CAT.EUS20-134 Ⓒ-UK

Cylinder with Lock

Series CLS

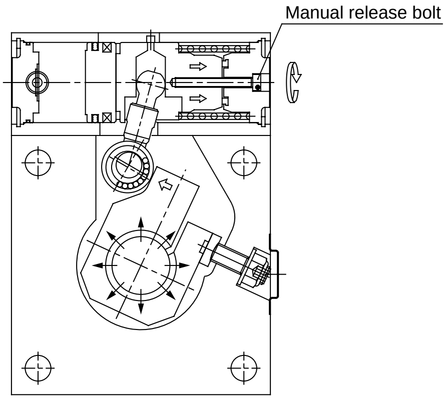
ø125, ø140, ø160, ø180, ø200, ø250

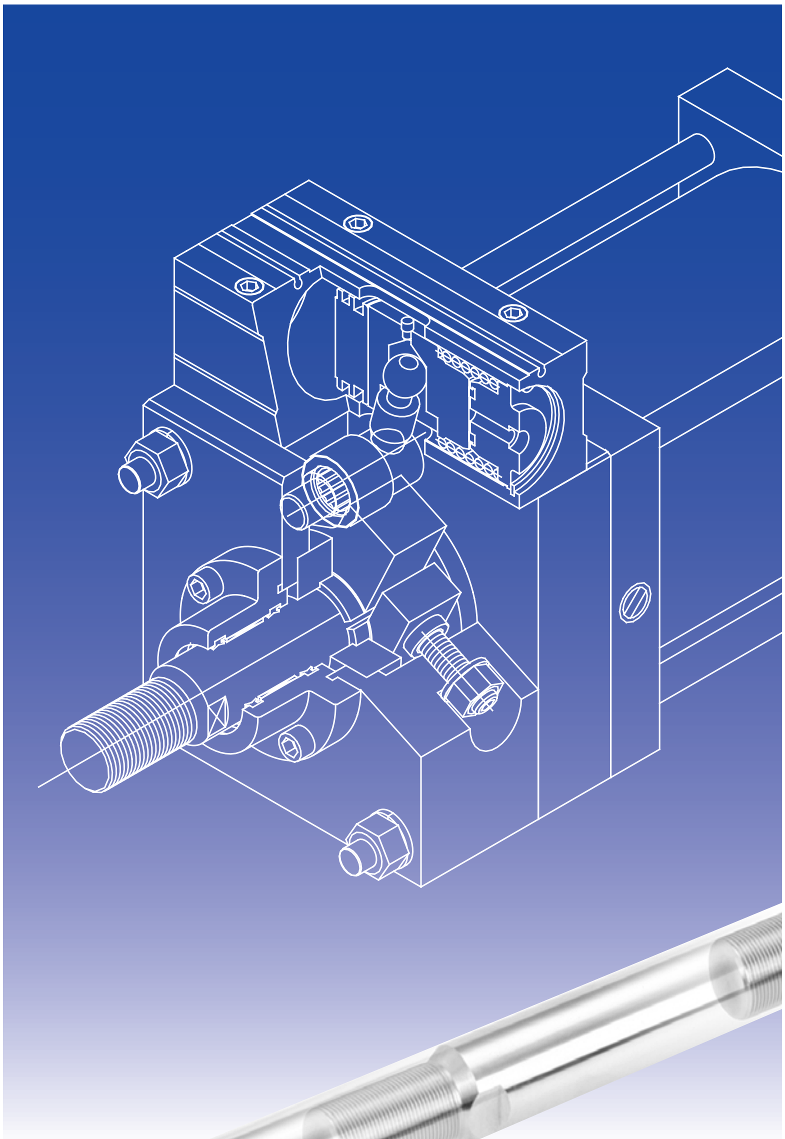
A locking cylinder ideal for intermediate stops, emergency stops and drop prevention. Small switches can also be mounted.

A locking cylinder emergency stops

Manual unlocking function

Even if the air supply is cut off or discharged, the lock can be released by screwing in the manual release bolt (hexagon socket head screw).





Design minimises influence of unlocking air quality

A design largely unaffected by factors such as moisture and drainage in compressed air has been realised by separating the lock mechanism and the brake cylinder.

Can be locked in both directions

An equal holding force can be obtained on either reciprocating stroke of the cylinder.

Compact lock unit is light weight and saves space

Overall length has been reduced by using an independent brake cylinder (–15% compared to previous series). Weight reduction has also been realised through parts simplification (max. –40% compared to previous series).

Steady holding force

Outstanding durability and steady holding force are maintained by using a brake shoe with superior wear resistance.

Lock unit switch

By providing a switch on the brake cylinder, the operating state of the lock unit (brake piston) can be detected using the switch signal.

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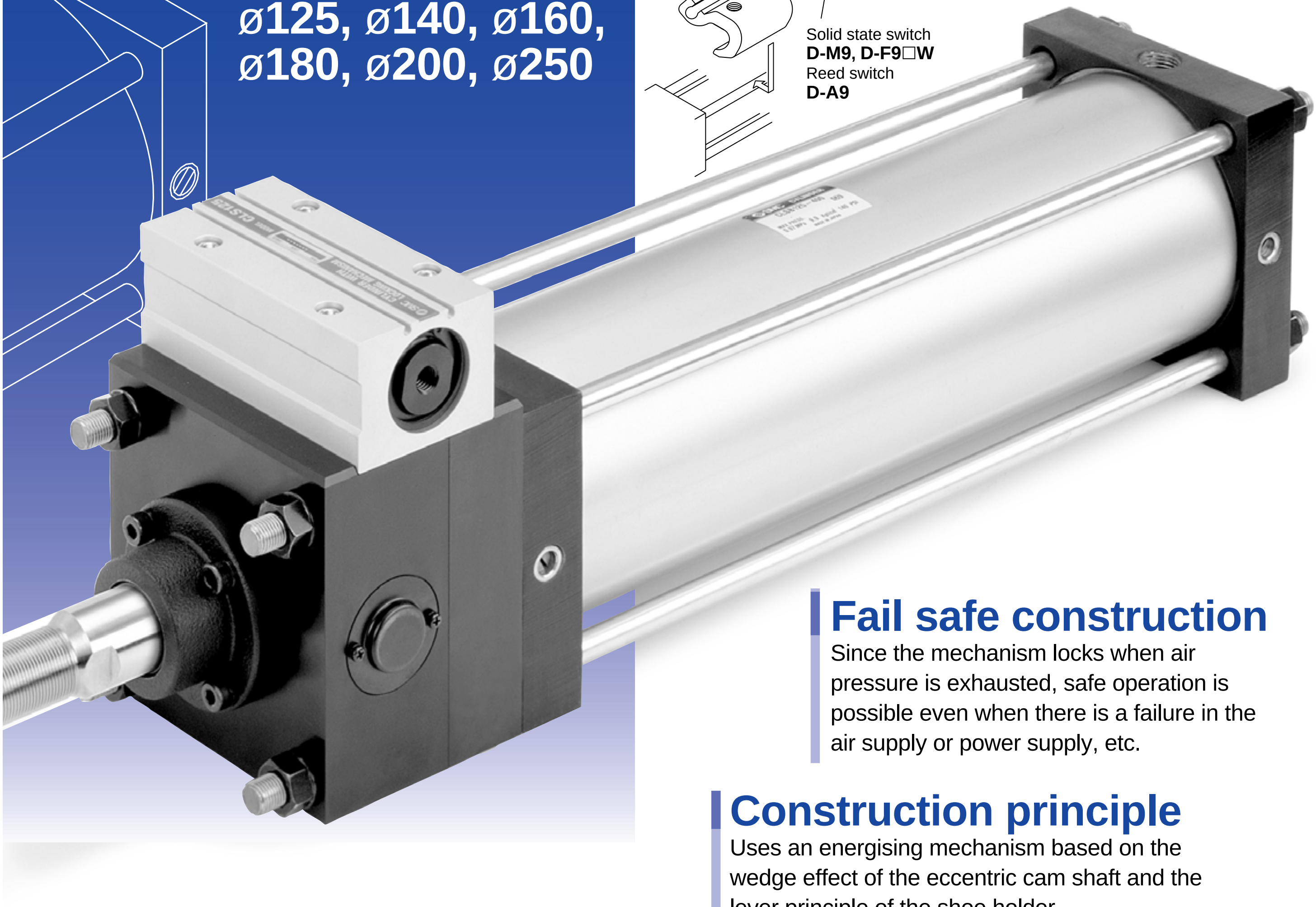
ideal for intermediate stops, and drop prevention.

Cylinder with Lock

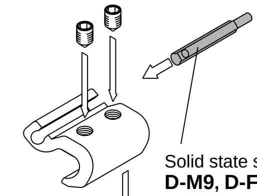
Series CLS

ø125, ø140, ø160, ø180, ø200, ø250



New Small auto switches are mountable.

Small auto switches can also be mounted on the cylinder unit.

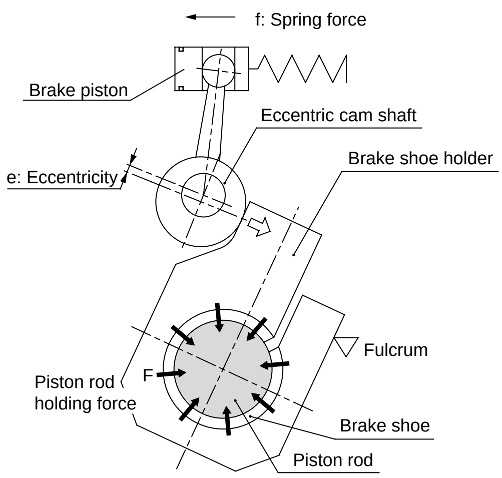


Fail safe construction

Since the mechanism locks when air pressure is exhausted, safe operation is possible even when there is a failure in the air supply or power supply, etc.

Construction principle

Uses an energising mechanism based on the wedge effect of the eccentric cam shaft and the lever principle of the shoe holder.



Maintenance simplified

The lock monitor makes it possible to confirm the operating state of the lock unit (brake piston) and the state of wear for each part, providing a guide for maintenance.

Series Variations

Series	Action	Type	Standard variations: Built-in auto switch magnets	Standard variations: With rod boot	Lock type: Spring lock	Bore size (mm)	Standard stroke (mm)
Cylinder with lock Series CLS	Double acting	Single rod Series CLS	●	●	●	125	Maximum 1600
						140	
						160	
						180	Maximum 2000
						200	
						250	Maximum 2400

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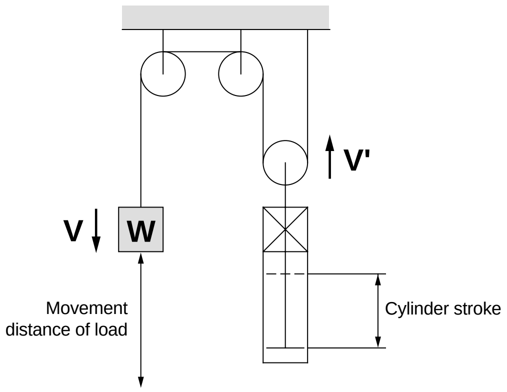
Series CLS
Model Selection

Caution on Model Selection

⚠ Caution

1. In order that the originally determined maximum speed is not exceeded, be certain to use a speed controller and adjust it so that the transfer through the total movement distance of the load is not less than the applicable movement time.
   The movement time is the time that is necessary for the load to travel the total movement distance from start to finish without any intermediate stops.
2. In cases where the cylinder stroke and the movement distance of the load are different (double speed mechanism, etc.), use the movement distance of the load for selection purposes.

Example)



3. Shown below is an example of the model selection procedure for an intermediate stop application (including an emergency stop in operation). Only when locking in a drop prevention application, when no kinetic energy is applied, the maximum load weight should be determined by using graphs 5 through 7 (taking into consideration the upper limit of the load weight at a maximum speed of 100 mm/s).

Selection Example

- **Load weight:** m = 320 kg
- **Movement distance:** st = 400 mm
- **Movement time:** t = 2 s
- **Load condition:** Vertical downward = Load in direction of rod extension
- **Operating pressure:** P = 0.4 MPa

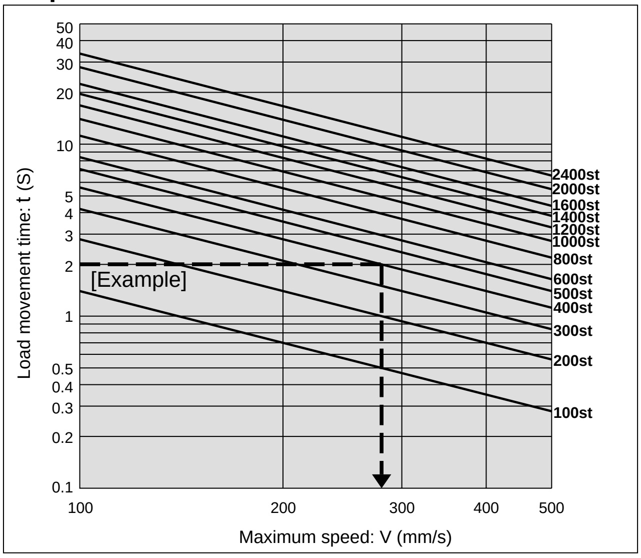
Step 1: From Graph 1 find the maximum movement speed of the load
∴ Maximum speed V: approx. 280 mm/s

Step 2: Select Graph 6 based upon the load condition and operating pressure. And then from the intersection of the maximum speed V = 280 mm/s found in Step 1, and the load weight m = 320 kg
∴ ø140→ select a CLS140 or larger bore size.

Step 1 Find the maximum load speed: V.

Find the maximum load speed: V (mm/s) from the load movement time: t (s) and the movement distance: st (mm).

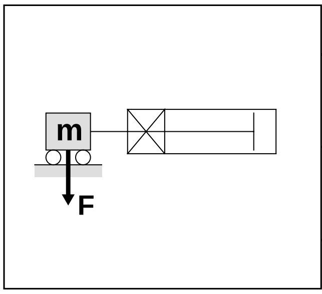
Graph 1

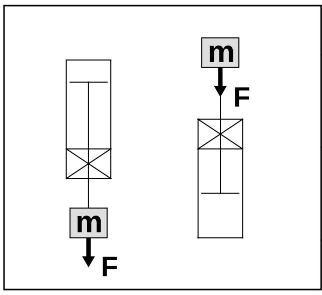


Step 2 Find the cylinder bore size.

Select a graph based upon the load condition and operating pressure, and then find the point of intersection for the maximum speed found in Step 1 and the load weight. Select the bore size on the line above the point of intersection.

Load condition	Operating pressure	
Direction of load at right angle to rod (∗ Being held by a guide)	from 0.3 MPa	Graph 2
	from 0.4 MPa	Graph 3
	from 0.5 MPa	Graph 4
Load in direction of rod extension **Load in direction of rod retraction**	from 0.3 MPa	Graph 5
	from 0.4 MPa	Graph 6
	from 0.5 MPa	Graph 7





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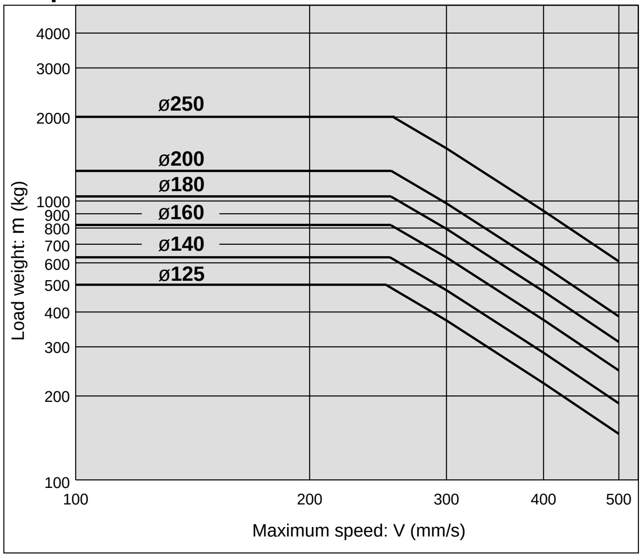
Selection Graph

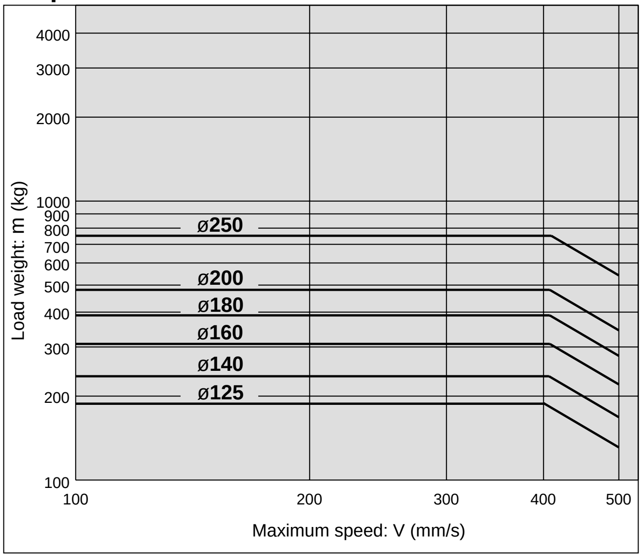
Graph 2

0.3 MPa ≤ P < 0.4 MPa



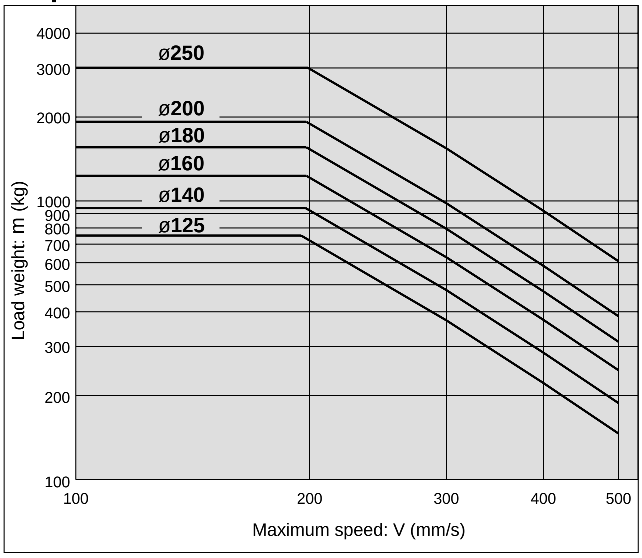
Graph 5

0.3 MPa ≤ P < 0.4 MPa



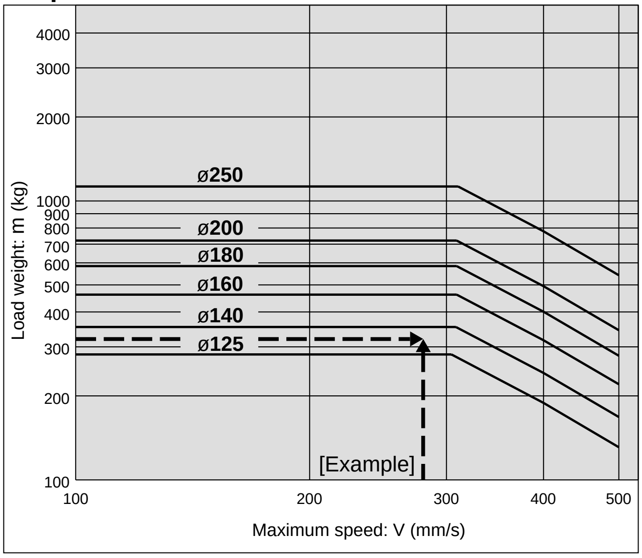
Graph 3

0.4 MPa ≤ P < 0.5 MPa



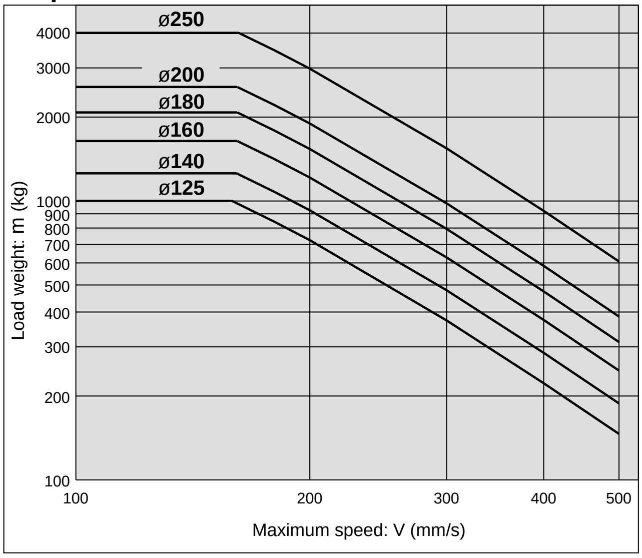
Graph 6

0.4 MPa ≤ P < 0.5 MPa



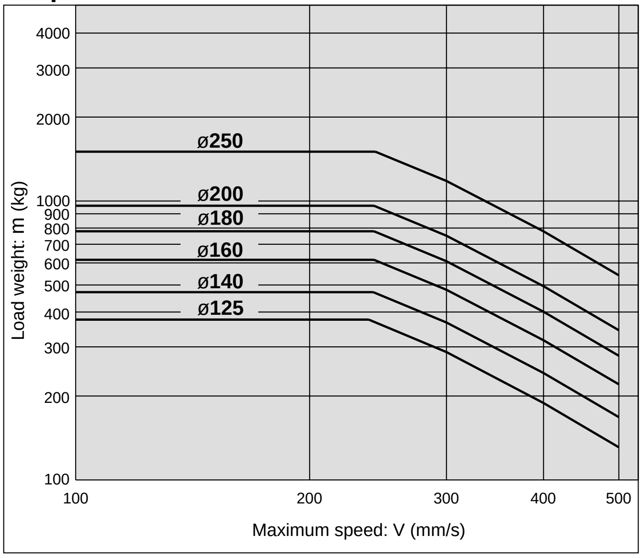
Graph 4

0.5 MPa ≤ P



Graph 7

0.5 MPa ≤ P



Cylinder with Lock
Double Acting, Single Rod
Series CLS
ø125, ø140, ø160, ø180, ø200, ø250

How to Order

Without Auto Switch: CLS [L] [ ] [125] [ ] – [100] [ ] — [D] [M9B]

With Auto Switch: CDLS [L] [125] [ ] – [100] [ ] – [M9B] [ ] – [D] [M9B]

With auto switch (Built-in magnet): D

Mounting bracket

B	Basic type	**C**	Single clevis type
L	Foot type	**D**	Double clevis type
F	Rod side flange type	**T**	Centre trunnion type
G	Head side flange type		

Tube material

Symbol	Bore size	Tube material	
		Without auto switch	With auto switch
-	ø125 to ø160	Aluminum tube	Aluminum tube
	ø180, ø200	Steel tube	
	ø250	Steel tube	—
F	ø125 to ø160	Steel tube	—

Bore size

Symbol	Without auto switch	With auto switch
125	125 mm	125 mm
140	140 mm	140 mm
160	160 mm	160 mm
180	180 mm	180 mm
200	200 mm	200 mm
250	250 mm	—

Cylinder suffix

Rod boot	**J**	Nylon tarpaulin
	K	Heat resistant tarpaulin
Cushion	**-**	With cushion on both sides
	N	Without cushion
	R	With cushion on rod side
	H	With cushion on head side

∗ Indicate in alphabetical order when 2 or more symbols are applicable.

Thread type

Nil	Rc
TN	NPT

Cylinder stroke (mm)
Refer to the maximum stroke table on page 2.

Number of auto switches

-	2 pcs.
S	1 pc.
n	"n" pcs.

Cylinder unit auto switch type

-	Without auto switch (Built-in magnet cylinder)

∗ Select applicable auto switches from the table below.

Lock unit built-in magnet

-	Without magnet (Without auto switch)
D	Built-in magnet

Lock unit auto switch type

-	Without auto switch

∗ Refer to the table below for applicable auto switch models.

Cylinder Unit/Applicable Auto Switches/Refer to "SMC Best Pneumatics 2004" catalogue for further information on auto switches.

Type	Special function	Electrical entry	Indicator light	Wiring (output)	Load voltage			Auto switch model		Lead wire length (m)∗			Pre-wired connector	Applicable load	
					DC		AC	Tie-rod mounting	Band mounting	0.5 (Nil)	3 (L)	5 (Z)			
Reed switch	—	Grommet	Yes	3-wire (NPN equiv.)	—	5 V	—	**A96**	—	●	●	—	—	IC circuit	—
				2-wire	24 V	12 V	100 V	**A93**	—	●	●	—	—	—	Relay, PLC
			No			5 V, 12 V	100 V or less	**A90**	—	●	●	—	—	IC circuit	
			Yes			12 V	100 V, 200 V	**A54**	—	●	●	●	—	—	
		Terminal conduit					—	—	**A33**	—	—	—	—		PLC
							100 V, 200 V	—	**A34**	—	—	—	—		Relay, PLC
		DIN terminal						—	**A44**	—	—	—	—		
	Diagnostic indication (2-colour indicator)	Grommet				—	—	**A59W**	—	●	●	—	—		
Solid state switch	—	Grommet	Yes	3-wire (NPN)	24 V	5 V, 12 V	—	**M9N**	—	●	●	○	○	IC circuit	Relay, PLC
				3-wire (PNP)				**M9P**	—	●	●	○	○		
				2-wire	—	—	100 V, 200 V	**J51**	—	●	●	○	—	—	
					24 V	12 V	—	**M9B**	—	●	●	○	○		
		Terminal conduit		3-wire (NPN)		5 V, 12 V		—	**G39**	—	—	—	—	IC circuit	
				2-wire		12 V		—	**K39**	—	—	—	—	—	
	With diagnostic output (2-colour indicator)	Grommet		3-wire (NPN)		5 V, 12 V		**M9NW**	—	●	●	○	○	IC circuit	
				3-wire (PNP)				**M9PW**	—	●	●	○	○		
				2-wire		12 V		**M9BW**	—	●	●	○	○	—	
	Water resistant (2-colour indicator)							**M9BA**	—	—	●	○	○		
	With diagnostic output (2-colour indicator)			4-wire (NPN)		5 V, 12 V		**F59F**	—	●	●	○	○	IC circuit	

∗ Lead wire length symbol 0.5 m .... Nil (Example) M9N
3 m .... L M9NL
5 m .... Z M9NZ

∗ Solid state switches marked with "○" are produced upon receipt of order.

- There are applicable auto switches other than listed above. For details, refer to page 14.
- For details about auto switches with pre-wired connector, refer to "SMC Best Pneumatics 2004" catalogue.

Lock Unit/Applicable Auto Switches

Type	Special function	Indicator light	Wiring (output)	Load voltage			Auto switch model	Lead wire length (m)			Applicable load	
				DC		AC		0.5 (Nil)	3 (L)	5 (Z)		
Reed switch	Grommet	Yes	2-wire	24 V	12 V	100 V	**A93**	●	●	—	—	Relay, PLC
		No			5 V, 12 V	100 V or less	**A90**	●	●	—	IC circuit	
Solid state switch	Grommet	Yes	3-wire (NPN)	24 V	5 V, 12 V	—	**M9N**	●	●	○	IC circuit	Relay, PLC
			3-wire (PNP)				**M9P**	●	●	○		
			2-wire		12 V		**M9B**	●	●	○	—	

How to Order:
(For details, refer to page 24.)

Symbol	Specifications
-XA□	**Change of rod end style**
-XC3	**Special port location**
-XC14	**Change of trunnion bracket mounting position**

Model

Series	Type	Action	Bore size (mm)	Locking action
CLS□	Non-lube	Double acting	125, 140, 160, 180, 200, 250	Spring locking
CDLS□			125, 140, 160, 180, 200	

Cylinder Specifications

Type	Non-lube
Fluid	Air
Proof pressure	1.46 MPa 1.05 MPa*
Max. operating pressure	0.97 MPa 0.7 MPa*
Min. operating pressure	0.08 MPa
Piston speed	50 to 500 mm/s**
Cushion	Yes
Ambient and fluid temperature	Without auto switch: 0°C to 70°C With auto swiatch: 0°C to 60°C (with no freezing)
Stroke length tolerance	to 250: $^{+1.0}_{0}$, 251 to 1000: $^{+1.4}_{0}$, 1001 to 1500: $^{+1.8}_{0}$, 1501 to 2000: $^{+2.2}_{0}$, 2001 to 2400: $^{+2.6}_{0}$
Mounting	Basic type, Foot type, Rod side flange type, Head flange type, Single clevis type, Double clevis type, Centre trunnion type

* For ø180 and ø200 with auto switches.
** There are load limitations depending on the piston speed when locked, the mounting method, and the operating pressure.

Lock Specifications

Locking action	Spring locking (exhaust locking)
Unlocking pressure	0.25 MPa or more
Locking pressure	0.20 MPa or less
Max. operating pressure	1.0 MPa
Locking direction	Both directions

Stopping Accuracy

Unit: mm

Lock type	Piston speed (mm/s)		
	100	300	500
Spring lock	±0.5	±1.0	±2.0

Conditions:
Horizontal, Supply pressure P = 0.5 MPa
Load weight .... Upper limit of allowed value
Solenoid valve for locking ... Mounted directly to unlocking port
Maximum value from range of 100 measured stopping positions

Spring Lock Holding Force
(Maximum Static Load)

Bore size (mm)	**125**	**140**	**160**	**180**	**200**	**250**
Holding force (KN)	8.4	10.5	13.8	17.4	21.5	33.6

* Be sure to make cylinder selections in accordance with the method given on front matter 1.

Cylinder Stroke

Unit: mm

Tube material	Aluminum alloy	Carbon steel tube	
Bore size (mm)	Basic type, Head side flange type, Single clevis type, Double clevis type, Centre trunnion type, Foot type, Rod side flange type	Basic type, Head side flange type, Single clevis type, Double clevis type, Centre trunnion type	Foot type Rod side flange type
125, 140	Up to 1000	Up to 1000	Up to 1600
160	Up to 1200	Up to 1200	Up to 1600
180	—	Up to 1200	Up to 2000
200	—	Up to 1200	Up to 2000
250	—	Up to 1200	Up to 2400

Cylinder Stroke/Auto Switch Mounting on Cylinder Unit (Built-in Magnet)

Unit: mm

Bore size (mm)	Basic type, Head side flange type, Single clevis type, Double clevis type, Centre trunnion type	Foot type Rod side flange type
125, 140	to 1000	to 1400
160	to 1200	to 1400
180	to 1200	to 1500
200	to 998	to 998
Note	For ø200, 998 to 1200 strokes are available as made to order.	For ø200, 998 to 1500 strokes are available as made to order.

Mounting Bracket Part No.

Bore size (mm)	125	140	160	180	200	250
Foot type Note 1)	CS1-L12	CS1-L14	CS1-L16	CS1-L18	CS1-L20	CS1-L25
Rod side flange type Note 2)	CS1-FL12	CS1-FL14	CS1-FL16	CS1-FL18	CS1-FL20	CS1-FL25
Head side flange type	CS1-F12	CS1-F14	CS1-F16	CS1-F18	CS1-F20	CS1-F25
Single clevis type	CS1-C12	CS1-C14	CS1-C16	CS1-C18	CS1-C20	CS1-C25
Double clevis Note 3)	CS1-D12	CS1-D14	CS1-D16	CS1-D18	CS1-D20	CS1-D25

Note 1) When ordering foot brackets, 2 pcs. should be ordered for each cylinder.
Note 2) ø125 to ø250 rod side flange types use series CS1 long stroke flanges.
Note 3) A clevis pin, flat washer and cotter pin are packed with the double clevis type.

Rod Boot Material

Symbol	Material	Max. ambient temperature
J	Nylon tarpaulin	60°C
K	Heat resistant tarpaulin	110°C*

* Maximum ambient temperature for the rod boot itself.

Accessories

Mounting brackets		Basic type	Foot type	Rod side flange type	Head side flange type	Single clevis type	Double clevis type	Centre trunnion type
Standard equipment	Clevis pin	—	—	—	—	—	●	—
Options	Rod end nut	●	●	●	●	●	●	●
	Single knuckle joint	●	●	●	●	●	●	●
	Double knuckle joint (with pin)	●	●	●	●	●	●	●
	With rod boot	●	●	●	●	●	●	●

* Refer to the accessory models and dimensions on page 12.

Weight/Numbers inside ( ) are for steel tube

Unit: kg

Bore size (mm)		125	140	160	180	200	250
Lock unit weight		9.40	11.37	16.93	26.20	36.4	61.70
Basic weight	Basic type	23.49 (24.96)	28.30 (30.11)	40.87 (43.08)	57.30 (63.91)	75.46 (82.01)	— (138.94)
	Foot type	25.12 (26.59)	30.82 (32.63)	43.67 (45.88)	61.50 (68.11)	80.34 (86.89)	— (148.44)
	Flange type	26.17 (27.64)	33.30 (35.11)	47.26 (49.47)	67.13 (73.74)	87.37 (93.92)	— (160.78)
	Single clevis type	26.56 (28.03)	32.59 (34.40)	46.36 (48.57)	65.69 (72.30)	85.36 (91.91)	— (157.33)
	Double clevis type (includes clevis pin & cotter pin)	27.02 (28.49)	33.34 (35.15)	47.21 (49.42)	67.37 (73.98)	87.39 (93.94)	— (160.52)
	Centre trunnion type	27.62 (29.09)	34.03 (35.84)	48.27 (50.48)	68.46 (75.07)	89.45 (96.00)	— (166.78)
Additional weight per 100 mm of stroke		1.77 (2.66)	1.96 (3.01)	2.39 (3.58)	2.85 (4.95)	3.42 (5.75)	— (9.08)
Accessories	Single knuckle	0.91	1.16	1.56	3.07	2.90	5.38
	Double knuckle (with pin)	1.37	1.81	2.48	4.74	4.59	9.22
	Rod end nut	0.16	0.16	0.23	0.33	0.56	1.01

Calculation (Ex.) CLSL140-100
Basic weight .... 30.82 (foot type, ø140)
Additional weight .... 1.96/100 mm stroke
Cylinder stroke .... 100 mm stroke
30.82 + 1.96 x 100/100 = 32.78 kg

Cylinder Unit Auto Switch Mounting Bracket Part No.

Auto switch model	Bore size (mm) 125	140	160	180	200
D-A9□, A9□V D-M9□, M9□V D-M9□W, M9□WV D-M9BAL	BS5-125	BS5-125	BS5-160	BS5-180	BS5-200
D-A5□, A6□, A59W D-F5□, J5□ D-F5□W, J59W, F5BAL D-F5□F, F5NTL	BT-12	BT-12	BT-16	BT-18A	BT-20
D-A3□, A44, G39, K39	BS1-125	BS1-140	BS1-160	BS1-180	BS1-200
D-Z7□, Z80 D-Y5□, Y6□, Y7P, Y7PV D-Y7□W, Y7□WV D-Y7BAL	BS4-125	BS4-125	BS4-160	BS4-180	BS4-200

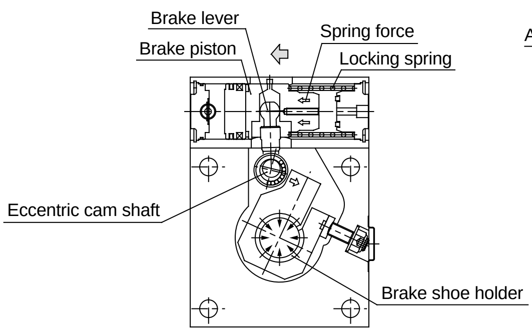
[Mounting screws set made of stainless steel]

The following set of mounting screws made of stainless steel are also available. Use it in accordance with the operating environment. (Please order the mounting band separately, since it is not included.)

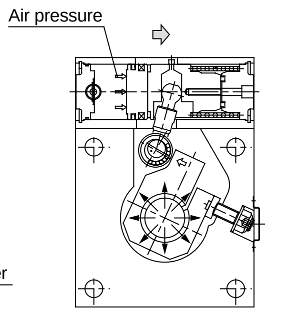
BBA1: For use with D-A5/A6/F5/J5

- "D-F5BAL" switch is set on the cylinder with the stainless steel screws above when shipped. When the switches are shipped as individual parts, the BBA1 is included.

Construction Principle



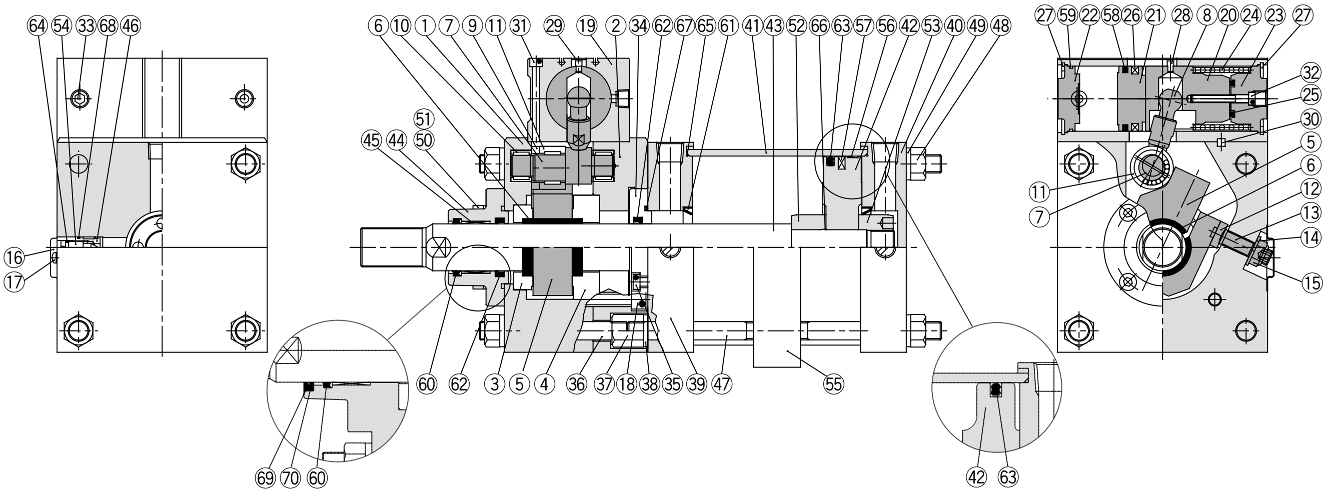
Locked condition (when air is exhausted.)



Unlocked condition (when air is supplied.)

Spring locking (exhaust locking)
The brake piston actuated by the force of the spring turns the eccentric cam shaft via the brake lever. This turning force distorts the brake shoe holder due to the wedge effect of the cam, acting on the brake shoe and locking the piston rod by tightening on it with a large force.
Unlocking occurs when air pressure is supplied to the unlocking port, causing the brake piston to counteract the force of the spring and push the brake lever back. This removes the force which is distorting the shoe holder and unlocks the piston rod.

Construction



ø180, ø200, ø250

Steel tube

Component Parts

No.	Description	Material	Note
1	**Cover A**	Aluminum alloy	Black hard anodized (ø125, ø140, ø160)
			Hard anodized & coated (ø180, ø200, ø250)
2	**Cover B**	Aluminum alloy	Black hard anodized (ø125, ø140, ø160)
			Hard anodized & coated (ø180, ø200, ø250)
3	**Thrust washer A**	Carbon steel	Electroless nickel plated (ø125, ø140, ø160)
			Special treatment (ø180, ø200, ø250)
4	**Thrust washer B**	Carbon steel	Electroless nickel plated (ø125, ø140, ø160)
5	**Brake shoe holder A**	Chromium molybdenum steel	Special treatment
6	**Brake shoe**	Special friction material	
7	**Eccentric cam shaft**	Special steel	
8	**Brake lever**	Chromium molybdenum steel	Zinc chromated
9	**Washer**	Carbon steel	Zinc chromated
10	**Needle bearing**	–	
11	**Needle bearing**	–	
12	**Stopper**	Special steel	Electroless nickel plated
13	**Adjustment screw**	Chromium molybdenum steel	Zinc chromated
14	**Conical spring washer**	Spring steel	Zinc chromated
15	**U nut**	Carbon steel	Zinc chromated
16	**Cover**	Steel plate	Black zinc chromated
17	**Cover holding screw**	Carbon steel	
18	**Cover holding bolt**	Chromium molybdenum steel	Nickel plated
19	**Brake tube**	Aluminum alloy	Clear hard anodized
20	**Brake piston A**	Carbon steel	Tufftride
21	**Brake piston B**	Aluminum alloy	Chromated
22	**Bottom plate**	Aluminum alloy	Black anodized
23	**Spring collar**	Aluminum alloy	Black anodized
24	**Brake spring**	Steel wire	Zinc chromated
25	**Bumper B**	Polyurethane rubber	
26	**Magnet**	–	(With switch for lock unit)
27	**Snap ring**	Carbon tool steel	Phosphate coated
28	**Marker**	Resin	White
29	**Trim plate**	Resin	
30	**Key**	Carbon steel	
31	**Brake tube holding bolt**	Chromium molybdenum steel	Nickel plated
32	**Manual release bolt**	Chromium molybdenum steel	Nickel plated
33	**Plug with breathing hole**	–	Black zinc chromated
34	**Retaining plate B**	Aluminum alloy	
35	**Retaining plate holding bolt**	Chromium molybdenum steel	Nickel plated
36	**Unit holding tie-rod**	Carbon steel	Chromated
37	**Wing nut**	Carbon steel	Nickel plated
38	**Conical spring washer**	Spring steel	Nickel plated
39	**Rod cover**	Rolled steel plate	Black coated
40	**Head cover**	Rolled steel plate	Black coated
41	**Cylinder tube**	Aluminum alloy	Hard anodized (ø125 to ø200)
		Carbon steel pipe	Hard chrome plated (ø125 to ø250)

Component Parts

No.	Description	Material	Note
42	**Piston**	Aluminum alloy casting	In case of aluminum tube
		Cast iron	In case of steel tube
43	**Piston rod**	Carbon steel	Hard chrome plated
44	**Retaining plate**	Cast iron	Black coated (ø125, ø140, ø160)
45	**Bushing**	Copper alloy	
46	**Valve guide**	Brass	
47	**Tie-rod**	Carbon steel	Chromated
48	**Tie-rod nut**	Rolled steel plate	Black zinc chromated
49	**Spring washer**	Steel wire	Black zinc chromated
50	**Retaining plate bolt**	Chromium molybdenum steel	Black zinc chromated
51	**Spring washer**	Steel wire	Black zinc chromated
52	**Cushion ring A**	Rolled steel	Zinc chromated
53	**Cushion ring B**	Rolled steel	Zinc chromated
54	**Cushion valve**	Rolled steel	Electroless nickel plated
55	**Tie-rod reinforcement ring**	Rolled steel	Black coated (long stroke)
56	**Wear ring**	Resin	In case of aluminum tube
57	**Magnet**	–	For built-in magnet type
58	**Piston seal**	NBR	
59	**Tube gasket**	NBR	
60	**Wiper ring**	NBR	
61	**Cushion seal**	NBR	
62	**Rod seal**	NBR	
63	**Piston seal**	NBR	
64	**Valve seal**	NBR	
65	**Tube gasket**	NBR	
66	**Piston gasket**	NBR	
67	**Retaining plate gasket**	NBR	
68	**Guide gasket**	NBR	
69	**Coil scraper**	Phosphor bronze	(ø180, ø200, ø250)
70	**Coil scraper holder**	Aluminum alloy	Black anodized (ø180, ø200, ø250)

Replacement Parts: Seal Kit

Bore size (mm)	Order No.	Contents
125	CLS125-PS	A set of above Nos. 60, 62, 63, 64, 65 & 67
140	CLS140-PS	
160	CLS160-PS	
180	CLS180-PS	
200	CLS200-PS	
250	CLS250-PS	

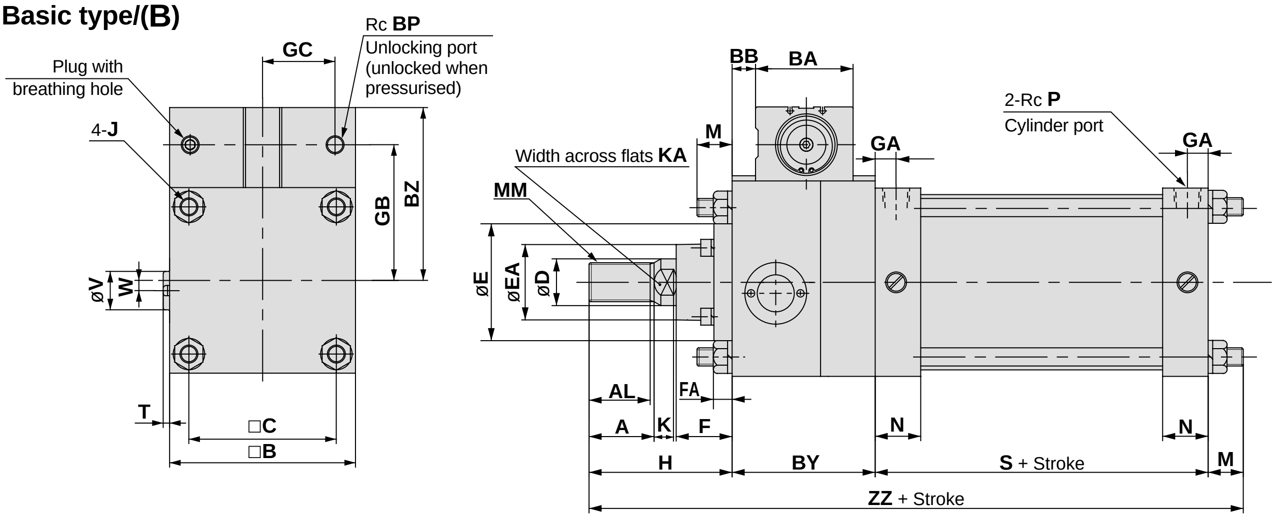
∗ Since the lock section for Series CLS is normally replaced as a unit, replacement seal kits are for the cylinder section only.

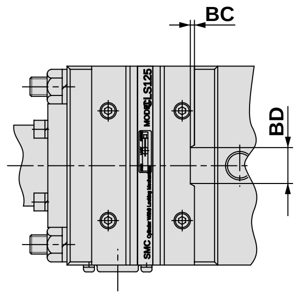
∗∗ Seal kits are sets consisting of items 60, 62, 63, 64, 65 and 67, which can be ordered using the order number for each cylinder bore size.

Series CLS

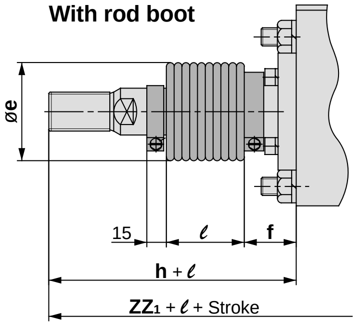
Dimensions

Basic type/(B)

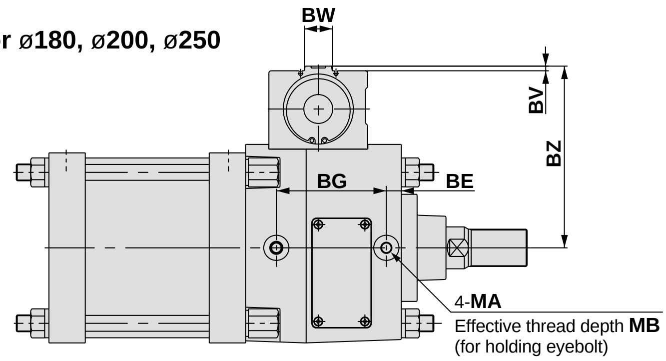




With rod boot



For ø180, ø200, ø250



(mm)

Bore size (mm)	Stroke range (mm)	A	AL	B	BA	BB	BC	BD	BE	BG	BY	BZ	BV	BW	BP	C	D	E	EA	F	FA	GA	GB	GC	H	J	K	KA	M	MM	MA	MB	N
125	to 1000	50	47	145	75	18	—	—	—	—	110	136	—	—	1/4	115	36	90	59	43	14	16	107	58	110	M14 x 1.5	15	31	27	M30 x 1.5	—	—	35
140	to 1000	50	47	161	78	18	3	30	—	—	110	146	—	—	1/4	128	36	90	59	43	14	16	114	64	110	M14 x 1.5	15	31	27	M30 x 1.5	—	—	35
160	to 1200	56	53	182	95	23	5	46	—	—	132	169	—	—	1/4	144	40	90	59	43	14	18.5	130	74	120	M16 x 1.5	17	36	30.5	M36 x 1.5	—	—	39
180	to 1200	63	60	204	106	36	—	—	16	118	167	195	5	30	3/8	162	45	115	70	48	17	18.5	149	86	135	M18 x 1.5	20	41	35	M40 x 1.5	M12	25	39
200	to 1200	63	60	226	124	40.5	—	—	21	131	187	216	5.5	34	3/8	182	50	115	74	48	17	18.5	165	97	135	M20 x 1.5	20	46	35	M45 x 1.5	M16	31	39
250	to 1200	71	67	277	152	58	—	—	35	155	237	261.5	6	42	1/2	225	60	140	86	60	20	23	200	117	160	M24 x 1.5	25	56	41.5	M56 x 2	M20	41	49

(mm)

Bore size (mm)	P	S	T	V	W	ZZ
125	1/2	98	5	30	—	345
140	1/2	98	5	30	8	345
160	3/4	106	5	30	9	388.5
180	3/4	111	—	—	—	448
200	3/4	111	—	—	—	468
250	1	141	—	—	—	579.5

With Rod Boot

(mm)

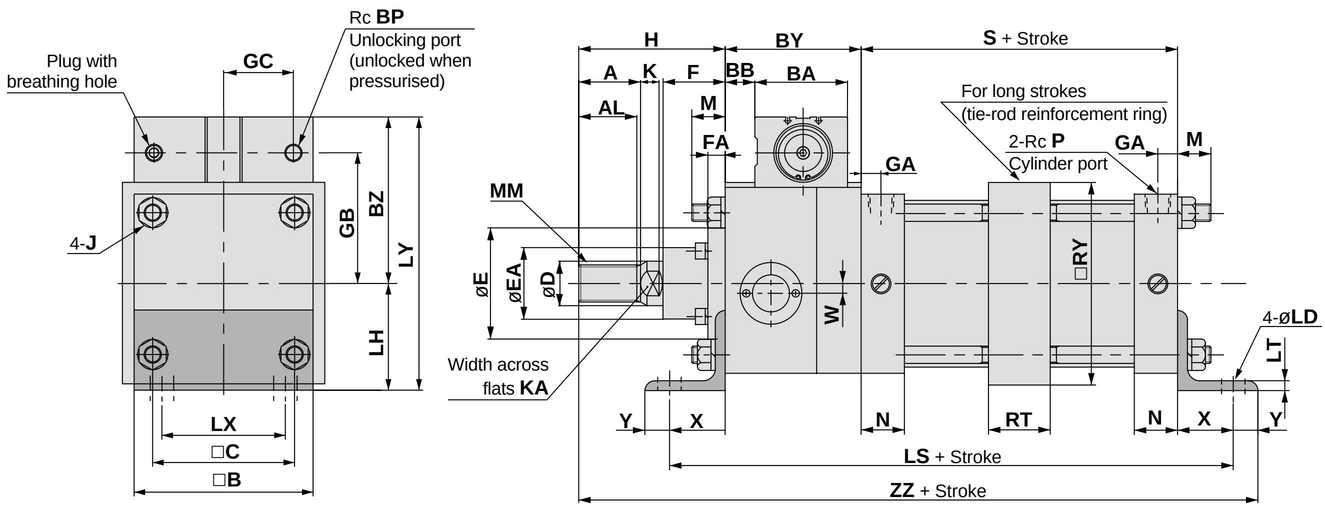
Bore size (mm)	Stroke range (mm)	e	f	h	ℓ	ZZ_1
125	30 to 1000	75	40	133	0.2 stroke	368
140	30 to 1000	75	40	133	0.2 stroke	368
160	30 to 1200	75	40	141	0.2 stroke	409.5
180	30 to 1200	85	45	153	0.2 stroke	466
200	30 to 1200	90	45	153	0.2 stroke	486
250	30 to 1200	105	55	176	0.17 stroke	595.5

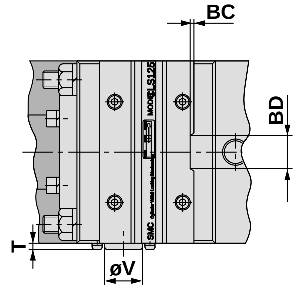
With Auto Switch

(mm)

Bore size (mm)	Stroke range (mm)	S	Without rod boot	With rod boot
			ZZ	ZZ_1
125	to 1000	98	345	368
140	to 1000	98	345	368
160	to 1200	106	388.5	409.5
180	to 1200	115	452	470
200	to 998	120	477	495

Axial foot type/(L)





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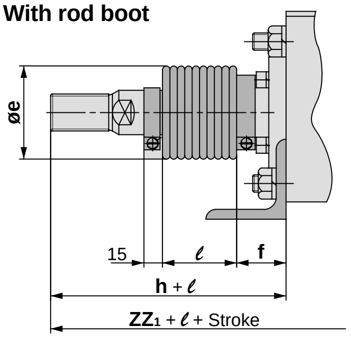
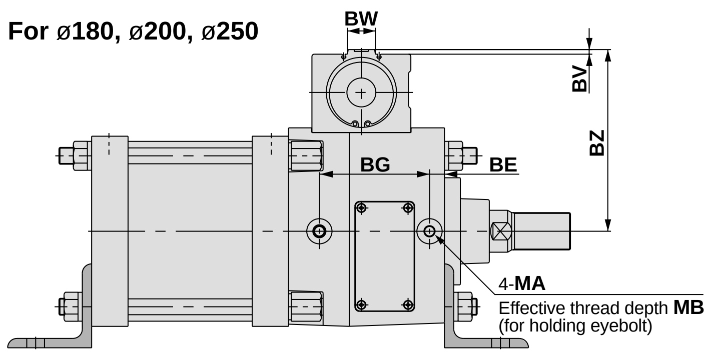


For ø180, ø200, ø250



(mm)

Bore size (mm)	Stroke range (mm)	Long stroke range (mm)	A	AL	B	BA	BB	BC	BD	BE	BG	BY	BZ	BV	BW	BP	C	D	E	EA	F	FA	GA	GB	GC	H	J	K	KA	LD	LH	LS	LT	LX	LY	M
125	to 1400	1401 to 1600	50	47	145	75	18	—	—	—	—	110	136	—	—	1/4	115	36	90	59	43	14	16	107	58	110	M14 x 1.5	15	31	19	85	298	8	100	221	27
140	to 1400	1401 to 1600	50	47	161	78	18	3	30	—	—	110	146	—	—	1/4	128	36	90	59	43	14	16	114	64	110	M14 x 1.5	15	31	19	100	298	9	112	246	27
160	to 1400	1401 to 1600	56	53	182	95	23	5	46	—	—	132	169	—	—	1/4	144	40	90	59	43	14	18.5	130	74	120	M16 x 1.5	17	36	19	106	338	9	118	275	30.5
180	to 1800	1801 to 2000	63	60	204	106	36	—	—	16	118	167	195	5	30	3/8	162	45	115	70	48	17	18.5	149	86	135	M18 x 1.5	20	41	24	125	398	10	132	320	35
200	to 1800	1801 to 2000	63	60	226	124	40.5	—	—	21	131	187	216	5.5	34	3/8	182	50	115	74	48	17	18.5	165	97	135	M20 x 1.5	20	46	24	132	418	10	150	348	35
250	to 2000	2001 to 2400	71	67	277	152	58	—	—	35	155	237	261.5	6	42	1/2	225	60	140	86	60	20	23	200	117	160	M24 x 1.5	25	56	29	160	538	12	180	421.5	41.5

(mm)

Bore size (mm)	MM	MA	MB	N	P	RT	RY	S	T	V	W	X	Y	ZZ
125	M30 x 1.5	—	—	35	1/2	36	164	98	5	30	—	45	20	383
140	M30 x 1.5	—	—	35	1/2	36	184	98	5	30	8	45	30	393
160	M36 x 1.5	—	—	39	3/4	45	204	106	5	30	9	50	25	433
180	M40 x 1.5	M12	25	39	3/4	45	228	111	—	—	—	60	30	503
200	M45 x 1.5	M16	31	39	3/4	45	257	111	—	—	—	60	30	523
250	M56 x 2	M20	41	49	1	55	325	141	—	—	—	80	40	658

With Rod Boot

(mm)

Bore size (mm)	Stroke range (mm)	e	f	h	ℓ	ZZ_1
125	30 to 1400	75	40	133	0.2 stroke	406
140	30 to 1400	75	40	133	0.2 stroke	416
160	30 to 1400	75	40	141	0.2 stroke	454
180	30 to 1800	85	45	153	0.2 stroke	521
200	30 to 1800	90	45	153	0.2 stroke	541
250	30 to 2000	105	55	176	0.17 stroke	674

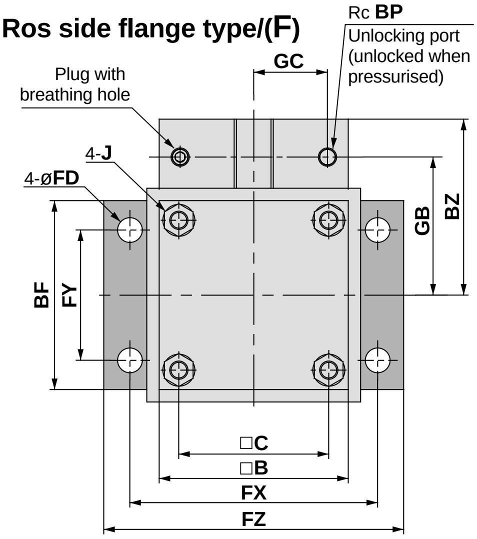
With Auto Switch

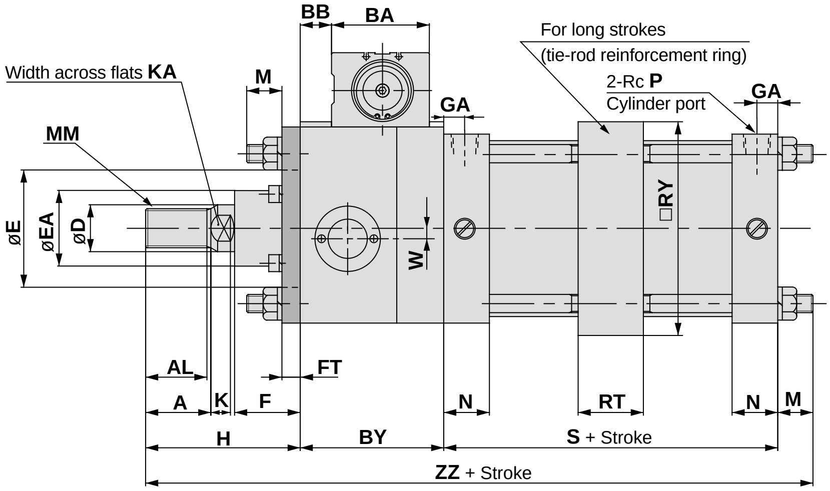
(mm)

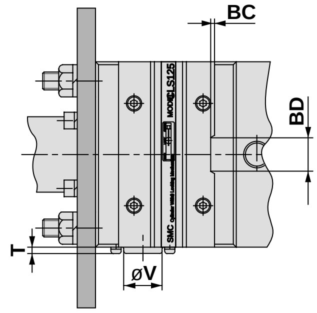
Bore size (mm)	Stroke range (mm)	S	LS	Without rod boot	With rod boot
				ZZ	ZZ_1
125	to 1400	98	298	383	406
140	to 1400	98	298	393	416
160	to 1400	106	338	433	454
180	to 1500	115	402	507	525
200	to 998	120	427	532	550

Dimensions

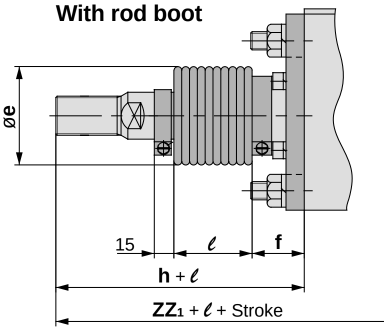
Ros side flange type/(F)



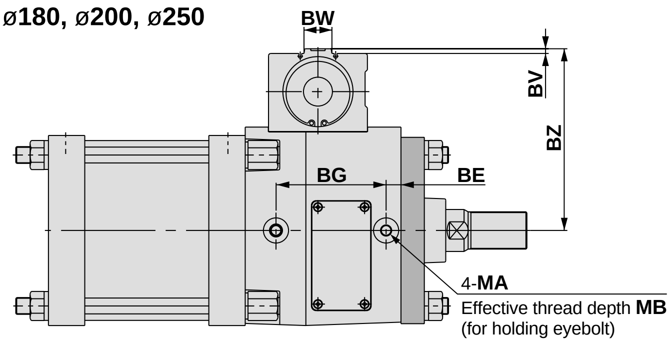




With rod boot



For ø180, ø200, ø250



(mm)

Bore size (mm)	Stroke range (mm)	Long stroke range (mm)	A	AL	B	BA	BB	BC	BD	BE	BG	BF	BY	BZ	BV	BW	BP	C	D	E	EA	F	FD	FT	FX	FY	FZ	GA	GB	GC	H	J	K	KA	M
125	to 1400	1401 to 1600	50	47	145	75	18	—	—	—	—	145	110	136	—	—	1/4	115	36	90	59	43	19	14	190	100	230	16	107	58	110	M14 x 1.5	15	31	19
140	to 1400	1401 to 1600	50	47	161	78	18	3	30	—	—	160	110	146	—	—	1/4	128	36	90	59	43	19	20	212	112	255	16	114	64	110	M14 x 1.5	15	31	19
160	to 1400	1401 to 1600	56	53	182	95	23	5	46	—	—	180	132	169	—	—	1/4	144	40	90	59	43	19	20	236	118	275	18.5	130	74	120	M16 x 1.5	17	36	22
180	to 1800	1801 to 2000	63	60	204	106	36	—	—	16	118	200	167	195	5	30	3/8	162	45	115	70	48	24	25	265	132	320	18.5	149	86	135	M18 x 1.5	20	41	26
200	to 1800	1801 to 2000	63	60	226	124	40.5	—	—	21	131	225	187	216	5.5	34	3/8	182	50	115	74	48	24	25	280	150	335	18.5	165	97	135	M20 x 1.5	20	46	26
250	to 2000	2001 to 2400	71	67	277	152	58	—	—	35	155	275	237	261.5	6	42	1/2	225	60	140	86	60	29	30	355	180	420	23	200	117	160	M24 x 1.5	25	56	30

(mm)

Bore size (mm)	MM	MA	MB	N	P	RT	RY	S	T	V	W	ZZ
125	M30 x 1.5	—	—	35	1/2	36	164	98	5	30	—	337
140	M30 x 1.5	—	—	35	1/2	36	184	98	5	30	8	337
160	M36 x 1.5	—	—	39	3/4	45	204	106	5	30	9	380
180	M40 x 1.5	M12	25	39	3/4	45	228	111	—	—	—	439
200	M45 x 1.5	M16	31	39	3/4	45	257	111	—	—	—	459
250	M56 x 2	M20	41	49	1	55	325	141	—	—	—	568

With Rod Boot

(mm)

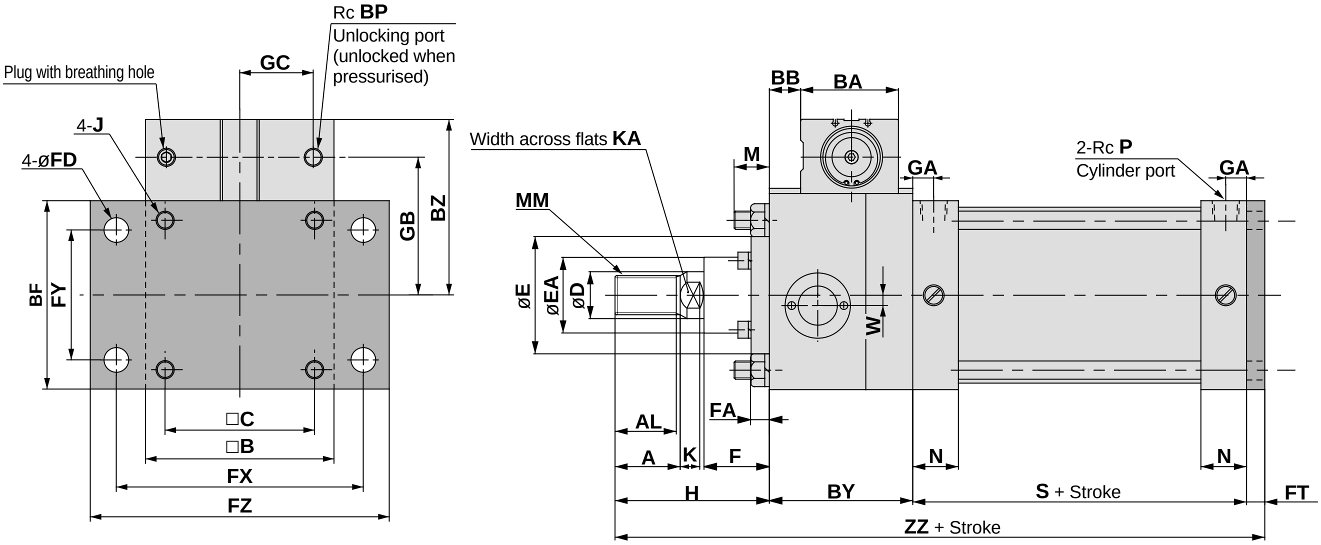
Bore size (mm)	Stroke range (mm)	e	f	h	ℓ	ZZ_1
125	30 to 1400	75	40	133	0.2 stroke	360
140	30 to 1400	75	40	133	0.2 stroke	360
160	30 to 1400	75	40	141	0.2 stroke	401
180	30 to 1800	85	45	153	0.2 stroke	457
200	30 to 1800	90	45	153	0.2 stroke	477
250	30 to 2000	105	55	176	0.17 stroke	584

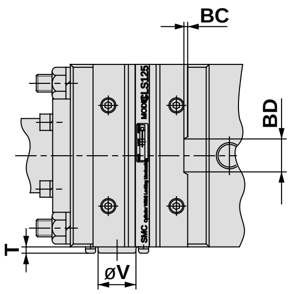
With Auto Switch

(mm)

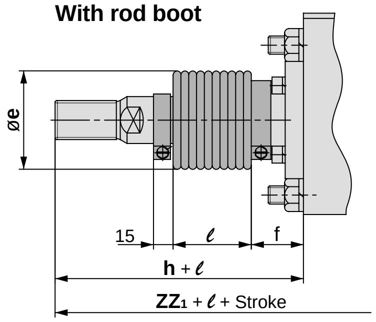
Bore size (mm)	Stroke range (mm)	S	Without rod boot	With rod boot
			ZZ	ZZ_1
125	to 1400	98	337	360
140	to 1400	98	337	360
160	to 1400	106	380	401
180	to 1500	115	443	461
200	to 998	120	468	486

Head side flange type/(G)

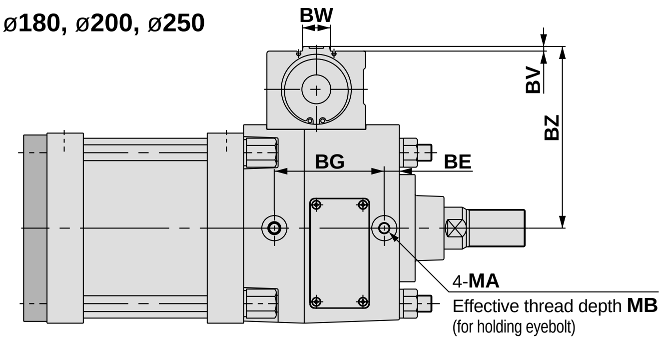




With rod boot



For ø180, ø200, ø250



(mm)

Bore size (mm)	Stroke range (mm)	A	AL	B	BA	BB	BC	BD	BE	BG	BF	BY	BZ	BV	BW	BP	C	D	E	EA	F	FA	FD	FT	FX	FY	FZ	GA	GB	GC	H	J	K	KA	M
125	to 1000	50	47	145	75	18	—	—	—		145	110	136	—	—	1/4	115	36	90	59	43	14	19	14	190	100	230	16	107	58	110	M14 x 1.5	15	31	19
140	to 1000	50	47	161	78	18	3	30	—		160	110	146	—	—	1/4	128	36	90	59	43	14	19	20	212	112	255	16	114	64	110	M14 x 1.5	15	31	19
160	to 1200	56	53	182	95	23	5	46	—		180	132	169	—	—	1/4	144	40	90	59	43	14	19	20	236	118	275	18.5	130	74	120	M16 x 1.5	17	36	22
180	to 1200	63	60	204	106	36	—	—	16	118	200	167	195	5	30	3/8	162	45	115	70	48	17	24	25	265	132	320	18.5	149	86	135	M18 x 1.5	20	41	26
200	to 1200	63	60	226	124	40.5	—	—	21	131	225	187	216	5.5	34	3/8	182	50	115	74	48	17	24	25	280	150	335	18.5	165	97	135	M20 x 1.5	20	46	26
250	to 1200	71	67	277	152	58	—	—	35	155	275	237	261.5	6	42	1/2	225	60	140	86	60	20	29	30	355	180	420	23	200	117	160	M24 x 1.5	25	56	30

(mm)

Bore size (mm)	MM	MA	MB	N	P	S	T	V	W	ZZ
125	M30 x 1.5	—	—	35	1/2	98	5	30	—	332
140	M30 x 1.5	—	—	35	1/2	98	5	30	8	338
160	M36 x 1.5	—	—	39	3/4	106	5	30	9	378
180	M40 x 1.5	M12	25	39	3/4	111	—	—	—	438
200	M45 x 1.5	M16	31	39	3/4	111	—	—	—	458
250	M56 x 2	M20	41	49	1	141	—	—	—	568

With Rod Boot (mm)

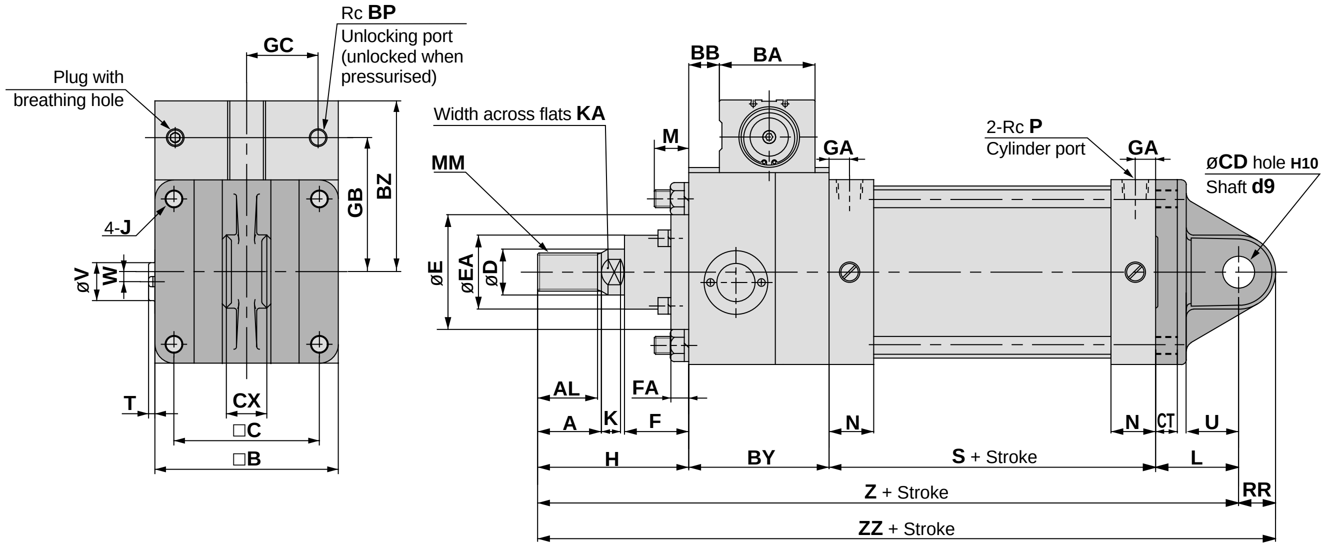
Bore size (mm)	Stroke range (mm)	e	f	h	ℓ	ZZ_1
125	30 to 1000	75	40	133	0.2 stroke	355
140	30 to 1000	75	40	133	0.2 stroke	361
160	30 to 1200	75	40	141	0.2 stroke	399
180	30 to 1200	85	45	153	0.2 stroke	456
200	30 to 1200	90	45	153	0.2 stroke	476
250	30 to 1200	105	55	176	0.17 stroke	584

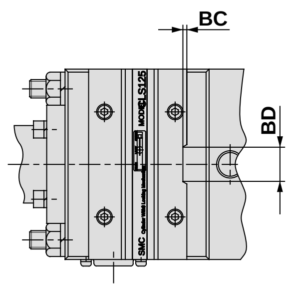
With Auto Switch (mm)

Bore size (mm)	Stroke range (mm)	S	Without rod boot	With rod boot
			ZZ	ZZ_1
125	to 1000	98	332	355
140	to 1000	98	338	361
160	to 1200	106	378	399
180	to 1200	115	442	460
200	to 998	120	467	485

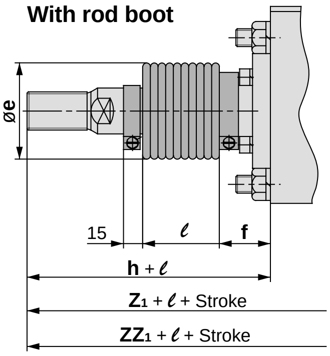
Dimensions

Single clevis type/(C)

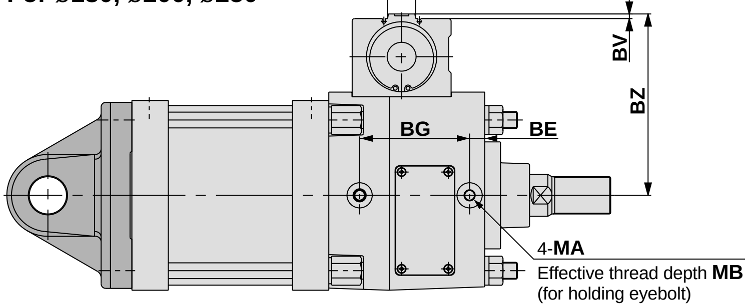




With rod boot



For ø180, ø200, ø250



(mm)

Bore size (mm)	Stroke range (mm)	A	AL	B	BA	BB	BC	BD	BE	BG	BY	BZ	BV	BW	BP	C	CDH10	CT	CX	D	E	EA	F	FA	GA	GB	GC	H	J	K	KA	L	M
125	to 1000	50	47	145	75	18	—	—	—		110	136	—	—	1/4	115	$25^{+0.084}_{0}$	17	$32^{-0.1}_{-0.3}$	36	90	59	43	14	16	107	58	110	M14 x 1.5	15	31	65	19
140	to 1000	50	47	161	78	18	3	30	—		110	146	—	—	1/4	128	$28^{+0.084}_{0}$	17	$36^{-0.1}_{-0.3}$	36	90	59	43	14	16	114	64	110	M14 x 1.5	15	31	75	19
160	to 1200	56	53	182	95	23	5	46	—		132	169	—	—	1/4	144	$32^{+0.100}_{0}$	20	$40^{-0.1}_{-0.3}$	40	90	59	43	14	18.5	130	74	120	M16 x 1.5	17	36	80	22
180	to 1200	63	60	204	106	36	—	—	16	118	167	195	5	30	3/8	162	$40^{+0.100}_{0}$	23	$50^{-0.1}_{-0.3}$	45	115	70	48	17	18.5	149	86	135	M18 x 1.5	20	41	90	26
200	to 1200	63	60	226	124	40.5	—	—	21	131	187	216	5.5	34	3/8	182	$40^{+0.100}_{0}$	25	$50^{-0.1}_{-0.3}$	50	115	74	48	17	18.5	165	97	135	M20 x 1.5	20	46	90	26
250	to 1200	71	67	277	152	58	—	—	35	155	237	261.5	6	42	1/2	225	$50^{+0.100}_{0}$	30	$63^{-0.1}_{-0.3}$	60	140	86	60	20	23	200	117	160	M24 x 1.5	25	56	110	30

(mm)

Bore size (mm)	MM	MA	MB	N	P	RR	S	T	U	V	W	Z	ZZ
125	M30 x 1.5	—	—	35	1/2	29	98	5	35	30	—	383	412
140	M30 x 1.5	—	—	35	1/2	32	98	5	40	30	8	393	425
160	M36 x 1.5	—	—	39	3/4	36	106	5	45	30	9	438	474
180	M40 x 1.5	M12	25	39	3/4	44	111	—	50	—	—	503	547
200	M45 x 1.5	M16	31	39	3/4	44	111	—	50	—	—	523	567
250	M56 x 2	M20	41	49	1	55	141	—	65	—	—	648	703

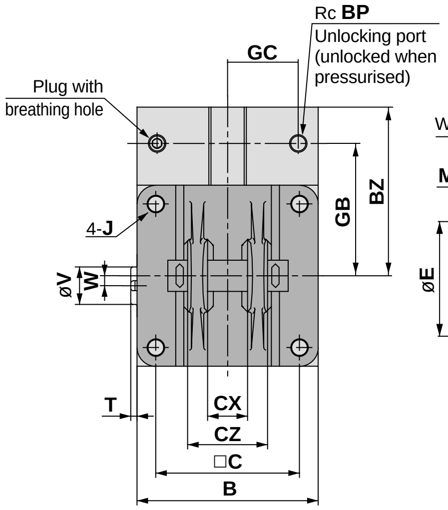
With Rod Boot (mm)

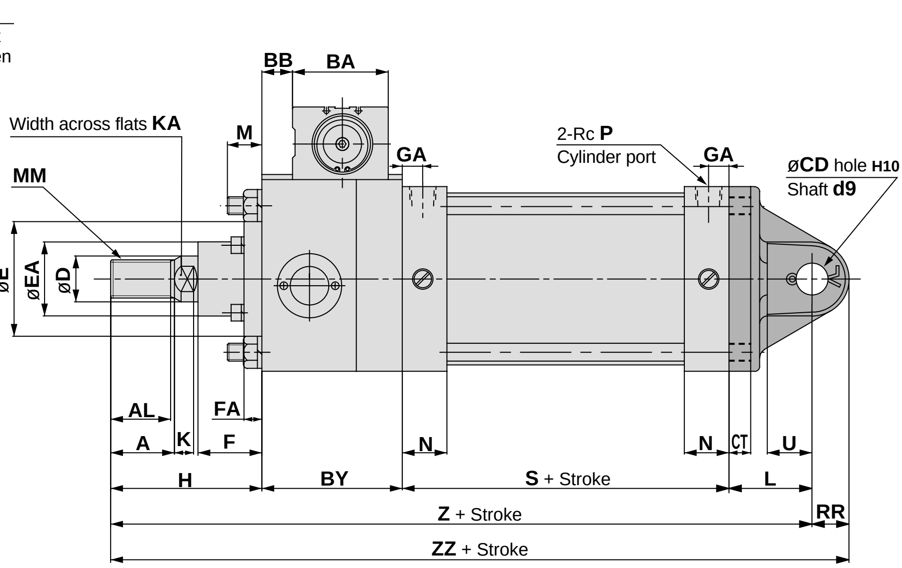
Bore size (mm)	Stroke range (mm)	e	f	h	ℓ	Z_1	ZZ_1
125	30 to 1000	75	40	133	0.2 stroke	406	435
140	30 to 1000	75	40	133	0.2 stroke	416	448
160	30 to 1200	75	40	141	0.2 stroke	459	495
180	30 to 1200	85	45	153	0.2 stroke	521	565
200	30 to 1200	90	45	153	0.2 stroke	541	585
250	30 to 1200	105	55	176	0.17 stroke	664	719

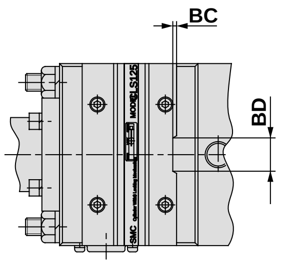
With Auto Switch (mm)

Bore size (mm)	Stroke range (mm)	S	Without rod boot		With rod boot	
			Z	ZZ	Z_1	ZZ_1
125	to 1000	98	383	412	406	435
140	to 1000	98	393	425	416	448
160	to 1200	106	438	474	459	495
180	to 1200	115	507	551	525	569
200	to 998	120	532	576	550	594

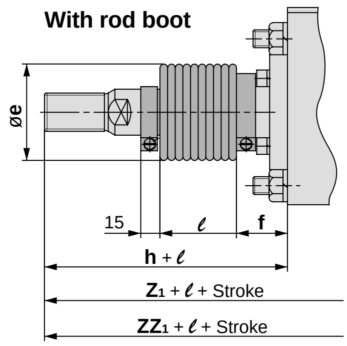
Double clevis type/(D)



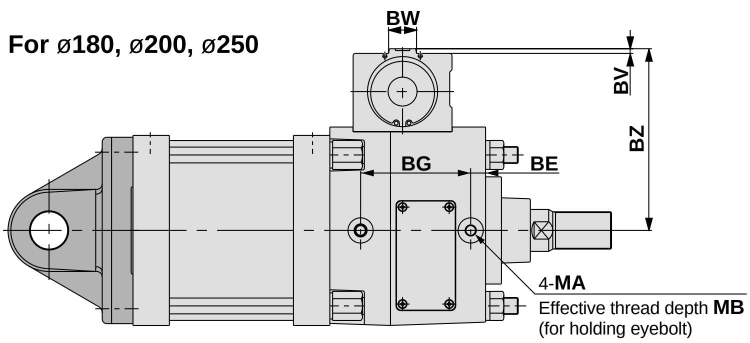




With rod boot



For ø180, ø200, ø250



(mm)

Bore size (mm)	Stroke range (mm)	A	AL	B	BA	BB	BC	BD	BE	BG	BY	BZ	BV	BW	BP	C	CD_{H10}	CT	CX	CZ	D	E	EA	F	FA	GA	GB	GC	H	J	K	KA	L
125	to 1000	50	47	145	75	18	—	—	—		110	136	—	—	1/4	115	$25^{+0.084}_{0}$	17	$32^{+0.3}_{+0.1}$	$64^{0}_{-0.2}$	36	90	59	43	14	16	107	58	110	M14 x 1.5	15	31	65
140	to 1000	50	47	161	78	18	3	30	—		110	146	—	—	1/4	128	$28^{+0.084}_{0}$	17	$36^{+0.3}_{+0.1}$	$72^{0}_{-0.2}$	36	90	59	43	14	16	114	64	110	M14 x 1.5	15	31	75
160	to 1200	56	53	182	95	23	5	46	—		132	169	—	—	1/4	144	$32^{+0.100}_{0}$	20	$40^{+0.3}_{+0.1}$	$80^{0}_{-0.2}$	40	90	59	43	14	18.5	130	74	120	M16 x 1.5	17	36	80
180	to 1200	63	60	204	106	36	—	—	16	118	167	195	5	30	3/8	162	$40^{+0.100}_{0}$	23	$50^{+0.3}_{+0.1}$	$100^{-0.1}_{-0.3}$	45	115	70	48	17	18.5	149	86	135	M18 x 1.5	20	41	90
200	to 1200	63	60	226	124	40.5	—	—	21	131	187	216	5.5	34	3/8	182	$40^{+0.100}_{0}$	25	$50^{+0.3}_{+0.1}$	$100^{-0.1}_{-0.3}$	50	115	74	48	17	18.5	165	97	135	M20 x 1.5	20	46	90
250	to 1200	71	67	277	152	58	—	—	35	155	237	261.5	6	42	1/2	225	$50^{+0.100}_{0}$	30	$63^{+0.3}_{+0.1}$	$126^{-0.1}_{-0.3}$	60	140	86	60	20	23	200	117	160	M24 x 1.5	25	56	110

(mm)

Bore size (mm)	M	MA	MB	MM	N	P	RR	S	T	U	V	W	Z	ZZ
125	19	—	—	M30 x 1.5	35	1/2	29	98	5	35	30	—	383	412
140	19	—	—	M30 x 1.5	35	1/2	32	98	5	40	30	8	393	425
160	22	—	—	M36 x 1.5	39	3/4	36	106	5	45	30	9	438	474
180	26	M12	25	M40 x 1.5	39	3/4	44	111	—	50	—	—	503	547
200	26	M16	31	M45 x 1.5	39	3/4	44	111	—	50	—	—	523	567
250	30	M20	41	M56 x 2	49	1	55	141	—	65	—	—	648	703

With Rod Boot (mm)

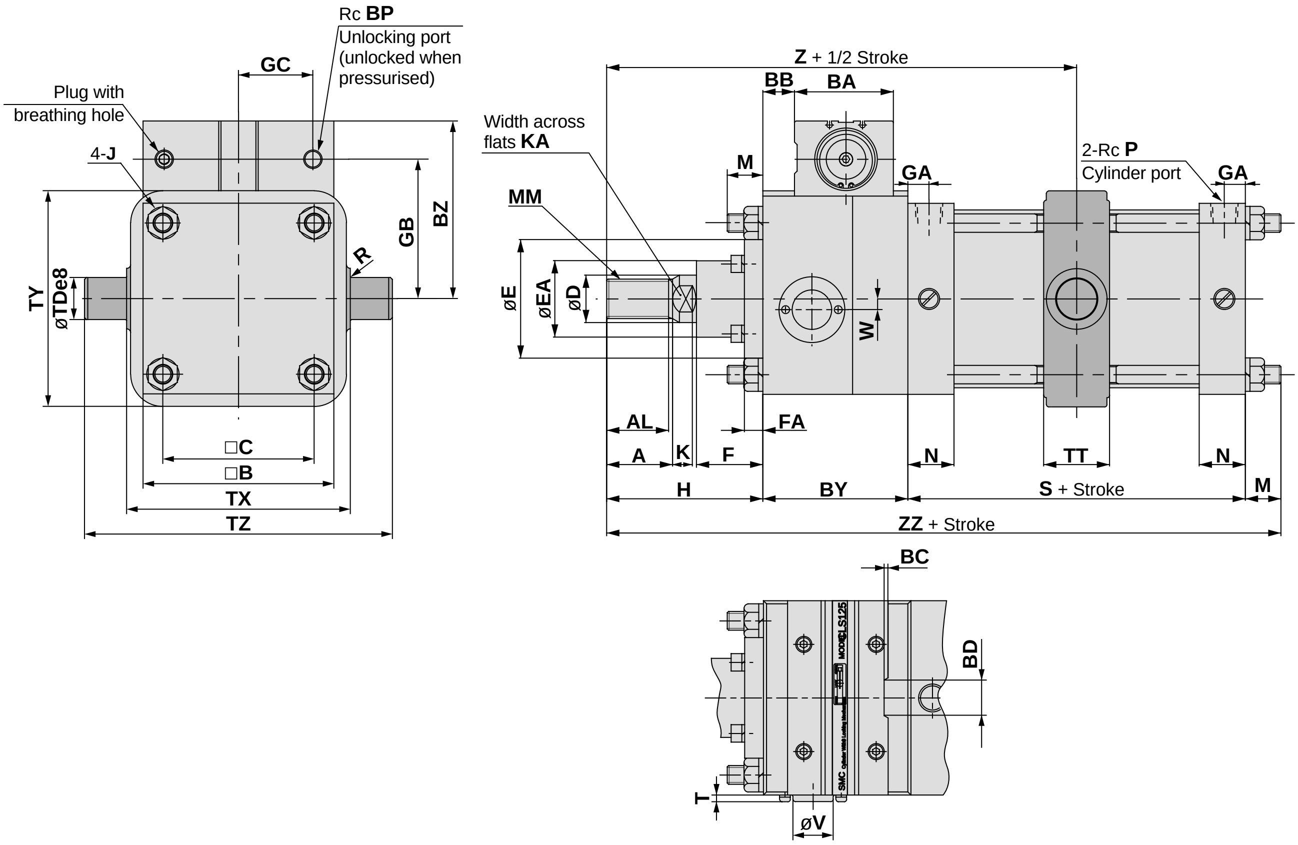
Bore size (mm)	Stroke range (mm)	e	f	h	ℓ	Z_1	ZZ_1
125	30 to 1000	75	40	133	0.2 stroke	406	435
140	30 to 1000	75	40	133	0.2 stroke	416	448
160	30 to 1200	75	40	141	0.2 stroke	459	495
180	30 to 1200	85	45	153	0.2 stroke	521	565
200	30 to 1200	90	45	153	0.2 stroke	541	585
250	30 to 1200	105	55	176	0.17 stroke	664	719

With Auto Switch (mm)

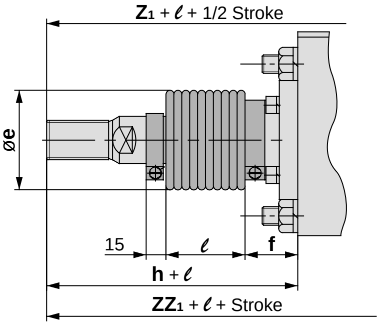
Bore size (mm)	Stroke range (mm)	S	Without rod boot		With rod boot	
			Z	ZZ	Z_1	ZZ_1
125	to 1000	98	383	412	406	435
140	to 1000	98	393	425	416	448
160	to 1200	106	438	474	459	495
180	to 1200	115	507	551	525	569
200	to 998	120	532	576	550	594

Dimensions

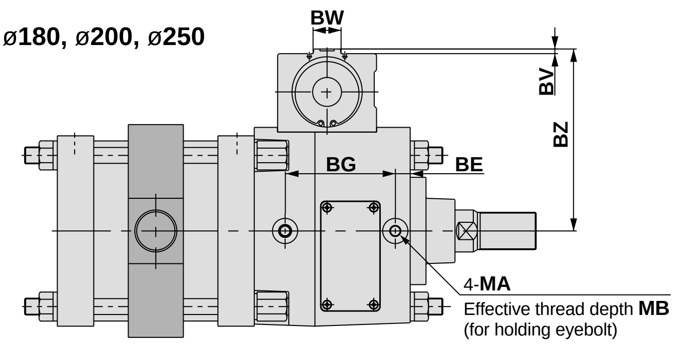
Centre trunnion type/(T)



With rod boot



For ø180, ø200, ø250



(mm)

Bore size (mm)	Stroke range (mm)	A	AL	B	BA	BB	BC	BD	BE	BG	BY	BZ	BV	BW	BP	C	D	E	EA	F	FA	GA	GB	GC	H	J	K	KA	M	MM	MA	MB	N	P
125	25 to 1000	50	47	145	75	18	—	—	—		110	136	—	—	1/4	115	36	90	59	43	14	16	107	58	110	M14 x 1.5	15	31	19	M30 x 1.5	—	—	35	1/2
140	30 to 1000	50	47	161	78	18	3	30	—		110	146	—	—	1/4	128	36	90	59	43	14	16	114	64	110	M14 x 1.5	15	31	19	M30 x 1.5	—	—	35	1/2
160	35 to 1200	56	53	182	95	23	5	46	—		132	169	—	—	1/4	144	40	90	59	43	14	18.5	130	74	120	M16 x 1.5	17	36	22	M36 x 1.5	—	—	39	3/4
180	30 to 1200	63	60	204	106	36	—	—	16	118	167	195	5	30	3/8	162	45	115	70	48	17	18.5	149	86	135	M18 x 1.5	20	41	26	M40 x 1.5	M12	25	39	3/4
200	30 to 1200	63	60	226	124	40.5	—	—	21	131	187	216	5.5	34	3/8	182	50	115	74	48	17	18.5	165	97	135	M20 x 1.5	20	46	26	M45 x 1.5	M16	31	39	3/4
250	30 to 1200	71	67	277	152	58	—	—	35	155	237	261.5	6	42	1/2	225	60	140	86	60	20	23	200	117	160	M24 x 1.5	25	56	30	M56 x 2	M20	41	49	1

(mm)

Bore size (mm)	R	S	T	TD_{e8}	TT	TX	TY	TZ	V	W	Z	ZZ
125	1	98	5	$32^{-0.050}_{-0.089}$	50	170	164	234	30	—	269	337
140	1.5	98	5	$36^{-0.050}_{-0.089}$	55	190	184	262	30	8	269	337
160	1.5	106	5	$40^{-0.050}_{-0.089}$	60	212	204	292	30	9	305	380
180	2	111	—	$45^{-0.050}_{-0.089}$	59	236	228	326	—	—	357.5	439
200	2	111	—	$45^{-0.050}_{-0.089}$	59	265	257	355	—	—	377.5	459
250	3	141	—	$56^{-0.060}_{-0.106}$	69	335	325	447	—	—	467.5	568

With Rod Boot

(mm)

Bore size (mm)	Stroke range (mm)	e	f	h	ℓ	Z_1	ZZ_1
125	30 to 1000	75	40	133	0.2 stroke	292	360
140	30 to 1000	75	40	133	0.2 stroke	292	360
160	30 to 1200	75	40	141	0.2 stroke	326	401
180	30 to 1200	85	45	153	0.2 stroke	375.5	457
200	30 to 1200	90	45	153	0.2 stroke	395.5	477
250	30 to 1200	105	55	176	0.17 stroke	483.5	584

With Auto Switch

(mm)

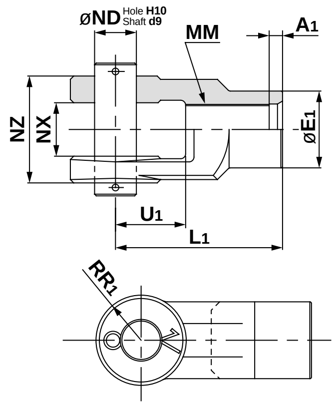
Bore size (mm)	Stroke range (mm)	S	Without rod boot		With rod boot	
			Z	ZZ	Z_1	ZZ_1
125	to 1000	98	269	337	292	360
140	to 1000	98	269	337	292	360
160	to 1200	106	305	380	326	401
180	to 1200	115	359.5	443	377.5	461
200	to 998	120	382	468	400	486

Series CLS

Accessory Dimensions

Y Type Double Knuckle Joint

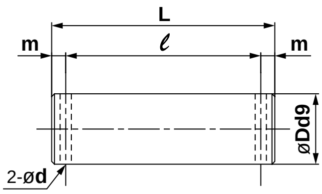
∗ Pins and snap rings for double clevis and double knuckle joint are included when shipped.



Material: Cast iron (mm)

Model	Applicable bore size (mm)	A_1	E_1	L_1	MM	ND_{H10}	NX	NZ	RR_1	U_1
Y-12	**125**	8	46	100	M30 x 1.5	$25^{+0.084}_{0}$	$32^{+0.3}_{+0.1}$	$64^{-0.1}_{-0.3}$	27	42
Y-14	**140**	8	48	105	M30 x 1.5	$28^{+0.084}_{0}$	$36^{+0.3}_{+0.1}$	$72^{-0.1}_{-0.3}$	30	47
Y-16	**160**	8	55	110	M36 x 1.5	$32^{+0.1}_{0}$	$40^{+0.3}_{+0.1}$	$80^{-0.1}_{-0.3}$	34	46
Y-18	**180**	8	70	125	M40 x 1.5	$40^{+0.1}_{0}$	$50^{+0.3}_{+0.1}$	$100^{-0.1}_{-0.3}$	42.5	54
Y-20	**200**	8	70	125	M45 x 1.5	$40^{+0.1}_{0}$	$50^{+0.3}_{+0.1}$	$100^{-0.1}_{-0.3}$	42.5	54
Y-25	**250**	9	86	160	M56 x 2	$50^{+0.1}_{0}$	$63^{+0.3}_{+0.1}$	$126^{-0.1}_{-0.3}$	53	81

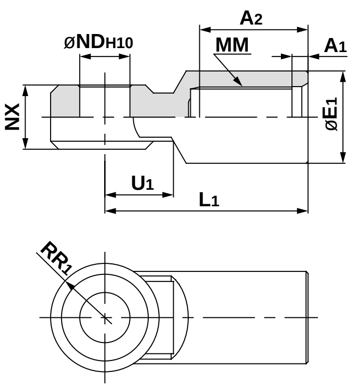
Clevis Pin/Knuckle Pin



Material: Carbon steel (mm)

Model	Applicable bore size (mm)	d (drill through)	Dd9	L	ℓ	m	Cotter pin
IY-12	**125**	4	$25^{-0.065}_{-0.117}$	79.5	69.5	5	ø4 x 40ℓ
IY-14	**140**	4	$28^{-0.065}_{-0.117}$	86.5	76.5	5	ø4 x 40ℓ
IY-16	**160**	4	$32^{-0.080}_{-0.142}$	94.5	84.5	5	ø4 x 40ℓ
IY-18	**180, 200**	4	$40^{-0.080}_{-0.142}$	115	105	5	ø4 x 55ℓ
IY-25	**250**	5	$50^{-0.080}_{-0.142}$	144	132	6	ø5 x 65ℓ

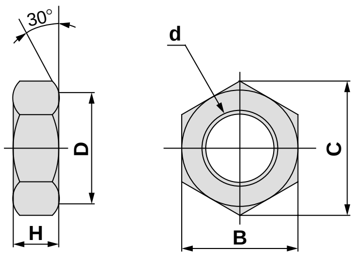
I Type Single Knuckle Joint



Material: Cast iron (mm)

Model	Applicable bore size (mm)	A_1	A_2	E_1	L_1	MM	ND_{H10}	NX	RR_1	U_1
I-12	**125**	8	54	46	100	M30 x 1.5	$25^{+0.084}_{0}$	$32^{-0.1}_{-0.3}$	27	33
I-14	**140**	8	54	48	105	M30 x 1.5	$28^{+0.084}_{0}$	$36^{-0.1}_{-0.3}$	30	39
I-16	**160**	8	60	55	110	M36 x 1.5	$32^{+0.1}_{0}$	$40^{-0.1}_{-0.3}$	34	39
I-18	**180**	8	67	70	125	M40 x 1.5	$40^{+0.1}_{0}$	$50^{-0.1}_{-0.3}$	42.5	44
I-20	**200**	8	67	70	125	M45 x 1.5	$40^{+0.1}_{0}$	$50^{-0.1}_{-0.3}$	42.5	44
I-25	**250**	9	75.5	86	160	M56 x 2	$50^{+0.1}_{0}$	$63^{-0.1}_{-0.3}$	53	66

Rod End Nut

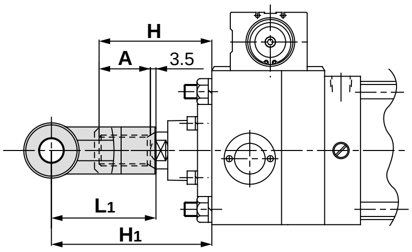


Material: Rolled steel (mm)

Model	Applicable bore size (mm)	d	H	B	C	D
NT-12	**125,140**	M30 x 1.5	18	46	53.1	44
NT-16	**160**	M36 x 1.5	21	55	63.5	53
NT-18	**180**	M40 x 1.5	23	60	69.3	57
NT-20	**200**	M45 x 1.5	27	70	80.8	67
NT-25	**250**	M56 x 2	34	85	98.1	82

Series CLS
Accessory Dimensions

Single/Double Knuckle Joint Mounting



(mm)

Bore size (mm) \ Symbol	H	A	L_1	H_1	Applicable knuckle joint part nos.	
					I type single knuckle	Y type double knuckle
125	110	50	100	156.5	I-12	Y-12
140	110	50	105	161.5	I-14	Y-14
160	120	56	110	170.5	I-16	Y-16
180	135	63	125	193.5	I-18	Y-18
200	135	63	125	193.5	I-20	Y-20
250	160	71	160	245.5	I-25	Y-25

A, H dimensions when single/ double knuckle joint and rod end nut are mounted together.

Bore size (mm)	A	H
125	65	125
140	65	125
160	76	140
180	83	155
200	88	160
250	106	195

* Single knuckle joint and double knuckle joint should be used separately. (Fasten by screwing completely into the rod end threads.)
* When using a single/double knuckle joint together with a rod end nut, the **A** and **H** dimensions should be extended. (For extension of the **A** and **H** dimensions, refer to the table above and specify the made-to-order product **–XA0**.)

Minimum Stroke for Auto Switch Mounting on Cylinder Unit

n: Quantity

Auto switch model	No. of auto switches mounted		Mounting brackets other than centre trunnion	Centre trunnion type				
				ø125	**ø140**	**ø160**	**ø180**	**ø200**
D-A9□	2 pcs. (Different sides, Same side), 1 pc.		15	100	105	110		
	"n" pcs.		$15 + 35\frac{(n-2)}{2}$ n = 2, 4, 6, 8···	$100 + 35\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$105 + 35\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$110 + 35\frac{(n-4)}{2}$ n = 4, 8, 12, 16···		
D-A9□V	2 pcs. (Different sides, Same side), 1 pc.		10	75	80	85		
	"n" pcs.		$10 + 25\frac{(n-2)}{2}$ n = 2, 4, 6, 8···	$75 + 25\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$80 + 25\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$85 + 25\frac{(n-4)}{2}$ n = 4, 8, 12, 16···		
D-M9□ **D-M9□W**	2 pcs. (Different sides, Same side), 1 pc.		15	105	110	115		
	"n" pcs.		$15 + 35\frac{(n-2)}{2}$ n = 2, 4, 6, 8···	$105 + 35\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$110 + 35\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$115 + 35\frac{(n-4)}{2}$ n = 4, 8, 12, 16···		
D-M9□V **D-M9□WV**	2 pcs. (Different sides, Same side), 1 pc.		10	80	85	90		
	"n" pcs.		$10 + 20\frac{(n-2)}{2}$ n = 2, 4, 6, 8···	$80 + 20\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$85 + 20\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$90 + 20\frac{(n-4)}{2}$ n = 4, 8, 12, 16···		
D-M9BAL	2 pcs. (Different sides, Same side), 1 pc.		25	120	125	130	135	
	"n" pcs.		$25 + 45\frac{(n-2)}{2}$ n = 2, 4, 6, 8···	$120 + 45\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$125 + 45\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$130 + 45\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$135 + 45\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	
D-A5□, A6□, A59W **D-F5□, J5□, F5□W, J59W** **D-F5BAL, F59F**	2 pcs. (Different sides, Same side), 1 pc.		25	125	135	135	150	150
	"n" pcs. (Same side)		$25 + 55\frac{(n-2)}{2}$ n = 2, 4, 6, 8···	$125 + 55\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$135 + 55\frac{(n-4)}{2}$ n = 4, 8, 12, 16···		$150 + 55\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	
D-F5NTL	2 pcs. (Different sides, Same side), 1 pc.		35	145	155		170	
	"n" pcs. (Same side)		$35 + 55\frac{(n-2)}{2}$ n = 2, 4, 6, 8···	$145 + 55\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$155 + 55\frac{(n-4)}{2}$ n = 4, 8, 12, 16···		$170 + 55\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	
D-A3□ **D-G39** **D-K39**	2 pcs.	Different sides	35	110				150
		Same side	100	110				150
	"n" pcs.	Different sides	35 + 30 (n – 2)	110 + 30 (n – 2) n = 2, 4, 6, 8···				150 + 30 (n – 2) n = 2, 4, 6, 8···
		Same side	100 + 100 (n – 2)	110 + 100 (n – 2) n = 2, 4, 6, 8···				150 + 100 (n – 2) n = 2, 4, 6, 8···
	1 pc.		15	110				150
D-A44	2 pcs.	Different sides	35	110				150
		Same side	55	110				150
	"n" pcs.	Different sides	35 + 30 (n – 2)	110 + 30 (n – 2) n = 2, 4, 6, 8···				150 + 30 (n – 2) n = 2, 4, 6, 8···
		Same side	55 + 55 (n – 2)	110 + 50 (n – 2) n = 2, 4, 6, 8···				150 + 50 (n – 2) n = 2, 4, 6, 8···
	1 pc.		15	110				150
D-Z7□, Z80 **D-Y59□, Y7P** **D-Y7□W**	2 pcs. (Different sides, Same side), 1 pc.		15	105		110	115	
	"n" pcs.		$15 + 40\frac{(n-2)}{2}$ n = 2, 4, 6, 8···	$105 + 40\frac{(n-4)}{2}$ n = 4, 8, 12, 16···		$110 + 40\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$115 + 40\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	
D-Y69□, Y7PV **D-Y7□WV**	2 pcs. (Different sides, Same side), 1 pc.		10	90		95	100	
	"n" pcs.		$10 + 30\frac{(n-2)}{2}$ n = 2, 4, 6, 8···	$90 + 30\frac{(n-4)}{2}$ n = 4, 8, 12, 16···		$95 + 30\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$100 + 30\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	
D-Y7BAL	2 pcs. (Different sides, Same side), 1 pc.		20	115		120	125	
	"n" pcs.		$20 + 45\frac{(n-2)}{2}$ n = 2, 4, 6, 8···	$115 + 45\frac{(n-4)}{2}$ n = 4, 8, 12, 16···		$120 + 45\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	$125 + 45\frac{(n-4)}{2}$ n = 4, 8, 12, 16···	

Other than the applicable auto switches listed in "How to Order", the following auto switches can be mounted.
For detailed specifications, refer to page 17 or "SMC Best Pneumatics" catalogue.

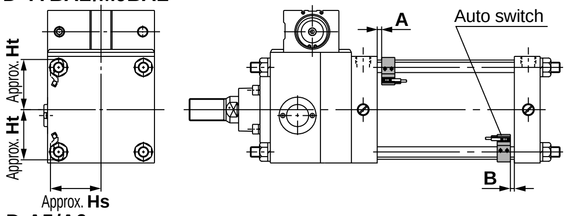
Type	Model	Electrical entry	Features
Reed switch	**D-A90V**	Grommet (In-line)	Without indicator light
	D-A93V, A96V		—
	D-Z73, Z76	Grommet (In-line)	
	D-A53, A56		
	D-A64, A67		Without indicator light
	D-Z80		
Solid state switch	**D-F59, F5P, J59**	Grommet (In-line)	—
	D-Y59A, Y59B, Y7P		
	D-F59W, F5PW, J59W		2-colour indication
	D-Y7NW, Y7PW, Y7BW		
	D-F5BAL, Y7BAL		2-colour indication, Water resistant
	D-F5NTL		With timer
	D-M9NV, M9PV, M9BV	Grommet (Perpendicular)	—
	D-Y69A, Y69B, Y7PV		
	D-M9NWV, M9PWV, M9BWV		2-color indication
	D-Y7NWV, Y7PWV, Y7BWV		

* With pre-wire connector is also available in solid state auto switches. For specifications, refer to "SMC Best Pneumatics" catalogue.
* Normally closed (NC = b contact), solid state switch (D-F9G/F9H/Y7G/Y7H type) are also available. For details, refer to "SMC Best Pneumatics" catalogue.

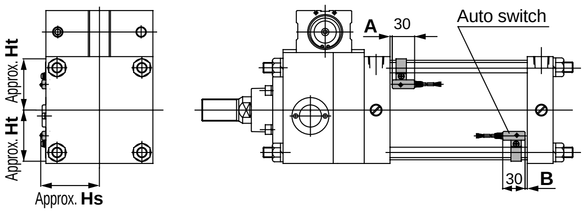
Cylinder Unit Auto Switches/Proper Mounting Position and Height for Stroke End Detection

<Tie-rod mounting type>

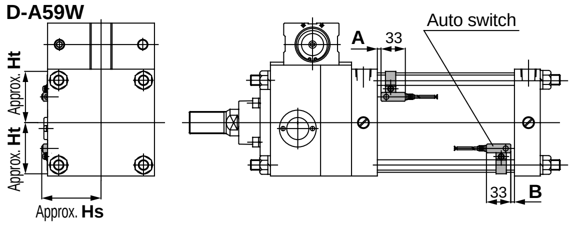
D-Y7□/Z80/A9□/A9□V
D-Y59□/Y69□/Y7P/Y7PV/M9□/M9□V
D-Y7□W/Y7□WV/M9□W/M9□WV
D-Y7BAL/M9BAL



D-F5□/J5□/D-F5NTL
D-F5□W/J59W
D-F5BAL/F59F

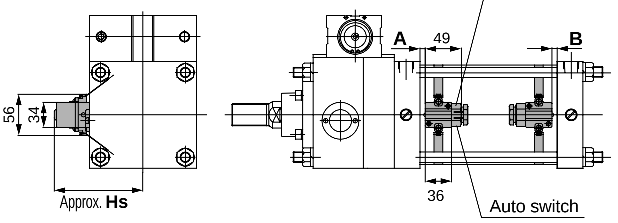


D-A5/A6
D-A59W

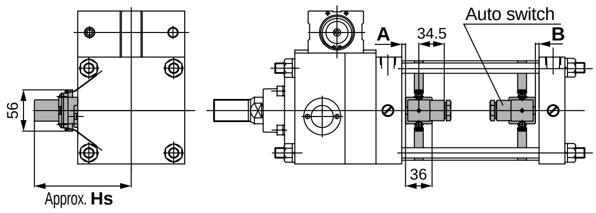


<Band mounting type>

D-A3
D-G39/K39



D-A44



Proper Auto Switch Mounting Positions

(mm)

Auto switch model / Bore size (mm)	D-M9□ D-M9□V D-M9□W D-M9□WV		D-A9□ D-A9□V		D-M9BAL		D-Z7□ D-Z80 D-Y5□ D-Y6□ D-Y7P D-Y7PV D-Y7□W D-Y7□WV D-Y7BAL		D-A5□ D-A6□ D-A3□ D-A44 D-G39 D-K39		D-A59W		D-F5□W D-J59W D-F5BAL D-F5□ D-J5□ D-F59F		D-F5NTL	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
125	8	8	4	4	7	7	1.5	1.5	0	0	2	2	4.5	4.5	9.5	9.5
140	8	8	4	4	7	7	1.5	1.5	0	0	2	2	4.5	4.5	9.5	9.5
160	8	8	4	4	7	7	1.5	1.5	0	0	2	2	4.5	4.5	9.5	9.5
180	13.5	11.5	9.5	7.5	12.5	10.5	7	5	3.5	1.5	7.5	5.5	10	8	15	13
200	16	14	12	10	15	13	9.5	7.5	6	4	10	8	12.5	10.5	17.5	15.5

∗ Figures in the table above are used as a reference when mounting the auto switches for stroke end detection. In the case of actually setting the auto switches, adjust them after confirming their operation.

Auto Switch Mounting Height

(mm)

Auto switch model / Bore size (mm)	D-A9□(V) D-M9□ D-M9□W D-M9BAL		D-M9□V D-M9□WV		D-Z7□ D-Z80 D-Y5□ D-Y6□ D-Y7P D-Y7PV D-Y7□W D-Y7□WV		D-Y7BAL		D-A3□ D-G39 D-K39	D-A44	D-A5□ D-A6□ D-A59W		D-F5□ D-J5□ D-F5□W D-J59W D-F5BAL D-F59F D-F5NTL	
	Hs	Ht	Hs	Ht	Hs	Ht	Hs	Ht	Hs	Ht	Hs	Ht	Hs	Ht
125	69	69.5	71.5	69.5	69	69.5	71	69.5	116	126	75.5	69.5	74.5	70
140	76	76	77.5	76	76	76	77	76	124	134	81	76.5	80	76.5
160	85	85	86	85	85	85	88.5	85	134.5	144.5	89	87.5	88	87.5
180	95	95	95.5	95	95	95	97.5	95	144	154	97.0	97.5	96	97.5
200	106	106	106	106	106	106	108	106	154	164	107.0	108.0	107.5	108.0

Operating Range

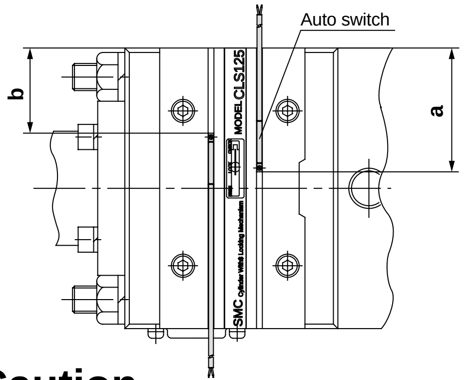
(mm)

Auto switch model	Bore size				
	125	**140**	**160**	**180**	**200**
D-M9□, D-M9□V	4	4.5	4.5	4.5	4.5
D-M9□W, D-M9□WV	7	7	7	7	7
D-M9BAL	7	7.5	8	8	8
D-A9□, D-A9□V	12	12.5	11.5	12	12.5
D-Z7□, Z80	14	14.5	13	14	14.5
D-A3□, A44, D-A5□, A6□	10	10	10	10	10
D-A59W	17	17	17	17	17
D-Y59□, Y69□, D-Y7P, Y7PV, D-Y7□W, Y7□WV	12	13	7	7.5	8
D-Y7BAL	6	6	7	7	7
D-F5□, J5□, F59F, D-F5□W, J59W, D-F5BAL, F5NTL	5	5	5.5	6	6
D-G39, K39	11	11	10	10	10

∗ Since this is a guideline including hysteresis, not meant to be guaranteed (assuming approximately ±30% dispersion). There may be the case to change substantially depending on an ambient environment.

Proper Mounting Positions for Lock Unit Auto Switches

The operating status (at the unlocked end) of the lock unit (brake piston) can be detected by a signal from the auto switch, which is mounted on the brake cylinder of the CLS series.



(mm)

Auto switch model / Bore size (mm)	D-A90 D-A93		D-M9N D-M9P D-M9B	
	a	**b**	**a**	**b**
125	62	42	58	46
140	70.5	50.5	66.5	54.5
160	70.5	50.5	66.5	54.5
180	80.5	60.5	76.5	64.5
200	86	66	82	70
250	102	82	98	86

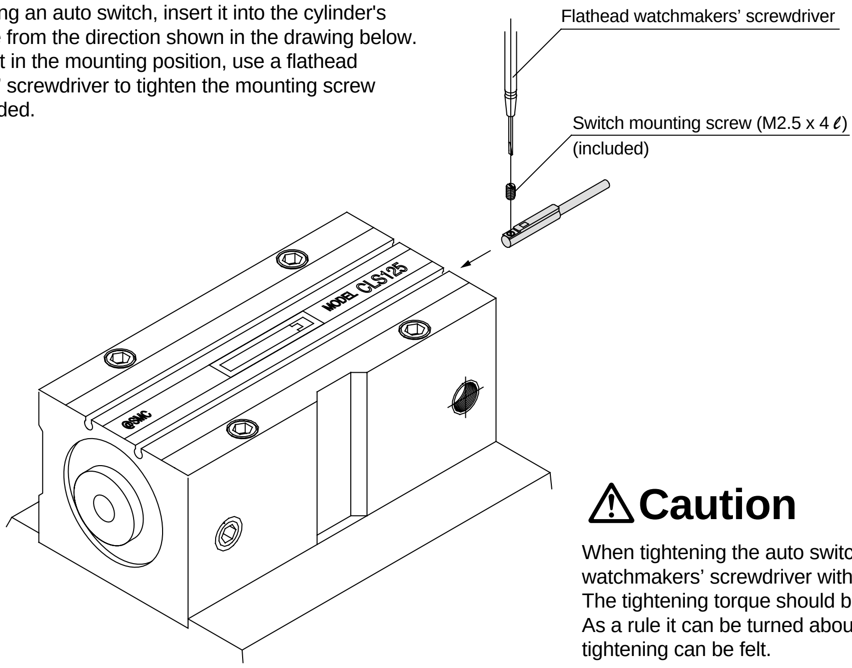
∗ Be sure to confirm operation after mounting.

⚠Caution

A single auto switch is available only on the lock unit.

Mounting of Lock Unit Auto Switches

When mounting an auto switch, insert it into the cylinder's switch groove from the direction shown in the drawing below. After placing it in the mounting position, use a flathead watchmakers' screwdriver to tighten the mounting screw which is included.



⚠Caution

When tightening the auto switch mounting screw, use a watchmakers' screwdriver with a handle 5 to 6 mm in diameter. The tightening torque should be 0.10 to 0.20 N·m.
As a rule it can be turned about 90° past the point at which tightening can be felt.

Series CLS
Auto Switch Specifications

Auto Switch Common Specifications

Type	Reed switch	Solid state switch
Leakage current	None	3-wire: 100 µA or less 2-wire: 0.8 mA or less
Operating time	1.2 ms	1 ms or less
Impact resistance	300 m/s^2	1000 m/s^2
Insulation resistance	50 MΩ or more at 500 VDC Mega (between lead wire and case)	
Withstand voltage	1000 VAC for 1 minute (between lead wire and case)	
Ambient temperature	–10 to 60°C	
Enclosure	IEC529 standard IP67, JIS C 0920 waterproof construction	

Lead Wire Length

Lead wire length indication

(Example) **D-M9P$\boxed{\text{L}}$**

Lead wire length

Nil	0.5 m
L	3 m
Z	5 m

Note 1) Applicable auto switch with 5 m lead wire "Z"
Reed switch: None
Solid state switch: Manufactured upon receipt of order as standard.

Note 2) To designate solid state switches with flexible specifications, add "-61" after the lead wire length.

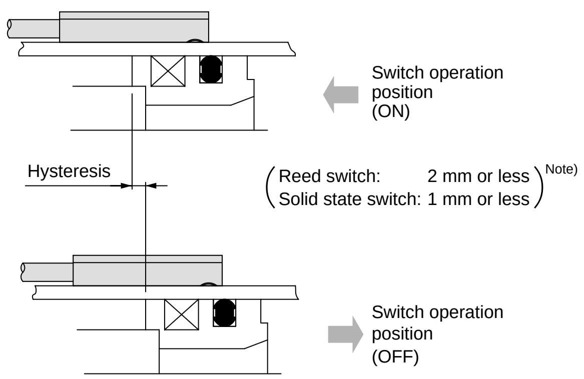
∗ Oilproof flexible heavy-duty cable is used for D-M9□ as standard. There is no need to add the suffix -61 to the end of part number.

(Example) D-M9PWVL-$\boxed{\text{61}}$

Flexible specification

Auto Switch Hysteresis

The hysteresis is the difference between the position of the auto switch as it turns "on" and as it turns "off". A part of operating range (one side) includes this hysteresis.



Note) Hysteresis may fluctuate due to the operating environment. Contact SMC if hysteresis causes an operational problem.

Contact Protection Boxes: CD-P11, CD-P12

<Applicable switch model>

D-A9/A9□V

The auto switches above do not have a built-in contact protection circuit. Therefore, please use a contact protection box with the switch for any of the following cases:

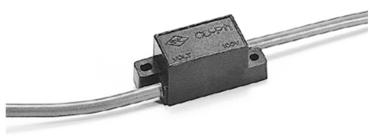
① **Where the operation load is an inductive load.**
② **Where the wiring length to load is greater than 5 m.**
③ **Where the load voltage is 100 VAC.**

The contact life may be shortened. (Due to permanent energising conditions.)

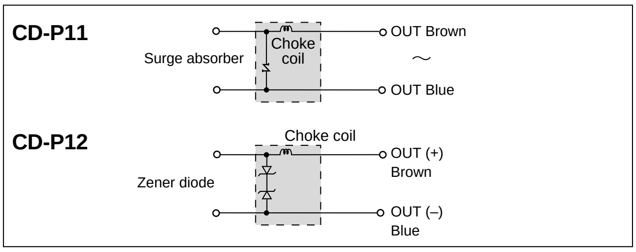
Specifications

Part no.	CD-P11		CD-P12
Load voltage	100 VAC	200 VAC	24 VDC
Maximum load current	25 mA	12.5 mA	50 mA

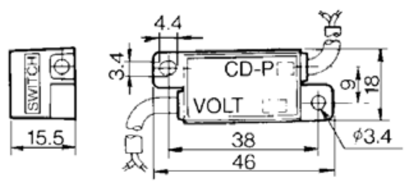
∗ Lead wire length — Switch conneciton side 0.5 m
Load connection side 0.5 m



Internal Circuit



Dimensions



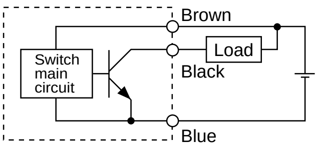
Connection

To connect a switch unit to a contact protection box, connect the lead wire from the side of the contact protection box marked SWITCH to the lead wire coming out of the switch unit. Keep the switch as close as possible to the contact protection box, with a lead wire length of no more than 1 metre.

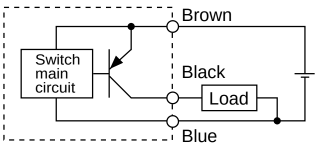
Series CLS
Auto Switch Connections and Examples

Basic Wiring

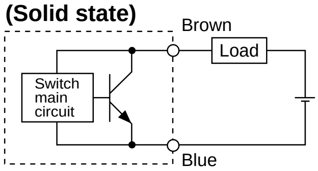
Solid state 3-wire, NPN



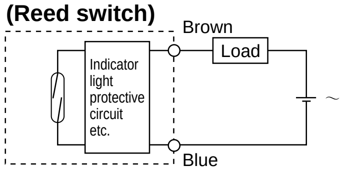
Solid state 3-wire, PNP



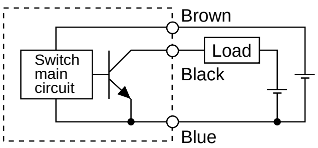
2-wire (Solid state)

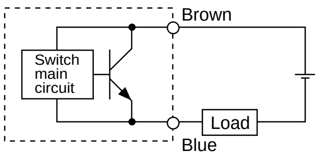


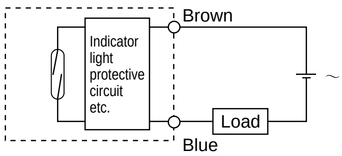
2-wire (Reed switch)



(Power supplies for switch and load are separate.)

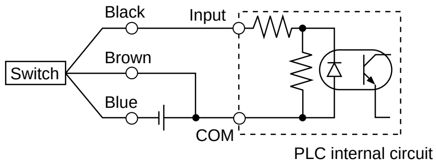




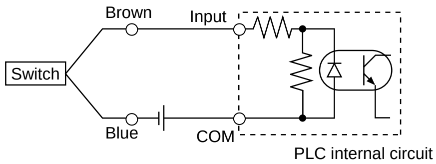


Example of Connection to PLC (Programmable Logic Controller)

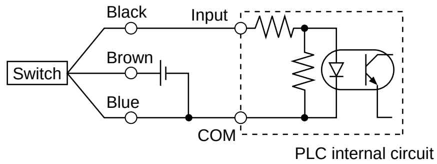
• Sink input specifications
3-wire, NPN



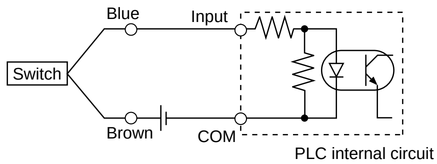
2-wire



• Source input specifications
3-wire, PNP



2-wire

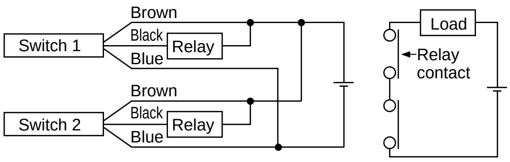


Connect according to the applicable PLC input specifications, since the connection method will vary depending on the PLC input specifications.

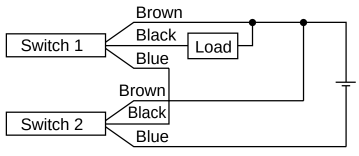
Example of AND (Serial) and OR (Parallel) Connection

● **3-wire**

AND connection for NPN output (using relays)

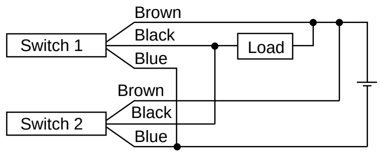


AND connection for NPN output (performed with switches only)

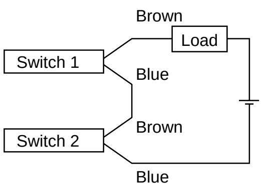


The indicator lights will illuminate when both switches are turned ON.

OR connection for NPN output



2-wire with 2-switch AND connection

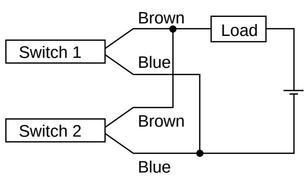


When two switches are connected in series, a load may malfunction because the load voltage will decrease when in the ON state.
The indicator lights will illuminate if both of the switches are in the ON state.

$$\text{Load voltage at ON} = \text{Power supply voltage} - \text{Internal voltage drop} \times 2 \text{ pcs.}$$
$$= 24\text{ V} - 4\text{ V} \times 2\text{ pcs.}$$
$$= 16\text{ V}$$

Example: Power supply is 24 VDC.
Internal voltage drop in switch is 4 V.

2-wire with 2-switch OR connection



(Solid state)
When two switches are connected in parallel, a malfunction may occur because the load voltage will increase when in the OFF state.

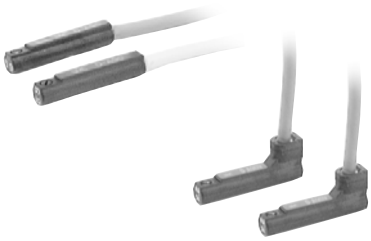
(Reed switch)
Because there is no current leakage, the load voltage will not increase when turned OFF. However, depending on the number of switches in the ON state, the indicator lights may sometimes dim or not light because of the dispersion and reduction of the current flowing to the switches.

$$\text{Load voltage at OFF} = \text{Leakage current} \times 2\text{ pcs.} \times \text{Load impedance}$$
$$= 1\text{ mA} \times 2\text{ pcs.} \times 3\text{ k}\Omega$$
$$= 6\text{ V}$$

Example: Load impedance is 3 kΩ.
Leakage current from switch is 1 mA.

Reed Switch: Direct Mounting Style
D-A90(V)/D-A93(V)/D-A96(V) CE

Grommet
Electrical entry direction: In-line

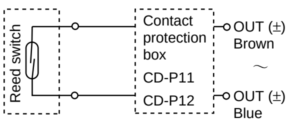


⚠Caution
Operating Precautions

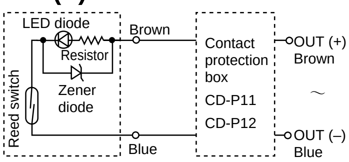
Fix the switch with the existing screw installed on the switch body. The switch may be damaged if a screw other than the one supplied, is used.

Auto Switch Internal Circuit

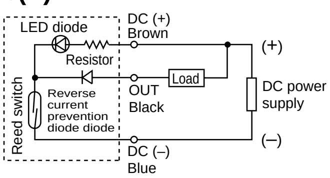
D-A90(V)



D-A93(V)



D-A96(V)



Note) ① In a case where the operation load is an inductive load.
② In a case where the wiring load is greater than 5 m.
③ In a case where the load voltage is 100 VAC.

Use the auto switch with a contact protection box in any of the above mentioned cases.
(For details about the contact protection box, refer to page 17.)

Auto Switch Specifications

For details about certified products conforming to international standards, visit us at www.smcworld.com.

PLC: Programmable Logic Controller

D-A90/D-A90V (Without indicator light)			
Auto switch part no.	D-A90/D-A90V		
Applicable load	IC circuit, Relay, PLC		
Load voltage	24 V AC/DC or less	48 V AC/DC or less	100 V AC/DC or less
Maximum load current	50 mA	40 mA	20 mA
Contact protection circuit	None		
Internal resistance	1 Ω or less (including lead wire length of 3 m)		

D-A93/D-A93V/D-A96/D-A96V (With indicator light)			
Auto switch part no.	D-A93/D-A93V		D-A96/D-A96V
Applicable load	Relay, PLC		IC circuit
Load voltage	24 VDC	100 VAC	4 to 8 VDC
Load current range and max. load current Note 3)	5 to 40 mA	5 to 20 mA	20 mA
Contact protection circuit	None		
Internal voltage drop	D-A93 — 2.4 V or less (to 20 mA)/3 V or less (to 40 mA) D-A93V — 2.7 V or less		0.8 V or less
Indicator light	Red LED illuminates when ON.		

- Lead wires
  D-A90(V)/D-A93(V) — Oilproof heavy-duty vinyl cable: ø2.7, 0.18 mm² x 2 cores (Brown, Blue), 0.5 m
  D-A96(V) — Oilproof heavy-duty vinyl cable: ø2.7, 0.15 mm² x 3 cores (Brown, Black, Blue), 0.5 m

Note 1) Refer to page 17 for reed switch common specifications.
Note 2) Refer to page 17 for lead wire lengths.
Note 3) In less than 5 mA condition, the indicating light visibility becomes low, and it may be unreadable in less than 2.5 mA codition. However, as long as the contact ouput is over a 1 mA condition, there will be no problem.

Weight

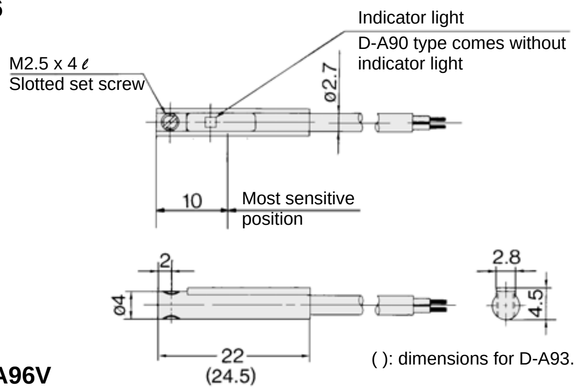
(g)

Auto switch part no.	D-A90	D-A90V	D-A93	D-A93V	D-A96	D-A96V
Lead wire length: 0.5 m	6	6	6	6	8	8
Lead wire length: 3 m	30	30	30	30	41	41

Dimensions

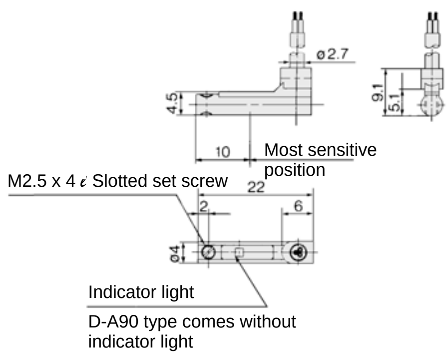
(mm)

D-A90/D-A93/D-A96



( ): dimensions for D-A93.

D-A90V/D-A93V/D-A96V



Solid State Switch: Direct Mounting Style
D-M9N(V)/D-M9P(V)/D-M9B(V) CE

Grommet

- **2-wire load current is reduced (2.5 to 40 mA)**
- **Lead free**
- **UL certified (style 2844) lead cable is used.**

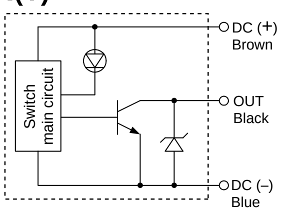
⚠Caution

Operating Precautions

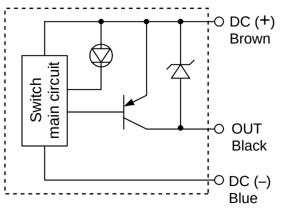
Fix the switch with the existing screw installed on the switch body. The switch may be damaged if a screw other than the one supplied, is used.

Auto Switch Internal Circuit

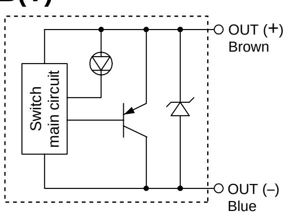
D-M9N(V)



D-M9P(V)



D-M9B(V)



Auto Switch Specifications

For details about certified products conforming to international standards, visit us at www.smcworld.com.

PLC: Programmable Logic Controller

D-M9□/D-M9□V (With indicator light)						
Auto switch part no.	D-M9N	D-M9NV	D-M9P	D-M9PV	D-M9B	D-M9BV
Electrical entry direction	In-line	Perpendicular	In-line	Perpendicular	In-line	Perpendicular
Wiring type	3-wire				2-wire	
Output type	NPN		PNP		—	
Applicable load	IC circuit, Relay, PLC				24 VDC relay, PLC	
Power supply voltage	5, 12, 24 VDC (4.5 to 28 V)				—	
Current consumption	10 mA or less				—	
Load voltage	28 VDC or less		—		24 VDC (10 to 28 VDC)	
Load current	40 mA or less				2.5 to 40 mA	
Internal voltage drop	0.8 V or less				4 V or less	
Leakage current	100 µA or less at 24 VDC				0.8 mA or less	
Indicator light	Red LED illuminates when ON.					

- Lead wires
  Oilproof heavy-duty vinyl cable: ø2.7 x 3.2 ellipse
  D-M9B(V) 0.15 mm^2 x 2 cores
  D-M9N(V), D-M9P(V) 0.15 mm^2 x 3 cores

Note 1) Refer to page 17 for solid state switch common specifications.
Note 2) Refer to page 17 for lead wire lengths.

Weight

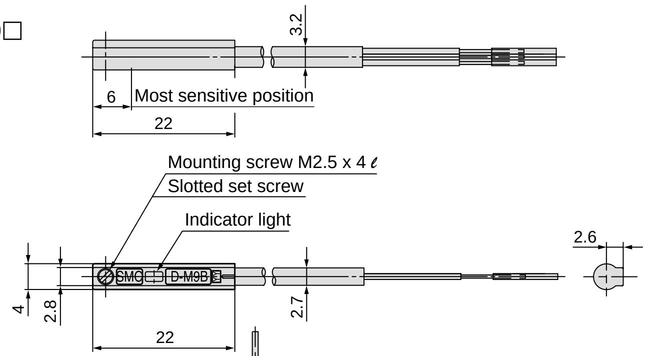
(g)

Auto switch part no.		D-M9N(V)	D-M9P(V)	D-M9B(V)
Lead wire length (m)	0.5	8	8	7
	3	41	41	38
	5	68	68	63

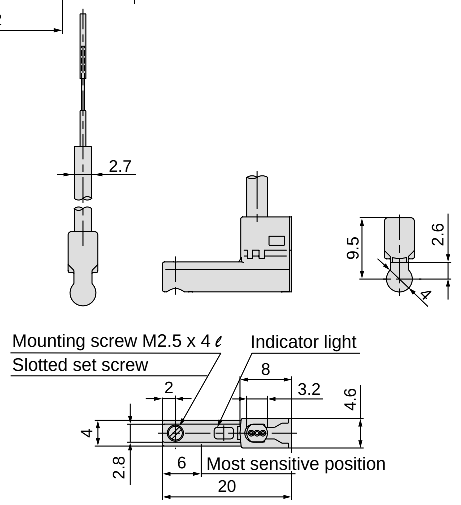
Dimensions

(mm)

D-M9□

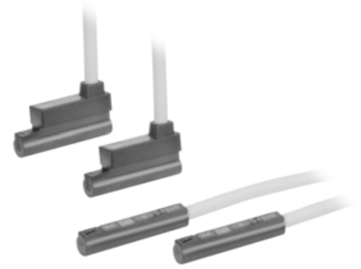


D-M9□V



2-colour Indication Solid State Switch: Direct Mounting Style
D-F9NW(V)/D-F9PW(V)/D-F9BW(V) CE

Grommet

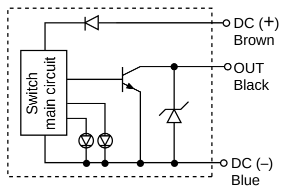


⚠Caution
Operating Precautions

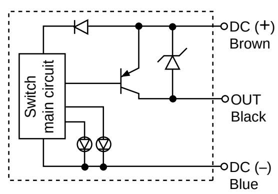
Fix the switch with the existing screw installed on the switch body. The switch may be damaged if a screw other than the one supplied, is used.

Auto Switch Internal Circuit

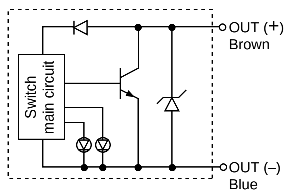
D-F9NW(V)



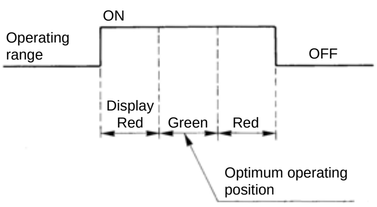
D-F9PW(V)



D-F9BW(V)



Indicator light/Display method



Auto Switch Specifications

For details about certified products conforming to international standards, visit us at www.smcworld.com.

PLC: Programmable Logic Controller

D-F9□W/D-F9□WV (With indicator light)						
Auto switch part no.	D-F9NW	D-F9NWV	D-F9PW	D-F9PWV	D-F9BW	D-F9BWV
Electrical entry direction	In-line	Perpendicular	In-line	Perpendicular	In-line	Perpendicular
Wiring type	3-wire				2-wire	
Output type	NPN		PNP		—	
Applicable load	IC circuit, Relay IC, PLC				24 VDC relay, PLC	
Power supply voltage	5, 12, 24 VDC (4.5 to 28 VDC)				—	
Current consumption	10 mA or less				—	
Load voltage	28 VDC or less		—		24 VDC (10 to 28 VDC)	
Load current	40 mA or less		80 mA or less		5 to 40 mA	
Internal voltage drop	1.5 V or less (0.8 V or less at 10 mA load current)		0.8 V or less		4 V or less	
Leakage current	100 µA or less at 24 VDC				0.8 mA or less	
Indicator light	Operating position ·········· Red LED illuminates. Optimum operating position ·········· Green LED illuminates.					

● Lead wires
Oilproof heavy-duty vinyl cable: ø2.7, 0.15 mm^2 x 3 cores (Brown, Black, Blue), 0.18 mm^2 x 2 cores (Brown, Blue), 0.5 m

Note 1) Refer to page 17 for solid state switch common specifications.
Note 2) Refer to page 17 for lead wire lengths.

Weight

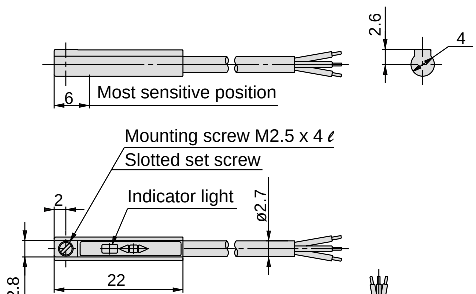
(g)

Auto switch part no.		D-F9NW(V)	D-F9PW(V)	D-F9BW(V)
Lead wire length (m)	0.5	7	7	7
	3	34	34	32
	5	56	56	52

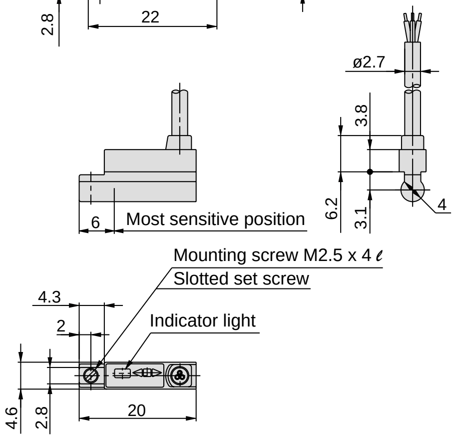
Dimensions

(mm)

D-F9□W



D-F9□WV



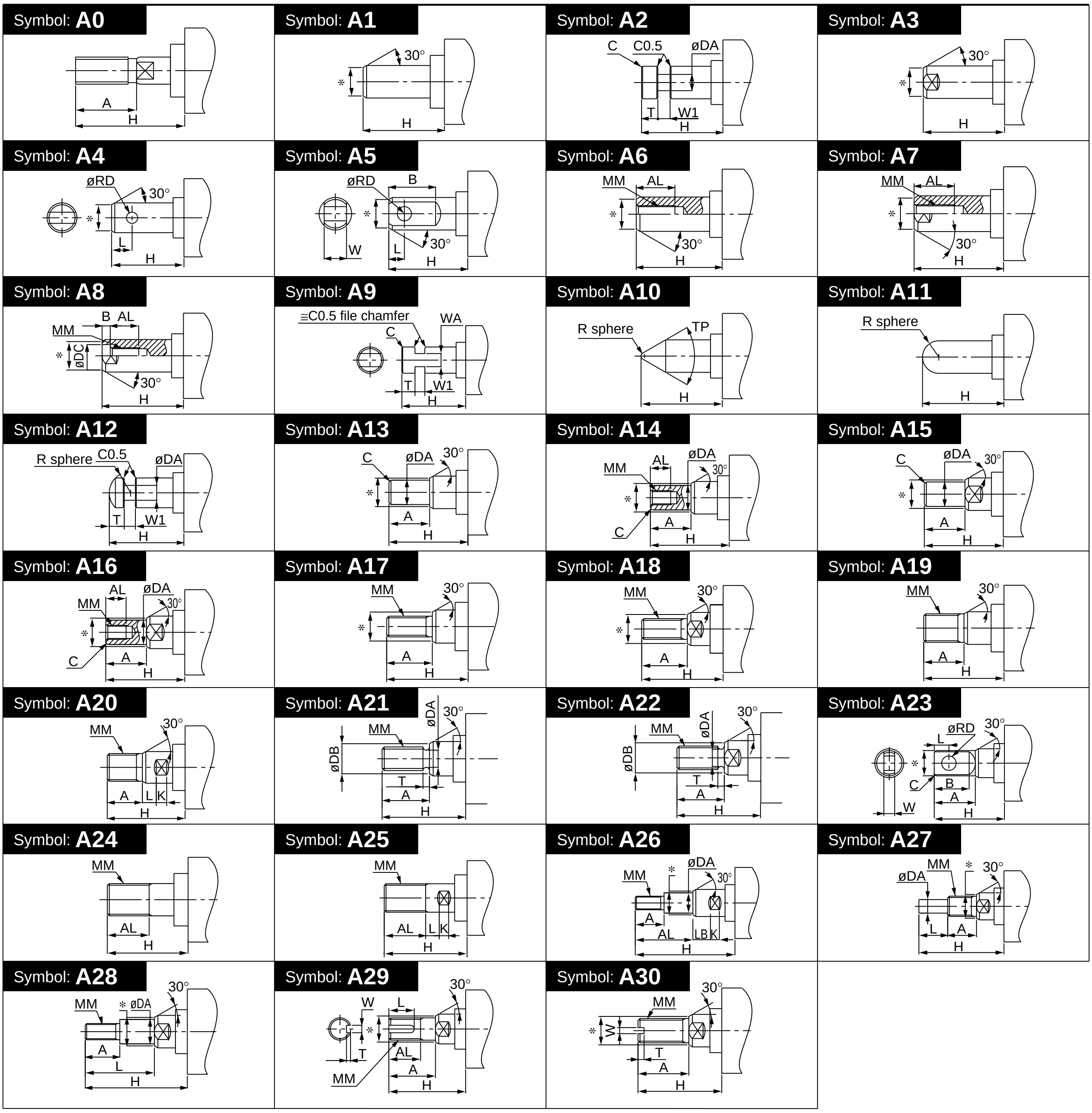
Series *CLS*
Simple Specials

Change of rod end style

1 -XA0 to XA30

Non-standard rod end styles are categorised.

1) SMC will make appropriate arrangements if no dimension, tolerance, or finish instructions are given in the diagram.
2) Standard dimensions marked with "*" will be as follows to the rod diameter (D). Enter any special dimension you desire.
D > 25 → D – 4 mm



Series CLS
Simple Specials

Change of trunnion bracket mounting position

2 -XC14

The position for mounting the trunnion pivot bracket on the cylinder can be moved from the standard mounting position to any desired position.

CLS [Standard part no.] — XC14 [A]

Change of trunnion bracket mounting position (XC14)

Trunnion mounting position (A)

Nil	Mounting positions other than the A or B positions shown below
A	Front trunnion
B	Rear trunnion

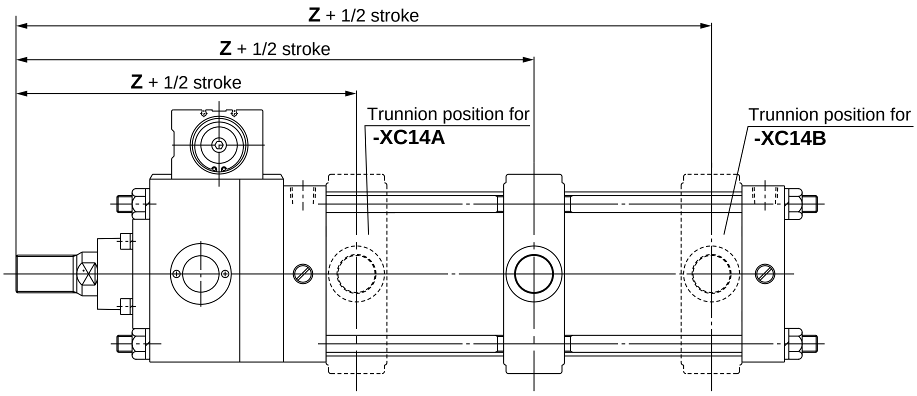
Specifications

Action	Double acting: Single rod
Mounting bracket	T bracket only

Specifications other than above are the same as standard type.

Precautions

1) Specify "Z + 1/2 stroke" in the case the trunnion bracket position is not -XC14A, B or trunnion is not a centre trunnion.
2) SMC will make appropriate arrangements if no dimension, tolerance, or finish instructions are given in the diagram.
3) The possible range of trunnion bracket mounting position is indicated in the table below.
4) Some trunnion mounting positions do not allow auto switch mounting. Please consult with SMC for more information.



Series CLS

(mm)

Symbol / Bore size	Z+1/2 stroke					
	Without rod boot					
	-XC14A	-XC14B	-XC14		Reference Standard (Centre trunnion)	Minimum stroke
			Minimum	Maximum		
125	280	258 + Stroke	280.5	257.5 + Stroke	269 + 0.5 Stroke	25
140	282.5	255.5 + Stroke	283	255 + Stroke	269 + 0.5 Stroke	30
160	321	289 + Stroke	321.5	288.5 + Stroke	305 + 0.5 Stroke	35

(mm)

Symbol / Bore size	Z+1/2 stroke					
	With rod boot					
	-XC14A	-XC14B	-XC14		Reference Standard (Centre trunnion)	Minimum stroke
			Minimum	Maximum		
125	303 + 0.2 Stroke	281 + 1.2 Stroke	303.5 + 0.2 Stroke	280.5 + 1.2 Stroke	292 + 0.7 Stroke	25
140	305.5 + 0.2 Stroke	278.5 + 1.2 Stroke	306 + 0.2 Stroke	278 + 1.2 Stroke	292 + 0.7 Stroke	30
160	345 + 0.2 Stroke	310 + 1.2 Stroke	345.5 + 0.2 Stroke	309.5 + 1.2 Stroke	326 + 0.7 Stroke	35

Made to Order

Please contact SMC for detailed dimensions, specifications, and lead times.

Special port location

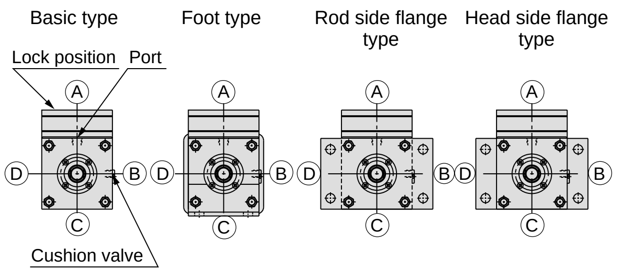
1 -XC3

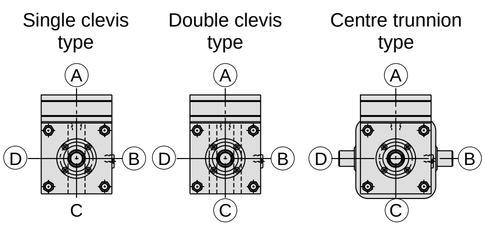
Compared with the standard type, a cylinder which changes the connection port location of rod/head cover and the location of cushion valve.

CLS Standard part no. **—XC3 A C A**

- **Special port location** — XC3
- **Rod port location viewed from the head end** — A
- **Cushion valve location viewed from the rod end** — C
- **Lock position viewed from the rod end (Brake cylinder position)** — A

Relation between port location and cushion valve location





1) As shown in the above diagram, the symbols for the positions of the ports and cushion valves are as follows: viewed from the rod side, the top position is rendered A: then, B, C, and D, in the clockwise direction.
2) The type in which the ports and the cushion valves are combined is applicable only when the rod cover and the head cover are changed to the same position.
3) The symbol indicates as "-XC3ⒶⒷⒶ" is the standard specification, and there are no part numbers A or B.
4) Lock positions B, D are not applicable for the rod end flange style because the brake cylinder and mounting hole for the flange bracket interfere with each other.
5) Those shown above are the same as standard, other than the symbols that indicate the positions of the ports and the cushion valves.

Series CLS
Safety Instructions

These safety instructions are intended to prevent a hazardous situation and/or equipment damage. These instructions indicate the level of potential hazard by labels of **"Caution", "Warning"** or **"Danger"**. To ensure safety, be sure to observe ISO 4414 Note 1), JIS B 8370 Note 2) and other safety practices.

■Explanation of the Labels

Labels	Explanation of the labels
⚠ **Danger**	In extreme conditions, there is a possible result of serious injury or loss of life.
⚠ **Warning**	Operator error could result in serious injury or loss of life.
⚠ **Caution**	Operator error could result in injury or equipment damage.

Note 1) ISO 4414: Pneumatic fluid power – General rules relating to systems
Note 2) JIS B 8370: General Rules for Pneumatic Equipment
Note 3) Injury indicates light wounds, burns and electrical shocks that do not require hospitalisation or hospital visits for long-term medical treatment.
Note 4) Equipment damage refers to extensive damage to the equipment and surrounding devices.

■Selection/Handling/Applications

1. **The compatibility of the 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 for the specific pneumatic system must be based on specifications or post analysis and/or tests to meet the specific requirements. The expected performance and safety assurance are the responsibility of the person who has determined the compatibility of the system. This person should continuously review the suitability of all items specified, referring to the latest catalogue information with a view to giving due consideration to any possibility of equipment failure when configuring a system.
2. **Only trained personnel should operate pneumatically operated machinery and equipment.**
   Compressed air can be dangerous if handled incorrectly. 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 performed once measures to prevent falling or runaway of the driven objects have been confirmed.
   2. When equipment is removed, confirm that safety process as mentioned above. Turn off the supply pressure for this equipment and exhaust all residual compressed air in the system.
   3. Before machinery/equipment is restarted, take measures to prevent quick extension of a cylinder piston rod, etc.
4. **Contact SMC if the product will 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 beverages, recreation equipment, emergency stop circuits, clutch and brake circuits in 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.
   4. If the products are used in an interlock circuit, prepare a double interlock style circuit with a mechanical protection function for the prevention of a breakdown. And, examine the devices periodically if they function normally or not.

■Exemption from Liability

1. **SMC, its officers and employees shall be exempted from liability for any loss or damage arising out of earthquakes or fire, action by a third person, accidents, customer error with or without intention, product misuse, and any other damages caused by abnormal operating conditions.**
2. **SMC, its officers and employees shall be exempted from liability for any direct or indirect loss or damage, including consequential loss or damage, loss of profits, or loss of chance, claims, demands, proceedings, costs, expenses, awards, judgments and any other liability whatsoever including legal costs and expenses, which may be suffered or incurred, whether in tort (including negligence), contract, breach of statutory duty, equity or otherwise.**
3. **SMC is exempted from liability for any damages caused by operations not contained in the catalogues and/or instruction manuals, and operations outside of the specification range.**
4. **SMC is exempted from liability for any loss or damage whatsoever caused by malfunctions of its products when combined with other devices or software.**

Series ***CLS***
Auto Switch Precautions 1

Be sure to read this before handling.

Design & Selection

⚠Warning

1. Confirm the specifications.

Read the specifications carefully and use this product appropriately. The product may be damaged or malfunction if it is used outside the range of specifications of current load, voltage, temperature or impact. We do not guarantee any damage in any case the product is used outside of the specification range.

2. Pay attention to the length of time that a switch is ON at an intermediate stroke position.

When an auto switch is placed at an intermediate position of the stroke and a load is driven at the time the piston passes, the auto switch will operate, but if the speed is too great the operating time will be shortened and the load may not operate properly. The maximum detectable piston speed is:

$$\text{V (mm/s)} = \frac{\text{Auto switch operating range (mm)}}{\text{Time load applied (ms)}} \times 1000$$

In cases of high piston speed, the use of an auto switch (D-F5NT) with a built-in OFF delay timer (approx. 200 ms) makes it possible to extend the load operating time.

3. Keep wiring as short as possible.

<Reed switch>

As the length of the wiring to a load gets longer, the rush current at switching ON becomes greater, and this may shorten the product's life. (The switch will stay ON all the time.)

1) For an auto switch without a contact protection circuit, use a contact protection box when the wire length is 5 m or longer.

2) Even if an auto switch has a built-in contact protection circuit, when the wiring is more than 30 m long, it is not able to adequately absorb the rush current and its life may be reduced. It is again necessary to connect a contact protection box in order to extend its life. Please contact SMC in this case.

<Solid state switch>

3) Although wire length should not affect switch function, use a wire 100 m or shorter.

4. Do not use a load that generates surge voltage. If a surge voltage is generated, the discharge occurs at the contact, possibly resulting in the shortening of product life.

<Reed switch>

If driving a load such as a relay that generates a surge voltage, use a switch with a built-in contact protection circuit or use a contact protection box.

<Solid state switch>

Although a zener diode for surge protection is connected at the output side of a solid state auto switch, damage may still occur if the surge is applied repeatedly. When a load, such as a relay or solenoid, which generates surge is directly driven, use a type of switch with a built-in surge absorbing element.

5. Cautions for use in an interlock circuit

When an auto switch is used for an interlock signal requiring high reliability, devise a double interlock system to avoid trouble by providing a mechanical protection function, or by also using another switch (sensor) together with the auto switch. Also perform periodic maintenance and confirm proper operation.

6. Do not make any modifications to the product.

Do not take the product apart. It may cause human injuries and accidents.

⚠Caution

1. Use caution when multiple cylinders are used and close to each other.

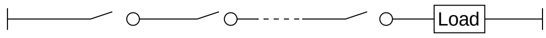
When two or more auto switch cylinders are lined up in close proximity to each other, magnetic field interference may cause the switches to malfunction. Maintain a minimum cylinder separation of 40 mm. (When the allowable interval is specified for each cylinder series, use the indicated value.)

2. Take note of the internal voltage drop of the switch.

<Reed switch>

1) Switches with an indicator light (Except D-A56, A96, A96V, Z76)

- If auto switches are connected in series as shown below, take note that there will be a large voltage drop because of internal resistance in the light emitting diodes. (Refer to internal voltage drop in the auto switch specifications.)
  [The voltage drop will be "n" times larger when "n" auto switches are connected.]
  Even though an auto switch operates normally, the load may not operate.



- In the same way, when operating under a specified voltage, although an auto switch may operate normally, the load may not operate. Therefore, the formula below should be satisfied after confirming the minimum operating voltage of the load.

$$\begin{array}{c}\text{Supply}\\\text{voltage}\end{array} - \begin{array}{c}\text{Internal voltage}\\\text{drop of switch}\end{array} > \begin{array}{c}\text{Minimum operating}\\\text{voltage of load}\end{array}$$

2) If the internal resistance of a light emitting diode causes a problem, select a switch without an indicator light (Model D-A6□, A90, A90V, Z80).

<Solid state switch>

3) Generally, the internal voltage drop will be greater with a 2-wire solid state auto switch than with a reed switch. Take the same precautions as in 1).
Also, note that a 12 VDC relay is not applicable.

3. Pay attention to leakage current.

<Solid state switch>

With a 2-wire solid state auto switch, current (leakage current) flows to the load to operate the internal circuit even when in the OFF state.

$$\begin{array}{c}\text{Operating current of}\\\text{load (OFF condition)}\end{array} > \text{Leakage current}$$

If the criteria given in the above formula are not met, it will not reset correctly (stays ON). Use a 3-wire switch if this specification will not be satisfied.
Moreover, leakage current flow to the load will be "n" times larger when "n" auto switches are connected in parallel.

4. Ensure sufficient clearance for maintenance activities.

When designing an application, be sure to allow sufficient clearance for maintenance and inspections.

Series CLS
Auto Switch Precautions 2
Be sure to read this before handling.

Mounting & Adjustment

⚠Warning

1. Instruction manual

Install the products and operate them only after reading the instruction manual carefully and understanding its contents. Also keep the manual where it can be referred to as necessary.

2. Do not drop or bump.

Do not drop, bump or apply excessive impacts (300 m/s^2 or more for reed switches and 1000 m/s^2 or more for solid state switches) while handling. Although the body of the switch may not be damaged, the inside of the switch could be damaged and cause a malfunction.

3. Mount switches using the proper fastening torque.

When a switch is tightened beyond the range of fastening torque, the mounting screws, mounting bracket or switch may be damaged. On the other hand, tightening below the range of fastening torque may allow the switch to slip out of position. (Refer to switch mounting for each series regarding switch mounting, moving, and fastening torque, etc.)

4. Mount a switch at the centre of the operating range.

Adjust the mounting position of an auto switch so that the piston stops at the centre of the operating range (the range in which a switch is ON).
(The mounting position shown in a catalogue indicates the optimum position at stroke end.) If mounted at the end of the operating range (around the borderline of ON and OFF), operation will be unstable.

<D-M9□(V)>
When the D-M9 auto switch is used to replace old series auto switch, it may not activate depending on operating condition because of its shorter operating range.

Such as
- Application where the stop position of actuator may vary and exceed the operating range of the auto switch, for example, pushing, pressing, clamping operation, etc.
- Application where the auto switch is used for detecting an intermediate stop position of the actuator. (In this case the detecting time will be reduced.)

In these applications, set the auto switch to the centre of the required detecting range.

5. Securing the space for maintenance

When installing the products, please allow access for maintenance.

Mounting & Adjustment

⚠Caution

1. Do not carry a cylinder (actuator) by the auto switch lead wires.

Never carry a cylinder (actuator) by its lead wires. This may not only cause broken lead wires, but it may cause internal elements of the switch to be damaged by the stress.

2. Fix the switch with appropriate screw installed on the switch body. If using other screws, switch may be damaged.

Wiring

⚠Warning

1. Confirm proper insulation of wiring.

Be certain that there is no faulty wiring insulation (contact with other circuits, ground fault, improper insulation between terminals, etc.). Damage may occur due to excess current flow into a switch.

2. Do not wire with power lines or high voltage lines.

Wire separately from power lines or high voltage lines, avoiding parallel wiring or wiring in the same conduit with these lines. Control circuits, including auto switches, may malfunction due to noise from these other lines.

⚠Caution

1. Avoid repeatedly bending or stretching lead wires.

Broken lead wires will result from applying bending stress or stretching force to the lead wires.

2. Be sure to connect the load before power is applied.

<2-wire type>
If the power is turned ON when an auto switch is not connected to a load, the switch will be instantly damaged because of excess current.

3. Do not allow short circuit of loads.

<Reed switch>
If the power is turned ON with a load in a short circuited condition, the switch will be instantly damaged because of excess current flow into the switch.

<Solid state switch>
Model D-M9□(V), M9□W(V), J51 and all models of PNP output type switches do not have built-in short circuit prevention circuits. If loads are short circuited, the switches will be instantly damaged, as in the case of reed switches.
Take special care to avoid reverse wiring with the power supply line (brown) and the output line (black) on 3-wire type switches.

Series *CLS*
Auto Switch Precautions 3

Be sure to read this before handling.

Wiring

⚠Caution

4. Avoid incorrect wiring.

<Reed switch>

A 24 VDC switch with indicator light has polarity. The brown lead wire or terminal No.1 is (+) and the blue lead wire or terminal No.2 is (–).

1) If connections are reversed, a switch will operate, however, the light emitting diode will not light up.
Also note that a current greater than that specified will damage a light emitting diode and it will no longer operate.
Applicable models:
D-Z73, D-A93, A93V, D-A33, A34, A44, D-A53, A54

2) Note however, that in the case of 2-colour indicator type auto switches (D-A59W), if the wiring is reversed, the switch will be in a normally ON condition.

<Solid state switch>

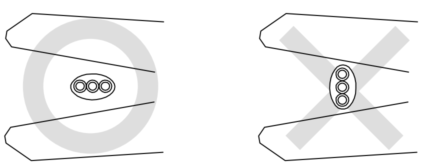
1) If connections are reversed on a 2-wire type switch, the switch will not be damaged if protected by a protection circuit, but the switch will always stay in an ON state. However, it is still necessary to avoid reversed connections, since the switch could be damaged by a load short circuit in this condition.

2) If connections are reversed (power supply line + and power supply line –) on a 3-wire type switch, the switch will be protected by a protection circuit. However, if the power supply line (+) is connected to the blue wire and the power supply line (–) is connected to the black wire, the switch will be damaged.

<D-M9□(V)>

D-M9□(V) does not have built-in short circuit protection circuit. Be aware that if the power supply connection is reversed (e.g. (+) power supply wire and (–) power supply wire connection is reversed), the switch will be damaged.

5. When the cable sheath is stripped, confirm the stripping direction. The insulator may be split or damaged depending on the direction. (D-M9□(V) only)



Recommended Tool

Model name	Model no.
Wire stripper	D-M9N-SWY

∗ Stripper for a round cable (ø2.0) can be used for a 2-wire type cable.

Operating Environment

⚠Warning

1. Never use in an atmosphere of explosive gases.

The construction of auto switches is not intended to prevent explosion. Never use in an atmosphere with an explosive gas since this may cause a serious explosion.

2. Do not use in an area where a magnetic field is generated.

Auto switches will malfunction or magnets inside cylinders will become demagnetised. (Consult with SMC regarding the availability of a magnetic field resistant auto switch.)

3. Do not use in an environment where the auto switch will be continually exposed to water.

Although switches, except for some models (D-A3□, A44, G39, K39), satisfy IEC standard IP67 construction (JIS C 0920: watertight construction), do not use switches in applications where continually exposed to water splash or spray. Poor insulation or swelling of the potting resin inside switches may cause malfunction.

4. Do not use in an environment with oil or chemicals.

Consult with SMC if auto switches will be used in an environment with coolant, cleaning solvent, various oils or chemicals. If auto switches are used under these conditions for even a short time, they may be adversely affected by improper insulation, malfunction due to swelling of the potting resin, or hardening of the lead wires.

5. Do not use in an environment with temperature cycles.

Consult with SMC if switches are used where there are temperature cycles other than normal temperature changes, as they may be adversely affected internally.

6. Do not use in an environment where there is excessive impact shock.

<Reed switch>

When excessive impact (300 m/s^2 or more) is applied to a reed switch during operation, the contact point will malfunction and generate or cut off a signal momentarily (1 ms or less). Consult with SMC regarding the need to use a solid state switch depending upon the environment.

7. Do not use in an area where surges are generated.

<Solid state switch>

When there are units (solenoid type lifter, high frequency induction furnace, motor, etc.) which generate a large amount of surge in the area around cylinders (actuators) with solid state auto switches, this may cause deterioration or damage to the switches. Avoid sources of surge generation and crossed lines.

Series CLS
Auto Switch Precautions 4

Be sure to read this before handling.

Operating Environment

⚠Caution

1. Avoid accumulation of iron debris or close contact with magnetic substances.

When a large amount of ferrous debris such as machining chips or spatter is accumulated, or a magnetic substance (something attracted by a magnet) is brought into close proximity with an auto switch cylinder (actuator), it may cause the auto switch (actuator) to malfunction due to a loss of the magnetic force inside the cylinder.

2. Consult with SMC concerning water resistance, elasticity of lead wires, usage at welding sites, etc.

3. Do not use in direct sunlight.

4. Do not mount the product in locations where it is exposed to radiant heat.

Maintenance

⚠Warning

1. Perform the following maintenance periodically in order to prevent possible danger due to unexpected auto switch malfunction.

1) Securely tighten switch mounting screws.
If screws become loose or the mounting position is dislocated, retighten them after readjusting the mounting position.

2) Confirm that there is no damage to lead wires.
To prevent faulty insulation, replace switches or repair lead wires, etc., if damage is discovered.

3) Confirm the lighting of the green light on the 2-colour indicator type switch.
Confirm that the green LED is on when stopped at the established position. If the red LED is on, the mounting position is not appropriate. Readjust the mounting position until the green LED illuminates.

2. Maintenance procedures are outlined in the operation manual.

Not following proper procedures could cause the product to malfunction and could lead to damage to the equipment or machine.

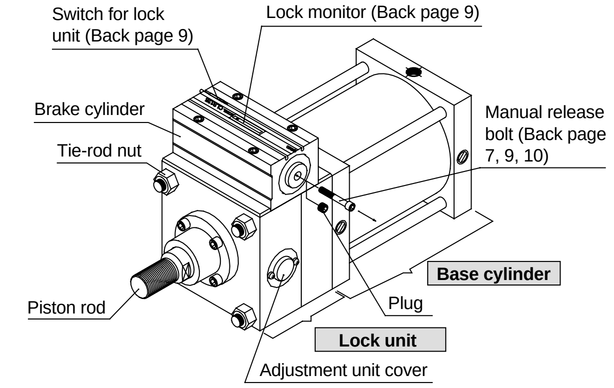
3. Removal of equipment, and supply/exhaust of compressed air

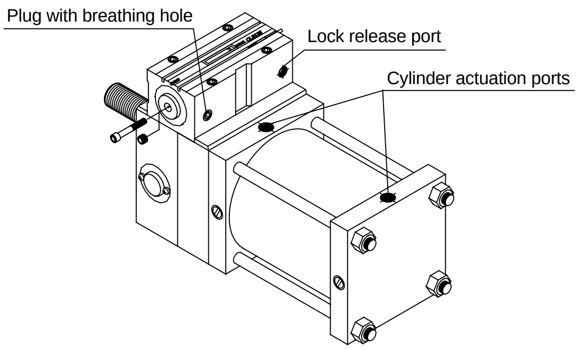
Before any machinery or equipment is removed, first ensure that the appropriate measures are in place to prevent the fall or erratic movement of driven objects and equipment, then cut off the electric power and reduce the pressure in the system to zero. Only then should you proceed with the removal of any machinery and equipment.
When machinery is restarted, proceed with caution after confirming that appropriate measures are in place to prevent cylinders from sudden movement.

Series CLS
Specific Product Precautions 1

Be sure to read this before handling. For Safety Instructions, Actuator Precautions, refer to “Precautions for Handling Pneumatic Devices” (M-03-E3A).

Parts Description

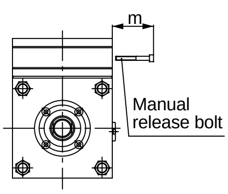




Design of Equipment and Machinery

⚠ Warning

1. **Construct so that the human body will not come into direct contact with driven objects or the moving parts of the cylinder with brake.**
   Devise a safe structure by attaching protective covers that prevent direct contact with the human body, or in cases where there is a danger of contact, provide sensors or other devices to perform an emergency stop, etc., before contact occurs.
2. **Use a balance circuit, taking cylinder lurching into consideration.**
   In cases such as an intermediate stop, where a lock is operated at a desired position within the stroke and air pressure is applied from only one side of the cylinder, the piston will lurch at high speed when the lock is released. In such situations, there is a danger of causing human injury by having hands or feet, etc., caught, and also a danger of causing damage to the equipment. In order to prevent this lurching, a balance circuit such as the recommended air pressure circuits (Back page 8) should be used.
3. **When designing equipment and machinery, give consideration to clearance and mounting orientation so that manual release of the lock (using the manual release bolt) will be possible.**



∗ Minimum Clearance for Manual Release

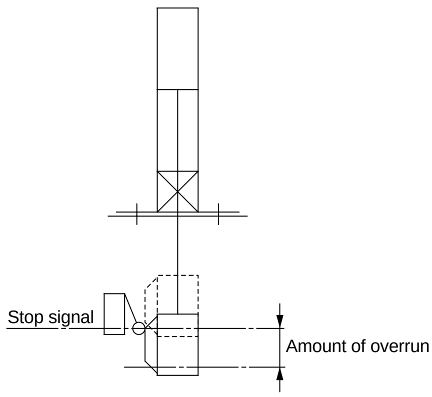
Bore size (mm)	Clearance (mm)
125	50
140 **160**	60
180	70
200	80
250	90

Selection

⚠ Warning

1. **When in a locked condition, do not apply a load accompanied by an impact shock, strong vibration or turning force, etc.**
   Use caution, because an external action such as an impacting load, strong vibration or turning force, may damage the locking mechanism or reduce its life.
2. **Consider stopping accuracy and the amount of overrun when an intermediate stop is performed.**
   Due to the nature of a mechanical lock, there is a momentary lag with respect to the stop signal, and a time delay occurs before stopping. The cylinder stroke resulting from this delay is the overrun amount. The difference between the maximum and minimum overrun amounts is the stopping accuracy.
   - Place a limit switch before the desired stopping position, at a distance equal to the overrun amount.
   - The limit switch must have a detection length (dog length) of the overrun amount + α.
   - SMC’s auto switches have operating ranges from 8 to 14 mm (depending on the switch model).
     When the overrun amount exceeds this range, self-holding of the contact should be performed at the switch load side.

   ∗ Refer to page 2 regarding stopping accuracy.



3. **In order to further improve stopping accuracy, the time from the stop signal to the operation of the lock should be shortened as much as possible.**
   To accomplish this, use a device such as a highly responsive electric control circuit or solenoid valve driven by direct current, and place the solenoid valve as close as possible to the cylinder.
4. **Note that stopping accuracy will be influenced by changes in piston speed.**
   When piston speed changes during the course of the cylinder stroke due to variations in the load or disturbances, etc., the dispersion of stopping positions will increase. Therefore, consideration should be given to establishing a standard speed for the piston just before it reaches the stopping position.
   Moreover, the dispersion of stopping positions will increase during the cushioned portion of the stroke and during the accelerating portion of the stroke after the start of operation, due to the large changes in piston speed.

Series CLS
Specific Product Precautions 2

Be sure to read this before handling. For Safety Instructions, Actuator Precautions, refer to “Precautions for Handling Pneumatic Devices” (M-03-E3A).

Selection

⚠ Warning

5. Holding force (maximum static load) means the maximum capability of holding a static load that is not accompanied by vibration or impact under the condition that no load is applied. Therefore, it does not refer to a load that cannot be held constantly.

Determine the optimum bore size which meets your application based on the model selection procedure. The procedures for Model Selection, assuming the intermediate stop application (including the emergency stop in operation), are shown on the front matter pages 1 and 2. Only when locking the cylinder in a condition where a kinetic energy is not applied, such as in a drop prevention application, the maximum load weight when using the lock should not exceed the upper limit of the load weight, according to the operating pressure, when the maximum speed is V = 100 mm/s in Graph 5 through 7 on the front matter page 2.

Mounting

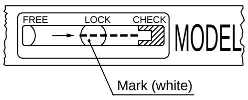
⚠ Warning

1. Be certain to connect the piston rod end to the load with the lock released.

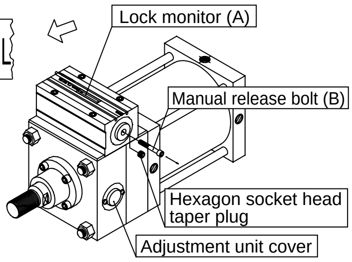
If connected when in the locked condition, turning force or a load greater than the holding force may operate on the piston rod and cause damage to the lock mechanism. The CLS series is equipped with an emergency unlocking mechanism, however, the load should be connected to the piston rod end with the lock in the released condition. This can be accomplished manually or by simply connecting an air line to the unlocking port and supplying air pressure of 0.25 MPa or more.

2. The unit is shipped from the factory with the lock in the released condition. Since the lock will not operate in this condition, be sure to put it in the locked condition before operation, following the procedure given below.

(1) Remove the manual release bolt (B) using a hexagon wrench. (The manual release bolt can be removed easier by applying air pressure to the lock release port.)
(2) Confirm that the white mark on the lock monitor (A) is in the LOCK position.
(3) Plug the bolt insertion hole with the included hexagon socket head taper plug.



Lock monitor (A) details



Manual Release Bolt Unit: mm

Bore size (mm)	Size
125	M6 x 35 ℓ
140	M6 x 40 ℓ
160	M8 x 40 ℓ
180	M10 x 50 ℓ
200	M10 x 55 ℓ
250	M12 x 70 ℓ

∗ Use a hexagon socket head cap screw if the included manual release bolt is not available.

Hexagon Socket Head Taper Plug Size

Bore size (mm)	Hexagon socket head taper plug
125, **140**	Rc 1/4
160	Rc 3/8
180, **200**	Rc 1/2
250	Rc 3/4

Mounting

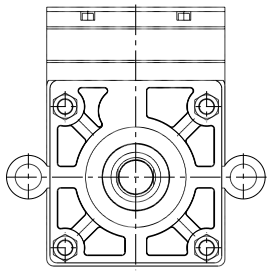
⚠ Warning

3. Mount the cylinder after confirming that the lock is working correctly by applying or releasing air pressure to or from the lock release port. Apply air pressure (more than 0.25 MPa) to unlock the cylinder or release the air pressure (0 MPa) to lock the cylinder.

4. The adjustment screw inside the adjustment unit cover is set before shipment. Since any discrepancy in this adjustment can cause cylinder or lock malfunction, etc., never touch the screw.

5. When raising the unit, do not insert your hands or fingers.

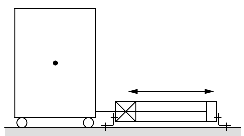
As this is a heavyweight product, be sure to use caution.
Screw holes for installing eyebolts are provided for ø180, ø200 and ø250. (Eyebolts are not included in the unit.)



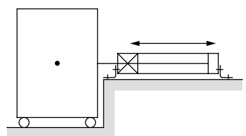
⚠ Caution

1. Do not apply an offset load to the piston rod.

Particular care should be taken to match the load’s centre of gravity with the centre of the cylinder shaft. When there is a large discrepancy, the piston rod may be subjected to uneven wear or damage due to the inertial moment during locking stops.



X Load centre of gravity and cylinder shaft centre are not matched.



○ Load centre of gravity and cylinder shaft centre are matched.

∗ An offset load can be operated if there is an effective guide to absorb all of the generated moment.

Series *CLS*
Specific Product Precautions 3

Be sure to read this before handling. For Safety Instructions, Actuator Precautions, refer to “Precautions for Handling Pneumatic Devices” (M-03-E3A).

Mounting

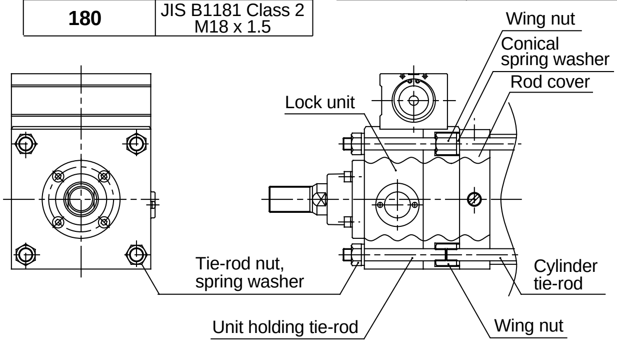
⚠ Caution

2. Cautions when using the base unit and when changing bracket positions, etc.

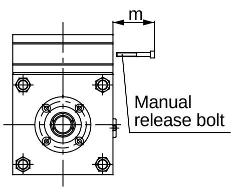
The lock unit and cylinder rod cover are assembled as shown in the drawing below. For this reason, it cannot be installed as in the case of common air cylinders, by using the basic type and screwing the cylinder tie-rods directly to machinery.
Furthermore, when brackets are replaced, the unit holding tie-rods may become loose and they should be retightened.

Bore size (mm)	Tie-rod nut
125 **140**	JIS B1181 Class 2 M14 x 1.5
160	JIS B1181 Class 2 M16 x 1.5
180	JIS B1181 Class 2 M18 x 1.5

Bore size (mm)	Tie-rod nut
200	JIS B1181 Class 2 M20 x 1.5
250	JIS B1181 Class 2 M24 x 1.5



3. When installing the cylinder to machinery, etc., secure enough clearance and consider the mounting direction for manual lock release (releasing with the manual release bolt).



∗ Minimum Clearance for Manual Release

Bore size (mm)	Clearance (mm)
125	50
140 **160**	60
180	70
200	80
250	90

Adjustment

⚠ Caution

1. Adjust the cylinder’s air balance. Balance the load by adjusting the air pressure in the rod and head sides of the cylinder with the load connected to the cylinder and the lock in a released condition. Lurching of the cylinder when unlocked can be prevented by carefully adjusting this air balance.

2. Adjust the mounting positions of the detectors on auto switches, etc. When intermediate stops are to be performed, adjust the mounting positions of detectors on auto switches, etc., taking into consideration the overrun amount with respect to the desired stopping positions.

Pneumatic Circuits

⚠ Warning

1. Be certain to use a pneumatic circuit which will apply balancing pressure to both sides of the piston when in a locked stop.

In order to prevent cylinder lurching when restarting or manually unlocking after a locked stop, a circuit should be used to apply balancing pressure to both sides of the piston, thereby canceling the force generated by the load in the direction of piston movement.

2. Use a solenoid valve for unlocking with an effective area that is 25% or more of the effective area of the cylinder drive solenoid valve.

The larger the effective sectional area is, the shorter the locking time will be (the overrun amount will be shorter), and stopping accuracy will be improved.

3. Place the solenoid valve for unlocking close to the cylinder, and no further than the cylinder drive solenoid valve.

The shorter the distance from the cylinder (the shorter the piping), the shorter the overrun amount will be, and stopping accuracy will be improved.

4. Allow at least 0.5 seconds from a locked stop (intermediate stop of the cylinder) until release of the lock.

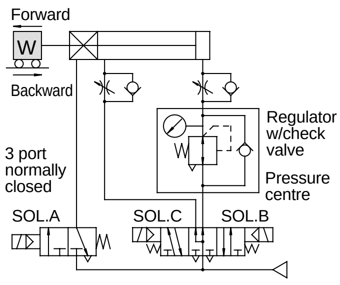
When the locked stop time is too short, the piston rod (and load) may lurch at a speed greater than the control speed of the speed controller.

5. When restarting, control the switching signal for the unlocking solenoid valve so that it acts before or at the same time as the cylinder drive solenoid valve.

If the signal is delayed, the piston rod (and load) may lurch at a speed greater than the control speed of the speed controller.

6. Basic circuits

1. [Horizontal]

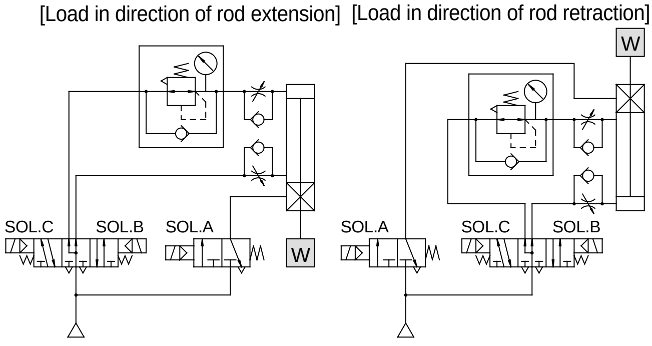


SOL.A	SOL.B	SOL.C	Action
ON	ON	OFF	Forward
OFF	OFF	OFF	Locked stop
ON	OFF	OFF	Unlocked
ON	ON	OFF	Forward
ON	OFF	ON	Backward
OFF	OFF	OFF	Locked stop
ON	OFF	OFF	Unlocked
ON	OFF	ON	Backward

0.5 s or more
0 to 0.5 s
0.5 s or more
0 to 0.5 s

2. [Vertical]

[Load in direction of rod extension] [Load in direction of rod retraction]



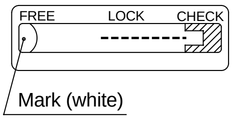
Series CLS
Specific Product Precautions 4

Be sure to read this before handling. For Safety Instructions, Actuator Precautions, refer to “Precautions for Handling Pneumatic Devices” (M-03-E3A).

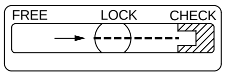
Lock Monitor

⚠ Caution

The CLS series is equipped with a lock monitor on the lock unit. Use the lock monitor as a criterion to confirm the operating condition of the lock unit (brake piston) and the state of wear (life) of the brake shoe.



Unlocked

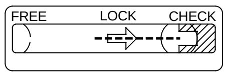


Locked by operation of brake

∗ Please note that the position of the mark when locked varies somewhat from unit to unit.

Brake shoe life

The position of the lock condition mark on the lock monitor gradually moves to the right side with wear of the shoe, etc. When the mark is half way or more into the CHECK zone, this indicates that the brake shoe is near the end of its life. (The brake will not immediately become ineffective in this condition.)



Auto Switch for Lock Unit

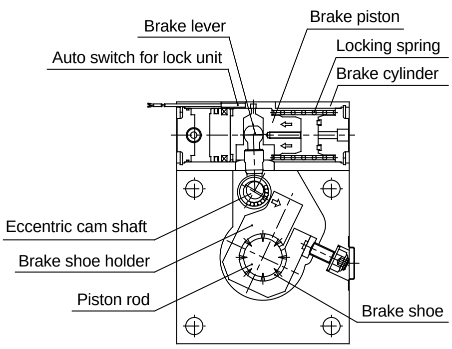
⚠ Caution

1. By installing a switch on the brake cylinder of the CLS series, the operating condition (unlocked side) of the lock unit (brake piston) can be detected as a switch signal.

∗ The condition of the lock monitor and the detection signal from the lock unit switch do not directly confirm the locking condition at the piston rod, but confirm this indirectly from the position of the brake piston.

Lock unit mechanism

The spring force applied to the brake piston is transmitted and magnified through the lever, eccentric cam shaft and brake shoe holder, finally tightening on the piston rod via the brake shoe and locking the piston rod by means of their mutual frictional force.



Locked condition (when air is exhausted.)

Manual Unlocking

⚠ Warning

1. Never perform the manual unlocking operation (with the manual release bolt, etc.) until safety has been confirmed.

1) If air pressure is applied to only one side of the cylinder when unlocking is performed, the moving parts of the cylinder may lurch at high speed causing a serious hazard.
2) When unlocking is performed, be sure to confirm that personnel are not within the movement range of the load, and also that no problems will be caused if the load is actuated.

2. When unlocking in the case of loads which move up and down, take measures to assure that the load will not drop.

1) Perform work with the load at its lowest position.
2) Prevent dropping of the load by using a support or brace, etc.
3) Verify that balanced pressure is applied to both sides of the piston.

⚠ Caution

1. The CLS series manual release mechanism is an emergency unlocking mechanism only.

During an emergency when the air supply is cut off, it is used to alleviate a problem by forcibly pulling the brake piston back to release the lock.

2. In the case of large bore cylinders, even when the lock is released, operational resistance as shown in the table below is generated in a non-load state.

Bore size (mm)	125	140	160	180	200	250
Operational resistance (N)	962	1206	1576	1995	2463	3848

3. Care must be taken, because if the manual release bolt is screwed in only part way and air is supplied to the unlocking port, or it is changed from a supply to an exhaust state, the head of the manual release bolt may be ejected from the end of the brake cylinder or be pulled in creating a serious hazard.

Unlocking procedure using the manual release bolt

1. Remove the hexagon socket head taper plug which is on the same side as the brake cylinder adjustment unit cover.

2. Insert the manual release bolt (see table below) into the threads and screw it in clock-wise.

3. The lock is released by screwing in the manual release bolt until the white mark of the lock monitor on the top of the brake cylinder moves to the FREE position.

Unit: mm

Bore size (mm)	125	140	160	180	200	250
Manual release bolt	M6 x 35ℓ	M6 x 40ℓ	M8 x 40ℓ	M10 x 50ℓ	M10 x 55ℓ	M12 x 70ℓ
Screw depth	30	32	35	40.5	45	55

∗ In case the manual release bolt is not available, use an appropriate hexagon socket head bolt (full thread) as shown above.

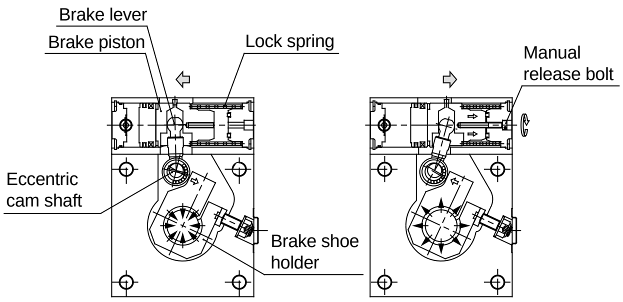
SMC

Series CLS
Specific Product Precautions 5

Be sure to read this before handling. For Safety Instructions, Actuator Precautions, refer to “Precautions for Handling Pneumatic Devices” (M-03-E3A).

Manual Unlocking

⚠ Caution



Locked (with air evacuated)

Manually unlocked (with manual release bolt screwed in)

[Principle]

When the manual release bolt is screwed clockwise, the brake piston is pulled back and the spring is compressed. This causes the lever to be returned, releasing the lock.

Operating Environment

⚠ Caution

1. In locations where the cylinder body will be directly exposed to cutting oil or coolant, etc., a cover or other protection should be provided for the cylinder body and rod.

Maintenance

⚠ Caution

1. The operating condition of the lock unit (brake piston) can be confirmed externally by means of the lock monitor.

1) When the lock monitor mark has moved half way or more into the CHECK zone
If used in this condition, the holding force will gradually decrease. If an operational problem is found in the course of checking the lock’s operating condition, early replacement of the cylinder body or lock unit is necessary. Contact SMC regarding replacement of the lock unit.

2) When the lock monitor mark moves into the CHECK zone prematurely
Since there is a possibility of damage to the lock unit, consult with SMC after reviewing the method of operation.

2. This cylinder is a non-lube type. Do not lubricate the cylinder or apply grease to the piston rod, as there is a danger of drastically reducing brake performance.

3. When replacing seals in the base cylinder, it is recommended that the lock unit be separated from the base cylinder so that replacement work can be done on the cylinder alone. Refer to separate instructions for seal replacement.

4. Never disassemble the lock unit.

- A heavy duty spring is contained in part of the unit, which presents a serious hazard if disassembly is performed incorrectly.
- In addition, the lock unit is adjusted before shipment. If readjustment is not performed correctly after reassembly, a serious danger will be created, as performance will not meet specifications.

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