

Please read the following safety precautions carefully before ordering pneumatic cylinders.

Safety Precautions

References: JIS B9702: Safety of machinery principles of risk assessment
JIS B8170: Pneumatic fluid power general rules relating to systems

Warning Following information is based on a risk assessment for Konan pneumatic cylinders (hereafter referred to as "cylinder"). Each section provides information essential for safe operation of cylinder systems and prevention of risk and damage that may affect operators. Please read carefully.

① Selection of cylinders

1.1 Shock and mechanical safety

A cylinder is an actuator to drive loads by means of pneumatic pressure. It is often used for high-speed operation systems and equipment with heavy loads. In order to enable safe operation of a system incorporating the cylinder, it is essential to select appropriate type and size of cylinders for the load and motion energy as well as take into consideration the load connection method.

In particular, if motion energy of the load is high (large mass and high-speed operation), sufficient strength and rigidity of mounting structure is necessary. Installation of separate shock absorber may also be required.

For example, as described in the Technical Information 9-5 of the catalogue No. 2224, use of a cylinder with excessive mass of loads may cause damage to piston and connection components that may affect operators and surrounding mechanical systems.

1.2 Load factor and redundant safety

Theoretical output of a cylinder is provided by multiplying supply pressure by piston area (cylinder area). In order to get enough speed (dynamic output), determine the supply pressure and cylinder diameter so that load factor to the theoretical output becomes no more than 70%.

In case that the cylinder plays a significant part of the system functionality or that it is used with conditions in which maintenance is difficult, the system should be designed to lower the cylinder load factor. Also, a system design with multiple cylinders taking into consideration the redundant safety should be employed to avoid rapid functional deterioration.

For example, selecting a larger size cylinder will double the energy absorbing capacity of air cushion, making impact resistance reinforced.

1.3 Buckling of piston rod

Make sure load force during rod out does not exceed the allowable buckling load of the cylinder piston rod. Buckling load can be determined referring to the Technical Information 4 of the catalogue No. 2224.

1.4 Mechanical back-up

For securing safe operation of a cylinder even in case of entire error of functions involving pneumatic pressure, select a spring offset cylinder or take other measures to maintain the operation by means of different energy sources.

1.5 Entire safety consideration

Select the cylinder model and size in a comprehensive planning and design process of a pneumatic control system, taking into consideration the direct performance requirement as well as the safety in various conditions, including installation, adjustment, full-scale operation, failure, and disposal.

② Cylinder installation

Cylinders have precise operational functions and are used for applications with versatile conditions and environment. It is therefore sometimes difficult to assume all concerned risks or risk factors when designing a cylinder. In such cases the cylinder function and performance may be deteriorated in a period shorter than the maintenance period set by the manufacturer. In order to avoid the risks, install the cylinder as instructed below.

2.1 Installation site

Install a cylinder in a place where setting and maintenance is easy.

that prevents or stops operation of the cylinder when people come closer.

4.3 Constraint during operation

Before connecting a cylinder and a load, firmly fix the both in order to avoid unintended movement due to gravity or operational work.

4.4 Weight

See Section 1.1 of the Users Instructions.

4.5 Residual energy

See Section 3.3 of the Safety Precautions.

4.6 Other

Care should be taken for risks related to cylinder system operation such as: sudden blowout of compressed air; unintended actuation of the cylinder due to residual pressure after exhaustion of air inside the system; and bursting out of the cylinder just after restarting air supply.

Warning ⑤ Use of cylinder

5.1 Modification

Do not modify a cylinder. Unexpected risk may arise.

5.2 Lateral load and bending pressure on a piston rod

If a cylinder is operated with lateral load and bending pressure on the piston rod, the piston rod and cylinder tube may be damaged, which may result in deformation, abnormal wearing, and friction fluctuation as well as irregular or abnormal functioning of the cylinder, affecting operators or the mechanical system. In order to avoid this, follow the steps below.

- 1) Remove the lateral load by establishing a guide for the load.
- 2) After alignment to match the piston rod shaft center and the load operating shaft, fix the cylinder and connect the piston rod and the load.
- 3) If the piston rod shaft center and the load operating shaft do not match or the load oscillates, select a method to use fittings such as pin and ball joint to avoid external bending pressure on the piston rod.

5.3 Mounting of protection cover

If the load on the piston rod and the driving component of the cylinder may possibly harm the operator during the cylinder operation, mount a protection cover so that the operator cannot directly touch the driving components.

5.4 Shock absorption using external shock absorber

Generally, rubber or air cushions are incorporated in the cylinder stroke edges to absorb external shock; however, these cushions are not enough for the load with high motion energy (large mass and high operation speed). In such cases, it is necessary to mount external rubber cushions or other shock absorbers.

External shock absorbers should have appropriate absorption characteristics as well as suitable connection surface and connection stand with sufficient strength and rigidity.

Caution ⑥ Cylinder adjustment

6.1 Speed adjustment

If a cylinder needs speed adjustment, install a speed control valve to restrict the exhausting air from the cylinder port (meter-out control).

- 1) Do not reverse flow direction of a speed controller.
- 2) Konan standard SC6 series speed controller has an adjustment screw. When it is turned clockwise, the speed decreases to become zero (valve closed). When the screw is then turned counter-clockwise, the cylinder speed increases corresponding to the number of screw revolution. However, the SC6-08-size speed controller has a reverse structure. Therefore, turning the adjustment screw counter-clockwise fully reduces the speed to zero (with the valve fully closed) and turning the screw clockwise increases the cylinder speed corresponding to the number of screw revolution.
- 3) For safety, fully close the speed controller before air supply, then pressurize and gradually increase the cylinder speed using a directional control valve.
- 4) After adjustment, firmly fasten the locknut of adjustment screw.

6.2 Air cushion adjustment

2.2 Operating procedure

After installation, conduct a cylinder operation test for any abnormality, including lateral or uneven load on the piston rod and air leakage from the piston rod or connection components. If no abnormalities are found, then check the entire system operation.

2.3 Bursting out of a cylinder

If a piston of a cylinder is not in the position under control of a directional control valve at air supply after installation or during maintenance, it may rapidly shift to the control position. In order to avoid this risk, install a slow-start valve at the IN port of the directional control valve.

2.4 Indication

If a cylinder nameplate cannot be seen due to installation environment, place an alternative indication near the cylinder.

2.5 Residual pressure

A cylinder should be installed taking into consideration the risks for sudden blowout of air and unintended operation due to air pressure remaining in the cylinder even after exhaustion of air.

2.6 Training

A sufficiently trained person should be responsible for installation and maintenance of a cylinder. (Konan provides training for operation and maintenance of pneumatic components. Feel free to contact our sales personnel for details.)

③ Maintenance of solenoid valves

Maintenance should be performed in accordance with the following steps. Feel free to contact our sales personnel for separate maintenance manual.

3.1 Daily inspection

- 1) Exhaust drain from the air filter.
- 2) During operation of the system, observe the cylinder visually and acoustically from a safe place for loosening of screws and other external abnormalities as well as abnormal noise.

Confirm residual oil film on the surface of piston rod, taking care of the inspector's safety. Inspection should also be performed while the system is not in operation without exhausting inlet pressure for: loosening of screws; flaws on the piston rod surface; and air leakage from piston packings, exhaust port of the directional control valve, and piping joint.

3.2 Periodical inspection

Following periodical inspection should be conducted by-annually or annually.

- 1) Precise inspection should be performed after electric/pneumatic shut-down and the status recorded. Repair should be performed if necessary.
- 2) Overhaul should be performed in the 2nd annual inspection and components exchanged as specified or if necessary. The overhaul should also be performed when the cylinder operational distance reaches 1000 km, even before two years from the date of last inspection.

3.3 Residual energy

Maintenance requiring actual operation of a system should be performed after pneumatic/electric shut-down and exhaustion of all residual electrical charge and compressed air from the system. Make sure the movable components do not move during the

A cylinder with air cushion incorporates a cushion needle (needle valve) that adjusts the cushion. As the cushioning effect differs depending on the load speed and motion energy, speed adjustment and cushion adjustment should be conducted at the same time. For safety, start the adjustment with the needle valve fully closed (screw at right end) to maximize cushioning effect and then stop the screw where the cylinder stops promptly without any shock (approx. 2 turns counter-clockwise from the fully closed position). A needle valve with locking function should be firmly locked.

Caution ⑦ Intermediate stop of a cylinder

A cylinder can be stopped intermediately by controlling with a 3-position closed-center type directional control valve. Due to compressible nature of air, however, precise stop position or retention rigidity of the stop position like those of hydraulic cylinder cannot be achieved with a pneumatic cylinder. As sealing portions inside a cylinder system allow minimal leakage, it is also difficult to maintain the stop position for a long time. If long-term retention of stop position is necessary, install mechanical retention equipment such as brake, lock, or latching system.

Warning ⑧ Deflection of a long-stroke cylinder

A cylinder with stroke longer than the specified maximum length is prone to cause deflection of piston rod or tube due to its own weight. Follow the below when using such a cylinder.

- 1) If the cylinder body is firmly fixed, prepare a tube supporting equipment.
- 2) Select a cylinder supporting equipment sufficient for the buckling load of the piston rod.
- 3) Remove lateral load and match the center of piston rod and working load.
- 4) If the load oscillates, mount intermediate trunnion for support and use the cylinder not to make inertial force at oscillation excessively large.

Caution ⑨ Spray lubrication using a lubricator

9.1 Selection of oilless cylinders

Select an oilless cylinder in case of following conditions.

- 1) The cylinder is not frequently used. Lubricated oil may not reach the cylinder due to little spray volume.
- 2) Flow capacity of pipings is several times larger than the cylinder volume, or the cylinder is mounted on a place much higher than the lubricator. The spray oil will not reach the cylinder. Konan provides a lubricator that can be installed between the directional control valve and the cylinder. Feel free to contact our sales personnel for details.

9.2 Oilless enclosed cylinder

- 1) Use specified grease after overhaul of an oilless enclosed cylinder. Reconfirm the type of grease with our sales personnel.
- 2) A greased oilless enclosed cylinder can be lubricated but the grease will be exhausted. Although durability is enhanced after the lubrication, continual lubrication will be required.

9.3 Lubrication

- 1) Use JIS K 2213 (ISO VG32 or VG46) type turbine oil for lubrication using a lubricator.
- 2) Spray volume of a lubricator is determined by the number of oil drops (typically 0.03 cm³ per drop or 1.5 to 2.5 drops per 1 m³ of air). Another method for adjusting lubrication is to determine dropping volume based on the residual oil (thin layer of oil) on the surface of the piston rod.

9.4 Centralized lubrication

In principle 1 lubricator should be used for 1 cylinder. Lubricating multiple cylinders may result in uneven oil supply to each cylinder, particularly if there are differences in the operation frequency, pipe length, size, and installation height of the cylinders. By grouping the cylinders with similar conditions, centralized lubrication can be achieved.

Reference ⑩ Cylinder system control

10.1 Sequence control

Follow the below steps for sequence control of a cylinder.

- 1) Detect the piston position.

maintenance, and mechanically fix them if necessary for safety. Care should also be taken for components that may drop out during the maintenance operation and components with sharp edges to ensure safety.

3.4 Communication

If multiple persons are involved in the maintenance operation, keep all the personnel informed about the conditions including power-off, completion of residual pressure exhaustion, power-on, and resumption of air supply.

Users Instructions

Caution ① Transport of cylinders

1.1 Weight

Heavy-weight cylinders should be transported with the aid of a conveyer equipment. Cylinder weight can be confirmed by referring to Konan Pneumatic Cylinder Catalogue and product drawings. Qualified personnel should be responsible for the operation of forklift truck, crane, or slinging according to the regulations and company safety code.

Care should also be taken for transport of light-weight cylinders not to cause cylinder tube deformation and other component damage.

1.2 Dropping

During lifting or horizontal transportation of a cylinder, handle the cylinder carefully not to drop or damage.

1.3 Dust prevention

Plastic plug is attached to the cylinder connection ports to prevent dusts and rusts from entering the cylinder. Do not remove the plug until immediately before piping. If the plug is lost, take a protection measure with alternative cover.

Caution ② Storage

2.1 Storage during transport

If a cylinder is to be installed where it is exposed to wind and rain or other adverse environment, transport the cylinder to the specified site just before installation. If the cylinder is to be stored at the installation site by necessity, keep it packed and protect with a sheet cover. In such case make sure to shorten the storage period as much as possible.

2.2 Storage

A cylinder should be stored as follows to prevent contamination and material deterioration.

- 1) Avoid high temperature and humidity as well as places with dusts and moisture.
- 2) If a cylinder is to be stored for more than 1 year, keep it packed or provide equivalent protection.
- 3) Long-term storage may result in sticking of packings or other components due to shortage of lubrication. In such cases, conduct pre-conditioning operation of the cylinder before regular use.
- 4) After a long period of storage, permanent deformation, change of size, or deterioration of packings and other components would be a concern. After such storage period, conduct a cylinder operation test. If any abnormalities are found, perform an overhaul or exchange deformed/deteriorated components as appropriate.

Warning ③ Surrounding environment

3.1 Vibration/shock

- 1) If a cylinder is to be used in a place where it is exposed to excessive shock or vibration, confirm acceleration rate and other conditions before consulting our sales personnel.
- 2) If the cylinder is used in a place where vibration is a concern,

- 2) Interlock the control of other cylinders in the system.
- 3) If operation is stopped in the middle of sequence, make sure to restart the operation from the stopped position safely. If impossible, manually control the cylinder piston to return to the starting position.
- 4) Set a sequence starting position at which movable components do not move after air exhaustion.

10.2 Power failure and pneumatic pressure failure

- 1) In case of power failure or emergency stop of a cylinder operation, ensure the cylinder at operation stops or shifts to a safe position. Care should be taken not to damage personnel or equipment after recovery of the power failure or the system operation. Indicate procedure to recover power failure.
- 2) In order to complete a cycle operation even in case of pneumatic pressure failure, reserve sufficient amount of pneumatic pressure in an air tank.
- 3) In case of the system shut-down due to emergency stop or power failure, avoid damage to personnel or equipment when restarting the cylinder operation after power recovery or system reset.

Warning ⑪ Clamp system

If dropout of a workpiece due to pneumatic pressure drop in a cylinder-driven clamp system is anticipated, use a cylinder with spring return or lock.

Warning ⑫ Lifting system

Following should be considered when using a cylinder for lifting systems.

- 1) Do not use a cylinder for elevators transporting people.
- 2) If external force due to loading/unloading of workpiece, etc. is added at the stop position, use a cylinder with lock or establish other mechanical positioning system.
- 3) Set the start-up position at the lower end of the lifting system.
- 4) If power failure occurs during a solenoid valve operation, stop the cylinder or shift it to a safe position. If the valve is manually operated, use a latch valve.

Warning ⑬ Residual pressure exhaustion

Follow the below for exhaustion of residual pressure inside a pneumatic control system at installation or maintenance.

- 1) Use a manual control valve for exhaustion of residual pressure.
- 2) Place manometers, pressure switches, and other residual pressure indicators at each section with residual pressure.
- 3) In a sequence control system, make sure to centrally control all related residual pressure exhaustion. If this is impossible, indicate the place and switching condition of the air exhaustion equipment with a tag.
- 4) If allowing separate maintenance of each cylinder, install a 3-port manual valve or other residual pressure exhaustion valve at the inlet or outlet of the directional control valve.
- 5) In a system circuit using a check valve (non-return valve), a pilot check valve, and/or a closed center check valve, exhaust residual pressure separately or indicate warnings for residual pressure, as air may be contained even the system is not in operation.
- 6) Indicate the residual pressure exhaustion valve in the system circuit drawing.

Reference ⑭ Circuit and piping

14.1 Pressure drop

In a pneumatic control system with long pipes at the end or entrance of the system, sufficient pressure may not be supplied due to pressure drop. Piping thus should be designed properly, or supplementary air tank should be installed to secure supply pressure if a cylinder is operated intermittently.

14.2 Air filtration

Air supplied to a cylinder should be filtered by a filter with nominal filtration rating of no more than 40 mm to remove solid contaminants. Exhaust liquid drain or oil through the filter or drain separator after sufficient cooling of the air. Exposure to contaminated, high temperature compressed air may deteriorate packings or other components, making the cylinder life shorter.

14.3 Piping

- 1) Do not remove the plastic plug and keep the cylinder p-I asked

④ Cylinder installation site

Use of a cylinder at the following sites requires compliances with special functional specifications and regulations. Consult our sales personnel in the planning process for anything unclear.

- 1) Operating conditions not within the specified range
- 2) Significant risk for users, properties, or environment is anticipated

Eg: Use for nuclear power plants, vehicles, medical components, components related to the Occupational Health and Safety Law and/or the High Pressure Gas Safety Law, etc.

ensure the cylinder is firmly fixed at the setting and connection portions fastened tightly. Particularly, if the cylinder is to be used frequently, take into consideration the fatigue resistance.

3) After start of operation, inspect the connection portions in a periodical manner to check any loose parts or deformation and re-fasten screws. Loose parts may cause unintended motion of the cylinder, significantly affecting operators and surrounding systems.

3.2 Handling during installation

Rough handling of a cylinder may diminish regular performance of the cylinder. For example, riding on, hammering, or dropping the cylinder may cause damage and deformation of the cylinder tube and piston rod. Slight deformation of the cylinder tube diameter will result in malfunction. Also, flaw or deformation of movable components of piston rod will damage packings, causing air leakage.

3.3 Surrounding environment

Environment surrounding a cylinder should be considered carefully. Avoid places where the cylinder is exposed to rain and wind, direct sunlight, salt, corrosive gas, chemical fluids, organic solvents, steam, etc. Corrosion resistance measure can be taken depending on the environment. Feel free to contact our sales personnel for details.

3.4 Working temperature

Use a cylinder with specified range of ambient/working temperature and supply pressure.

- 1) Temperature of compressed air around an air compressor may become high, which may cause deterioration of packings or malfunction of the cylinder.
- 2) In a place where temperature is close to 0C, remove moisture in the compressed air with an air dryer. If the dehumidification is not performed, significant amount of moisture may freeze inside the cylinder to cause malfunction.

Warning ④ Safety measures

4.1 Operation space

Secure sufficient operation space for safe installation and maintenance of a cylinder. This should be considered sufficiently, since in many cases a pneumatic control system is installed after completion of a main system. Ensuring safety is the first and foremost priority.

4.2 Mechanical safety

- 1) Intrinsic safety
Make sure to avoid significant damage to operators (squashing, dragging, blow, cutting, burn, electric shock, etc.) by contact with movable, heated, or energized components.
- 2) Safety measures
Put protection cover to the piston rod and other movable components during the system operation to prevent operators from approaching. Take utmost care not to insert arms, hands, or fingers into the system.
- 3) Safety system
If setting of a protection cover or other safety measures cannot be taken due to the functional problem of the system, add equipment

- just before piping in order to prevent dusts and rusts from entering the cylinder during storage or installation. Use galvanized pipe for steel tube piping and remove dusts after screwing.
- 2) Before connection, clean the pipes by air flushing or washing to remove internal dusts, moisture, and oil.
- 3) If a seal tape is used for screwing, wrap the tape around twice or three times in a direction opposite to the screwing direction, leaving 1.5 to 2 threads from the screw edge.
- 4) For piping works using tapered male thread joints or steel tubes, use sealing materials such as seal tape and fasten to adhere tightly to the threads. Do not use wrenches and spanners that are excessively large for the joint or those with long extended handle. Do not step on the wrench/spanner to fasten the pipe. Excessive fastening may result in collapse of screws. In case of 6A to 25A (Rc1/8 to 1) size tapered male screws, 4 to 5 threads should be screwed. For operators with little experiences, an exercise before actual piping is recommended.

Caution ⑮ Special cylinders

For cylinders with special specifications like below, consult our sales personnel and inform the conditions for use.

- 1) Use with carbon dioxide gas or nitrogen gas
- 2) Use under conditions with high/low temperature or high radiant heat
- 3) Use at a place with ozone or salt and underwater
- 4) Externally washed as part of a sanitary system

Warning ⑯ Disposal

- 1) Do not incinerate a cylinder for disposal. It may explode or emit poisonous gas.
- 2) Check the material of each component of a cylinder with catalogue or operation manual for segregation disposal. Konan cylinders do not include materials indisposable as general industrial waste.

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