



# Hydraulic Cylinders Precautions 1

Be sure to read this before handling products.

## Design

### Warning

#### 1. There is a possibility of dangerous sudden action by cylinders if sliding parts of machinery are twisted due to external forces, etc.

In such cases, human injury may occur, e.g. by hands or feet getting caught in the machinery, or damage to the machinery itself may occur. Therefore, the machine should be designed to operate smoothly and to avoid such dangers.

#### 2. A protective cover is recommended to minimize the risk of personal injury.

If a stationary object and the moving parts of a cylinder are in close proximity, personal injury may occur. Design the structure to avoid contact with the human body.

#### 3. Securely tighten all stationary parts and connected parts so that they will not become loose.

Especially when a cylinder operates with high frequency or is installed where there is a lot of vibration, ensure that all parts remain secure.

#### 4. There are cases in which a deceleration circuit or shock absorber may be required.

When a driven object is operated at a high speed or the load is heavy, a cylinder's cushion will most likely not be sufficient to absorb the impact. Install a deceleration circuit to reduce the speed before cushioning, or install an external shock absorber to relieve the impact.

In this case, the rigidity of the machinery should also be examined.

#### 5. Consider a possible drop in operating pressure due to a power outage.

When a cylinder is used as a clamping mechanism, there is a danger of workpieces dropping if there is a decrease in clamping force due to a drop in circuit pressure caused by a power outage. Therefore, safety equipment should be installed to prevent human injury or damage to machinery. Suspension mechanisms and lifting devices also require drop prevention measures.

#### 6. Consider a possible loss of power source.

Measures should be taken to protect against human injury or equipment damage in the event that there is a loss of power to equipment controlled by air pressure, electricity, or hydraulics.

#### 7. Design the circuitry to prevent the sudden lurching of driven objects.

When hydraulic pressure in a cylinder is zero, the driven object will lurch at a high speed if pressure is applied to one side of the piston. Therefore, equipment should be selected and circuits designed to prevent sudden lurching because there is a danger of human injury and/or damage to equipment when this occurs.

#### 8. Consider emergency stops.

Design the system so that bodily injury and/or damage to machinery and equipment will not occur when machinery is stopped by a manual emergency stop or a safety device triggered by abnormal conditions.

#### 9. Consider the action when operation is restarted after an emergency or abnormal stop.

Design machinery so that bodily injury or equipment damage will not occur upon the restart of operation.

When the cylinder has to be reset at the starting position, install manual safety equipment.

## Selection

### Warning

#### 1. Confirm the specifications.

The products featured in this catalog are designed strictly for use in industrial oil hydraulic system applications. If the products are used in conditions that are outside the range of pressure and temperature specifications, damage and/or malfunction may occur. Do not use in these conditions. (Refer to the specifications.)

Please consult with SMC if a fluid other than hydraulic fluid is to be used.

#### 2. Intermediate stops

Since hydraulic cylinders are not guaranteed for zero oil leakage, it may not be possible to hold a stopped position for an extended period of time.

#### 3. Take surge pressure into consideration.

Use cylinders which can withstand the surge pressures (maximum allowable pressure) generated in hydraulic systems. (Refer to specifications.)

Inside cylinders, pressure may be generated that is higher than the set pressure for the relief valve, e.g. internal pressure due to load inertia or surge pressure when switching valves. Consider these factors and determine the operating pressure so that the pressure generated inside the cylinders will be within the maximum allowable pressure.

Pressure terminology used in this catalog is defined as follows:

<b>Nominal pressure</b>	Pressure assigned to a cylinder for convenient identification. It is not necessarily the same as the operating pressure which guarantees performance under specified conditions.
<b>Maximum allowable pressure</b>	The maximum allowable value for the pressure that is generated inside cylinders (such as surge pressure).
<b>Proof pressure</b>	Test pressure that the cylinder must be able to withstand without lowering system performance when returning to the nominal pressure.
<b>Minimum operating pressure</b>	Minimum pressure at which a horizontally installed cylinder operates with no-load.

#### 4. Take into account compatibility with hydraulic fluids.

Hydraulic fluid	Compatibility
Standard mineral hydraulic fluid	○
W/O hydraulic fluid	○
O/W hydraulic fluid	○
Water-glycol hydraulic fluid	*1
Phosphate hydraulic fluid	×

\*1 Please consult with SMC.

### Caution

#### 1. Use the product within the limits of the maximum usable stroke.

The piston rod will be damaged if operated beyond the maximum stroke. Refer to the Hydraulic Cylinder Stroke Selection (Best Pneumatics No. 11) for maximum strokes.



# Hydraulic Cylinders Precautions 2

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## Selection

### ⚠ Caution

#### 2. Operate the piston within a range such that collision damage will not occur at the stroke end.

Operate within a range such that damage will not occur when a piston having inertial force stops by striking the cover at the stroke end.

- (1) Take load factors and piston speed (Best Pneumatics No. 11) into consideration and determine the operability by referring to the chart under "Selection standards."
- (2) When using a cylinder with no cushion, the speed when the piston strikes the cover should be reduced to 50 mm/sec or lower (a level at which no metallic sound is generated), or a stopper should be installed on the outside.

#### 3. Use a flow control valve to adjust the hydraulic cylinder drive speed, gradually increasing from a low speed to the desired speed setting.

#### 4. Provide intermediate supports for long stroke cylinders.

Provide intermediate supports for cylinders with long strokes to prevent piston rod damage due to sagging of the piston rod, deflection of the tube, vibration, or external loads.

## Mounting

### ⚠ Caution

#### 1. Be certain to align the axis center of the piston with the load and direction of movement when connecting.

When not properly aligned, twisting of the piston rod and tubing may occur, and damage may be caused due to wear on certain areas, such as the inner tube surface, bushings, piston rod surface, and seals.

#### 2. When an external guide is used, connect the piston rod end and the load in such a way that there is no interference at any point within the stroke.

#### 3. Do not scratch or gouge the sliding parts of the cylinder tube, piston rod, etc., by striking or grasping them with other objects.

Cylinder bores are manufactured to precise tolerances so that even a slight deformation may cause faulty operation. Also, scratches, gouges, etc., on the piston rod may lead to damaged seals or cause oil leakage.

#### 4. Do not apply excessive lateral load to the piston rod.

##### Easy checking method

Minimum operating pressure after the cylinder is mounted to the equipment [MPa] = Minimum operating pressure of cylinder [MPa] + {Load mass [kg] x 9.8 x Friction coefficient of guide/Sectional area of cylinder [mm<sup>2</sup>]}

If smooth operation is confirmed within the above value, the load on the cylinder is the resistance of the thrust only and it can be judged as having no lateral load.

#### 5. Do not use until you confirm that the equipment can operate properly.

Following mounting, repairs, or conversions, confirm that the product is mounted correctly by conducting suitable function and leakage tests after piping and power connections have been made.

## Mounting

### ⚠ Caution

#### 6. Operation manual

The product should be mounted and operated after the operation manual is thoroughly read and its contents are understood.

Keep the operation manual where it can be referred to as necessary.

## Piping

### ⚠ Caution

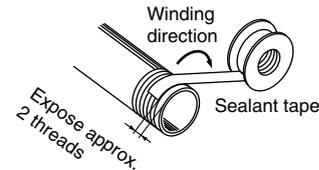
#### 1. Preparation before piping

Before piping is connected, it should be thoroughly blown out with air (flushing) or washed to remove chips, cutting oil, and other debris from inside the pipe.

#### 2. Winding of sealant tape

When screwing together pipes and fittings, be certain that chips from the pipe threads and sealing material do not get inside the piping.

Also, when sealant tape is used, leave 1.5 to 2 thread ridges exposed at the end of the pipe.



#### 3. Set up so that air cannot accumulate inside the piping.

## Cushion

### ⚠ Caution

#### 1. Readjust using the cushion needle.

Cushion needles are adjusted at the time of shipment. When the cylinder is put into service, the cushion needles should be readjusted based on factors such as the size of the load and the operating speed. When the cushion needles are turned clockwise, restriction of the air flow becomes greater and thus the cushioning effect also increases.

#### 2. Do not operate with the cushion needle in a fully closed condition.

This will contribute to the generation of surge pressure, and the cylinder or equipment can be damaged.

#### 3. Do not overly loosen the cushion needle.

This may cause oil to flow out. (As a guideline, loosen the needle 2 turns or less from the fully closed position.)

## Air Release

### ⚠ Caution

#### 1. Operate after opening the air release valve and completely releasing any internal air.

Residual air can cause malfunction.

#### 2. When adjusting the air release, do not excessively loosen the plug.

Use caution, since excessively loosening the plug may cause it to fly out or fluid to blow out, posing a danger of human injury.



# Hydraulic Cylinders Precautions 3

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## Hydraulic Fluid

### Warning

#### 1. Use clean fluid.

Do not use deteriorated fluid or fluid containing foreign matter, moisture, or corrosive additives, as this can cause the malfunction, damage, or corrosion of parts.

### Caution

#### 1. Install hydraulic fluid filters.

Provide your hydraulic system with hydraulic fluid filters with a filtration size of 10  $\mu\text{m}$  or smaller.  
Refer to SMC's hydraulic filter specifications.

#### 2. Use the product within the specified range of fluid and ambient temperatures.

Take measures to prevent freezing, as moisture in hydraulic fluid will freeze at 0°C or below, and this may cause damage to seals or lead to malfunction.

#### 3. Use hydraulic fluid with a viscosity grade equivalent to ISO VG32 or VG46.

## Operating Environment

### Warning

#### 1. Do not use in an environment where there is a danger of corrosion.

Refer to each construction drawing for information on the materials of cylinders.

#### 2. Install a protective cover if the product is to be used in a dusty environment or where it will be exposed to chips and spatter.

When water droplets or coolant are spattering, use a water-resistant hydraulic cylinder.

## Maintenance

### Warning

#### 1. Perform maintenance and inspection according to the procedures indicated in the operation manual.

If handled improperly, malfunction or damage of machinery and equipment may occur.

#### 2. Removal of equipment

Before machinery is removed, first ensure that there are measures in place to prevent the fall or sudden, erratic movement of driven objects and equipment. Then, cut off the air supply and electric power, and reduce the pressure in the system to zero.

When machinery is restarted, proceed with caution after confirming that appropriate measures are in place to prevent sudden movement.

### Caution

#### 1. Perform periodic maintenance on filters installed in a hydraulic system in order to keep the oil clean.

If the oil used in hydraulic cylinders contains foreign matter, parts, such as the piston seals and rod seals, will be damaged.