CKD Corporation

SM-
214915-A

INSTRUCTION MANUAL

SELTOP CYLINDER

ULK, ULK-V (ϕ20~ϕ40)

Please read this instruction manual carefully before using this product, particularly the section describing safety.

Retain this instruction manual with the product for further consultation whenever necessary.

For Safety Use

To use this product safely, basic knowledge of pneumatic equipment, including materials, piping, electrical system and mechanism, is required (to the level pursuant to JIS B 8370 Pneumatic System Rules).

We do not bear any responsibility for accidents caused by any person without such knowledge or arising from improper operation.

Our customers use this product for a very wide range of applications, and we cannot keep track of all of them. Depending on operating conditions, the product may fail to operate to maximum performance, or cause an accident. Thus, before placing an order, examine whether the product meets your application, requirements, and how to use it.

This product incorporates many functions and mechanisms to ensure safety. However, improper operation could result in an accident. To prevent such accidents, read this instruction manual carefully for proper operation.

Observe the cautions on handling described in this manual, as well as the following instructions:

⚠ Precautions

- Before performing an overhaul inspection on the actuator, deactivate residual pressure completely.
- While the actuator is operating, do not step into or place hands in the driving mechanism.
- To prevent an electric shock, do not touch the electric wiring connections (exposed live parts) of the actuator equipped with a solenoid valve or switch.
  Perform an overhaul inspection with the power off. Also, do not touch these live parts with wet hands.

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SELTOP CYLINDER
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NOTE : Letters & figures enclosed within Gothic style bracket (examples such as [C2-4PP07] · [V2-503-B] etc.) are editorial symbols being unrelated with contents of the book.

1. PRODUCT

1.1 Specifications

1) Caulking type, ULK and ULK-V

Model / Item		ULK	ULK-V
Type of actuation and Classification		Double-acting	Double-acting, with solenoid valve
Media		Compressed air	
Max. Working pressure	MPa {kgf/cm²}	1.0 {10.2}	Cylinder section 1.0 {10.2} Brake section 0.6 {6.1}
Min. Working pressure	MPa {kgf/cm²}	Cylinder section 0.15 {1.53} Brake section 0.3 {3.0}	
Withstanding pressure	MPa {kgf/cm²}	1.6 {16.3}	
Ambient temperature	°C	−10~60 (Not to be frozen)	−10~50 (Not to be frozen)
Tube bore	mm	φ20 · φ25 · φ32 · φ40	
Dia. of Connecting port	Rc	Rc1/8	
Stroke tolerance	mm	$^{+2.0}_{0}$ (~200), $^{+2.4}_{0}$ (200~)	
Working piston speed	mm/s	50~500	
Cushion		Rubber cushion	
Lubrication		Not required. (Use Turbine oil Class 1, ISO VG32 if required.)	
Positioning accuracy		±1.0 (300mm/s at no load.)	
Holding force	N {0.102 kgf}	φ20 : 251, φ25 : 393, φ32 : 643, φ40 : 1005	

2) Specification for solenoid valve (For releasing brake)

Item	Specification		
Rated voltage (V)	AC100V (50/60Hz)	AC200V (50/60Hz)	DC24V
Starting current (A)	0.056/0.044	0.028/0.022	0.075
Holding current (A)	0.028/0.022	0.014/0.011	
Power consumption (W)	1.8/1.4	1.8/1.4	1.8
Tolerable fluctuation of Voltage	±10%		
Class of Insulation	B Class Moulded coil		

● Note : Coils for AC100 · 200V are serviceable with AC110 · 220V (60Hz) respectively.

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1.2 Selection of Related Equipment

The over-run and positioning accuracy depends on the response of brake release valve (Sol 2 on Basic circuit schematics, Article 4.1) and the effective sectional area of the tube. (Models ULK-V, however, have built-in solenoid valve for brake.)

Select equipment from the Selection Guide Table. (The table provided below is an example of related equipment.)

Selection guide of related equipment

Name of Related equip. / Tube bore(mm)	SOL-1 Directional control valve	SOL-2 Solenoid valve for brake	Pressure reducing valve with check valve	Speed controller	Silencer	Tubing
φ20、φ25、φ32	4KB150	Built in the Cylinder	2419-1C R1100-6	SC3G-6-6 SC1-6	SLW-6A	φ6×φ4 Nylon tube
φ40	4K250 4L250	Built in the Cylinder	2419-2C R1100-6	SC1-8	SLW-6A	φ8×φ6 Nylon tube

• Note : No solenoid valves (Sol 2) for brake are built-in. to Models ULK.
Make use of Microsol R5136 or 3KA110 in place of Sol 2.

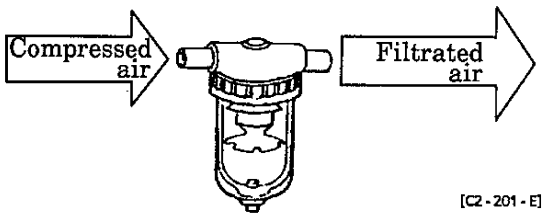
1.3 Installation of Switch on Cylinder

Switch is able to be installed on the cylinder directly. Refer to the SM-3566-A concerning the cylinder with switch.

2. CAUTION

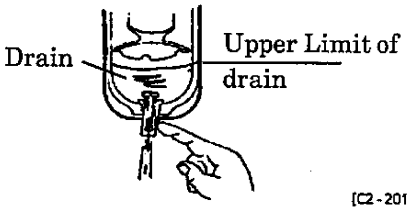
2.1 Fluid

1) Use the compressed air, filtrated and dehumidified. Carefully select a filter of an adequate filtration rate (5μm or lower preferred), flow rate and its mounting location (as closest to directional control valve as possible).



[C2-201-E]

2) Be sure to drain out the accumulation in filter periodically.
3) Note that the intrusion of carbide of compressor oil (such as carbon or tarry substance) into the circuit causes malfunction of solenoid valve and cylinder. Be sure to carry out thorough inspection and maintenance of compressor.
4) This cylinder does not require lubrication. It is recommended, however, to use Turbine oil Grade 1, ISO VG32 as lubricant if lubrication is preferred.



[C2-201-F]

3. OPERATION

3.1 Operation

1) Range of working pressure

Unit MPa {kgf/cm²}

Model	Pressure range for Cylinder		Pressure range for Brake	
	Max. Working pressure	Min. Working pressure	Max. Working pressure	Min. Working pressure
ULK	1.0 {10.2}	0.15 {1.53}	1.0 {10.2}	0.3 {3.0}
ULK-V			0.6 {6.1}	

2) Manual release of brake

(1) Manually releasing the brake

(In case of non-pressurization to brake parts.)

Remove the cover, and loosen the brake plates A with a key-stone tip screwdriver in the direction of the arrow. The brakes will be released. The brakes can also be released by inserting the bolt in the hole of the brake plates A as shown in Fig. 1.

However, if both brake plates are not folded down all the way, only the PUSH side brake may be released. In regular operation, remove the bolt, and put the cover in position.

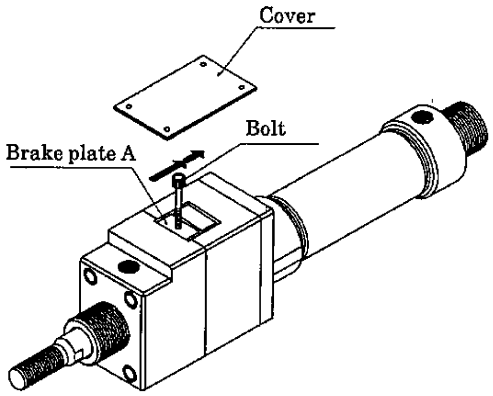


Fig. 1

(2) Manually operating the brake solenoid valve

(In case pressurization to brake parts.)

As shown in Fig. 2, the brakes can be released by pushing the manual operating device of the solenoid valve with a bar.

The device is a non-lock type and the brake will work again if the device is released.

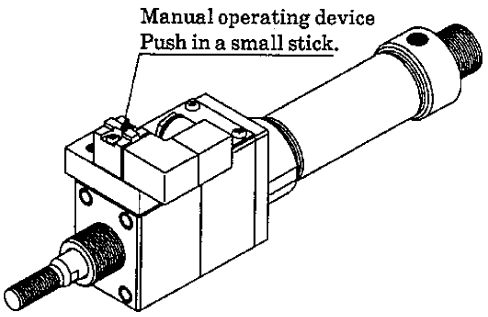


Fig. 2

4. INSTALLATION

4.1 Fundamental Circuit

1) To retain an accurate operation, comply the following fundamentals and design such circuit as illustrated below.

① Supply the pressure to both side of piston when piston is stopped. (This is to eliminate the piston from popping out on succeeding start.)

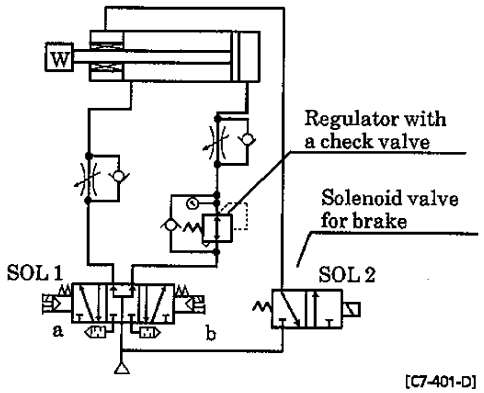
② To make thrust balanced (including the load), install a regulator with a check valve within the circuit which provides larger thrust.

③ Install the solenoid valve for brake as close to the brake port as possible.

In case of horizontal load

The lay-out per Fig. 1 prevents the piston rod from popping out at the moment the brake system is released as the pressure is delivered on both sides of piston when the cylinder motion is stopped by shifting the solenoid valve to its neutral position. Keep balancing by installing a regulator with a check valve to the circuit of cylinder head side.

Fig. 1



SOL-1		SOL-2	Actuating
a	b		
OFF	OFF	OFF	Halt
ON	OFF	ON	Retract
OFF	ON	ON	Advance

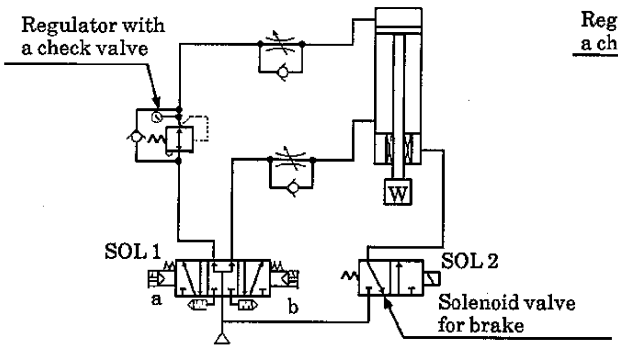
★ Pressure within the regulator with check valve $= \frac{(D^2-d^2)}{D^2} P$

D : Cylinder bore [mm]
d : Diameter of rod [mm]
P : Working pressure [MPa]

In case downward load

When the lay-out of circuit is as shown in Fig. 2, install a reducing valve with a check valve to the circuit of cylinder head side for the purpose of reducing the downward thrust of the rod and keeping a balance because the cylinder rod is apt to be suddenly pulled down due to the load at the moment the brake system is released.

Fig 2



SOL-1		SOL-2	Actuating
a	b		
OFF	OFF	OFF	Halt
ON	OFF	ON	Advance
OFF	ON	ON	Retract

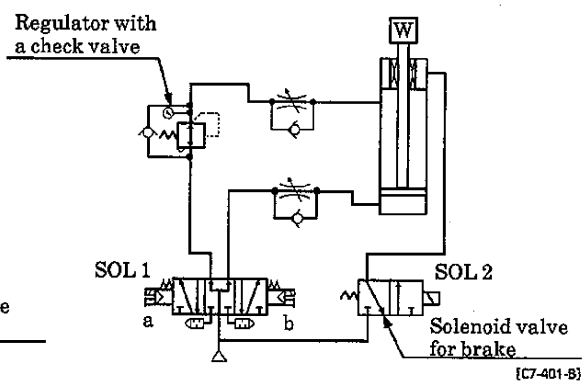
★ Pressure within the regulator with check valve $= \dfrac{\pi (D^2 - d^2)P - 4W}{\pi D^2}$

D : Cylinder bore [mm]
d : Diameter of rod [mm]
P : Working pressure [MPa]
W: Load [N]

In case of upward load

When the load is upward as shown in Fig. 3, install a reducing valve with a check valve to the circuit of piston rod side for the purpose of reducing reversed thrust of the rod and keeping a balance because the cylinder rod is apt to be pushed backward due to the load at the moment the brake system is released.

Fig 3



SOL-1		SOL-2	Actuating
a	b		
OFF	OFF	OFF	Halt
ON	OFF	ON	Retract
OFF	ON	ON	Advance

★ Pressure within the regulator with check valve $= \dfrac{\pi D^2 P - 4W}{\pi (D^2 - d^2)}$

D : Cylinder bore [mm]
d : Diameter of rod [mm]
P : Working pressure [MPa]
W: Load [N]

2) Keeping a balance of propulsion

Keep a balance of propulsion by regulator with check valve as per fundamental circuit diagram posted above. Adjust pressure in the duration of raising it instead of reducing it. Guide line value is calculated out of formulae posted above (★ marked).

4.2 Electric Control Circuit

Carefully observe the following items as position accuracy is influenced by each control equipment as well as circuit.

① Select the equipment with a quick response time and high accuracy.

② So design to have brake release signal and cylinder control signal are put out simultaneously or have brake release signal is put out a moment ahead of cylinder control signal to avoid piston rod from popping out.

③ Make the sensor switch of stop signal self-holding circuit.

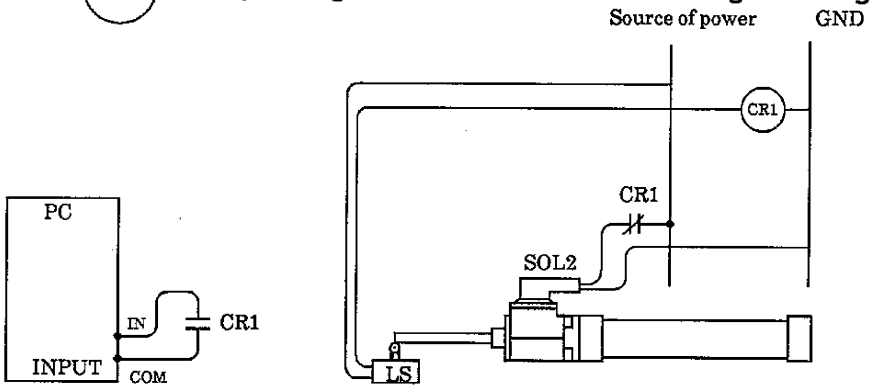
④ Select sensor switch of stop signal out of either cylinder switch, roller plunger type limit switch, proximity switch or that of photo tube.

⑤ Caution when sequencer is built in a circuit.

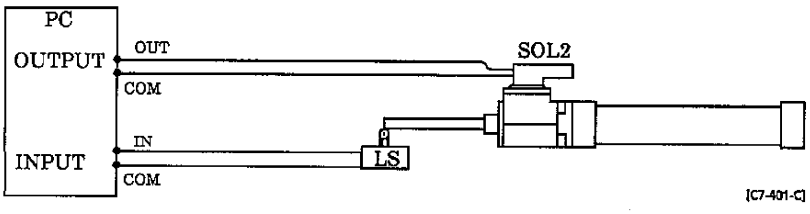
Positioning accuracy is ruined to extent of such as ±3mm ~ ±5mm when brake circuit is built through a sequencer because of dispersion of brake release timing due to dispersion of scanning time (±20msec ~ 30msec). Design the brake circuit directly through a relay instead of through sequencer.

※ Scanning time	.....	Time requirement a program routine executed one cycle
※ Dispersion	.....	Dispersion is ±1.5mm when scanning time is 30msec at the cylinder speed of 100mm/sec

○ Example of good circuit which does not go through sequencer

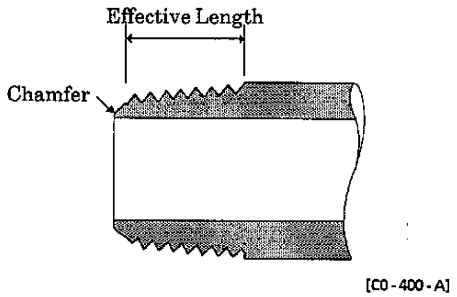


× Example of undesirable circuit which goes through sequencer



4.3 Piping

1) For piping beyond the filter, use pipes that hardly get corroded such as galvanized pipes, nylon tubes, rubber tubes, etc. (Refer to Selection Guide Table for Related Equipment.)
2) See to it that the pipe connecting cylinder and solenoid valve has effective sectional area needed for the cylinder to drive at specified speed. (Refer to Selection Guide Table for Related Equipment.)
3) Install filter preferably adjacent upper-stream to solenoid valve for eliminating rust, foreign substance and drain in the pipe.
4) Strictly observe the effective thread length of gas pipe and give a chamfer of approx. 1/2 pitch from the threaded end.
5) Flush air into the pipe to blow out foreign substances and chips before piping.



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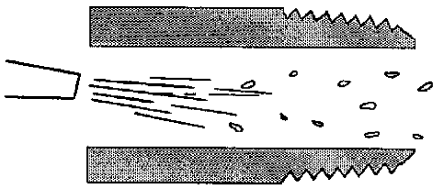
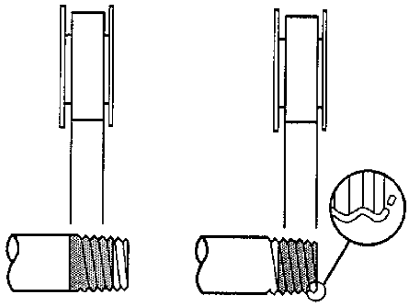
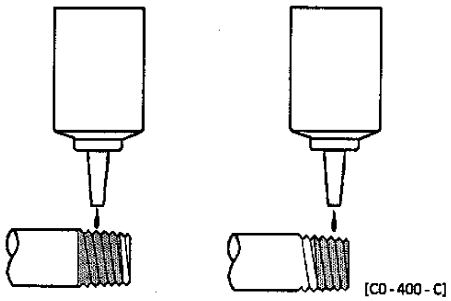

[C0-400-B]

6) Refrain applying sealant or sealing tape approx. two pitches of thread off the tip of pipe to avoid residual substances from falling into piping system.

● Seal Tape

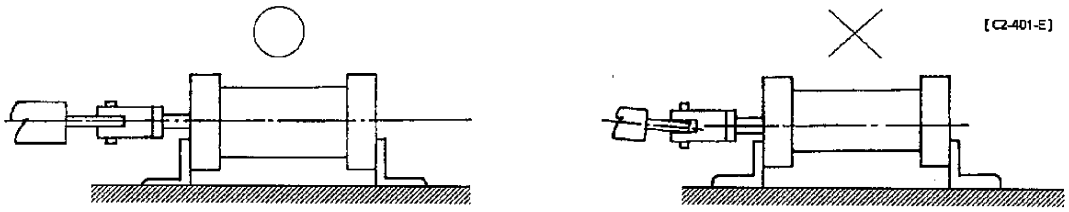

Correct Incorrect

● Sealant (Paste or liquid)

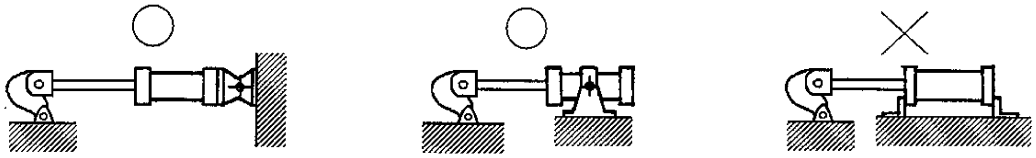

[C0-400-C]
Correct Incorrect

4.4 Installation

1) Use the cylinder load guide of low coefficient of skin friction and low ratio of volume alternation such as ball bearings or roller bearing for the purpose of securing positioning accuracy.
2) Operate cylinder within an ambient temperature range of −10 ~ 60°C (−10~50°C for the cylinder with electric solenoid valve).
3) Use a bellows type rod cover where a rod is exposed to the dusty ambient.
4) When cylinder is fixed and rod end is guided :
   In case the piston rod of cylinder and the load are misaligned, the bushings and packings of the cylinder are extremely worn out. Connect them using 'Free joint' (spheric surface joint) of CKD's product.
5) When cylinder is fixed and rod end is connected with pin joint :
   In case the load acting direction is not parallel with the rod axial center, the rod and tube may get entangled causing seizure or damage, etc. Hence, make sure that the rod axial center and the load transfer direction are aligned to each other.


[C2-401-E]

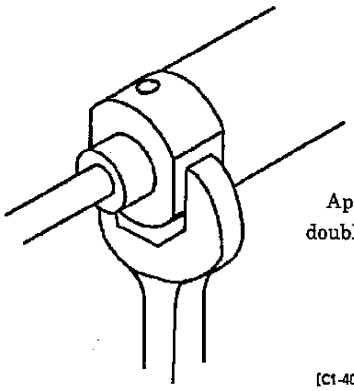
6) When the load acting direction changes within the cylinder stroke :
   Use an oscillating cylinder (clevis type or trunnion type) capable of making retation to a certain angle. Furthermore, install the rod and connecting metal (knuckle) at the tip of piston rod so that it moves in the same direction as the cylinder main body does.



[C2-401-F]

7) Assembling of supporting metal brackets.

Apply an open ended spanner onto double sided machined surface of mounting end cover as shown below when to hold the tube while attaching the mounting metal bracket.



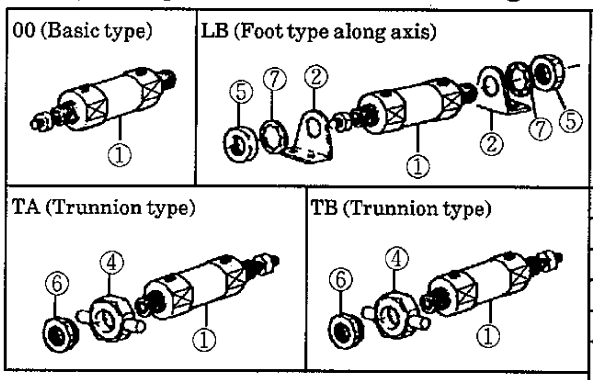
Apply an open ended spanner onto the double sided machined surfaces.

[C1-404-A]

Install the supporting metal brackets as shown in the illustration below.
Those are supplied with the cylinder at the time of deliver.
Tightening torque of mounting nut is 23N·m {230 kgf·cm}

Supporting metal bracket attaching

[C1-404-B]



No.	Parts name	No.	Parts name
①	Cylinder body	⑥	Nut (for both TA type and TB type)
②	Foot bracket		
③	Flange	⑦	Mounting washer (for LB type and FA type)
④	Trunnion (Axis type)		
⑤	Nut (for both LB type and FA type)		

5. MAINTENANCE

5.1 Periodic Inspection

1) In order to upkeep the cylinder in optimum condition, carry out periodic inspection once or twice a year.
2) Inspection items
   ① Check the mounting bolts and nuts of brake mechanism.
   ② Confirm the close and open motion of brake mechanism.
   ③ Check the mounting bolts and nuts of cylinder.
   ④ Check the mounting bolts and nuts to the piston rod end fittings and supporting fittings for slackening.
   ⑤ Check that the cylinder operates smoothly.
   ⑥ Check any change of the piston speed and cycle time.
   ⑦ Check for internal and/or external leakage.
   ⑧ Check the piston rod for flaw (scratch) and deformation.
   ⑨ Check the stroke for abnormality.
   ⑩ Check any corrosion inside of each port.

Carry out additional tightening or disassembling cylinder for correction as required, should there be any slackening abnormality.

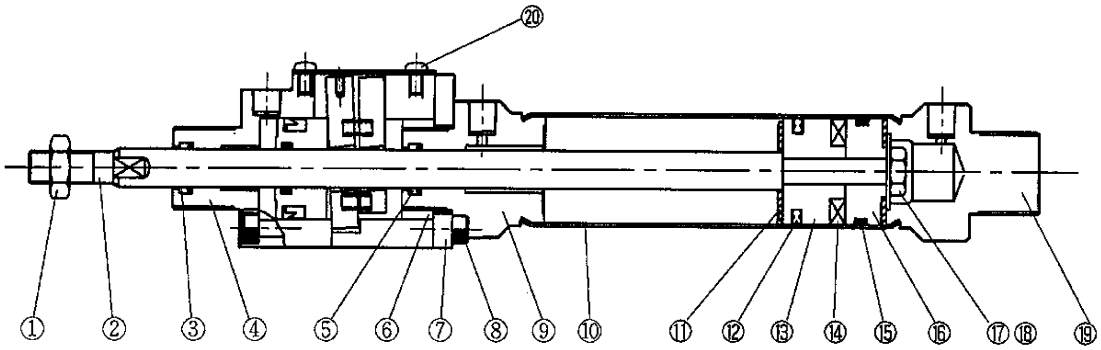
5.2 Trouble Shooting

Trouble	Cause	Correction
Brake does not release.	Insufficient pressure to the brake mechanism	Secure ample pressure.
	No signal to brake solenoid valve (In case NO type - Electric signal is there.)	Reaffirm the circuit to receive a signal. (Reaffirm the circuit to shut off a signal.)
	Solenoid valve for brake does not function	Check the circuit and repair the matter as is required. Repair or replace solenoid valve as is required.
	Damage to packing for brake piston	Replace the brake unit.
Rod does not stop.	Electric signal is there. (In case NO type - No signal to brake solenoid)	Reaffirm the circuit to shut off a signal. (Reaffirm the circuit to receive a signal.)
	Solenoid valve for brake does not function	Check the circuit and repair the matter as is required. Repair or replace solenoid valve as is required.
	Damage to packing for brake piston	Replace the brake unit.
	Left manual release of brake	Release the manually open status.
	Skips off the dog for brake signal a. Excessive cylinder speed b. Circuit is not self-holding circuit	 a. Either slow down the speed or increase the dog length. b. Revise the circuit to that of self holding.
Inaccurate positioning	Effective sectional area of solenoid valve for brake is not large enough.	Replace the solenoid valve with the one of larger effective sectional area.
	Either too fine or too long tubing of connecting solenoid valve for brake and brake port	Either replace tubing with the one of larger diameter or shorten it if possible. As an alternative, connect the solenoid valve directly
	Too low response of solenoid valve for brake	Replace the solenoid valve with the one of high response.
	Too low response of signal sensor switch to solenoid valve for brake	Replace the sensor switch with the one of high response.
	Relays within signal circuit of brake control are actuated sequentially.	Revise the signal circuit. (Carefully review the response time, particularly when using sequencer.)
	There is a slackening of mounting a dog for brake signal.	Correct and remove the play.
	Remarkable wear and tear on the shape of the dog	Replace with new dog if wear and tear is excessive.
	a. Slant angle is to be maintained less than 30° when using roller plunger type limit switch. b. More length of dog than over run length is required when making an interlocking by means of dog.	a. The larger angle cause load variation and results inaccurate positioning. (The slant angle can be up to 60° when using roller lever.) b. When relay is used for self holding circuit, dog length is required to provide an appropriate time length of relay actuating.

Trouble	Cause	Correction
Inaccurate positioning	Fluctuation of cylinder speed a. Misalignment of the center lines between piston rod and load guide b. The momentum inertia of load is excessive in comparison with thrust to cylinder. (Particularly when the positioning pitch is too small.) c. See if the stopping position is within the cushion chamber or just after piston comes out of cushion chamber.	a. Eliminate misalignment by using free joint or equivalent parts. b. Either use larger bore cylinder or revise to hydraulic oil cylinder of low pressure ramnge. c. Install a check valve to cushion in the event that stopping piston just when getting out of cushion chamber.
	Piston rod is apt to pop out a. Incorrect setting of pressure balancing regulator b. Delayed timing of stop release	a. Reset the pressure regulator. b. Shorten the timing of stop release. (See if supply line is chalked, also.)
	Fluctuation of load a. Feeding load change along curvature variation of copying profile (Steady change) b. Remarkable change of load due to perpendicular load (Step change)	a. Revise the specification to adopt hydraulic cylinder of low pressure range. b. Revise the circuit by building plural number of regulators for pressure balancing in the event that the range of load variation is relatively small or load changes stepping trend.
Piston rod does not move.	No signal to direction control solenoid valve	Correct the control circuit
	Misalignment of center lines at mounting cylinder	Correct the installation state and/or change the supporting system.
	Damage to piston packing	Replace piston packing.
Unsteady motion of rod	Misalignment of center lines at mounting	Correct the installation state and/or change the supporting system.
	Exertion of transverse (lateral) load	Install guide, correct the installation state and/or change the supporting system.
	Speed is less than the low speed limit	Relieve the load change. Consider of using low pressure hydraulic oil cylinder.
	Excessive load	Raise the pressure. Use the cylinder of larger bore.
	Speed control valve is built in the way of "Meter in" circuit.	Revise the installation direction of speed control valve.
Damage or distortion	Shock due to high speed operation	Raise the cushion effect. Lower the speed. Reduce the load. Improve cushion mechanism (such as adopting external cushion mechanism.)
	Exertion of transverse load	Install guide. Correct the installation state and/or change the supporting system.

5.3 Maintenance

1) Internal structure and expendable parts list



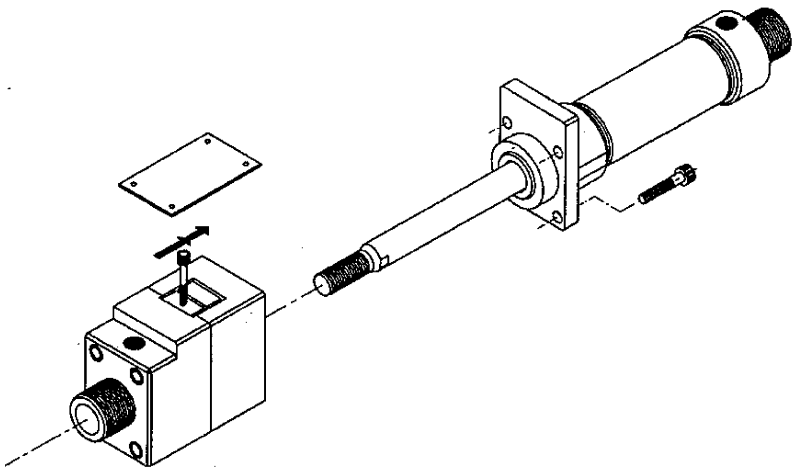
No.	Parts name	No.	Parts name
1	Rod nut	11	Cushion rubber
2	Piston rod	12	Piston packing
3	Brake rod packing	13	Piston A
4	Brake unit	14	Piston magnet
5	Rod packing	15	Wear ring
6	Lock nut	16	Piston B
7	Brake flange	17	Spacer
8	Hex. soc. hd. cap screw	18	Hex. nut
9	Rod cover	19	Head cover
10	Cylinder tube	20	Cross headed pan

• Note : This caulking type cannot be disassembled. If the brakes are worn, replace the entire brake unit.
Do not disassemble the brakes. It is very dangerous.
Select a brake unit type from among ULK-20~40.

2) Dismounting of the brake unit

(1) Unfasten the cross-headed pan small screw ⑳, and remove the cover. Using a hexagon wrench, unfasten the four bolts ⑧ securing the brake unit.

See the figure below.



(2) Manually releasing the brakes with the bolt, remove the brake unit ④ from the piston rod ②.

3) Mounting the brake unit

To mount the brake unit, follow the dismounting procedure described in 5.3 2). Observe the following precautions when mounting the brake unit:

(1) Do not apply grease to the piston rod.
(The brake retaining force will decrease.)

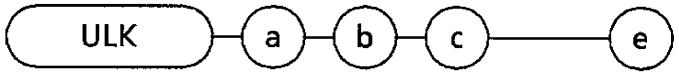
(2) When mounting the brake unit, uniformly tighten the brake unit lock bolts facing diagonally one by one.
After the bolts are tightened, confirm that the piston rod moves smoothly.

(3) Remove the hexagon socket head cap screw for manual brake release.

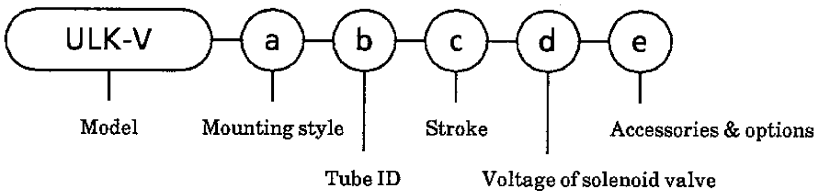
6. MODEL CODING

CAULKING TYPE

Double acting



Double acting, w/solenoid valve



Model		ⓐ Mounting style		ⓑ Tube ID(mm)		ⓒ Stroke(mm)
ULK	Double acting	OO	Basic type	20	ϕ20	Std. stroke
ULK-V	Double acting, w/solenoid valve	LB	Foot mounting type	25	ϕ25	25
		FA	Front flange mounting type	32	ϕ32	50
		CA	Single clevis mounting type	40	ϕ40	75
		CC	Single clevis unitized type			100
		TA	Front trunnion mounting type			125
		TB	Rear trunnion mounting type			150
						175
						200
						250
						300

Max. stroke 700

ⓓ Voltage of solenoid valve		ⓔ Accessories & options	
1	AC100V (50/60Hz)	I	Single knuckle
2	AC200V (50/60Hz)	Y	Double knuckle
3	DC24V	B2	Double bracket
		J	Bellow: Polyole fine elastomer
		L	Bellow: Silicone rubber glass cloth
		M	Alteration in piston rod material (Stainless)
		N	Alteration in piston rod lug length and thread area
		V	Boss cut off

- Example of Model coding
  ULK-V-LB-20-50-2-Y
  This model code indicates that the cylinder is an axial foot mounting type equipped with a sel top cylinder solenoid valve and a rod clevis. The tube inner diameter is 20 mm, the stoke is 50 mm and the solenoid valve voltage is 200 V AC.