



ORIGINAL INSTRUCTIONS



Refer to Declaration of Conformity for relevant Directives

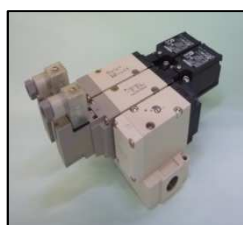
Instruction Manual

Monitored dump valve for use in safety related systems

With integrated soft-start valve

Series (25A-)VP#44(R)-X555(-##),

VP#44-X597



Safety component as defined by the Machinery

Directive 2006/42/EC article 2c.

The intended use of this valve is to vent a protected system to atmosphere when it is de-energised. When properly integrated into a suitable safety system the valve is compatible for use in systems up to Category 4, as defined by EN ISO 13849-1:2015.

1 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.

- <sup>1)</sup> 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.

This manual contains essential information for the protection of users and others from possible injury and/or equipment damage.

- Read this manual before using the product, to ensure correct handling, and read the manuals of related apparatus before use.
- Keep this manual in a safe place for future reference.
- To ensure safety of personnel and equipment the safety instructions in this manual must be observed, along with other relevant safety practices.

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

Warning

- 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.

1 Safety Instructions - continued

- 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.

- 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 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.

- Do not use this product outside of the specifications.**

- 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, combustions and recreation, or equipment in contact with food or beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the specification described in this document.

3) An application which could have negative effects on people, property or animals requiring special safety analysis outside the scope of ISO 13849 described in this document.

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.

- Always ensure compliance with relevant safety laws and standards.**

- All electrical work must be carried out in a safe manner by a qualified person in compliance with applicable national regulations.

Caution

- 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.

2 Specifications

Warning

Special specification products (as listed in section 4 'How to order') other than standard '-X555' might have specifications different from those shown in this Instruction Manual.

Refer to individual drawings for special specifications.

2.1 Functional description

This valve consists of a dual channel pair of dump valves which are connected to a main air supply via an integrated soft-start valve. The dump valves are capable of performing the safety function described in this document. The soft start valve is intended to allow the end user to perform machine operational start up procedures with reduced flow potential until a high operational pressure is achieved. At a defined pressure the soft start valve applies full flow in order to achieve full operation. The soft start function is intended for machine operation purposes and not for the performance of a safety function.

2 Specifications - continued

2.2 Valve specifications

	VP500	VP700
Type of Actuation	Normally closed	
Return method	Spring return	
Fluid	Air	
Proof pressure	1.05 MPa	
Internal pilot operating pressure range	0.25 to 0.7 MPa	
External pilot operating pressure range	Main pressure	0.25 to 0.7 MPa
	Pilot pressure	Same as main pressure
Ambient & operating fluid temp.	-10~+50°C (no freezing / no condensation)	
Lubrication	Not required <sup>(1)</sup>	
Operating frequency: Max	30 cycles per minute	
Operating frequency: Min	1 cycle per week <sup>(2)</sup>	
Duty cycle	Contact SMC	
Response time	See 2.12.2.1	See 2.12.2.2
Vibration / Impact resistance	150 / 30 m/s <sup>2</sup> <sup>(3,4)</sup>	
Ambient humidity	20% to 90%	
Air quality	5 µm filtration or smaller	
Environment	Indoor use only	
Enclosure	IP65	
B <sub>10D</sub>	10,000,000 cycles <sup>(5)</sup>	10,000,000 cycles <sup>(5)</sup>
Mission time	10,000,000 cycles <sup>(6)</sup>	10,000,000 cycles <sup>(6)</sup>
Mass (example)	VP#44-X555	1105g
		2000g

Note:

- If lubrication is used in the system, use class 1 turbine oil (no additive), ISO VG32.
- The valve must be energised/de-energised at least once per week.
- Shock resistance:
  - No malfunction resulted from the impact test using a drop impact tester.
  - The test was performed on the axis and right angle direction of the main valve and armature, for both energised and de-energised states.
- Vibration resistance:
  - No malfunction occurred in a one-sweep test between 8.3 and 2000 Hz.
  - Test was performed at both energised and de-energised state to the axis and right angles direction of the main valve and armature (valve in the initial stage).
- The B<sub>10D</sub> figure is estimated from SMC life tests under SMC test conditions.

6) See section 2.12.4 for details.

2.3 Flow specifications

Flow Passage:	Dual channel VP544		Dual channel VP744		Operational mode, for soft start mode see section 2.7
	1→2 (P→A)	2→3 (A→R)	1→2 (P→A)	2→3 (A→R)	
C[liter/(s.bar)]	5.2	6.7	9.8	9.7	
b	0.06	0.10	0.08	0.08	
Cv	1.1	1.3	2.1	2.1	

2.4 Pilot valve specifications

Electrical entry	D or Y type DIN terminal (See 3.7.1)
Coil rated voltage	24 VDC
Allowable voltage fluctuation	-10% to +10% <sup>(1)</sup>
Power consumption	0.45 W
Surge voltage suppressor	Varistor

1) Valve state is not defined if electrical input is outside of specified operating ranges.

2.5 Limit switch specifications

Electrical entry	G1/2 connector, M12 connector
Contact resistance	50 mΩ max
Minimum permissible load	5 VDC 1mA (resistive load)
Rated voltage	24 VDC + 10% max
Maximum permitted load current	50 mA <sup>(1)</sup>
Maximum permitted load inductance	0.5 H <sup>(1)</sup>
Rated insulation voltage	300 V
Electric shock protection class	Class II (double insulation)
Pollution degree	Level 3 (EN60947-5-1)
Vibration / Impact resistance	See note <sup>(2)(3)</sup>

2 Specifications - continued

2.5.1 Notes

1) For the purposes of EN ISO 13849-2:2012 table D.2 the switch is derated from the figures specified by the switch manufacturer. The switch load must be limited in the application in order to maintain the specified safety performance, including the B<sub>10D</sub> and mission time.

2) The Omron switch is subject to the following vibration and shock limitations specified by the manufacturer:

- 'Contact opening time should be less than a 1 ms pulse under vibration of 0.75 single amplitude, 10 to 55 Hz, 10 cycles in each direction for 45 minutes.'
- Shock: 300 m/s<sup>2</sup> (Contact open time: 1 ms maximum pulse)
- 3) The Rockwell Automation switch is subject to the following vibration and shock limitations specified by the manufacturer:
  - Impact: IEC60068-2-7 (30Gn, 3 pulses per axis).
  - Vibration: IEC60068-2-6 (10...55Hz, 0.35mm amplitude).

2.6 Pneumatic symbols

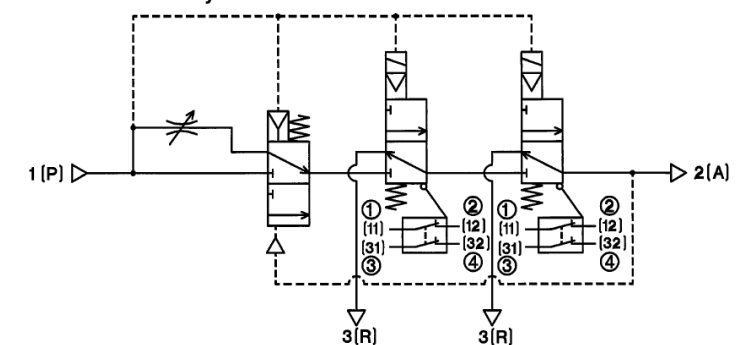


Figure 1 Internal pilot, Omron switch variant

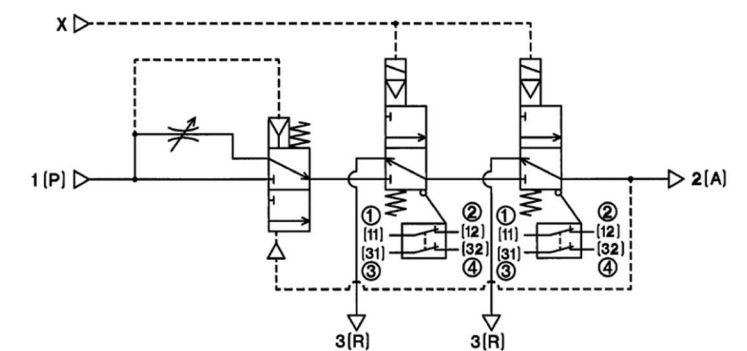


Figure 2 External pilot, Omron switch variant

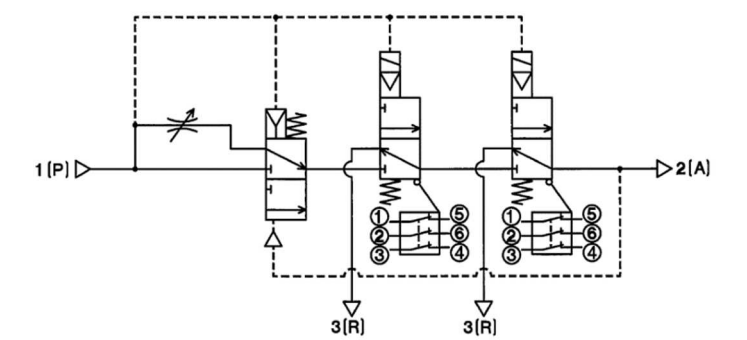


Figure 3 Internal pilot, Rockwell switch variant



## 2 Specifications - continued

### Caution

Response times are based on tests under SMC conditions and are not guaranteed. Always observe the terms of 2.12.3.

- Exhaust times will increase on the duplex valves when only one channel is functioning in a fault condition.
- Exhaust times are based on tests under SMC conditions and are not guaranteed. Always observe the terms of 2.12.3.

### 2.12.3 Relationship of flow and response performance to safety function

The safety function is to vent the compressed air in the protected system so that the protected system does not present a hazard when the application operates under the control of a suitable safety system. The time taken for the air to vent and remove the hazard is a function of:

- The flow capacity of the valve
- The flow restriction of silencers fitted to the valve
- The volume of the protected system
- The pressure of the air in the protected system
- The flow restrictions in the protected system

The end user is expected to establish the time taken to vent the application system and ensure that this time is consistent with the requirement of the overall safety system. This includes the selection of suitable silencers.

The performance of the system should be validated by test after each installation to ensure that the actual performance of the valve is consistent with the safety function. Validate the performance of the system under all foreseeable operating conditions of pressure, flow and volume.

### 2.12.4 Mission time according to the Safety Standard

The operational life of the product shall be limited to the mission time stated in section 2.1. The mission time is given in cycles, the user is expected to calculate an equivalent figure in time units based on the operating frequency of the application. After the mission time has expired for the component it shall be replaced with a new unit.

### 2.12.5 MTTFD according to the Safety Standard

The B<sub>10D</sub> for the component given in section 2.2 is derived from product knowledge and based on specific life tests. The system integrator should use this data to determine MTTFD and the Performance Level (PL) of the system using the methods described in the Safety Standard.

### 2.12.6 Diagnostic Coverage according to the Safety Standard

These valves are fitted with 'direct monitoring' according to Table E1 of the Safety Standard. When properly integrated these valve assemblies contribute to a DC value of 99% for the safety function.

### 2.12.7 Common Cause Failures according to the Safety Standard

CCF analysis is the responsibility of the system integrator. These valves have 2 channels made of identical valves. The use of this valve might not allow the system calculation to include CCF points for diversity.

## 3 Installation

### 3.1 Installation

#### Warning

- Do not install the product unless the safety instructions have been read and understood.
- Do not install the product if it appears to have been damaged during transport.
- The valve must be protected from contamination from the downstream system when air is vented through the valve.

## 3 Installation - continued

- Do not paint the product.
- Do not remove or cover up warnings or specifications printed or affixed to the product.
- Ensure sufficient space for maintenance activities. When installing the products, allow access for maintenance.
- Ensure that the connections of pipework and cables to the unit do not result in a residual trip hazard to system operators or maintainers.
- If air leakage increases or equipment does not operate to specification, stop operation.
- Check mounting conditions when air and power supplies are connected. Initial function and leakage tests should be performed after installation.

### 3.2 Environment

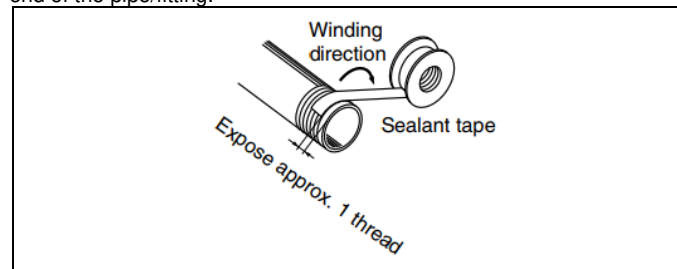
#### Warning

- Do not use in an environment where corrosive gases, chemicals, salt water or steam are present.
- Do not use in an explosive atmosphere.
- Do not expose to direct sunlight. Use a suitable protective cover.
- Do not install in a location subject to vibration or impact. Check the product specifications.
- Do not mount in a location exposed to radiant heat.
- Do not install in a location subject to strong magnetic fields.
- Do not install in an EMC environment other than 'industrial' according to the scope of standard listed on the Declaration of Conformity.
- If it is used in an environment where there is possible contact with oil, weld spatter, etc., exercise preventive measures.
- When the solenoid valve is mounted in a control panel or is energised for a long time, make sure ambient temperature is within the specification of the valve.
- Altitude limitation is 1000 m above sea level.

### 3.3 Piping

#### Caution

- Before piping make sure to clean up chips, cutting oil, dust etc.
- When installing piping or fittings, ensure sealant material does not enter inside the port. When using seal tape, leave 1 thread exposed on the end of the pipe/fitting.



- Tighten fittings to the specified tightening torque.

Connection thread size (R, NPT)	Tightening Torque (N·m)
1/8	3 to 5
3/8	15 to 20
1/2	20 to 25

- The valve must be protected from contamination from the downstream system when air is vented through the valve.

### 3.4 Lubrication

#### Caution

- SMC products have been lubricated for life at manufacture, and do not require lubrication in service.
- If a lubricant is used in the system, use turbine oil Class 1 (no additive), ISO VG32. Once lubricant is used in the system, lubrication must be continued because the original lubricant applied during manufacturing will be washed away.

## 3 Installation - continued

### 3.5 Air Supply

#### Caution

- Type of fluids  
Please consult with SMC when using the product in applications other than compressed air

When there is a large amount of drainage. Compressed air containing a large amount of drainage can cause malfunction of pneumatic equipment. An air dryer or water separator should be installed upstream from filters.

- Drain flushing  
If condensation in the drain bowl is not emptied on a regular basis, the bowl will overflow and allow the condensation to enter the compressed air lines. It causes malfunction of pneumatic equipment. If the drain bowl is difficult to check and remove, installation of a drain bowl with an auto drain option is recommended.

- Type of air  
Do not use compressed air that contains chemicals, synthetic oils including organic solvents, salt or corrosive gases, etc., as it can cause damage or malfunction.

#### Caution

- When extremely dry air is used as the fluid, degradation of the lubrication properties inside the equipment may occur, resulting in reduced reliability (or reduced service life) of the equipment. Please consult with SMC.
- Install an air filter upstream near the valve. Select an air filter with a filtration size of 5 µm or smaller.
- Take measures to ensure air quality, such as by installing an aftercooler, air dryer, or water separator. Compressed air that contains a large amount of drainage can cause malfunction of pneumatic equipment such as valves.
- If excessive carbon powder is seen, install a mist separator on the upstream side of the valve.

If excessive carbon dust is generated by the compressor it may adhere to the inside of a valve and cause it to malfunction.

- The air supply to the valve must be large enough to operate the valve and to deal with possible transient pressures. The supply should be a minimum of DN10 for the VP500 and DN13 for the VP700.
- When using the external pilot type valve it is recommended that the main supply pressure and the pilot pressure are taken from separate lines. The A/B options are available which have a check valve fitting in the pilot port (see section 4).
- If necessary, a check valve can be installed in the external pilot line to prevent a drop in pilot pressure.

#### Warning

- If a check valve is fitted to the external pilot supply, ensure there is no hazard created by any air trapped between the check valve and the pilot valves.
- Minimise the distance between the valve and the air supply and between the valve and the protected system. Do not place any devices between the valve and the protected system that might interfere with the safety function. The exhaust ports of the valve should not be left unconnected. The exhaust ports of the valves should never be blocked and must be protected from ingress of contamination by a suitable silencer or device which does not affect the valve function.

### 3.6 Noise

#### Caution

It is recommended that silencers or noise reduction devices are fitted to protect personnel from transient noise when the valves are de-energised. The pressure drop of silencers or devices must be taken into account during the design and testing of the application system to ensure that the safety function is maintained.

## 3 Installation - continued

### 3.7 Electrical Connection

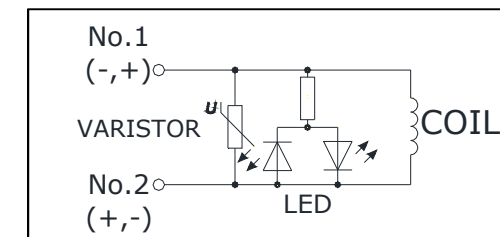
#### Caution

- When electric power is connected to a solenoid valve, be careful to apply the proper voltage. Improper voltage may cause malfunction or coil damage.
- Check if the connections are correct after completing all wiring.

#### 3.7.1 Pilot Valve

##### 3.7.1.1 Surge voltage suppression

For DIN terminal:



DIN terminal has no polarity.

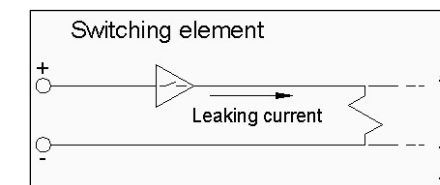
##### 3.7.1.2 Pilot valve connections

- DIN interchangeability  
The 'Y' type DIN terminal corresponds to the DIN connector with a terminal pitch of 8 mm, which complies with EN175301-803C. The pitch is different from the 'D' type DIN connector (which has a pitch of 9.4 mm): the two types are therefore not interchangeable.

- Applicable cable dia: Ø3.5 ~ Ø7 mm

##### 3.7.1.3 Leakage voltage

Ensure that any leakage current when the switching element is OFF causes ≤ 3% of the rated voltage across the valve.



##### 3.7.1.4 Using DIN connector with the pilot valve

#### Caution

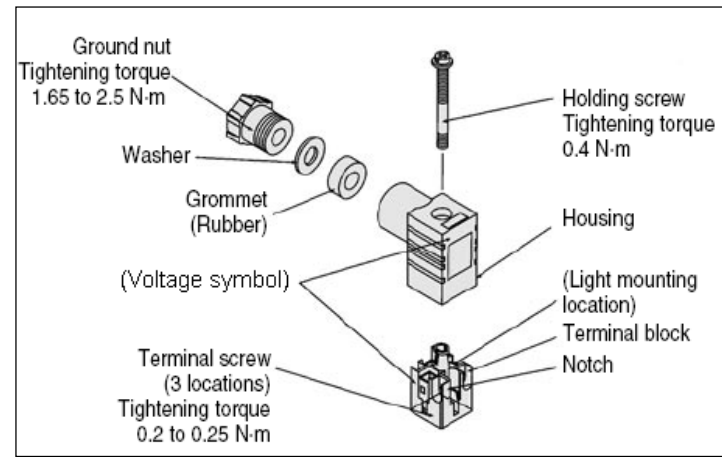
#### Connection

- Loosen the holding screw and pull the connector out of the solenoid valve terminal block.
- After removing the holding screw, insert a flat head screwdriver, etc. into the notch on the bottom of the terminal block and pry it open, separating the terminal block and the housing.
- Loosen the terminal screws (slotted screws) on the terminal block, insert the cores of the lead wires into the terminals according to the connection method, and fasten them securely with the terminal screws.
- Secure the cord by fastening the ground nut.

#### Caution

When making connections, take note that using other than the supported size (ø3.5 to ø7) heavy duty cord will not satisfy IP65 (enclosure) standards. Also, be sure to tighten the ground nut and holding screw within their specified torque ranges.

**3 Installation - continued**



**Changing the entry direction**

After separating the terminal block and housing, the cord entry can be changed by attaching the housing in the desired direction (4 directions at 90° intervals).

\* When equipped with a light, be careful not to damage the light with the cord's lead wires.

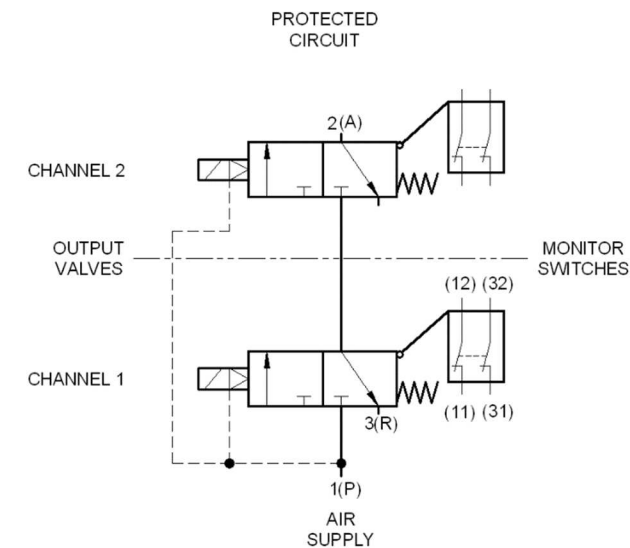
**Precautions**

Plug in and pull out the connector vertically without tilting to one side.

**Compatible cable**

Cord O.D.: Ø3.5 to Ø7  
(Reference) 0.5 mm<sup>2</sup>, 2-core or 3-core, equivalent to JIS C 3306

**3.7.2 Omron Limit Switch**



**3.7.3 Limit Switch: Omron conduit type**

**3.7.3.1 Screw tightening torque**

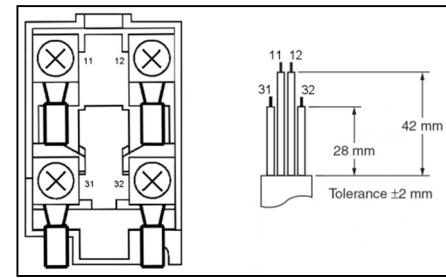
Screw position	Tightening torque (N·m)
Terminal screw	0.6 to 0.8
Cover clamping screw	0.5 to 0.7
Conduit mounting connection	1.8 to 2.2

Table 2 Conduit terminals tightening torque

**3.7.3.2 Wiring**

- When connecting to the terminals via insulating tube and M3.5 crimp terminals, arrange the crimp terminals as shown below so that they do not rise up onto the case or the cover. Application lead wire size: AWG20 to AWG18 (0.5 to 0.75 mm<sup>2</sup>)

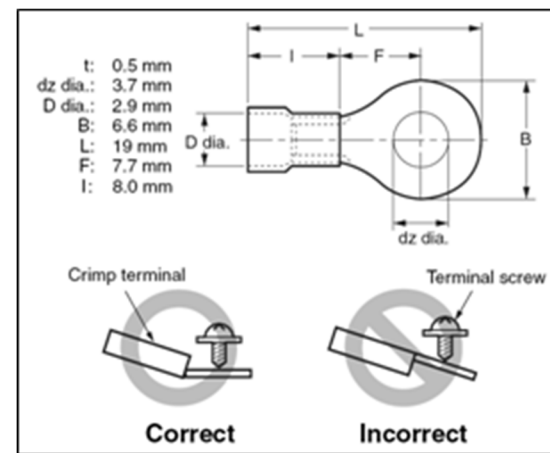
**3 Installation - continued**



- Do not push crimp terminals into gaps in the case interior. Doing so may cause damage or deformation of the case.
- Use crimp terminals not more than 0.5 mm in thickness. Otherwise, they will interfere with other components inside the case. The crimp terminal shown below is not more than 0.5 mm thick.

Manufacture	Type	Wire size
J.S.T.	FV0.5-3.7 (F type) V0.5-3.7 (straight type)	AWG20 (0.5 mm <sup>2</sup> )

J.S.T. is a Japanese manufacturer.



**3.7.3.3 Conduit Opening**

- Connect a recommended connector to the opening of the conduit and tighten the connector to the specified torque. The case may be damaged if an excessive tightening torque is applied.
- Use a cable with a suitable diameter for the connector.

**3.7.3.4 Recommended Connectors**

Use connectors with screws not exceeding 9 mm, otherwise the screws will protrude into the case interior, interfering with other components in the case. The connectors listed in the following table have connectors with thread sections not exceeding 9 mm. Use the recommended connectors to ensure conformance to the stated IP level.

**3 Installation - continued**

Size	Manufacturer	Model	Applicable cable diameter
G 1/2	LAPP	ST-PF1/2 5380-1002	6.0 to 12.0 mm
	Ohm Denki	OA-W1609	7.0 to 9.0 mm
		OA-W1611	9.0 to 11.0 mm

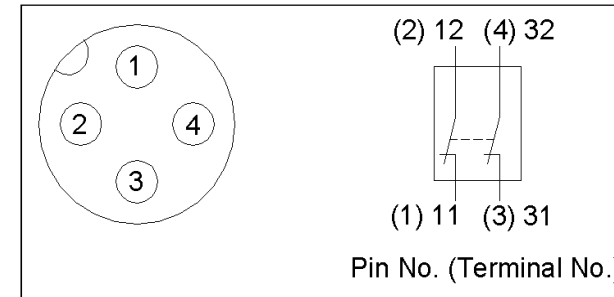
Table 3 Recommended conduit connectors

Use LAPP connectors together with seal packing (JPK-16, GP-13.5, GPM20, or GPM12), and tighten to the specified tightening torque. Seal packing is sold separately.

LAPP is a German manufacturer.

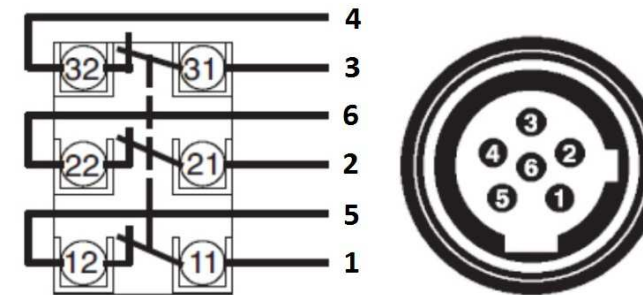
Ohm Denki is a Japanese manufacturer.

**3.7.4 Limit Switch: Omron M12 connector type**



- Orientation of the M12 connector is not guaranteed. Only a straight connector should be used.

**3.7.5 Rockwell Automation M12 connector type**



**3.7.5.1 Socket tightening (Connector type)**

- Turn the socket connector screws by hand and tighten until no space remains between the socket and the plug.
- Make sure that the socket connector is tightened securely. Otherwise, the rated degree of protection may not be maintained and vibration may loosen the socket connector.
- Orientation of the M12 connector is not guaranteed. Only a straight connector should be used.



## 7 Limitations of Use - continued

### • 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.

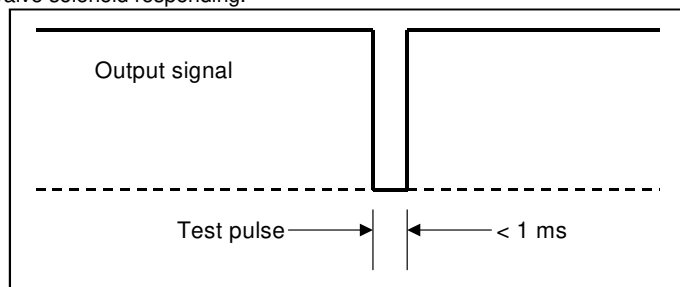
Measurement instruments that SMC manufactures or sells have not been qualified by type approval tests relevant to the metrology (measurement) laws of each country.

Therefore, SMC products cannot be used for business or certification ordained by the metrology (measurement) laws of each country.

## 7.2 Safety relays

### ⚠ Warning

If a safe output from a safety relay or PLC is used to operate this valve, ensure that any output test pulse duration is shorter than 1 ms to avoid the valve solenoid responding.



## 7.3 Limitations

### ⚠ Caution

This product is CE marked as a safety component as defined under the Machinery Directive 2006/42/EC. For details please refer to the Declaration of Conformity supplied with the product.

The valve may only be used to provide the stated safety function for the supply and removal of pressure from all or part of a pneumatic system, under the total control of a supervisory device. The valve can only perform as a safety component when properly installed in a system conforming to the appropriate safety standards.

Any such use must be within the specified limits and application conditions for the product.

In order to meet a required performance level as defined by the appropriate safety standard, the user must provide all the other necessary components to complete function of the safety system.

The user is responsible for the specification, design, implementation, validation and maintenance of the safety system.

### ⚠ Danger

- The machine designer is responsible for ensuring that the operation of this device is compatible with relevant safety regulations.
- Fitting a soft start device does not contribute directly to human risk reduction.
- The limited flow phase and the transition to full flow might cause unpredictable machine movements.

## 8 Contacts

AUSTRIA	SMC Pneumatik GmbH, Girakstrasse 8, AT-2100 Korneuburg
BELGIUM	SMC Belgium N.V./S.A. Nijverheidsstraat 20, B-2160 Wommelgem
BULGARIA	SMC Industrial Automation Bulgaria EOOD, Business Park Sofia, Building 8-6th floor, BG-1715 Sofia
CROATIA	SMC IndustrijskaAutomatikad.o.o. ZagrebačkaAvenija 104,10 000 Zagreb
CZECH REP.	SMC Industrial Automation CZ s.r.o. Hudcova 78a, CZ-61200 Brno
DENMARK	SMC Pneumatik A/S, Egeskovvej 1, DK-8700 Horsens
ESTONIA	SMC Pneumatics Estonia Oü, Laki 12, EE-10621 Tallinn
FINLAND	SMC Automation Oy, PL72, Tiistinniityntie 4, SF-02031 Espoo
FRANCE	SMC France, 1, Boulevard de Strasbourg, Parc Gustave Eiffel, Bussy Saint Georges, F-77607 Marne La Vallee Cedex 3
GERMANY	SMC Deutschland GmbH, Boschring 13-15, 63329 Egelsbach
GREECE	SMC Italia Hellas Branch, Anagenniseos 7-9-P.C. 14342 N.Philadelphia, Athens
HUNGARY	SMC Hungary IpariAutomatizálásiKft. Torbágy u. 19, HU-2045 Törökbálint

IRELAND	SMC Pneumatics (Ireland) Ltd. 2002 Citywest Business Campus, Naas Road, Saggart, Co. Dublin
ITALY	SMC Italia S.p.A. Via Garibaldi 62, I-20061 Carugate, (Milano)
LATVIA	SMC Pneumatics Latvia SIA, Dzelzavas str. 120g, Riga, LV-1021
LITHUANIA	UAB "SMC Pneumatics", Oslo g. 1, LT-04123 Vilnius
NETHERLANDS	SMC Nederland B.V. De Ruyterkade 120, NL-1011 AB Amsterdam
NORWAY	SMC Pneumatics Norway AS, Vollsveien 13 C, GranfosNæringspark, N-1366 Lysaker
POLAND	SMC Industrial Automation, Polska Sp z o.o. 02-826 Warszawa, ul. Poloneza 89
PORTUGAL	SMC Sucursal Portugal, S.A. Rua De Eng Ferrerira Dias 452 4100-246, Porto
ROMANIA	SMC Romania S.r.l. Str.Frunzei 29, Sector 2, Bucharest
RUSSIA	SMC Pneumatik LLC. Business centre, building 3, 15 Kondratjevskij prospect, St.Petersburg, 195197
SLOVAKIA	SMC PriemyselnaAutomatizáciaSpols.r.o. Fantranská 1223, Teplickanadvahom, 01301
SLOVENIA	SMC IndustrijskaAvtomatikad.o.o. Mirnskeceta 7, SLO-8210 Trebnje
SPAIN	SMC España S.A. Zuazobidea 14, 01015 Vitoria
SWEDEN	SMC Pneumatics Sweden AB, Ekshagsvägen 29-31, SE-141 71 Segeltorp
SWITZERLAND	SMC Schweiz AG, Dorfstrasse 7, Postfach, 8484 Weisslingen,
TURKEY	SMC PnömatikSanayiTicaretveServis A.Ş. GülbaharCaddesi, Aydın Plaza, No: 9/4 Güneşli – 34212, Istanbul
UK	SMC Pneumatics (U.K.) Ltd., Vincent Avenue, Crownhill, Milton Keynes, Buckinghamshire MK8 0AN

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 \*SMC Corporation, Akihabara UDX15F, 4-14-1, Sotokanda, Chiyoda-ku, Tokyo 101 0021  
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