1 Safety Instructions - continued

- Only trained personnel should operate pneumatically operated machinery and equipment. The equipment specified here may become unsafe if handled incorrectly. The assembly, operation, maintenance or operation of machinery 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.
- The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runway of the driven objects have been confirmed.
- 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.
- 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, 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) Any application which could have negative effects on people, property or other special safety analysis outside the scope of ISO 13849 described in this document.
- 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 regulations.

2 Specifications - continued

2.2 Valve specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Specification</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series</td>
<td>VP500</td>
<td>VP700</td>
</tr>
<tr>
<td>Terminal connection</td>
<td>Dual channel</td>
<td>Dual channel</td>
</tr>
<tr>
<td></td>
<td>G1/2-connector, M12 connector</td>
<td>G1/2-connector, M12 connector</td>
</tr>
<tr>
<td>Minimum permissible load</td>
<td>5 VDC (nominal voltage)</td>
<td>24 VDC</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>24 VDC</td>
<td>24 VDC</td>
</tr>
<tr>
<td>Rated power consumption</td>
<td>0.6 W</td>
<td>0.6 W</td>
</tr>
<tr>
<td>Surge voltage isolation</td>
<td>10% (I &lt; 10%)</td>
<td>10% (I &lt; 10%)</td>
</tr>
<tr>
<td>Surge voltage suppressor</td>
<td>Transformer</td>
<td>Transformer</td>
</tr>
</tbody>
</table>

Note:
1) If lubrication is used in the system, use class 1 turbine oil (no additive), ISO VG32.
2) The valve must be energized/de-energized at least once per week.
3) 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.
4) 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 valve (armature in the initial stage).
5) Same as operating pressure or higher.
6) In the case of switch option N4 and M, the life B10d and mission time is 10,000,000 cycles.

2.3 Flow specifications

The compatibility of pneumatic equipment is the responsibility of the person who designs the pneumatic system or decides its specifications. Since the products specified here can be used in various operating conditions, their compatibility with the specific pneumatic system must be decided by the person who designs the equipment or decides its specification based on necessary analysis and test results. The expected performance and safety performance of the equipment will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review the specification of the product expressed in this document. The specification of this product is subject to change and will be expressed in revisions of this document. The designer must monitor these revisions to ensure ongoing compatibility with the application.

2.4 Pilot valve specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric entry</td>
<td>G1/2-connector, M12 connector</td>
</tr>
<tr>
<td>Minimum permissible load</td>
<td>5 VDC (nominal voltage)</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>24 VDC</td>
</tr>
<tr>
<td>Rated power consumption</td>
<td>0.6 W</td>
</tr>
<tr>
<td>Surge voltage isolation</td>
<td>10% (I &lt; 10%)</td>
</tr>
<tr>
<td>Surge voltage suppressor</td>
<td>Transformer</td>
</tr>
</tbody>
</table>

2.5 Limit switch specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric entry</td>
<td>G1/2-connector, M12 connector</td>
</tr>
<tr>
<td>Minimum permissible load</td>
<td>5 VDC (nominal voltage)</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>24 VDC</td>
</tr>
<tr>
<td>Rated power consumption</td>
<td>0.6 W</td>
</tr>
<tr>
<td>Surge voltage isolation</td>
<td>10% (I &lt; 10%)</td>
</tr>
<tr>
<td>Surge voltage suppressor</td>
<td>Transformer</td>
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<td>Rated voltage isolation</td>
<td>10% (I &lt; 10%)</td>
</tr>
<tr>
<td>Surge voltage suppression</td>
<td>Transformer</td>
</tr>
</tbody>
</table>

Note:
1) If lubrication is used in the system, use class 1 turbine oil (no additive), ISO VG32.
2) The valve must be energized/de-energized at least once per week.
3) 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.
4) 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 same axis and right angles direction of the valve (armature in the initial stage).
5) Same as operating pressure or higher.
6) In the case of switch option N4 and M, the life B10d and mission time is 10,000,000 cycles.

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
2.7 Soft start specification and operating principle

2.7.1 Operating principle

In a safety related application, the machine safety system will energise the safety dump valves (1V1 and 2V1 in Figure 4) when the machine is safe for operation. When both valves are energised air will flow into the protected system via port 2 (A). The flow is initially limited by needle valve 0V1 and pressure in the protected system will remain low as the system fills or actuators move slowly. The pressure will eventually rise as the system becomes full or the actuators stop moving. As P2 pressure increases (see Figure 5) valve 0V2 switches and valve 0V1 is by-passed. In this condition air will flow into the protected system according to the figures given in section 2.3.

When either of the dump valves 1V1 or 2V1 are de-energised the protected system is vented to atmosphere. When the protected system pressure drops below P1 valve 0V2 returns to its spring state with 0V1 limiting the flow to 1V1 and 2V1.

2.8 Safety specification

Safety function: When the valve is de-energised the protected circuit is vented to atmosphere. The valve can be continuously energised to provide this function, subject to the specified minimum operating frequency.

• The valve assembly is capable up to Category 4 according to the Safety Standard when integrated into a suitable safety system.

In this section, ‘the Safety Standard’ refers to EN ISO 13849-1 and ‘the Validation Safety Standard’ refers to EN ISO 13849-2 as referenced in the Declaration of Conformity. Information about compatibility with the Safety Standard is given in section 2.12.

2.9 Declaration of Conformity

Below is a sample Declaration of Conformity (DoC) used for this product. An actual DoC will be supplied with each product.

2.12 Safety System

2.12.1 The System Interface

The diagram shows the valve in the dotted line box connected to a safety relay in dual channel mode following the principles of the Safety Standard.

2.12.2 VP744 Valve & Switch Response

• The valve response time ON (T1) depends on the supply pressure and the volume of the protected system. T1 times are not related to the safety function.

• The valve response time OFF (T2) depends on the volume (V) and the flow capacity of the protected system.

It is defined as the time interval in which the pressure in a test volume connected to an outlet port of the valve reduces from 0.63 MPa to 0.05 MPa in response to a change in the control signal to that valve. Refer to table below for indicative values under SMC conditions:

- The ON response time of the limit switch (T3) is shown in the table below.
- The OFF response time of the limit switch (T4) is shown in the table below.

<table>
<thead>
<tr>
<th>Volume / litre</th>
<th>Valve OFF response / T2, ms</th>
<th>Switch Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1150</td>
<td>30, 155</td>
</tr>
<tr>
<td>10</td>
<td>3560</td>
<td>25, 7060</td>
</tr>
<tr>
<td>20</td>
<td>7060</td>
<td></td>
</tr>
</tbody>
</table>

2.12.2.1 VP744 Valve & switch Response

- The valve response time ON (T1) depends on the supply pressure, the volume of the protected system and the soft start operation (see 2.7). T1 times are not related to the safety function.
- The valve response time OFF (T2) depends on the volume (V) and the flow capacity of the protected system. It is defined as the time interval in which the pressure in a test volume connected to an outlet port of the valve reduces from 0.63 MPa to 0.05 MPa in response to a change in the control signal to that valve. Refer to table below for indicative values under SMC conditions:
- The ON response time of the limit switch (T3) is shown in the table below.
- The OFF response time of the limit switch (T4) is shown in the table below.

<table>
<thead>
<tr>
<th>Volume / litre</th>
<th>Valve OFF response / T2, ms</th>
<th>Switch Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>930</td>
<td>30, 155</td>
</tr>
<tr>
<td>10</td>
<td>2750</td>
<td>40, 280</td>
</tr>
<tr>
<td>20</td>
<td>5350</td>
<td></td>
</tr>
</tbody>
</table>
2 Specifications - continued

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 pressure of the air in the protected system
- The pressure drop in the pressure-reducing valve

The end user is expected to establish this 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

Drain flushing

The air supply to the valve must be large enough to operate the valve and to deal with any expected pressures. The supply should be a minimum of DIN 10 for the VPS60 and DIN 13 for the VP700.

- Minimise the distance between the valve and the 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.

3.3 Lubrication

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

3.4 Leakage voltage

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 Using DIN connector with the pilot valve

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 of the system. The pressure drop of silencers or devices can be calculated using the methods described in the Safety Standard.

The exhaust ports of the valves should never be blocked and must be protected from contamination by a suitable silencer or device which does not affect the valve function.

3.6 Noise

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 of the system. The pressure drop of silencers or devices can be calculated using the methods described in the Safety Standard.

The exhaust ports of the valves should never be blocked and must be protected from contamination by a suitable silencer or device which does not affect the valve function.

3.7.1 Pilot Valve

DIN terminal has no polarity.

The 'Y' type DIN terminal corresponds to the DIN connector with a terminal pitch of 6 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.

3.7.1.2 Pilot valve connections

- DIN interconnection

3.7.3.2 Pilot valve connections

3.6 Noise

2.12.5 MTTFd according to the Safety Standard

3.7.1.2 Pilot valve connections

The T100 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 MTTF and the Performance Level (PL) of the system using the methods described in the Safety Standard.

3.7.1.4 Using DIN connector with the pilot valve

- DIN interconnection

3.6 Noise

3.7.1 Pilot Valve

DIN terminal has no polarity.

3.7.2 Pilot valve connections

3.7.1.2 Pilot valve connections

- DIN interconnection

3.6 Noise

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

3.4 Leakage voltage

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.

3.7.3.2 Pilot valve connections

When making connections, take note that usually other than the supported size (±3.5 to ±7) heavy duty cord will not satisfy IP65 (enclosure) standards. Also, be sure to tighten the ground nut and holding screw within their specified torque range.
### 3.7.2 Omron Limit Switch

**3.7.2.1 Limit Switch: Omron conduit type**

<table>
<thead>
<tr>
<th>Screw position</th>
<th>Tightening torque / N·m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal screw</td>
<td>0.6 to 0.8</td>
</tr>
<tr>
<td>Cover clamping screw</td>
<td>0.5 to 0.7</td>
</tr>
<tr>
<td>Conduit mounting connection</td>
<td>1.8 to 2.4</td>
</tr>
</tbody>
</table>

Table 2 Conduit terminals tightening torque

- 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 mm²)

- 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.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Applicable cable diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAPP</td>
<td>ST-PF1/2 5380-1002</td>
<td>6.0 to 12.0 mm</td>
</tr>
<tr>
<td>Ohm Denki</td>
<td>DA W1660</td>
<td>7.0 to 9.5 mm</td>
</tr>
<tr>
<td></td>
<td>DA W1611</td>
<td>9.0 to 11.0 mm</td>
</tr>
</tbody>
</table>

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.

**3.7.3 Rockwell Automation M12 connector type**

**3.7.4.1 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.
4 How to Order

4.1 (25A) VP444(R)-S2Z1-0##-##-X555 - How to order

<table>
<thead>
<tr>
<th>Variant</th>
<th>VP</th>
<th>25A</th>
</tr>
</thead>
<tbody>
<tr>
<td>15...</td>
<td>44</td>
<td>5</td>
</tr>
<tr>
<td>18...</td>
<td>44</td>
<td>5</td>
</tr>
</tbody>
</table>

External pilot check & connection type

Y400 A' spacer and "Y400T A' spacer with bracket.
Contact SMC for details.

5 Outline Dimensions (mm)

<table>
<thead>
<tr>
<th>VP500</th>
<th>VP700</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>53.2</td>
</tr>
<tr>
<td>B</td>
<td>47.5</td>
</tr>
<tr>
<td>C</td>
<td>55.2</td>
</tr>
<tr>
<td>D</td>
<td>109.9</td>
</tr>
<tr>
<td>E</td>
<td>201.8</td>
</tr>
<tr>
<td>F</td>
<td>125.0</td>
</tr>
<tr>
<td>G</td>
<td>14.4</td>
</tr>
<tr>
<td>H</td>
<td>3.7</td>
</tr>
<tr>
<td>I</td>
<td>101.3</td>
</tr>
<tr>
<td>J</td>
<td>75.5</td>
</tr>
<tr>
<td>K</td>
<td>62.2</td>
</tr>
<tr>
<td>L</td>
<td>91.5</td>
</tr>
<tr>
<td>M</td>
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</tr>
<tr>
<td>N</td>
<td>15.6</td>
</tr>
<tr>
<td>O</td>
<td>28.5</td>
</tr>
<tr>
<td>P</td>
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</tr>
<tr>
<td>Q</td>
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</tr>
<tr>
<td>R</td>
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</tr>
<tr>
<td>S</td>
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</tr>
<tr>
<td>T</td>
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</tr>
<tr>
<td>U</td>
<td>62.5</td>
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<tr>
<td>V</td>
<td>73.5</td>
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<td>W</td>
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<tr>
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<tr>
<td>Y</td>
<td>24.9</td>
</tr>
<tr>
<td>Z</td>
<td>27.2</td>
</tr>
<tr>
<td>AA</td>
<td>12.5</td>
</tr>
<tr>
<td>AB</td>
<td>14.5</td>
</tr>
<tr>
<td>AC</td>
<td>22.5</td>
</tr>
</tbody>
</table>

Note: The 25A- variants are compatible for use in the secondary battery manufacturing environment. These variants are copper and zinc free and suitable for use with low dew point air supplies (-70°C). Contact SMC for more information.

5.1 Mounting

- Mounting orientation: Unrestricted.
- The valve assembly can be mounted using two M6 bolts
- The sub plate is compatible with the AC series PRL unit by the use of Y300-A spacers.
- Spacer Y300-A can be used with the VP500 sub plate, and the Y400-A with the VP700 sub plate.

5.2 Silencers

Ensure that any silencers fitted to the valve remain clean and uncontaminated in operation because blockage will affect the safety function. Examine any silencers at least once per month and more frequently if necessary due to the nature of the application environment.

5 Outline Dimensions - continued

6.1 General Maintenance

- Not following proper maintenance procedures could cause the product to malfunction and lead to equipment damage.
- If handled improperly, compressed air can be dangerous. Maintenance of pneumatic systems should be performed only by qualified personnel.
- Before performing maintenance, turn off the power supply and be sure to cut off the supply pressure. Confirm that the air is released to atmosphere.
- After installation and maintenance, apply operating pressure and power to the equipment and perform appropriate functional and leakage tests to make sure the equipment is installed correctly.
- If any electrical connections are disturbed during maintenance, ensure that they are reconnected correctly and safety checks are carried out as required to ensure continued compliance with applicable national regulations.

- Do not make any modification to the product.
- Do not disassemble the product, unless required by installation or maintenance instructions.

6.2 Maintainable parts

- Under no circumstances attempt to change the solenoid of the pilot valve as this is an integral part of the valve and doing so will negate any such SMC warranty.

- There are no replaceable parts on these safety products.

6.3 Periodic testing

The product should be tested for proper operation of the safety function once per month or whenever considered necessary for the purposes of the end user. The test should consist of operation of the safety system and observation of the following:

When the connected control system is energising the solenoids:
- Check that the solenoid indicator lamps are illuminated.
- Check that the connected downstream system is properly pressurised.
- Check that the switch contacts are open.
- For VP444 duplex valve assembly check that when only one channel of the system (one of the solenoids) is energised that the protected system does not become pressurised. Check this for both channels.

When the connected control system is not energising the solenoids:
- Check that the solenoid indicator lamps are not illuminated.
- Check that the connected downstream system is properly vented to atmosphere and ensure that the condition of the silencers is not causing an extension of the vent time.
- Check that the switch contacts are closed.
- For the VP444 duplex valve assembly check that when only one channel of the system (one of the solenoids) is de-energised that the protected system is vented to atmosphere. Check this for both channels.

6.4 Silencers

- Warning

Ensure that any silencers fitted to the valve remain clean and uncontaminated in operation because blockage will affect the safety function. Examine any silencers at least once per month and more frequently if necessary due to the nature of the application environment.

7 Limitations of Use

7.1 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 first1). 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.

1) 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.

Page 5 of 6
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 is 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 regulations governing that export are known and followed.

- 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 purposes. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

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.

Output signal

---

Test pulse < 1 ms

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 perform 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 machine designer must provide all the 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.