No.	C55＊－OM0003I	

OPERATION MANUAL

TITLE：ISO COMPACT CYLINDER
C55*20～63-* SERIES

○Read this manual thoroughly before mounting and operation.

○Especially, carefully read the description concerning safety.

○Keep this manual where accessible when necessary.

SMC CORPORATION

FORMAT No.FOM007-2

1. Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard by labeling "**Caution**","**Warning**" or "**Danger**". To ensure safety, be sure to observe ISO4414 [Note1], JIS B 8370 [Note2] and other safety practices.

⚠ **Caution**: Operator error could result in injury or equipment damage.

⚠ **Warning**: Operator error could result in serious injury or loss of life.

⚠ **Danger**: In extreme conditions, there is a possibility of serious injury or loss of life.

Note1) ISO4414:Pneumatic fluid power－Recommendations for the application of equipment to transmission and control systems

Note2) JIS B 8370:Pneumatic system axiom.

⚠ Warning

1. **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 are used in various operating conditions, their compatibility with the specific pneumatic system must be based on specifications or after analysis and/or tests to meet your specific requirements.

2. **Only trained personnel should operate pneumatically operated machinery and equipment.**
   Compressed air can be dangerous if an operator is unfamiliar with it. Assembly, handling or repair of pneumatic systems should be performed by trained and experienced operators.

3. **Do not service machinery/equipment or attempt to remove components until safety is confirmed.**
   1. Inspection and maintenance of machinery/equipment should only be perfomed after confirmation of safe locked-out control positions.
   2. When equipment is to be removed, confirm the safety process as mentioned above. Cut the supply pressure for the equipment and exhaust all residual

compressed air in the system.

3. Before machinery/equipment is re-started, take measures to prevent quick extensions of the cylinder piston rod, etc.(Bleed air into the system gradually to create back-pressure.)

4. Contact SMC if the product is to be used in any of the following conditions:

1. Conditions and environments beyond the given specifications, or if product is used outdoors.
2. Installation on equipment in conjunction with atomic energy, railway, air navigation, vehicles, medical equipment, food and beverage, recreation equipment, emergency stop circuits, press applications, or safety equipment.
3. An application which has the possibility of having negative effects on people, property, or animals, requiring special safety analysis.

2. Product specification

2-1. Specifications

Acting style	Double acting					
Bore size	φ20	φ25	φ32	φ40	φ50	φ63
Fluid	Air					
Proof pressure	1.5MPa					
Max. operating pressure	1.0MPa					
Min. operating pressure	0.05MPa					
Ambient and fluid temperature	Without auto switch : −10～+70℃(No freezing) With auto switch : −10～+60℃(No freezing)					
Lubrication	Non-lube					
Rod end thread tolerance	JIS class 2					
Stroke length tolerance	$^{+1.0}_{0}$ mm					
Cushion	Rubber cushion (Both side)					
Piston speed	50～500 mm/sec					
Allowable kinetic energy	0.110J	0.18J	0.29J	0.52J	0.91J	1.54J

⚠ Warning

1) Use with knowledge of the feature of the product.

C55:ISO compact cylinder is outside dimension and the total length in accordance with the ISO21287 standard.

There is a possibility to occur following when similar use to presented ISO cylinder. (VDMA25562/ISO6431 cylinder : C95 series.)

1. Life cycle is shorter.
2. Causing the damage accident according to the use state.

2) Check the specifications.

This products are designed according to use in industrial compressed air systems. If the products are used in conditions where pressure, temperature, etc., are out of specification, damage and/or malfunction may be caused. Do not use under these conditions. Consult SMC if you use a fluid other than non-industry use or compressed air.

3) A deceleration circuit or shock absorber, etc., may be required.

When a driven object is operated at high speeds or the load is heavy, a cylinder's cushion will not be sufficient to absorb the shock. Install a deceleration circuit to reduce the speed before the stroke end, or install an external shock absorber to relieve the shock. In this case, the rigidity of the machinery should also be examined.

3. How to set and use

3-1. Operating air

For compressed air supplied to the cylinder, use the air which is filtrated by SMC's filter such as AF series and adjusted to specified setting pressure by SMC's regulator such as AR series.

⚠ Warning

1) Use clean air.

If compressed air includes chemicals, synthetic oils containing organic solvents, salt or corrosive gases, etc., it can cause damage or malfunction.

⚠ Caution

2) Install air filters.

Install air filters at the upstream side of valves. The filtration degree should be 5 μm or less.

3) Install an air dryer, after cooler, etc.

Air that includes excessive condensate may cause malfunction of valves and other pneumatic equipment. To prevent this, install an air dryer, after cooler, etc.

4) Use the product within the specified range of fluid and ambient temperature.

Take measures to prevent freezing, since moisture in circuits will be frozen under 5℃, and this may cause damage to seals and lead to malfunction.

Allowable temperature range of standard cylinder is;

- With switch →－10～70℃ (No freezing)
- Without switch→－10～60℃ (No freezing)

Note) Difference between with and without switch comes from－10～60℃ operating temperature of built-in magnet and auto switch. Using seal is same.

Use the cylinder within above range. If used out of range, abnormal wear and tear due to seal hardening causes air leakage, and lubricating grease which doesn't perform properly may lead failure.

5) Lubrication of cylinder.

The cylinder has been lubricated for life at the factory and can be used without any further lubrication. However, in the event that it will be lubricated, use class 1 turbine oil (with no additives) ISO VG32.

Stopping lubrication later may lead to malfunction due to the loss of the original lubricant. Therefore, lubrication must be continued once it has been started.

3-2. Caution on design

⚠ Warning

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

In such cases, human injury may occur; e.g., by catching hands or feet in the machinery, or damage to the machinery itself may occur.

Therefore, the machine should be designed to avoid such dangers.

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

If a stationary object and 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.

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

4) Avoid giving external force over maximum output to the cylinder.

A pieces of cylinder broken by the force may damage the human and the device.

5) Set the mounting base suitable to large force given by the cylinder.

If the mounting base doesn't have enough hardness, the human and the device may be damaged.

6) Don't use plural cylinders synchronously without guide.

It is difficult to control speed of the cylinder using air, which is compressive fluid, because speed is given an effect by change of supplied pressure, load, temperature, lubrication and each part, and difference of the performance of each cylinder. For a short time, it is possible to adjust speed of plural cylinders by speed controller, but for a long time, above mentioned factors may break synchronism of those cylinders. If synchronism is broken, lateral load caused by difference of position is given to piston rod and may wear seal and bearing, and make galling to cylinder tube and piston. If it is necessary to use plural cylinders synchronously, use the guide with hardness and high accuracy not to make difference to speed of each cylinder which has individual output.

7) Consider a possible drop in operating pressure due to a power outage, etc.

When a cylinder is used in a clamping mechanism, there is a danger of work dropping if there is a drop in circuit pressure caused by a power outage, etc. Therefore, safety equipment should be installed to prevent damage to machinery and human injury. Suspension mechanisms and lifting devices also require consideration for drop prevention.

8) Consider a possible loss of power source.

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

9) Consider emergency stops.

Design so that human injury and/or damage to machinery and equipment will not be caused when machinery is stopped by a safety device under abnormal conditions, a power outage or a manual emergency stop.

10) Consider the action when operation is restarted after an emergency stop or abnormal stop.

Design the machinery so that human injury or equipment damage will not occur upon restart of operation. When the cylinder has to be reset at the starting position, install manual safety equipment.

11) Intermediate stops.

When intermediate stopping of a cylinder piston is performed with a 3 position closed center directional control valve, it is difficult to achieve stopping positions as accurate and minute as with hydraulic pressure, due to the compressibility of air.

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

⚠ Caution

1) Operate the piston within a range such that collision damage will not occur at the end of the stroke.

Operate within a range such that damage will not occur when the piston having inertial force stops by striking the cover at the stroke end. Refer to “3-6. Allowable kinetic energy”.

3-3. Mounting and setting

⚠ Caution

1) Don’t give excessive lateral load to piston rod.

Give the load to piston rod in axis direction. If it is impossible to avoid giving lateral load, make lateral load to bearing of cylinder 1/20 of maximum output of the cylinder or less.

Limit of lateral load to the rod end.

(1) Single rod

How to calculate allowable lateral load

$$f_B = \frac{F}{20} \text{ 、} F = \frac{\pi}{4} D^2 \cdot P$$

$$f_R \leqq \frac{L_1}{L_1+(L_2+\text{STROKE})} \cdot f_B$$

F: Maximum output (N)
f_B: Maximum load given to bush (N)
D: Inside diameter of cylinder tube (mm)
P: Maximum operating pressure (MPa)
f_R: Allowable lateral load (N)

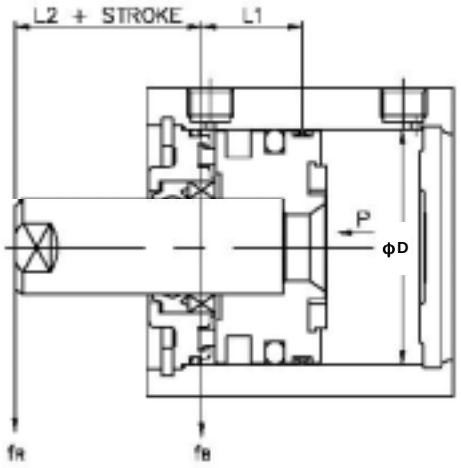


Fig.1

Table 1.

D (mm)	L1 (mm)	L2 (mm)	f_B (N)	Stroke range (mm)
ϕ20	24.75	12.25	15.7	5～150
ϕ25	26.70	11.30	24.5	
ϕ32	24.65	18.20	40.2	
ϕ40	22.90	19.70	62.8	
ϕ50	21.35	19.65	98.2	
ϕ63	21.60	20.60	155.9	

Note1) If load is given to the rod end, add the distance to the center of gravity to L2.

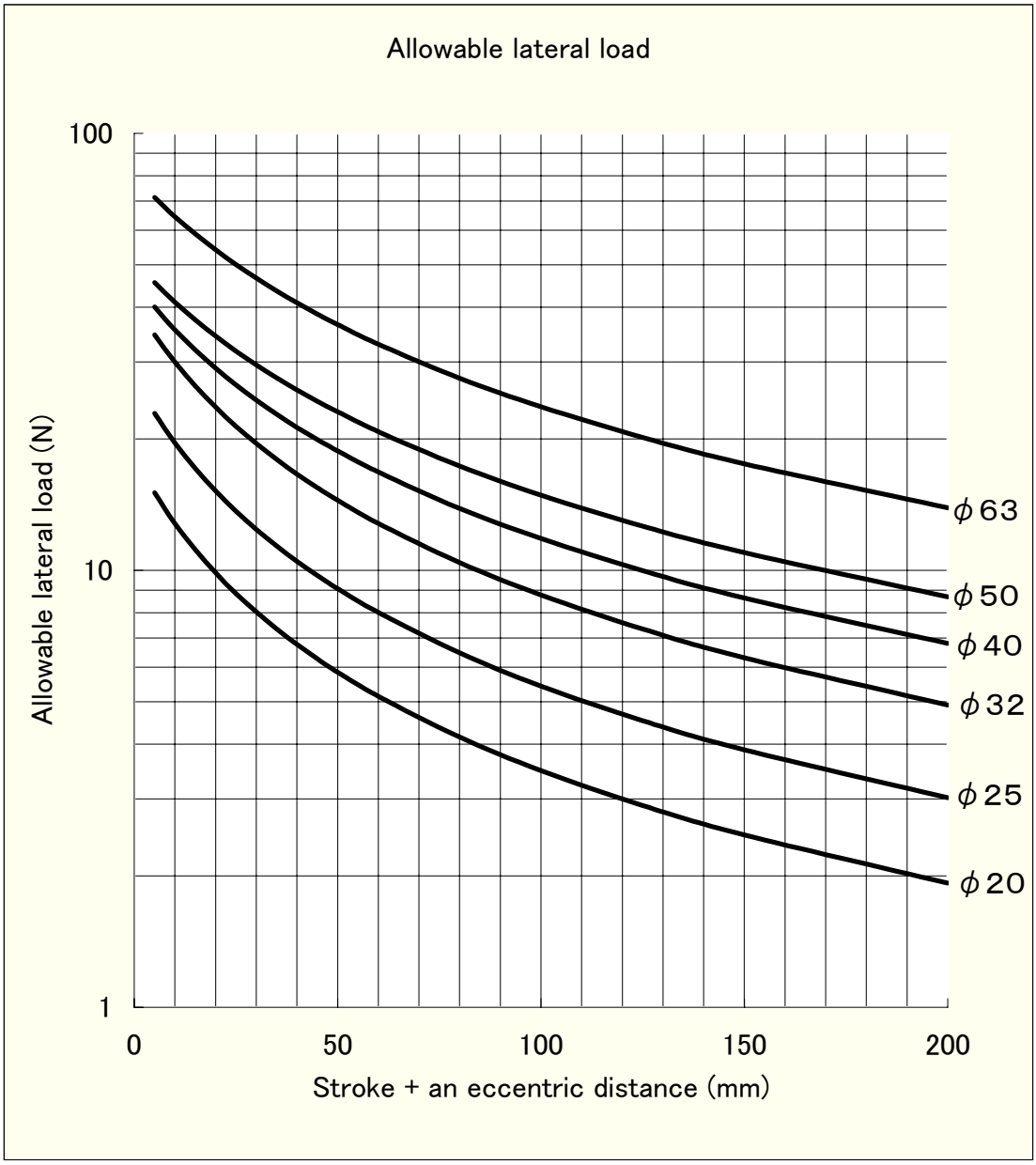


Fig 2.Allowable lateral load (at Single rod and female thread type)

2) Make sure to connect the piston rod and the load so that their axial center and movement directions match.

If they do not match, stress could be applied to the piston rod and the cylinder tube, causing the inner surface of the cylinder tube, the bushing, the piston rod surface, and the seals to wear and to become damaged.

3) When an external guide is used, connect the external slider and the load in such a way that there is no interference at any point within the stroke.

4) Do not scratch or gouge the sliding portion of the cylinder tube or the piston rod by striking it with an object, or squeezing it.

The cylinder tube bore is manufactured under precise tolerances. Thus, even a slight deformation could lead to a malfunction. Furthermore, any scratches or gouges on the sliding portion of the piston rod could damage the seals, which could lead to air leakage.

5) Do not use until you verify that the equipment can operate properly.

After mounting, repair or modification, etc., connect the air supply and electric power, and then confirm proper mounting by means of appropriate function and leak inspections.

6) Prevent intrusion of obstruction such as cutting chip from supply port into inside of the cylinder.

If the cylinder is put on the floor at field during positioning for installation, cutting chip made by the drill for mounting hole may intrude from supply port of the cylinder and cause failure.

7) When removing a load, be sure to secure the wrench flats of the piston rod on the load side.

Especially, for double rod cylinder, keep above instruction. If this is done without securing the piston rod on the load side, be aware that the coupled (screwed-in) portion of the piston rod could become loosened.

8) Cut the length of piping short.

Too long cylinder piping makes volume of mist in the cylinder (the mist is caused by adiabatic expansion) less than one in the piping tube, and prevent the mist from being released to air. Residual mist in the tube becomes pooled by repeating actuation, and may leads to occurrence of water which removes the grease of the cylinder. As the result of it, the condition of lubrication becomes worse and air leakage caused by wear of seal and malfunction by increase of friction resistance occur. In order to solve this issue, following countermeasure is necessary.

(1) Cut piping tube from solenoid valve to cylinder short as much as possible and make mist release to atmosphere properly. Following formula is eferred.
Converted value of content volume of cylinder to atmospheric pressure × 0.7 ≧ Content volume of piping tube

(2) Make exhaust pressure discharge directly to atmosphere by installing speed exhaust controller ASV or quick exhaust valve.

(3) Direct piping port downwardly so that moisture occurring in piping wouldn't return to cylinder.

3-4. Operating environment requirement

⚠ Warning

1) Do not use in environments where there is a danger of corrosion.

Refer to the construction drawings regarding cylinder materials.

2) Install a cover over the rod if it is used in an area that is dusty, or in an environment in which water or oil splashes on the cylinder.

3) Avoid much humidity for storage of cylinder.

Store the cylinder with piston rod retracted under the environment with little

humidity and countermeasure for rusty.

⚠ Caution

4) Preparation before piping.

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

5) Wrapping of sealant tape.

When connecting pipes and fittings, etc., be certain that cutting 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 end of the pipe / fitting.

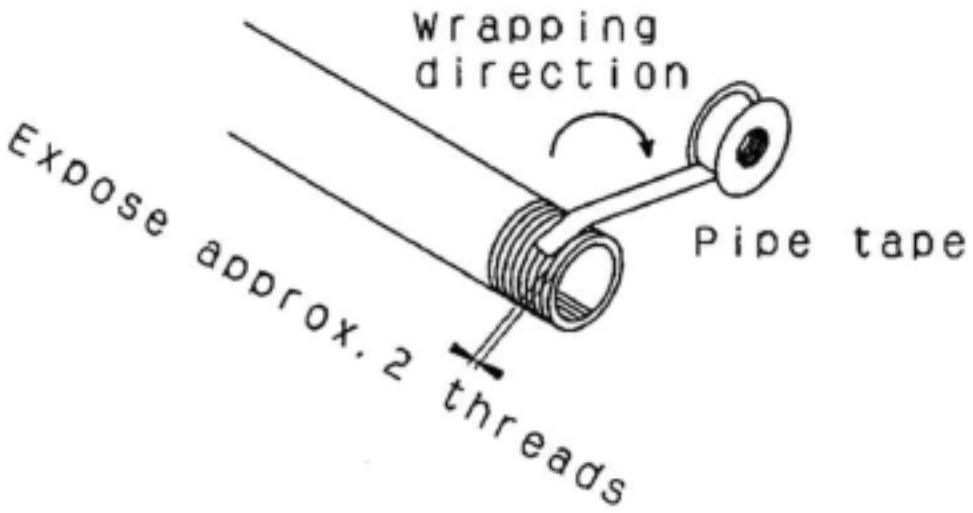


Fig.3

3-5. Speed control

When cylinder is adjusted to desired speed, install speed controller such as SMC's AS series near supply port of air. For this adjustment, either of supply air or exhaust air is squeezed, generally exhaust air is done.

⚠ Caution

Use a speed controller to adjust the drive speed, gradually increasing from a low speed to the desired speed setting.

3-6. Allowable kinetic energy.

Compact cylinder realizes shorter whole length and lighter weight than existing cylinder, but allowable value of this cylinder is lower due to fixing by the snap ring and rubber cushion. So, confirm allowable kinetic energy and lateral load, and avoid use out of these allowable values.

If inertial load is driven, operate the cylinder with allowable value of kinetic energy or less. Region surrounded by thick full line on Figure 8 shows the relation between load mass and maximum driving speed which can be applied.

Table2.Piston speed and allowable kinetic energy

Bore size (mm)	20	25	32	40	50	63
Piston speed (m/s)	0.05～0.5					
Allowable kinetic energy (J)	0.11	0.18	0.29	0.52	0.91	1.54

$$\text{Kinetic energy } E(J) = \frac{(m1+m2) \cdot V^2}{2}$$

m 1 : Mass of moving part kg

m 2 : Load mass kg

V : Piston speed m/s

Mass of moving part is referred to the catalogue.

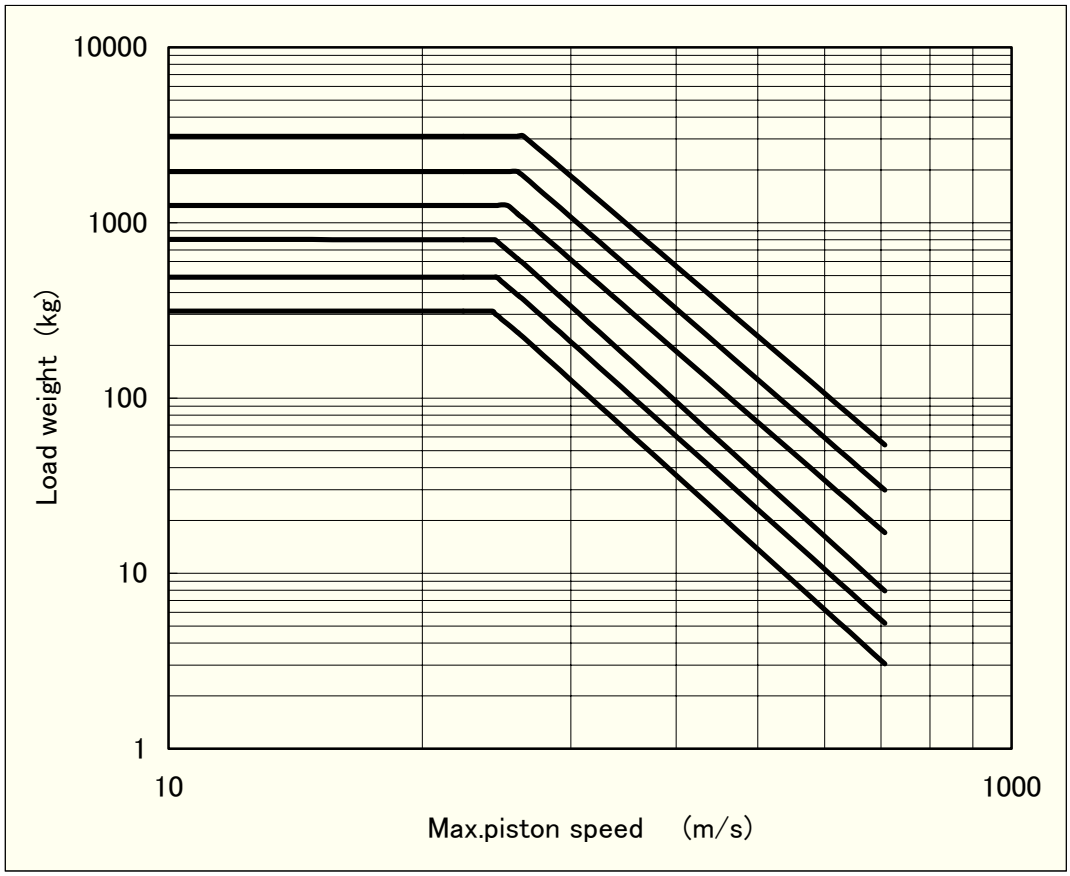


Fig 4. Applied range and kinetic energy

3-7. Direction control

When actuating direction of cylinder is changed, install adequate solenoid valve selected among SMC's various models.

⚠ Warning

1) Design circuitry to prevent sudden lurching of driven objects.

When a cylinder is driven by an exhaust center 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 high speeds if pressure is applied to one side of the cylinder because of the absence of air pressure inside the cylinder.

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.

2) Intermediate stops.

When intermediate stopping of a cylinder piston is performed with a 3 position closed center directional control valve, it is difficult to achieve stopping positions as accurate and minute as with hydraulic pressure, due to the compressibility of air.

3-8. Auto switch

The model and specification of applied auto switch is referred to the catalogue.
Handling of auto switch is referred to operation manual for auto switch.

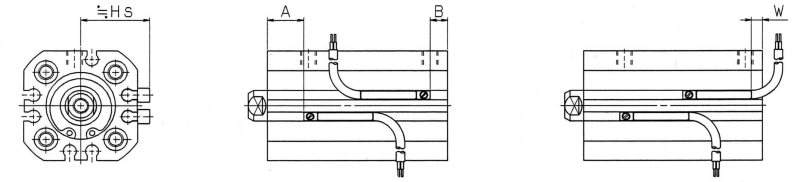
3-8-1. Adequate mounting position on detecting stroke end.

1) Reed switch : D-A9□
Solid state switch : D-M9□, D-F9BAL, D-F9□W

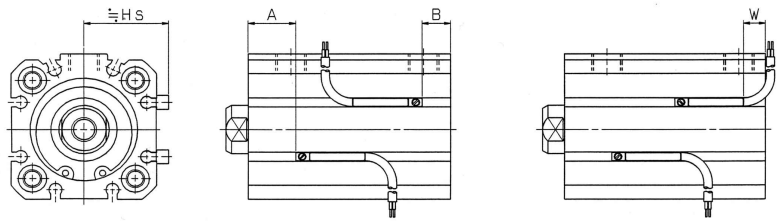
Table 3. (mm)

Bore size (mm)	D-A9□			D-M9□ D-F9□W			D-F9BAL			
	A	B	W	A	B	W	A	B	W	Hs
20	11.5	5.5	3.5(1)	15.5	9.5	-0.5	14.5	8.5	-9.5	22
25	11.5	7.5	5.5(3)	15.5	11.5	1.5	14.5	10.5	-7.5	24
32	15	9	7(4.5)	19	13	3	18	12	-6	27
40	16	9	7(4.5)	20	13	3	19	12	-6	30
50	9.5	15.5	13.5(11.5)	13.5	19.5	9.5	12.5	18.5	0.5	36
63	11.5	17.5	15.5(13.5)	15.5	21.5	11.5	14.5	20.5	2.5	41

φ20, 25



φ32, 40, 50, 63

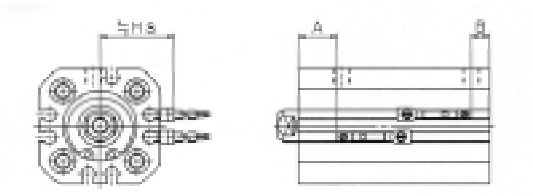


2) Reed switch : D-A9□V型
Solid state switch : D-M9□V型, D-F9□WV型

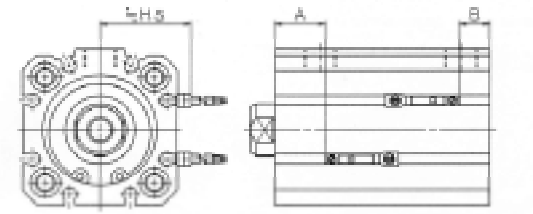
Table 4. (mm)

Bore Size (mm)	D-A9□V			D-M9□V D-F9□WV		
	A	B	Hs	A	B	Hs
20	11.5	5.5	22	15.5	9.5	24
25	11.5	7.5	24	15.5	11.5	26
32	15	9	27	19	13	29
40	16	9	30	20	13	32
50	9.5	15.5	36	13.5	19.5	38
63	11.5	17.5	41	15.5	21.5	43

φ20, 25



φ32, 40, 50, 63



3-8-2. Minimum stroke with auto switch

If auto switch is used with minimum stroke, there is possibility that in case of one piece, auto switch is turned to ON through at all points of the stroke, and in case of two pieces, both switches are turned to ON together at some points of the stroke even if auto switch is mounted to adequate position. At the time, adjust mounting position of auto switch in accordance with "3-8-3. How to mount auto switch".

Table 5. (mm)

Bore size (mm)	No. of Auto switches mounted	D-A9□	D-A9□V	D-M9□	D-M9□V	D-F9□W	D-F9□WV	D-F9BAL
20	2 pcs	10	10	15	5	15	10	20
	1 pc	10	5	15	5	15	5	20
25, 32, 40, 50	2 pcs	10	10	10	5	10	10	20
	1 pc	10	5	10	5	10	5	20
63	2 pcs	10	10	10	5	10	10	15
	1 pc	5	5	5	5	10	5	15

3-8-3. How to mount auto switch

(1) D-M9□□

After inserting the auto switch into switch mounting screw of cylinder from the direction of Figure 6 and setting it at the mounting position, tighten attached switch mounting screw. Use a watchmaker driver with 5～6mm grip diameter for tightening the auto switch mounting screw. Tightening torque shall be 0.10～0.20N･m. Tighten 90° more after you find the screw tightened.

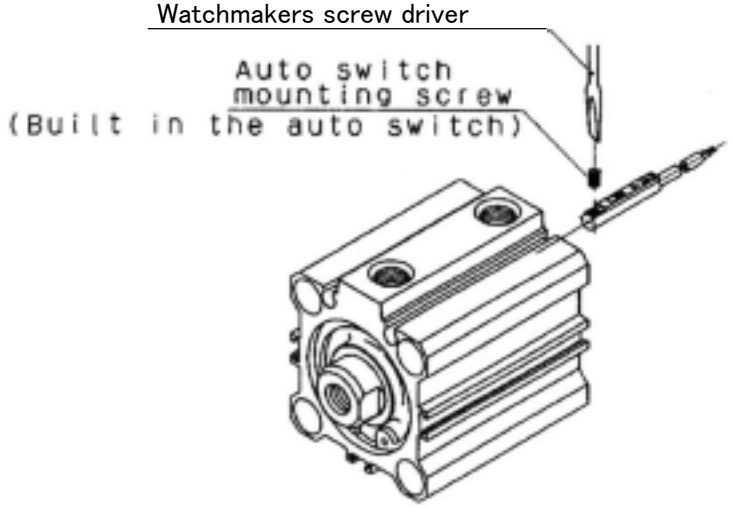


Fig 6.

4. Maintenance

⚠ Caution

1) **Snap ring installation/ Removal**

For installation and removal, use an appropriate pair of pliers (tool for installing a C snap ring).

Exercise caution even when using an appropriate pair of pliers (tool for installing a C snap ring), because of the possibility of the snap ring becoming detached from the tip of the pliers (tool for installing a C snap ring) and flying away, which could injure humans or damage the peripheral equipment. After installing the snap ring, make sure that it is placed securely in the ring groove before supplying air.

4-1. How to replace rod seal

a) Disassembling of cylinder

(1) Cleaning of appearance

Clean appearance, especially on surface of piston rod and collar part, so that dirt and obstruction couldn't intrude into cylinder at disassembling.

(2) Removal of snap ring

For removal, use an appropriate pair of pliers (tool for installing a C snap ring). And excise caution, because of because of the possibility of the snap ring becoming detached from the tip of the pliers (tool for installing a C snap ring) and flying away, which could injure humans or damage the peripheral equipment.

(3) Disassemble

Pull out with collar by installing bolt or nut to the piston rod end, and then remove the collar from the piston rod. At the time, excise caution not to damage inside of cylinder tube and collar bearing.

b) Removal of seal

(1) Rod seal

Insert the watchmakers screw driver from the front of collar and remove.
Do not damage the seal groove of collar.

(2) Piston seal

Push one side of the piston seal by hand, not the watchmaker screw driver, pitch projected part and pull out, because the piston seal groove is deep. (See figure 7.)

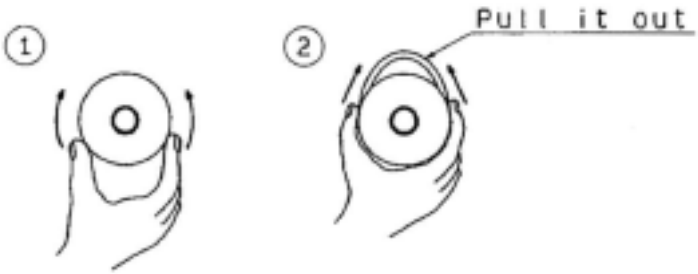


Fig 7. Piston seal

(3) Tube gasket

Push one side of the tube gasket by hand, pitch projected part and pull out.

c) Applying of grease

(1) Rod seal and piston seal

Apply grease on all circumference of seal for replacement lightly and evenly. And fill into the groove.(See figure 8.)

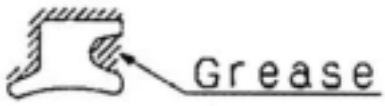


Fig 8. Rod seal

(2) Tube gasket

Apply grease lightly.

(3) Each part of cylinder

Apply grease on each part of cylinder. (See figure 9.)

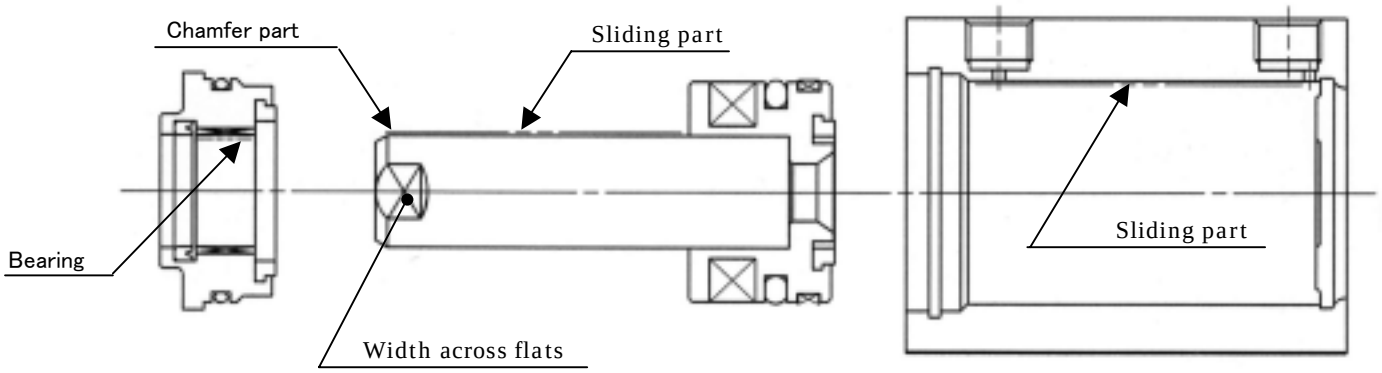


Fig 9.

d) Installation of seal

(1) Rod seal

Care for the direction of seal and install. (See figure 10.)

After installation, apply grease on the seal and bearing evenly.

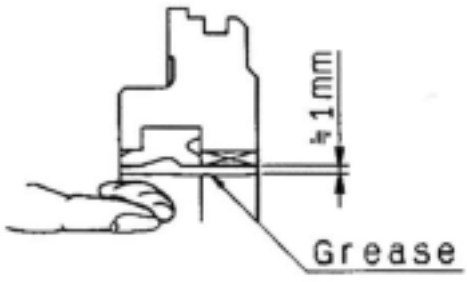


Fig 10. Rod seal

(2) Piston seal

Do not twist the seal at installation. After installation, apply grease between external circumference of seal and seal groove as figure 7.

(3) Tube gasket

Install not to fall.

e) Assembly of cylinder

(1) Insert collar into the piston rod.

Apply grease on the piston rod end or raised part to 30° and wrench flat part, and then insert carefully not to damage the rod seal.

(2) Insert the piston and collar into the tube.

Apply grease on the part for inserting cylinder tube, and then insert carefully not to damage the piston seal and tube gasket by snap ring groove.

(3) Snap ring installation

For installation, use an appropriate pair of pliers (tool for installing a C snap ring). Exercise caution, because of the possibility of the snap ring becoming detached from the tip of the pliers (tool for installing a C snap ring) and flying away, which could injure humans or damage the peripheral equipment. After installing the snap ring, make sure that it is placed securely in the ring groove before supplying air.

(4) Check of installation

Confirm air doesn't leak from the seal part and maximum working pressure makes performance of the cylinder smooth.

4-2. Check items

4-2-1. Daily check

1) Smoothness of performance
2) Change of piston speed and cycle time
3) Abnormality of stroke

4-2-2. Periodical check

1) Looseness of the cylinder mounting bolt and the rod end nut.
2) Looseness of the cylinder mounting frame and abnormal deflection
3) Smoothness of performance
4) Change of piston speed and cycle time
5) Outside leakage
6) Abnormality of stroke
7) Flaw on the piston rod
8) Flaw on the outside of the cylinder
9) Periodical drain exhaustion from air filter

Check above items, and if abnormality is found out, contact to Sales department.

⚠ Warning

1) **Maintenance should be done according to the procedures indicated in the operating manual.**
   If handled improperly, malfunction and damage of machinery or equipment may occur.
2) **Machine maintenance, and supply and exhaust of compressed air.**
   When machinery is serviced, first check measures to prevent dropping of driven objects and run-away of equipment, etc. Then cut off the supply pressure and electric power, and exhaust all compressed air from the system.
   When machinery is restarted, check that operation is normal with actuators in the proper positions.

4-3. Wearing parts

4-3-1. Seal Kit

Replaceable parts is referred to the table 3.

Table 6. Seal Kit

Bore size	Order number	Description
20	CQ2B20-PS	Rod Seal Piston seal Tube gasket One of each
25	CQ2B25-PS	
32	CQ2B32-PS	
40	CQ2B40-PS	
50	CQ2B50-PS	
63	CQ2B63-PS	

As single rod seal from SMC is not packed with sealed, so use within one year. For a long time storage, package with the product sealed (for example, sealed with polyethylene bag and put into a box) and store as procedure below.

4-3-2. How to store

1) Package the rod seal with sealed and store.
2) Avoid the direct ray of the sun and store under low temperature and humidity.
   Especially, shut off heat, radiation and equipment which has possibility to cause ozone.
3) Avoid to pile numerous rod seal and put heavy weight on it, it leads to deformation and flaw.
4) White particle may comes out surface of rubber product during storage, it makes no different to performance of the rod seal.

4-3-3.

For additional grease on replacement of the seal and maintenance of the cylinder, use a grease pack below.

Table 7. Grease pack

No. for order	Grease mass
GR-S-005	5g
GR-S-010	10g
GR-S-020	20g

5. Basic layout for using the cylinder.

If the cylinder is operated by using air filter, regulator, solenoid valve and speed controller, basic layout is as following (in case of meter-out control).

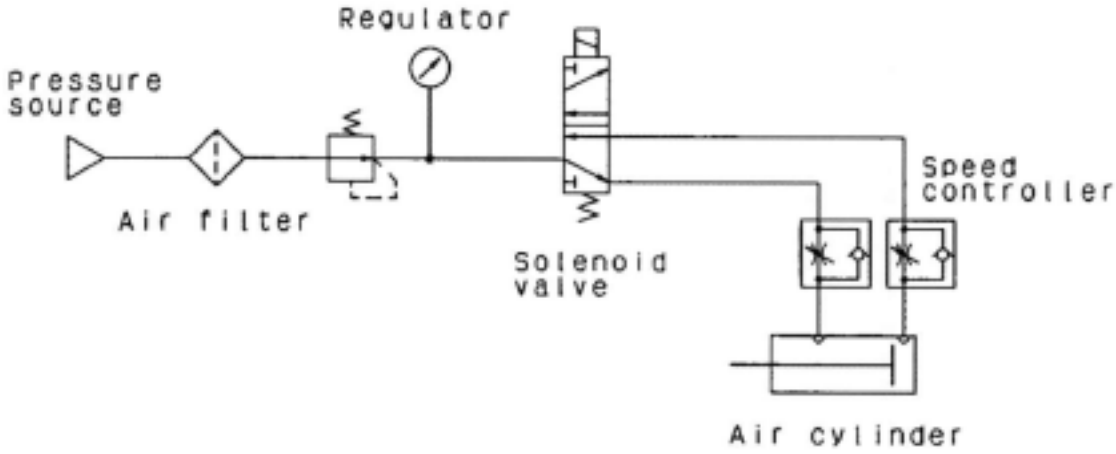


Fig 11.

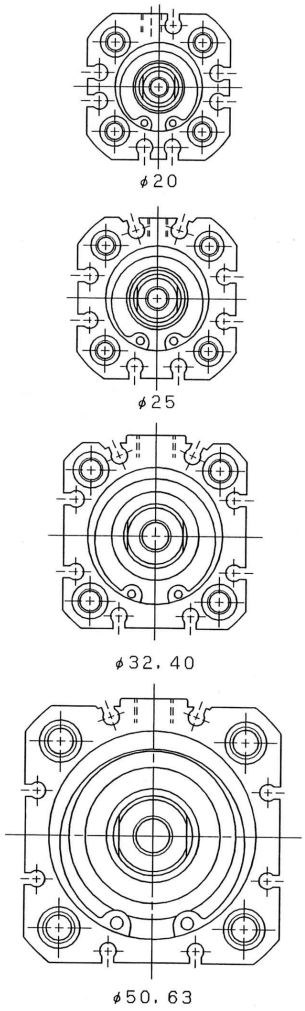
6. Troubleshooting

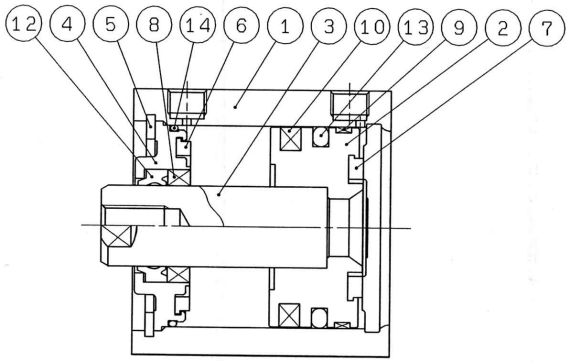
Detail of trouble	Cause	Countermeasure	Correspondence item
Performance is not smooth. Output lowers. Performance is not done at all.	A lack of grease on the sliding part.	**Add the grease.** Causes are guessed as below. ・Grease flew due to moisture (drain) included. ・Lubrication wasn't completed. ・Used under the environment splashed by liquid.	4-3 3-1 3-4
	Displacement of work and cylinder axis, or cylinder guides axis and cylinder axis.	**Centering should be done.** Confirm the cylinder with no supplied air performs smoothly, and consider the floating joint.	3-3
	Deformation of the piston rod.	**Replace the cylinder.** Causes are guessed as below. ・Displacement of the cylinder and load. ・Lateral load over allowable value was given. ・Excess of kinetic energy. ・Improper force was given on mounting load.	3-2 3-3

Performance is not smooth. Output lowers. Performance is not done at all.	Air leakage (Wearing of seal)	**Replace the seal.** Causes are guessed as below. ・Displacement of the cylinder and load. ・Lateral load over allowable value was given. ・Operating temperature exceeds its range. ・A lack of grease. ・Inclusion of obstruction.	4–1
	A lack of air pressure.	**Supply adequate pressure.** Causes are guessed as below. ・Pressure source lowered. ・Displacement of setting of the regulator. ・Clogging of piping.	2–1 3–1
	Low speed performance.	**Use within the specification range.**	2–1
	A lack of cylinder output.	**Increase operating pressure, or change inside diameter of the cylinder to bigger one.** Consideration of load factor is needed due to resistance caused by the cylinder and mechanism.	2–1

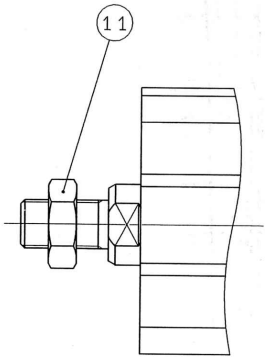
Performance is not smooth. Output lowers. Performance is not done at all.	Non conforming constitution of the system.	**Use adequate size of piping tube, fitting, directional control valve and speed controller.**	3-1 3-2
	Damage or failure of the equipment other than the cylinder.	**Check suspect systems one by one in order.** Causes are guessed as below. ・Failure of irectional control valve. ・Improper adjustment of speed controller. ・Failure of speed controller. ・Clogging of piping. ・Clogging of the filter.	3-1 3-2 3-4 3-5 3-7
Damage of parts.	High speed performance.	**Adjust speed within the specification range by using speed controller.**	2-1 3-5
	Over load.	**Use within the range of kinetic energy.**	3-6
	Lateral load.	**Use within the range of allowable lateral load.**	3-3
	Abnormal outside force.	**Interruption to mechanism, offset load and over lateral load cause deformation and damage of the cylinder.** **Remove these cause.**	3-3

7. Basic construction





Basic



Male thread type

Table 8. Parts list

No	Description	Material	Remarks
1	Cylinder tube	Aluminum alloy	Hard anodized
2	Piston	Aluminum alloy	Chromated
3	Piston rod	Stainless steel	ϕ20, 25
		Carbon steel	ϕ32 to 63, Hard chrome plated
4	Collar	Aluminum alloy	ϕ20 to 40, anodized
		Aluminum alloy casted	ϕ50, 63 painted after chromated
5	Snap ring	Carbon tool steel	Phosphate coated
6	Bumper A	Urethane	
7	Bumper B	Urethane	
8	Bushing	Lead-bronze casted	
9	Wearing	Resin	
10	Magnet	—	
11	Rod end nut	Carbon steel	Nickel plated
12	Piston seal	NBR	
13	Rod seal	NBR	
14	Tube gasket	NBR	