



Operation Manual

PRODUCT NAME

FREE MOUNT CYLINDER

MODEL/ Series

C(D)U	SERIES
C(D)UK	SERIES
C(D)UW	SERIES
C(D)UKW	SERIES

SMC Corporation

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Free Mount Cylinder / Series CU Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage.

These instructions indicate the level of potential hazard with the labels of "Caution," "Warning" or "Danger."

They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC), Japan Industrial Standards (JIS)*1) and other safety regulations*2).

*1) ISO 4414: Pneumatic fluid power -- General rules relating to systems

ISO 4413: Hydraulic fluid power -- General rules relating to systems

IEC 60204-1: Safety of machinery -- Electrical equipment of machines (Part 1: General requirements)

ISO 10218-1992: Manipulating industrial robots -- Safety

JIS B 8370: General rules for pneumatic equipment.

JIS B 8361: General rules for hydraulic equipment.

JIS B 9960-1: Safety of machinery -- Electrical equipment for machines. (Part 1: General requirements)

JIS B 8433-1993: Manipulating industrial robots - Safety. etc.

*2) Labor Safety and Sanitation Law, etc.



Caution

Caution indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.



Warning

Warning indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.



Danger

Danger indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.



Warning

1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results. The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.

The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.

1) Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.

2) Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.

3) An application which could have negative effects on people, property, or animals requiring special safety analysis.

4) Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.



Free Mount Cylinder / Series CU Safety Instructions

Caution

The product is provided for use in manufacturing industries.

The product herein described is basically provided for peaceful use in manufacturing industries.

If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.

If anything is unclear, contact your nearest sales branch.

Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following "Limited warranty and Disclaimer" and "Compliance Requirements".

Read and accept them before using the product.

Limited warranty and Disclaimer

The warranty period of the product is 1 year in service or 1.5 years after the product is delivered.*3)

Also, the product may have specified durability, running distance or replacement parts.

Please consult your nearest sales branch.

For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.

This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.

Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

***3) Vacuum pads are excluded from this 1 year warranty.**

A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.

Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

Compliance Requirements

When the product is exported, strictly follow the laws required by the Ministry of Economy, Trade and Industry (Foreign Exchange and Foreign Trade Control Law).

1. Specifications

1-1. Specifications

Bore size	$\phi 6$	$\phi 10$	$\phi 16$	$\phi 20$	$\phi 25$	$\phi 32$
Fluid	Air					
Port size	M5x0.8					Rc1/8
Max. operating pressure	0.7Mpa					
Proof pressure	1.05MPa					
Ambient and operating fluid temperature	Without switch: -10 to +70 °C (No freezing) With switch: -10 to +60 °C (No freezing)					
Piston speed	50 to 500mm/s					
Allowable kinetic energy J	Double acting D type 0.0125 Single acting T type 0.0062	0.025	0.05	0.1	0.2	0.3
Lubrication	Non-lube					
Bumper	Note 1) Double-side Rubber bumper	Double-side rubber bumper				
Stroke length tolerance	+1.0 0					
Note 2) Non-rotating accuracy of the rod	$\pm 0.8^\circ$				$\pm 0.5^\circ$	
Allowable rotational torque(Nm)	0.0015	0.02	0.04	0.10	0.15	0.20
Auto switch(Optional)	Reed auto switch D-A9* Solid state auto switch D-M9*					

Note 1) For the $\phi 6$ single-acting spring extended type (CDU(K)6- *T), only the rod side has the rubber bumper.

Note 2) No load: Rod retracted.

Min. operating pressure

Model		Tube I.D. (mm)		(Mpa)		
		$\phi 6$	$\phi 10, \phi 16$	$\phi 20, \phi 25, \phi 32$		
Standard	Double acting	Single rod	C(D)U*-*D	0.12	0.06	0.05
		Double rod	C(D)UW*-*D	0.15	0.10	0.08
	Single acting	Single rod	C(D)U*-*S, T	0.2	0.15	0.13
Non-rotating type	Double acting	Single rod	C(D)UK*-*D	0.15	0.10	0.08
		Double rod	C(D)UKW*-*D	0.18	0.13	0.11
	Single acting	Single rod	C(D)UK*-*S, T	0.23	0.18	0.16

1-2. Theoretical Force

a) Double acting single rod type [C(D)U(K)*-*D]

Bore size (mm)	Rod O.D. (mm)	Operating direction	Pressure receiving area(mm ²)	Operating pressure Mpa		
				0.3	0.5	0.7
$\phi 6$	3	OUT	28.3	8.49	14.2	19.8
		IN	21.2	6.36	10.6	14.8
$\phi 10$	4	OUT	78.5	23.6	39.3	55
		IN	66.0	19.8	33	46.2
$\phi 16$	6	OUT	201	60.3	101	141
		IN	172	51.6	86	121
$\phi 20$	8	OUT	314	94.2	157	220
		IN	264	79.2	132	185
$\phi 25$	10	OUT	491	147	246	344
		IN	412	124	206	288
$\phi 32$	12	OUT	804	241	402	563
		IN	691	207	346	454

b) Double acting double rod type [C(D)U(K)W*-*D]

(N)

Bore size (mm)	Rod O.D. (mm)	Pressure receiving area (mm ²)	Operating pressure Mpa		
			0.3	0.5	0.7
φ 6	3	21.2	6.36	10.6	14.7
φ 10	4	66	19.8	33	46.2
φ 16	6	172	51.6	86	121
φ 20	8	264	79.2	132	185
φ 25	10	412	124	206	288
φ 32	12	691	207	346	484

c) Spring retracted type [C(D)U(K)*-*S]

(N)

Bore size (mm)	Rod O.D. (mm)	Operating direction	Pressure receiving area (mm ²)	Operating pressure Mpa		
				0.3	0.5	0.7
φ 6	3	OUT	28.3	4.99	10.7	16.3
		IN	-	3.5		
φ 10	4	OUT	78.5	16.7	32.4	48.1
		IN	-	6.9		
φ 16	6	OUT	201	45.6	86.3	126
		IN	-	15		
φ 20	8	OUT	314	73	136	199
		IN	-	21		
φ 25	10	OUT	491	119	218	316
		IN	-	28		
φ 32	12	OUT	804	207	368	529
		IN	-	34		

Note) Prevent load from being applied to the piston rod when the piston rod is being retracted.

d) Spring extended type [C(D)U(K)*-*T]

(N)

Bore size (mm)	Rod O.D. (mm)	Operating direction	Pressure receiving area (mm ²)	Operating pressure Mpa		
				0.3	0.5	0.7
φ 6	3	OUT	-	1.6		
		IN	21.2	2.86	7.10	11.3
φ 10	4	OUT	-	3.0		
		IN	66.0	12.9	26.1	39.3
φ 16	6	OUT	-	5.9		
		IN	172	37.2	71.8	106
φ 20	8	OUT	-	5.9		
		IN	264	58	111	164
φ 25	10	OUT	-	11		
		IN	412	95	178	260
φ 32	12	OUT	-	16		
		IN	691	173	312	420

Note) Prevent load from being applied to the piston rod when the piston rod is being extended.

2. Installation and Handling

2-1 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, injury to personnel 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 operate smoothly and avoid such dangers.

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

If a driven object and moving parts of the product are in close proximity, injury to personnel may occur. Design the system to avoid all contact with the human body.

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

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

- ④ **A deceleration circuit or shock absorber etc., may be required.**

When a driven object is operated at high speed 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 cushioning, or install an external shock absorber to relieve the shock. In this case, please verify the rigidity of the equipment carefully.

- ⑤ **Consider the possibility of a reduction in the circuit air pressure caused by a power failure.**

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 injury to personnel. Suspension equipment and lifting devices also require measures to prevent dropping.

- ⑥ **Consider a possible loss of power source.**

Measures should be taken to prevent injury and equipment damage in the event that there is a power malfunction to equipment controlled by air pressure, electricity or hydraulics, etc.

- ⑦ **Design a circuit to prevent sudden action of a driven object.**

Design a circuit and choose equipment to prevent quick extension, which may cause injury to personnel or damage to machinery, in the following cases:

activating the cylinder with the exhaust centre type direction control valve starting after the circuit's residual pressure has been emitted pressure is added to one side of the piston from air within a cylinder

- ⑧ **Consider emergency stop.**

Design the system to prevent injury to personnel and damage to machinery and equipment when it is stopped by a safety device for a power outage or manual emergency stop.

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

Design the machinery so that injury to personnel 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.

2-2 Selection

Warning

- ① **Confirm the specifications.**

The product is designed only for use in industrial compressed air systems. Do not operate at pressures or temperatures, etc., beyond the range of specifications, as this can cause damage or malfunction. Please contact SMC if using for other fluids than compressed air.

- ② **Intermediate stop**

Due to the compressibility of air it is difficult for this product to make a piston stop at the required intermediate position accurately and precisely by using a 3 position closed center type directional control valve. Furthermore, since valves and cylinders are not guaranteed for zero air leakage, it may not be possible to hold a stopped position for extended periods of time. Contact SMC if it is necessary to hold the stopped position for extended periods of time.

Caution

- ① **Operate the product within a range such that the piston will not collide and be damaged at the stroke end.**

For applications where the piston with inertia force is expected to stop by colliding with the cover at the stroke end, use it within a range that will not cause damage (within the allowable kinetic energy).

- ② **Use a speed controller to adjust the cylinder drive speed, gradually increasing from a low speed to the desired speed setting.**

- ③ **When a load is mounted to the rod end, adjust the speed corresponding to the load mass. Refer to the catalog for details.**

2-3 Mounting

Caution

- ① **Be sure to connect the piston rod and the load so that their axial centers and movement directions match.**

When not axially aligned, 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 become damaged.

- ② **Do not scratch or dent the sliding parts of the cylinder tube or piston rod etc., by striking them with other objects.**

Cylinder bores are manufactured to precise tolerances, so that even a slight deformation may cause malfunction. Also, scratches or gouges, etc., in the piston rod may lead to damaged seals and cause air leakage.

- ③ **Tightening torque**

When the free-mount cylinder is mounted, refer to the table below.

Bore size (mm)	Hexagon socket head cap screw (mm)	Appropriate tightening torque (Nm)
φ6, φ10	M3	1.08±10%
φ16	M4	2.45±10%
φ20, φ25	M5	5.10±10%
φ32	M6	8.04±10%

- ④ **Do not use the product until you have verified 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.

- ⑤ **Operation Manual**

Install and operate only after reading the operation manual carefully and understanding the contents. Keep the manual in a safe place for future reference.

2-4 Piping

Caution

- ① **Before piping**

Before piping, perform air blow (flushing) or cleaning to remove any cutting chips, cutting oil, dust, etc. from the piping.

- ② **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 pipe tape is used, leave 1.5 to 2 thread ridges exposed at the end of the threads.

2-5 Lubrication

Caution

- ① **Lubrication of non-lubricating cylinder**

The product has been lubricated for life at the time of manufacture, and does not require lubrication in service. If a lubricant is used in the system, use turbine oil Class 1 (with no additive) ISO VG32.

2-6 Air Supply

Warning

- ① **Use clean air.**

Do not use compressed air which contains chemicals, synthetic oils containing organic solvents, salts or corrosive gases, etc., as this can cause damage or malfunction.

Caution

- ② **Install an air filter.**

Install an air filter upstream near the valve.

A filtration degree of 5 micron millimeter or less should be selected.

- ③ **Take appropriate measures to ensure air quality, such as by providing an after cooler, air dryer, or water separator.**

Do not use compressed air containing a lot of condensate, which can cause the operating failure of the product and other pneumatic equipment.

- ④ **Ensure that fluid and ambient temperature are within the specified range.**

When operating at temperatures below 5°C, moisture in the circuit may freeze and cause breakage of seals or malfunction. Corrective measures should be taken to prevent freezing.

For detailed information regarding the quality of the compressed air described above, refer to SMC's Cleaning Systems".

2-7 Operating environment

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 **An area exposed to direct sunlight.**

2-8 Maintenance

⚠ Warning

- ① **Maintenance should be performed according to the procedure indicated in the Operating Manual.**

Improper handling can cause damage and malfunction of equipment and machinery.

- ② **Machine maintenance, and supply and exhaust of compressed air**

Before components are removed, first confirm that measures are in place to prevent work pieces from dropping and/or equipment moving or running away, etc. Disconnect the air supply pressure, electrical power, and exhaust all compressed air from the system. When machinery is restarted, check that operation is normal with actuators in the proper positions.

⚠ Caution

- ③ **Drain flushing**

Remove condensate from air filters regularly.

2-9 Auto Switch Mounting Precautions

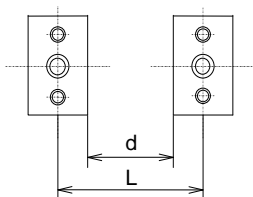
⚠ Caution

Precaution on Proximity installation

When the universal mounting cylinders with D-A□ or D-M□ auto switch are used, the auto switch could activate unintentionally if the cylinder installed distance is less than the dimension shown in the table. Therefore, make sure to provide a longer distance than the specified dimension. If the distance between the cylinders must be shorter than the dimension given in the table, affix a steel plate or a magnetic shield plate (MU-S025) to the area on the cylinder which is opposite to the auto switch mounted on another cylinder. (Please inquire for more details)

The auto switch without the shield plate may cause malfunction.

Tube I.D. (mm)	d	L
φ6	5	18
φ10	5	20
φ16	13	33
φ20	14	40
φ25	14	46
φ32	16	56



2-10 Precautions

⚠ Caution

- ① **Do not place your fingers in the clearance between the non-rotating plate and the cylinder tube.**

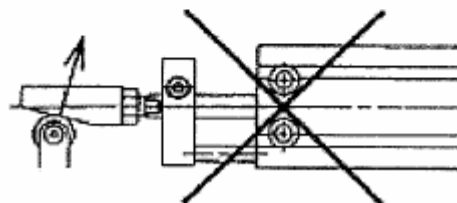
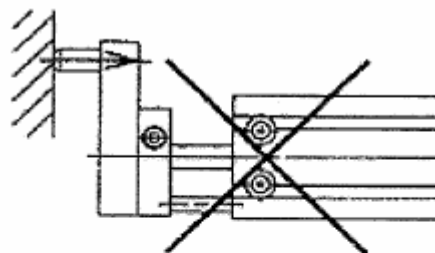
There is a danger that fingers of personnel could get caught between the

non-rotating plate and cylinder tube when the piston rod retracts.

Therefore, never place your hand in this area. Be careful not to get a finger

caught by the cylinder, as the cylinder outputs great force, it can lead to injury.

- ② **Do not use in a way that may cause a bending moment to be added to the rod. (Refer to the Fig. shown below)**



3. Maintenance

Caution

As a jig is required for bore size $\phi 6$, do not disassemble when replacing seals etc.
If overhaul is required, contact SMC Sales Office.

Checks

1. Daily check

- 1) Whether the operation is smooth or not.
- 2) Changes in piston speed and cycle time.
- 3) Whether the stroke is appropriate or not.

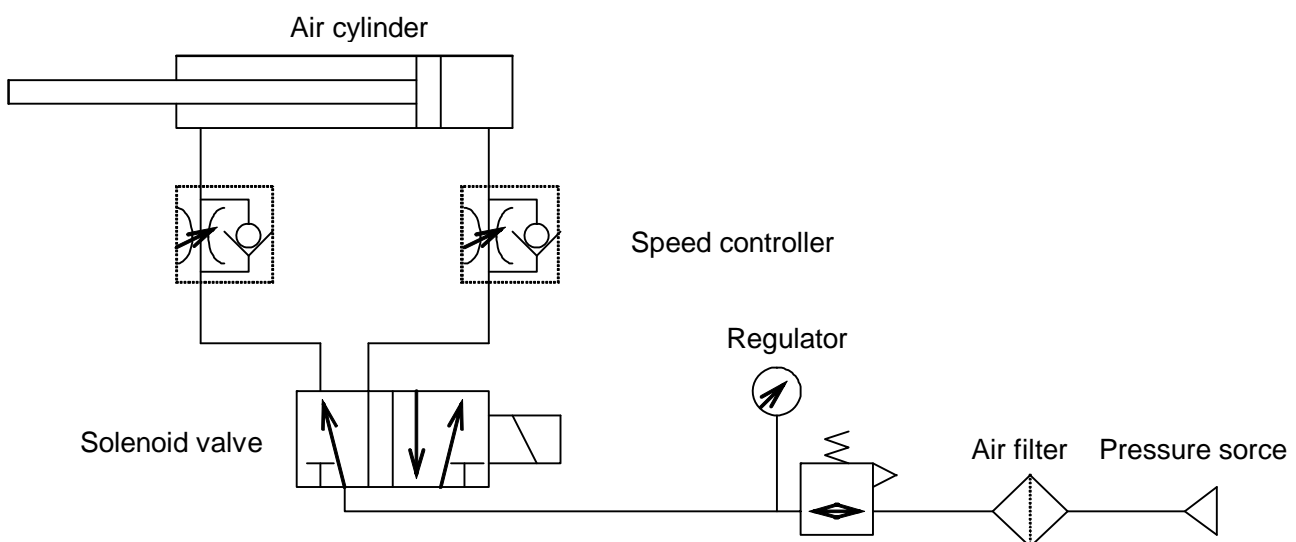
2. Regular inspection

- 1) Loosening of the cylinder mounting screw
- 2) Whether the operation is smooth or not.
- 3) Changes in piston speed and cycle time.
- 4) External leakage
- 5) Whether the stroke is appropriate or not.
- 6) If there are any scratches on the piston rod, and the grease condition.
- 7) Whether drainage in the air filter is regularly discharged or not.

Check the points above at least, and contact the sales representative if any failure is found.

4. Basic Circuit for Cylinder Operation

The basic circuit for operating the product with air filter, regulator, solenoid valve and speed controller is shown in the following figure.



For a double-acting cylinder, use a meter-out speed controller

For a single-acting cylinder, use a meter-in speed controller.

Open the speed controller gradually from the fully closed position to adjust the speed.

Do not adjust the speed starting with the speed controller in the fully open position, otherwise, damage may occur due to the piston striking the end cover at high speed.

5.Troubleshooting

Description	Possible causes	Countermeasures	Note
Insufficient output	The piston seal is worn out.	Replace the piston seal.	For ø6, request SMC to repair.
Operating speed is too slow.	The load is too much for the cylinder output.	<ul style="list-style-type: none"> ▪ Increase the bore size of the cylinder. 	
Operation is not smooth.	The cylinder operating speed is out of the range.	<ul style="list-style-type: none"> ▪ Change the cylinder speed to be within the allowable range. ▪ Use a low speed cylinder. ▪ Increase the bore size of the cylinder. 	
	The lateral load to the cylinder is over the allowable range.	<ul style="list-style-type: none"> ▪ Change the lateral load to be within the allowable range. ▪ Increase the bore size of the cylinder. ▪ Use a guide cylinder. 	
	Vibration is detected.	<ul style="list-style-type: none"> ▪ Install the product in a place where it is not applied with vibration. ▪ Avoid applying external force to the product. 	
	Water or coolant liquid is splashed.	<ul style="list-style-type: none"> ▪ Protect the cylinder with a cover to avoid liquid splash. 	
Deformation or breakage	Impact force due to high speed operation	<ul style="list-style-type: none"> ▪ Reduce the cylinder speed to be within the allowable range. ▪ Reduce the load. ▪ Install an external impact absorbing mechanism. 	
The auto switch does not operate. (Malfunctions.)	The auto switch is not mounted in the proper mounting position.	<ul style="list-style-type: none"> ▪ Install the auto switch at the correct position. 	Refer to Mounting Auto Switch (Precaution on proximity installation)
	<ul style="list-style-type: none"> ▪ The cylinders are mounted side by side. 	<ul style="list-style-type: none"> ▪ Mount to proximity installation position. 	
		<ul style="list-style-type: none"> ▪ Put magnetic shielding plates (MU-S025) between the cylinders which are installed in parallel. 	

Revision history

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Note: Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.

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