the limits of the operating pressure range.
4. The piston chamber and bellows chamber are directly connected to the atmosphere. Use in an environment where particulate discharge will not present a problem.

#### • High temperature type

1. In the case of gases which cause a large amount of deposits, heat the valve body to prevent deposits in the valve.

### Mounting

## Caution

#### • All models

1. In high humidity environments, keep valves packaged until the time of installation.
2. When using with auto switches, secure the lead wires so that they have sufficient slack, without any unreasonable force applied to them.
3. Perform piping so that excessive force is not applied to the flange sections. In case there is vibration of heavy objects or attachments, etc., secure them so that torque is not applied directly to the flanges.
4. Vibration resistance allows for normal operation up to 30 m/s<sup>2</sup> (45 to 250 Hz), but continuous vibration may cause a decline in durability. Arrange piping to avoid excessive vibrations or shocks.

### Mounting

## Caution

#### • High-temperature type (Temperature specifications/H0, H4, H5)

1. In models with heater (thermistor), take care not to damage the insulation components of the lead wires and connector section.
2. The setting temperature for models with heater should be established without a draft or heat insulation. It will change depending on conditions such as heat retaining measures and the heating of other piping. Fine adjustment is not possible.
3. When installing heater accessories or mounting a heater, check insulation resistance at the actual operating temperature. A short circuit breaker or fuse should be installed.
4. When a valve is to be heated, only the body section should be heated, excluding the bonnet (handle) section.
5. When a heater is in operation, the entire valve becomes hot. Be careful not to touch it with bare hands, as burns will result.

### Piping

## Caution

1. Before mounting, clean the surface of the flange seal and the O-ring with ethanol, etc.
2. There is an indentation of 0.1 to 0.2 mm in order to protect the flange seal surface, and it should be handled so that the seal surface is not damaged in any way. When using an outer ring, be sure that the O-ring is compressed sufficiently. (There is basically no problem with the outer ring.)

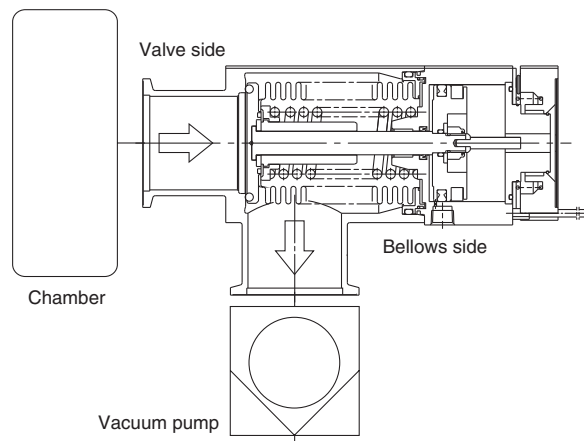
#### 3. Exhaust direction

During operation, the direction of the exhaust may be determined freely, but in cases where a flow is generated by the exhaust, a decline in durability may result.

The exhaust direction shown in the figure below (bellows side exhaust) is recommended.

Please take all available precautions, as the life of the equipment is affected by conditions of usage.

**Recommended exhaust direction**  
[Vacuum pump connected on bellows side]





# Series *XL AQ/XLDQ* Specific Product Precautions 2

Be sure to read this before handling.

## Maintenance

### **Caution**

1. Observe the caution plate during maintenance.
2. When removing deposits from a valve, take care not to damage any of its parts.
3. SMC specified parts should be used for service. Refer to "Construction" or "Maintenance Parts."
4. When removing valve or exterior seals, take care not to damage the sealing surfaces. When installing the valve seal, be sure that the O-ring is not twisted.
5. Refer to the instruction manual for replacement instructions.





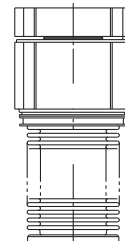
# Series XLAQ/XLDQ Specific Product Precautions 3

Be sure to read this before handling.

## Maintenance Parts

### Caution

1. Replace the bonnet assembly when changing the seal material.  
It may not be applicable when a seal material different from the current one has been chosen.



Bonnet assembly

### Bonnet Assembly: Component Part No.: ①

| Model | Temperature specifications | Indicator | Flange (Valve) size |               |               |               |
|-------|----------------------------|-----------|---------------------|---------------|---------------|---------------|
|       |                            |           | 16                  | 25            | 40            | 50            |
| XLAQ  | General use                | —         | XLAQ16-30-1         | XLAQ25-30-1   | XLAQ40-30-1   | XLAQ50-30-1   |
|       |                            | ○         | XLAQ16A-30-1        | XLAQ25A-30-1  | XLAQ40A-30-1  | XLAQ50A-30-1  |
|       | High temperature           | —         | XLAQ16-30-1H        | XLAQ25-30-1H  | XLAQ40-30-1H  | XLAQ50-30-1H  |
|       |                            | ○         | XLAQ16A-30-1H       | XLAQ25A-30-1H | XLAQ40A-30-1H | XLAQ50A-30-1H |
| XLDQ  | General use                | ○:        | —                   | —             | XLDQ40-30-1   | XLDQ50-30-1   |
|       | High temperature           | Standard  | —                   | —             | XLDQ40-30-1H  | XLDQ50-30-1H  |

Note 1) Add a suffix for the seal material (below Table 1) to the end of the part number when valve seal materials other than the standard (FKM: Compound No. 1349-80: Mitsubishi Cable Industries, Ltd.) are desired.

Note 2) An auto switch magnet is not attached. In cases where an auto switch magnet is attached, please add “-M9//” at the end of the part number. (Not available for high temperature models)

Note 3) Auto switch and solenoid valve are not attached. When a set including auto switch and solenoid valve is required, please add the symbols after the auto switch in “How to Order” at the end of the part number.

### External Seal/Valve Seal/S Valve Seal Assembly

| Model        | Description construction no. | Material | Flange (Valve) size |            |                             |                             |
|--------------|------------------------------|----------|---------------------|------------|-----------------------------|-----------------------------|
|              |                              |          | 16                  | 25         | 40                          | 50                          |
| XLAQ<br>XLDQ | External seal<br>③           | Standard | AS568-122V          | AS568-129V | AS568-140V                  | AS568-231V                  |
|              |                              | Special  | AS568-122□          | AS568-129□ | AS568-140□                  | AS568-231□                  |
|              | Valve seal<br>②              | Standard | B2401-V15V          | B2401-V24V | B2401-P42V                  | AS568-227V                  |
|              |                              | Special  | B2401-V15□          | B2401-V24□ | B2401-P42□                  | AS568-227□                  |
| XLDQ         | S valve seal assembly<br>④   | Standard | —                   | AS568-009V | XLD40-2-9-1A<br>AS568-016V  | XLD50-2-9-1A<br>AS568-016V  |
|              |                              | Special  | —                   | AS568-009□ | XLD40-2-9-1A□<br>AS568-016□ | XLD50-2-9-1A□<br>AS568-016□ |

Note 1) Add a suffix for the seal material (below Table 1) to the end of the part number (blank box) when valve seal materials other than the standard (FKM: Compound No. 1349-80: Mitsubishi Cable Industries, Ltd.) are desired.

Note 2) Refer to “Construction” of each series for the construction numbers.

Table 1

### Optional Seal Material

| Symbol        | -XN1     | -XP1              | -XQ1    | -XR1     | -XR2  | -XR3  | -XS1     | -XT1           | -XU1         | -XF1 |
|---------------|----------|-------------------|---------|----------|-------|-------|----------|----------------|--------------|------|
| Seal material | EPDM     | Barrel Perfluoro® | Kalrez® | Chemraz® |       |       | VMQ      | FKM for Plasma | ULTIC ARMOR® | FKM  |
| Compound no.  | 2101-80* | 70W               | 4079    | SS592    | SS630 | SSE38 | 1232-70* | 3310-75*       | UA4640       | **   |

Note) It may not be applicable when a seal material different from the current one has been chosen.

\* Produced by Mitsubishi Cable Industries, Ltd. \*\* Same specifications as the standard FKM type

Barrel Perfluoro® is a registered trademark of Matsumura Oil Co., Ltd.

Kalrez® is a registered trademark of E. I. du Pont de Nemours and Company or its affiliates.

Chemraz® is a registered trademark of Greene, Tweed Technologies, Inc.

ULTIC ARMOR® is a registered trademark of VALQUA, LTD.



## Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of “Caution,” “Warning” or “Danger.” They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC) <sup>1)</sup>, and other safety regulations.

-  **Caution:** **Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
-  **Warning:** **Warning** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
-  **Danger:** **Danger** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

- 1) ISO 4414: Pneumatic fluid power – General rules relating to systems.  
ISO 4413: Hydraulic fluid power – General rules relating to systems.  
IEC 60204-1: Safety of machinery – Electrical equipment of machines.  
(Part 1: General requirements)  
ISO 10218-1: Manipulating industrial robots - Safety.  
etc.

## Warning

### 1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results. The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review all specifications of the product referring to its latest catalogue information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

### 2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

### 3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.
2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

### 4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalogue.
3. An application which could have negative effects on people, property, or animals requiring special safety analysis.
4. Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.

## Caution

### 1. The product is provided for use in manufacturing industries.

The product herein described is basically provided for peaceful use in manufacturing industries.  
If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.  
If anything is unclear, contact your nearest sales branch.

## Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”. Read and accept them before using the product.

### Limited warranty and Disclaimer

1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first. <sup>2)</sup> Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.
2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided. This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.
3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalogue for the particular products.
- 2) Vacuum pads are excluded from this 1 year warranty.  
A vacuum pad is a consumable part, so it is warranted for a year after it is delivered. Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

### Compliance Requirements

1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction (WMD) or any other weapon is strictly prohibited.
2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulations of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

## Caution

### SMC products are not intended for use as instruments for legal metrology.

Measurement instruments that SMC manufactures or sells have not been qualified by type approval tests relevant to the metrology (measurement) laws of each country.  
Therefore, SMC products cannot be used for business or certification ordained by the metrology (measurement) laws of each country.

## Safety Instructions

Be sure to read “Handling Precautions for SMC Products” (M-E03-3) before using.

SMC Corporation (Europe)

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