



# Actuators Precautions 1

Be sure to read this before handling products.

## Design/Selection

### Warning

#### 1. Confirm the specifications.

Products represented in this catalog are designed only for use in compressed air systems (including vacuum).

Do not operate at pressures, temperatures, etc., beyond the range of specifications, as this can cause damage or malfunction. (Refer to the specifications.)

Please contact SMC when using a fluid other than compressed air made by pneumatic equipment (including vacuum).

We do not guarantee against any damage if the product is used outside of the specification range.

#### 2. Confirm the applicable specification range.

The cylinder specifications listed in the catalog apply to standard strokes, including intermediate strokes. Please consult with SMC for specifications on long strokes. There are also some made-to-order products (-XB□/-XC□) for which product specifications do not apply.

#### 3. There is a danger of sudden action by cylinders if the sliding parts of machinery are twisted, etc., or changes in forces occur.

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.

#### 4. If there is a chance that the product will pose a hazard to humans, install a protective cover.

If the moving portion of the product will pose a hazard to humans or will damage machinery or equipment, provide a construction that prevents direct contact with those areas.

#### 5. Be certain that the secured portions will not loosen.

Be certain to adopt a reliable connecting method if the cylinder is used very frequently or if it is used in a location that is exposed to a large amount of vibration.

#### 6. There may be cases in which a speed-reduction circuit or a shock absorber is required.

If the driven object moves at high speeds or is heavy, it will be unfeasible for only the cylinder's cushion to absorb the shock. Therefore, provide a speed-reduction circuit to reduce the cylinder's speed before the thrust is applied to the cushion or an external shock absorber to dampen the shock. If these countermeasures are taken, make sure to take the rigidity of the mechanical equipment into consideration.

#### 7. Consider the possibility of a power source related malfunction.

For equipment that relies on power sources such as compressed air, electricity, or hydraulic pressure, adopt a countermeasure to prevent the equipment from causing a hazard to humans or damage to the equipment in the event of a malfunction.

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

When a cylinder is driven by an exhaust center type directional control valve or when starting up after residual pressure is exhausted from the circuit, etc., the piston and its driven object will lurch at a high speed if pressure is applied to one side of the cylinder because of the absence of air pressure inside the cylinder. Therefore, select equipment and design circuits to prevent sudden lurching because there is a danger of human injury and/or damage to equipment when this occurs.

#### 9. Consider the action of the cylinder in the event of an emergency stop.

Devise a safe system so that if a person engages the emergency stop or if a safety device is tripped during a system malfunction, such as a power outage, the movement of the cylinder will not cause a hazard to humans or damage the equipment.

#### 10. Avoid synchronized operation using cylinders only.

Even if multiple pneumatic cylinders are initially set to the same speed, their speeds may vary due to changes in operating conditions. Therefore, avoid designs where a single load is moved by synchronizing multiple cylinder operations.

#### 11. Consider the action of the cylinder when restarting after an emergency stop.

Devise a safe design so that the restarting of the cylinder will not pose a hazard to humans or damage the equipment. Install manually controlled equipment for safety when the actuator has to be reset to the starting position.

#### 12. Intermediate stops

When an intermediate stopped position is performed with a 3-position closed center type/double check valve type directional control valve, it is difficult to achieve accurate and precise stopped positions due to the compressibility of air.

Furthermore, since valves and cylinders are not guaranteed for zero air leakage, it may not be possible to hold a stopped position for an extended period of time. Please contact SMC in case it is necessary to hold a stopped position for an extended period of time.

#### 13. Do not disassemble the product or make any modifications, including additional machining.

Doing so may cause human injury and/or an accident.

#### 14. Refer to the Auto Switches Precautions for using with an auto switch.

#### 15. When a cylinder is used in a clamping, suspending, or lifting mechanism

There is a danger of workpieces dropping if there is a decrease of thrust due to a drop in circuit pressure caused by a power outage, etc. Therefore, safety equipment should be installed to prevent damage to machinery and/or human injury.

#### 16. The cylinder speed, response time, behavior, and air cushion effectiveness may change due to changes in usage conditions, environmental changes, the usage period, etc.



# Actuators Precautions 2

Be sure to read this before handling products.

## Design/Selection

### ⚠ 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 Cylinder Model Selection Procedure for the maximum usable stroke.

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

For applications where a piston with inertial force strikes a cover and stops at the stroke end, follow the cylinder model selection procedure (the front matter), or select while taking into account the allowable kinetic energy indicated in each model's specifications.

#### 3. Use a speed controller to adjust the 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 rod damage due to the sagging of the rod, deflection of the tube, vibration, external loads, etc.

In addition, thoroughly examine the possibility of buckling and establish safety measures, such as constructing a guide outside of the product, etc.

#### 5. If pressure is applied to the external cylinder parts, there is a possibility that air will get inside the cylinder from the rod seal section. (Example: inside a chamber, etc.)

#### 6. Resumption after a long stop.

When resuming operation after a long stop, there are cases in which the starting pressure rises or there is a delay in the piston starting time due to adhesion.

Conducting several cycles of running-in operation will solve this problem. Please consider implementing this before resumption.

#### 7. Short Stroke

Using a stroke of a length which is smaller than the effective cushion length may result in reduced air cushion performance.

## Mounting

### ⚠ Warning

#### 1. Operation manual

Install the product and operate it only after reading the operation manual carefully and understanding its contents. Also, keep the manual in a location where it can be referred to as necessary.

#### 2. Ensure sufficient space for maintenance activities.

When installing the products, allow access for maintenance and inspection.

#### 3. Tighten threads with the proper tightening torque.

When installing the products, follow the listed torque specifications.

#### 4. Do not place a magnetic object near the product.

The auto switch is a magnetic sensing type. If a magnetic object is placed close to it, the actuator could operate suddenly, which could pose a hazard to humans or damage the machinery and equipment.

#### 5. Do not perform additional machining on the product.

Performing additional machining on the product can result in insufficient strength and cause damage to the product. This can lead to possible human injury or damage to the surrounding equipment.

## Mounting

### ⚠ Warning

#### 6. Do not enlarge the fixed throttle by modifying the pipe connectors.

If the hole diameter is enlarged, the product's rotation speed will increase, causing the shock force to increase and damage the product. As a result, it could pose a hazard to humans or damage the machinery and equipment.

#### 7. Risk to people with pacemakers

As coming into close proximity with strong magnets may interfere with the function of pacemakers, posing a life-threatening risk to those with pacemakers, they should stay away from products with built-in magnets or take safety measures to block their magnetic force. Failure to heed caution may result in the malfunction of electronic equipment such as pacemakers.

### ⚠ Caution

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

When not properly aligned, the rod and tube may be twisted, and damage may be caused due to wear on certain areas, such as the inner tube surface, bushings, rod surface, or seals.

For off-center loads, we recommend using in combination with a floating joint, etc., for effective deviation absorption. Confirm the allowable eccentricity and rotating angle before selecting for use.

#### 2. When an external guide is used, connect the 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 even a slight deformation may cause a malfunction. Also, scratches, gouges, etc., on the piston rod may lead to damaged seals or cause air leakage.

#### 4. Prevent the seizure of rotating parts.

Prevent the seizure of rotating parts (pins, etc.) by applying grease.

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

Confirm correct mounting by performing function and leak tests properly after compressed air and power are connected following mounting or repair.

#### 6. Cantilever fastening

If a cylinder is actuated at a high speed when mounted with one side fastened and one side free (basic type, flange type, direct mount type), the bending moment may act on the cylinder due to vibration at the stroke end, causing damage to the cylinder. In such cases, install a mounting bracket to suppress the vibration of the cylinder body, or reduce piston speed until the cylinder body does not vibrate at the stroke end.

Also, use a mounting bracket when moving the cylinder body or mounting a long stroke cylinder horizontally with one-sided fastening.

#### 7. Be very careful when handling the product.

Depending on the handling method, there is a risk that the corners of the product will injure your hands, fingers, etc.



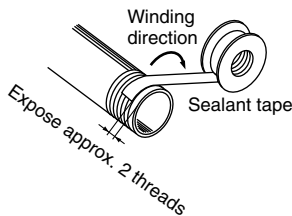
# Actuators Precautions 3

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## Piping

### ⚠ Caution

1. Refer to the Fittings and Tubing Precautions (pages 52 to 56) for handling One-touch fittings.
2. 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.
3. Winding of sealant tape  
When screwing piping or fittings into ports, ensure that chips from the pipe threads or sealing material do not enter the piping. Also, if sealant tape is used, leave 1.5 to 2 thread ridges exposed at the end of the threads.



## Cushion

### ⚠ Caution

1. Readjust using the cushion needle.  
Adjust the cushion needle on the cover when the product is put into service, based upon factors such as the size of the load and the operating speed. When the cushion needle is turned clockwise, the restriction becomes smaller and the cushion's effectiveness is increased. Tighten the lock nut securely after adjustment is performed.
2. Do not operate with the cushion needle in a fully closed condition.  
This could tear the seal.

## Lubrication

### ⚠ Warning

1. Lubricating lube type cylinders  
Install a lubricator in the circuit, and use class 1 turbine oil (with no additives) ISO VG32. Do not use machine oil or spindle oil. If turbine oil is used, refer to the Safety Data Sheet (SDS) of the oil.
2. Lubricating non-lube type cylinders  
These cylinders have been lubricated for life at the factory and can be used without any further lubrication. However, in the event that it is additionally lubricated, be sure to use class 1 turbine oil (with no additives) ISO VG32. Do not use machine oil or spindle oil. Stopping lubrication later on may lead to a malfunction because the new lubricant will displace the original lubricant. Therefore, lubrication must be continued once it has been started.  
If turbine oil is used, refer to the corresponding Safety Data Sheet (SDS).

## Air Supply

### ⚠ Warning

1. Type of fluids  
Please consult with SMC when using the product in applications other than compressed air.
2. When there is a large amount of drainage  
Compressed air containing a large amount of drainage can cause the malfunction of pneumatic equipment. An air dryer or water separator should be installed upstream from filters.
3. 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. This causes the malfunction of pneumatic equipment.  
If the drain bowl is difficult to check and remove, the installation of a drain bowl with an auto drain option is recommended. For compressed air quality, refer to the SMC Best Pneumatics No. 6 catalog.
4. Use clean air.  
Do not use compressed air that contains chemicals, synthetic oils that include organic solvents, salt, flammable gas, corrosive gases, etc., as it can cause damage or malfunction.

### ⚠ Caution

1. 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.
2. Install an air filter.  
Install an air filter upstream near the valve. Select an air filter with a filtration size of 5 µm or smaller.
3. 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 the malfunction of pneumatic equipment, such as valves. Therefore, take appropriate measures to ensure air quality, such as by providing an aftercooler, air dryer, or water separator.
4. Ensure that the fluid and ambient temperatures are within the specified range.  
If the fluid temperature is 5°C or less, the moisture in the circuit could freeze, causing damage to the seals or equipment malfunction. Therefore, take appropriate measures to prevent freezing.  
For compressed air quality, refer to the SMC Best Pneumatics No. 6 catalog.
5. Precautionary measures against condensation  
Moisture condensation can occur inside pneumatic systems due to a drop in temperatures caused by the piping or operating conditions. This can degrade or wash away grease, resulting in a shortened service life or a malfunction.  
For details, refer to the catalog "Precautionary measures against condensation in a pneumatic system" (CAT.P-E01-11).



# Actuators Precautions 4

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## Operating Environment

### Warning

- 1. Do not use in an atmosphere containing corrosive gases, chemicals, sea water, water, or water vapor as the generation of rust, corrosion, etc., may occur as a result. Direct contact with the above must also be avoided.**
  - About plated carbon steel machining  
The long machined parts (end threads of piston rods, double-sided chamfer portions, tie rod threads, etc.) are not plated. Consider a made-to-order product (-XC6/-XC7) if the product is to be used in an environment where the generation of rust or corrosion will be a problem.
  - Refer to each construction drawing for information on the materials of each actuator type.
- 2. Do not expose the product to direct sunlight for an extended period of time.**
- 3. Do not use in a place subject to heavy vibration and/or shock.**
- 4. Do not mount the product in locations where it is exposed to radiant heat.**
- 5. Do not use in dusty locations or where water, oil, etc., splash on the equipment.**

Use the heavy duty scraper type (-XC4) in situations where there is a lot of dust. Use a water-resistant cylinder when there is splashing or spraying of a liquid.
- 6. When using auto switches, do not operate in an environment with strong magnetic fields.**
- 7. If a shock absorber is attached to an actuator, read the Specific Product Precautions for the shock absorber.**
- 8. A decrease in the base oil of grease may be accelerated by the properties of the compressed air used in pneumatic equipment, the external environment, operating conditions, etc., and the resulting drop in lubricating performance may have an effect on the equipment's service life.**

### Caution

- 1. Internal lubricant or the base oil of grease may seep out of the cylinder depending on the operating conditions (an ambient temperature of 40°C or more, pressure retention, low-frequency actuation, etc.). Take great care when a clean environment is required.**

## Maintenance

### Warning

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

If handled improperly, human injury and/or malfunction or damage of machinery and equipment may occur.
- 2. Maintenance work**

If handled improperly, compressed air can be dangerous. Assembly, handling, repair, and element replacement of pneumatic systems should be performed by a knowledgeable and experienced person.
- 3. Drain flushing**

Remove drainage from air filters regularly.
- 4. Removal of equipment, and supply/exhaust of compressed air**

Before components are removed, first confirm that measures are in place to prevent workpieces from dropping, run-away equipment, etc. Then, cut off the supply pressure and electric power, and exhaust all compressed air from the system using the residual pressure release function.  
When machinery is restarted, proceed with caution after confirming that appropriate measures are in place to prevent sudden movement.



# Actuators Precautions 5

Be sure to read this before handling products.

## For Air-hydro Type

Please read this page along with the Actuators Precautions.

### Design/Selection

#### ⚠ Warning

1. **Do not use an air-hydro cylinder near flames or in equipment or machinery that exceeds an ambient temperature of 60°C.**

There is a danger of causing a fire because the air-hydro cylinder uses a flammable hydraulic fluid.

Refer to the Safety Data Sheet (SDS) of the hydraulic fluid when supplying the fluid.

2. **Do not use the product in a clean room.**

#### ⚠ Caution

1. **Select an air-hydro cylinder in combination with an air-hydro unit.**

Since the smooth operation of an air-hydro cylinder depends on its combination with an air-hydro unit, carefully select an appropriate air-hydro unit.

2. **Set the load of the air-hydro cylinder to be 50% or less of the theoretical force.**

For an air-hydro cylinder to obtain a level of constant speed and stopping accuracy similar to a hydraulic cylinder, it is necessary to keep the load at 50% or less of the theoretical output.

3. **Do not use in an environment, equipment, or machine that is not compatible with oil mist.**

Air-hydro cylinders generate oil mist during operation which may affect the environment.

4. **Be certain to install an exhaust cleaner on the directional control valve of the air-hydro cylinder.**

A very small amount of hydraulic fluid is discharged from the exhaust port of the air-hydro cylinder's directional control valve, which may contaminate the surrounding area.

5. **Install an air-hydro cylinder in locations where it can be serviced easily.**

Since the air-hydro cylinder requires maintenance, such as the refilling of hydraulic fluid and bleeding of air, ensure sufficient space for these activities.

### Piping

#### ⚠ Warning

1. **For air-hydro cylinder piping, use self-aligning fittings.**

Do not use One-touch fittings in the piping for an air-hydro cylinder because oil leakage may occur.

2. **For air-hydro cylinder piping, use hard nylon tubing or copper piping.**

As in the case of hydraulic circuits, surge pressures greater than the operating pressure may occur in an air-hydro cylinder's piping, making it necessary to use safer piping materials.

### Lubrication

#### ⚠ Warning

1. **Completely discharge the compressed air in the system before filling the air-hydro unit with hydraulic oil.**

Before supplying hydraulic fluid to the air-hydro unit, first confirm that safety measures are implemented to prevent the dropping of objects, the releasing of clamped objects, etc. Then, shut off the air supply and the equipment's electric power, and exhaust the compressed air in the system.

If the air-hydro unit's supply port is opened with compressed air still remaining in the system, there is a danger of hydraulic fluid being blown out.

Refer to the Safety Data Sheet (SDS) of the hydraulic fluid when supplying the fluid.

2. **Use petroleum hydraulic fluid which can be used as turbine oil.**

If non-flammable hydraulic fluid is used, it may cause problems.

The operating temperature range suitable for ISO VG32 is from 15 to 35°C. If a higher operating temperature range is required, select ISO VG46 (suitable for 25 to 45°C).

- \* Refer to the SMC website for details about each manufacturer's brand name of class 1 turbine oil (no additives) ISO VG32. Additionally, please contact SMC for details about class 2 turbine oil (with additives) ISO VG32.

### Maintenance

#### ⚠ Caution

1. **Bleed air from the air-hydro cylinder on a regular basis.**

Since air may accumulate inside an air-hydro cylinder, bleed air from it, for example, before starting work. Bleed air from the bleeder valve provided on the air-hydro cylinder or the piping.

2. **Confirm the oil level of the air-hydro system on a regular basis.**

Since a very small amount of hydraulic fluid is discharged from the air-hydro cylinder and air-hydro unit circuit, the fluid will gradually decrease. Therefore, check the fluid regularly and refill as necessary.

The oil level can be checked with the level gauge in the air-hydro converter.