

**KURODA**  
**SHOCK ABSORBER**

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Distributors:

Printed in Japan 1998.3.SK

**KURODA**

# SHOCK ABSORBER



**KURODA PRECISION INDUSTRIES LTD.**

# SHOCK ABSORBER

**SAseries**  
**SARseries**

(Air return type)

**SAEseries**

(Emergency model)



Select a proper type according to applications

## AA TYPE

Fixed, single orifice type

Large equivalent load.

Suitable for low speed range(0.3~0.5m/s).

## AC TYPE

Fixed, multi-orifice type

Small equivalent load.

Suitable for medium speed range.

## BB TYPE

Analog adjusting, single orifice type

Large equivalent load.

Suitable for low speed range with adjustable orifice.

## CC TYPE

Analog fine adjusting, multi-orifice type

Small equivalent load.

Suitable for high speed range (0.7~3m/s) with fine adjustable orifice.

## CD TYPE

Analog fine adjusting, special multi-orifice type

Designed to have multi-orifice performance in first half of stroke and single orifice performance in latter half of stroke, which can cover load variation caused by changing speed.

Suitable for medium speed range(0.4~1m/s) and the most for air cylinders with small collision and large thrust force.

SAseries				SARseries	
AAtype Fixed single orifice type	ACtype Fixed multi-orifice type	BBtype Analog adjusting single orifice type	CCtype Analog fine adjusting multi-orifice type	CDtype Analog fine adjusting special multi-orifice type	ACtype Fixed multi-orifice type



## SAEseries

Fixed  
Taper groove orifice



Without rod cap/S



With rod cap/C



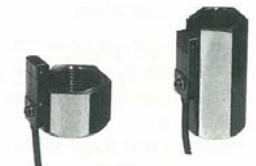
Adaptor  
for slant angle  
SA-A



Stopper nut  
For without  
rod cap  
SAS-N  
For with  
rod cap  
SAC-N



Holder with sensor  
Without stopper  
SA-H  
Without stopper  
SA-HN



Fixed type : Orifice area unadjustable.

Analog adjusting type : Orifice area entirely adjustable.

Analog fine adjusting type : Orifice area partly adjustable.

☆Emergency model

For emergency purpose only, short life time, High energy absorbing with compact body.



# SHOCK ABSORBER

## SA, SAE, SAR series

### ORDERING INSTRUCTIONS

#### SHOCK ABSORBER

##### SPRING RETURN TYPE

SA - S 10 13 A A 1 S

① ② ③ ④ ⑤ ⑥ ⑦

##### EMERGENCY MODEL

SAE - 20 10 C

② ③ ⑦

##### AIR RETURN TYPE

SAR - 14 15 A C 1 S - 100 K4

② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

#### ① Provision of dust wiper

No mark	No dust wiper
S	With dust wiper

#### ② Outer diameter(mm)

#### ③ Stroke(mm)

#### ④ Adjustment

A	Fixed type
B	Analog adjusting type
C	Analog fine adjusting type

#### ⑤ Absorbing mechanism

A	Single orifice(Piston)
B	Single orifice (Innertube)
C	Multi-orifice
D	Special multi-orifice

#### ⑥ Capacity

1	Standard type
2	Heavy duty type

#### ⑦ Provision of rod cap

S	No rod cap
C	With rod cap

#### ⑧ Provision of solenoid valve

No mark	No solenoid valve
100	With solenoid valve for AC 100/110V
200	With solenoid valve for AC 200/220V
D24	With solenoid valve for DC24V

(Note)Lead wire model is standard

#### ⑨ Provision of fitting

No mark	No fitting
K4	With instant fitting for φ4 tube (4-M5MS)

#### OPTION

##### STOPPER NUT

14 SA S - N

① ②

#### ① Outer diameter(mm)

#### ② Provision of rod cap

S	No rod cap
C	With rod cap

##### ADAPTOR FOR SLANT ANGLE

12 10 SA - A

① ②

#### ① Outer diameter(mm)

#### ② Stroke(mm)

##### HOLDER WITH SENSOR

16 12 SA - H N

① ② ③

#### ① Outer diameter(mm)

#### ② Stroke(mm)

#### ③ Provision of stopper

No mark	No stopper
N	With stopper

##### SOLENOID VALVE FOR SAR SERIES

AR-23HP - 100 L

Solenoid valve model ① ②

#### ① Voltage

100	AC100/110V
200	AC200/220V
D24	DC24V

#### ② Wiring

L	Lead wire
SP	Plug-in connector with indicator light & surge suppressor

# SHOCK ABSORBER

### SPECIFICATIONS

#### SA series/AA,AC type

Model No.	Unit	SA-0805		SA-1005		SA-1008		SA-□1210		SA-□1412	
		AA1	AA2	AA1	AA2	AA1	AA2	AA1	AA2	AC1	AC2
Adjustment		Fixed type									
Absorbing stroke	mm	5		5		8		10		12	
Max. energy absorbing capacity	J (kgf·m)	0.392 (0.04)	0.686 (0.07)	0.686 (0.07)	0.98 (0.1)	0.98 (0.1)	1.47 (0.15)	1.96 (0.2)	2.45 (0.25)	3.92 (0.4)	5.88 (0.6)
Max. equivalent mass	kg	3	5	5	8	7	10	15	30	15	20
Max. impact velocity	m/s	1		1		1		1		1.5	
Max. heat dissipation capacity per minute	J/min (kgf·m/min)	17.64 (1.8)	23.22 (2.37)	41.16 (4.2)		58.8 (6)		98 (10)		176.4 (18)	
Max. operating cycles	cycle/min	45		60		60		60		60	
Ambient temperature range	°C	-10~70									
Spring re-turning force	Set state	N(kgf)	1.96(0.2)	3.13(0.32)		3.13(0.32)		4.9(0.5)		3.52(0.36)	
	Compressed state	N(kgf)	3.04(0.31)	5.88(0.6)		5.88(0.6)		9.8(1.0)		8.23(0.84)	
Mounting structure strength	N(kgf)	980(100)		1470(150)		1470(150)		2940(300)		3626(370)	
Mass	g	10		10		13		23		50	
Dust wiper	Provided	○		○		○		○		○	
	Not provided	-		-		-		○		○	
Rod cap	Provided	○		○		○		○		○	
	Not provided	○		○		○		○		○	
Option	Stopper nut	08SAS-N		10SAS-N		12SAS-N		14SAS-N			
		08SAC-N		10SAC-N		12SAC-N		14SAC-N			
	Adaptor for slant angle	0805SA-A		1005SA-A		1008SA-A		1210SA-A		1412SA-A	
		-		-		-		1210SA-HN		1410SA-HN	
Holder with sensor	-		-		-		-		-		

#### SA series/BB type

Model No.	Unit	SA-1008	SA-□1210	SA-□1410	SA-□1612	SA-□2016	SA-□2530	SA-□2540	SA-□2725		
		BB1	BB1	BB1	BB1	BB1	BB1	BB1	BB1		
Adjustment		Analog adjusting type									
Absorbing stroke	mm	8	10	10	12	16	30	40	25		
Max. energy absorbing capacity	J (kgf·m)	1.47 (0.15)	2.94 (0.3)	3.92 (0.4)	9.8 (1.0)	29.4 (3.0)	49 (5.0)	63.7 (6.5)	79.4 (8.1)		
Max. equivalent mass	kg	10	30	30	50	300	400	500	650		
Max. impact velocity	m/s	1	1.5	1.5	1	1	1	1	1		
Max. heat dissipation capacity per minute	J/min (kgf·m/min)	58.8 (6)	98 (10)	176 (18)	235.2 (24)	343 (35)	490 (50)	637 (65)	539 (55)		
Max. operating cycles	cycle/min	60	60	60	60	60	60	60	60		
Ambient temperature range	°C	-10~70									
Spring re-turning force	Set state	N(kgf)	2.94(0.3)	4.9(0.5)	4.51(0.46)	5.39(0.55)	11.95(1.22)	16.56(1.69)	23.81(2.43)	16.17(1.65)	
	Compressed state	N(kgf)	5.88(0.6)	9.8(1.0)	9.8(1.0)	14.7(1.5)	18.03(1.84)	33.12(3.38)	71.44(7.29)	27.24(2.78)	
Mounting structure strength	N(kgf)	1274(130)	2940(300)	3626(370)	5292(37C)	9800(1000)	9800(1000)	9800(1000)	13720(1400)		
Mass	g	22.5	40	58	97	156	335	393	357		
Dust wiper	Provided	○		○		○		○		○	
	Not provided	-		○		○		○		○	
Rod cap	Provided	○		○		○		○		○	
	Not provided	○		○		○		○		○	
Option	Stopper nut	10SAS-N		12SAS-N		14SAS-N		16SAS-N		20SAS-N	
		10SAC-N		12SAC-N		14SAC-N		16SAC-N		20SAC-N	
	Adaptor for slant angle	1008SA-A		1210SA-A		1410SA-A		1612SA-A		2016SA-A	
		-		-		-		1612SA-H		2016SA-H	
Holder with sensor	-		1210SA-HN		1410SA-HN		1612SA-HN		2016SA-HN		
		-		-		-		2530SA-HN		-	

See "Note" on page 9.

# SHOCK ABSORBER

## SPECIFICATIONS

●SA series/CC type

Model No.	Unit	SA-1008 CC1	SA-□1210 CC1	SA-□1410 CC1	SA-□1612 CC1	SA-□2016 CC1	SA-□2530 CC1	
Adjustment		Analog fine adjusting type						
Absorbing stroke	mm	8	10	10	12	16	30	
Max. energy absorbing capacity	J (kgf·m)	1.76 (0.18)	4.9 (0.5)	5.88 (0.6)	9.8 (1.0)	29.4 (3.0)	49 (5)	
Max. equivalent mass	kg	2.5	4	4.5	10	120	150	
Max. impact velocity	m/s	3	3	3	3	3	3	
Max. heat dissipation capacity per minute	J/min (kgf·m/min)	58.8 (6)	98 (10)	147 (15)	235 (24)	343 (35)	490 (50)	
Max. operating cycles	cycle/min	50	60	60	60	60	60	
Ambient temperature range	°C	-10~70						
Spring re- turning force	Set state Compressed state	N(kgf) N(kgf)	2.94(0.3) 5.88(0.6)	4.9(0.5) 9.8(1)	4.51(0.46) 9.8(1)	5.39(0.55) 14.7(1.5)	11.95(1.22) 18.03(1.84)	16.56(1.69) 33.12(3.38)
Mounting structure strength	N(kgf)	1274(130)	2940(300)	3626(370)	5292(540)	9800(1000)	9800(1000)	
Mass	g	22.5	40	58	97	156	335	
Dust wiper	Provided Not provided	○ -	○ ○	○ ○	○ ○	○ ○	○ ○	
Rod cap	Provided Not provided	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	
Option	Stopper nut		10SAS-N 10SAC-N	12SAS-N 12SAC-N	14SAS-N 14SAC-N	16SAS-N 16SAC-N	20SAS-N 20SAC-N	25SAS-N 25SAC-N
	Adaptor for slant angle		1008SA-A	1210SA-A	1410SA-A	1612SA-A	2016SA-A	2530SA-A
	Holder with sensor		-	-	-	1612SA-H	2016SA-H	2530SA-H
			-	1210SA-HN	1410SA-HN	1612SA-HN	2016SA-HN	2530SA-HN

Model No.	Unit	SA-□2540 CC1	SA-□2725 CC1	SA-3035 CC1	SA-3650 CC1	SA-4250 CC1	SA-4280 CC1	
Adjustment		Analog fine adjusting type						
Absorbing stroke	mm	40	25	35	50	50	80	
Max. energy absorbing capacity	J (kgf·m)	63.7 (6.5)	79.4 (8.1)	196 (20)	392 (40)	441 (45)	720 (73.5)	
Max. equivalent mass	kg	200	300	700	1400	390	640	
Max. impact velocity	m/s	3	3	3	3	3	3	
Max. heat dissipation capacity per minute	J/min (kgf·m/min)	637 (65)	539 (55)	1176 (120)	2352 (240)	2744 (280)	4410 (450)	
Max. operating cycles	cycle/min	60	60	30	30	10	6	
Ambient temperature range	°C	-10~70						
Spring re- turning force	Set state Compressed state	N(kgf) N(kgf)	23.81(2.43) 71.44(7.29)	16.17(1.65) 27.24(2.78)	19.6(2.0) 44.1(4.5)	22.54(2.3) 68.6(7.0)	24.5(2.5) 83.3(8.5)	24.5(2.5) 98(10)
Mounting structure strength	N(kgf)	9800(1000)	13720(1400)	33320(3400)	47040(4800)	54057(5516)	54057(5516)	
Mass	g	393	357	640	1120	1300	1750	
Dust wiper	Provided Not provided	○ ○	○ ○	○ -	○ -	○ -	○ -	
Rod cap	Provided Not provided	- ○	○ ○	○ ○	○ ○	- ○	- ○	
Option	Stopper nut		27SAS-N 25SAC-N4	30SAS-N 30SAC-N	36SAS-N 36SAC-N	- -	- -	
	Adaptor for slant angle		-	2725SA-A	3035SA-A	3650SA-A	-	
	Holder with sensor		-	2725SA-H	-	-	-	
			-	2725SA-HN	-	-	-	

See "Note" on page 9.

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# SHOCK ABSORBER

## SPECIFICATIONS

●SA series/CD type

Model No.	Unit	SA-1008 CD1	SA-□1210 CD1	SA-□1410 CD1	SA-□1612 CD1	SA-□2016 CD1	SA-□2530 CD1	
Adjustment		Analog fine adjusting type						
Absorbing stroke	mm	8	10	10	12	16	30	
Max. energy absorbing capacity	J (kgf·m)	1.76 (0.18)	4.9 (0.5)	5.88 (0.6)	9.8 (1.0)	29.4 (3.0)	49 (5.0)	
Max. equivalent mass	kg	10	30	35	50	200	300	
Max. impact velocity	m/s	2	2	2	2	2	2	
Max. heat dissipation capacity per minute	J/min (kgf·m/min)	58.8 (6)	98 (10)	147 (15)	235.5 (24)	343 (35)	490 (50)	
Max. operating cycles	cycle/min	60	60	60	60	60	60	
Ambient temperature range	°C	-10~70						
Spring re- turning force	Set state Compressed state	N(kgf) N(kgf)	2.94(0.3) 5.88(0.6)	4.9(0.5) 9.8(1.0)	4.51(0.46) 9.8(1.0)	5.39(0.55) 14.7(1.5)	11.95(1.22) 18.03(1.84)	16.56(1.69) 33.12(3.38)
Mounting structure strength	N(kgf)	1274(130)	2940(300)	3626(370)	5292(540)	9800(1000)	9800(1000)	
Mass	g	22.5	40	58	97	156	335	
Dust wiper	Provided Not provided	○ -	○ ○	○ ○	○ ○	○ ○	○ ○	
Rod cap	Provided Not provided	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	
Option	Stopper nut		10SAS-N 10SAC-N	12SAS-N 12SAC-N	14SAS-N 14SAC-N	16SAS-N 16SAC-N	20SAS-N 20SAC-N	25SAS-N 25SAC-N
	Adaptor for slant angle		1008SA-A	1210SA-A	1410SA-A	1612SA-A	2016SA-A	2530SA-A
	Holder with sensor		-	-	-	1612SA-H	2016SA-H	2530SA-H
			-	1210SA-HN	1410SA-HN	1612SA-HN	2016SA-HN	2530SA-HN

Model No.	Unit	SA-□2540 CD1	SA-□2725 CD1	SA-3035 CD1	SA-3650 CD1	SA-4250 CD1	SA-4280 CD1	
Adjustment		Analog fine adjusting type						
Absorbing stroke	mm	40	25	35	50	50	80	
Max. energy absorbing capacity	J (kgf·m)	63.7 (6.5)	79.38 (8.1)	196 (20)	392 (40)	441 (45)	720 (73.5)	
Max. equivalent mass	kg	350	450	1300	2700	3500	5500	
Max. impact velocity	m/s	2	2	2	2	2	2	
Max. heat dissipation capacity per minute	J/min (kgf·m/min)	637 (65)	539 (55)	1176 (120)	2352 (240)	2744 (280)	4410 (450)	
Max. operating cycles	cycle/min	60	60	30	30	10	60	
Ambient temperature range	°C	-10~70						
Spring re- turning force	Set state Compressed state	N(kgf) N(kgf)	23.81(2.43) 71.44(7.29)	16.17(1.65) 27.24(2.78)	19.6(2.0) 44.1(4.5)	22.54(2.3) 68.6(7.0)	24.5(2.5) 83.3(8.5)	24.5(2.5) 98(10)
Mounting structure strength	N(kgf)	9800(1000)	13720(1400)	33320(3400)	47040(4800)	54057(5516)	54057(5516)	
Mass	g	393	357	640	1120	1300	1750	
Dust wiper	Provided Not provided	○ ○	○ ○	○ -	○ -	○ -	○ -	
Rod cap	Provided Not provided	- ○	○ ○	○ ○	○ ○	- ○	- ○	
Option	Stopper nut		27SAS-N 25SAC-N4	30SAS-N 30SAC-N	36SAS-N 36SAC-N	- -	- -	
	Adaptor for slant angle		-	2725SA-A	3035SA-A	3650SA-A	-	
	Holder with sensor		-	2725SA-H	-	-	-	
			-	2725SA-HN	-	-	-	

See "Note" on page 9.

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# SHOCK ABSORBER

## SPECIFICATIONS

### ●SAE series

Model No.	Unit	SAE-2010	SAE-3020	
Adjustment		Fixed type		
Absorbing stroke	mm	10	20	
Max. energy absorbing capacity	J (kgf·m)	19.6 (2.0)	98 (10)	
Max. equivalent mass	kg	30	140	
Max. impact velocity	m/s	2	2	
Ambient temperature range	°C	-10~70		
Spring re- turning force	Set state	N(kgf)	11.76(1.2)	29.4(3)
	Compressed state	N(kgf)	41.16(4.2)	68.6(7)
Mounting structure strength	N(kgf)	13720(1400)	23520(2400)	
Mass	g	55	250	
Rod cap	Provided	—	—	
	Not provided	○	○	

### ●SAR series (Air return type)

Model No.	Unit	SAR-1415	
		AC1	AC2
Adjustment		Fixed type	
Absorbing stroke	mm	15	
Max. energy absorbing capacity	J (kgf·m)	11.76 (1.2)	19.6 (2)
Max. equivalent mass	kg	40	70
Max. impact velocity	m/s	2	2
Max. heat dissipation capacity per minute	J/min (kgf·m/min)	352.8 (36)	588 (60)
Max. operating cycles	cycle/min	40	40
Ambient temperature range	°C	-10~70	
Pressure for return	MPa(kgf/cm <sup>2</sup> )	2.9~4.9(3~5)	
Mounting structure strength	N(kgf)	7840(800)	
Mass	g	53.5	
Rod cap	Provided	○	○
	Not provided	○	○
Option	Stopper nut	14SAS-N	
		14SAC-N	
	Adaptor for slant angle	—	
	Holder with sensor	1410SA-H	

- (NOTE) 1. Use minimum-energy absorbing capacity at about 1/5 of maximum energy absorbing capacity.  
 2. Maximum heat dissipation capacity per minute is a value applicable where ambient temperature is 20±10°C.  
 3. Mounting structure strength means the one for mounting racks for shock absorber.  
 4. Mass means net value without cap.  
 5. Holder with sensor, HN can use as stopper.

### ●VALVE SPECIFICATIONS FOR SAR series

Model No.	Unit	AR-23HP		
Acting		Direct acting		
Number of port		3		
Port size		M5		
Effective area (Cv)	mm <sup>2</sup>	0.5(0.027)		
Temperature range	°C	5~50		
Voltage	V	AC100/110, 200/220 DC24		
Insulation grade		JIS B		
Allowable voltage variation	%	AC±10, DC±15		
Frequency	Hz	50/60		
AC solenoid Power consumption	Holding	50Hz	VA	(100/200)2.3
		60Hz	VA	(100/200)1.8
	Inrush	50Hz	VA	(100/200)2.9
		60Hz	VA	(100/200)2.5
DC solenoid Power consumption	W	1.8		
Wiring		Lead wire, Plug-in connector		
Mass	g	50		

(NOTE) JIS stands for Japanese Industrial Standard.

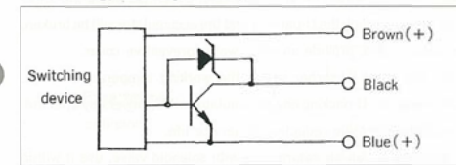
# SHOCK ABSORBER

## HOLDER with Sensor

### SENSOR SPECIFICATIONS

Voltage	V	DC12~24	
Current range	mA	max.100	
Current consumption at OFF	mA	max.15	
Residual voltage	At 100mA output	V	max.1
	At 50mA output	V	max.0.4
Response frequency	Hz	500	
Temperature range	°C	0~55	
Cable	Number of core	3-core	
	Length	m	1

### WIRING DIAGRAM



Attached note:

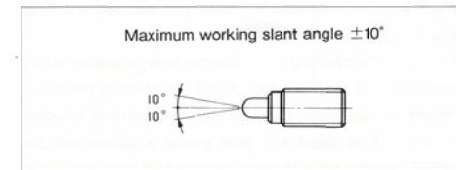
JIS for color code of lead wire has been changed. Our shipment will change as per new color code after stock has gone.

Current color : Red White Black

New color : Brown Black Blue

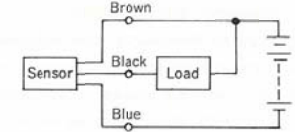
## ADAPTOR for Slant Angle

This adaptor can be set easily by screwing to a shock absorber.  
 Use this adaptor when load is applied to the shock absorber at an angle of more than 2.5°.



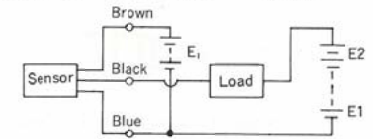
### CONNECTION OF SENSOR

●When power is common on both load and sensor.



●When power to load is not common with the sensor.

Use E1 and E2 at the same voltage.



# SHOCK ABSORBER

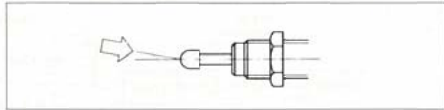


## PRECAUTIONS FOR HANDLING

### INSTALLATION

1. Disconnect electrical supply before installation.
2. Disconnect air supply and depressurize before installation.
3. Install the shock absorber so that load may be received at the center of the piston rod of the shock absorber. If slant angle to the piston rod is larger than 2.5°, the U-packing seal will be partly worn or the piston rod will be bent, resulting in defective return of the piston rod.

When a slant angle is applied, use Adaptor for Slant Angle.



4. Recommended torque for Hexagon nut to fix the shock absorber. Excess torque shall cause fatal damage on the shock absorber.

(N·m(kgf·cm))

Thread	Torque	Thread	Torque
M8	4(40)	M25	50(500)
M10, M12	8(80)	M27	60(600)
M14	10(100)	M30	80(800)
M16	15(150)	M36	100(1000)
M18, M20	30(300)	M40, M45	120(1200)
M22	40(400)		

5. Avoid using the shock absorber as a stopper. If the collision energy exceeds the specified value, the shock absorber may be broken. Provide a stopper 1 to 2 mm before the stroke end. Stopper Nut is optionally available.
6. Avoid using two or more adjusting shock absorbers arranged in parallel as a general rule. In this case, however, they can be used provided all of them have the same adjusting positions and receive the same force.

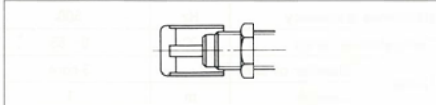
### SENSOR

1. Turn off the power supply before wiring.
2. Use care to prevent the sensor to protrude from the rod cap end when the piston rod is pushed. Otherwise the sensor will be damaged by the load.
3. Set holder position so that the sensor may be distant from the rod cap by more than 1 mm.
4. The sensor is not water-proof construction. When using under water dripping condition, water shelter is required.

Before Proceeding the works, you should first thoroughly read below mentioned precautions.

### ENVIRONMENT

1. Avoid using the shock absorber in a dusty location. Otherwise, the U-packing will be damaged, deteriorating the durability. It is recommendable to provide a dust preventive cover.



2. Avoid using the shock absorber in an environment where it will be splashed with water, oil or other liquid. Otherwise liquid will enter the inside through the U-packing and the accumulator will be broken. In such a case, provide an oil or water preventive cover.

3. Use the shock absorber within the working temperature range. Otherwise the U-packing and accumulator will be adversely affected, resulting excessive reduction of service life.

Especially for an air return type with solenoid valve, use it within the range of 5 to 50°C.

Note that the working temperature range for a shock absorber with fittings varies according to pressure an tube. Use care that the maximum temperature will not exceed 80°C.

4. Avoid using the shock absorber in vacuum.

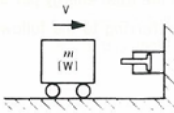
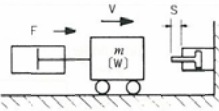
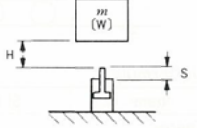
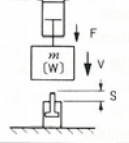
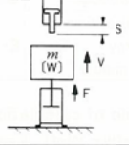
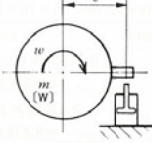
Otherwise oil leak will occur.

### USAGE AND ADJUSTMENT

1. Use care to prevent a damage to the piston rod. Otherwise, the U-packing seal will flaw, resulting in oil leak.
2. Since the fixed type shock absorber is not capable of receiving energy larger than the rated, avoid applying energy (weight and speed) over the rated load. If it undergoes overload, it will not absorb the energy.
3. When using the adjusting shock absorber under uncertain setting conditions, it is recommendable to set the adjusting position at Medium or Low firstly and then adjust it according to actual conditions. If an object with large energy is collided with the adjusting position set at High, the piston rod will bend, resulting in defective return of the rod.
4. When using a stopper fit it so that the piston rod will stop 1 to 1.5mm before the stroke end.
5. The air pressur for air return type shock absorber shall be kept within the range of 0.3 to 0.7 Mpa (3.1 ~ 7.1 kgf/cm²).
6. Use clean air. Otherwise moisture or dust will excessively deteriorate the durability of the shock absorber.

# SHOCK ABSORBER

## FORMULA FOR ABSORBING ENERGY

Applications	Formula	
	Absorbing energy	Equivalent load
Simple horizontal collision 	$E = \frac{mv^2}{2}$ $\left( E = \frac{W \cdot v^2}{2g} \right)$ $= 0.051W \cdot v^2$	$We = m$ $(We = W)$
Collision with thrust such as cylinder 	$E = \frac{mv^2}{2} + F \cdot S$ $\left( E = \frac{W \cdot v^2}{2g} + F \cdot S \right)$	$We = \frac{E}{0.5V^2}$ $\left( We = \frac{E}{0.051V^2} \right)$
Free falling collision 	$E = m \cdot g \cdot (H + S)$ $(E = W \cdot (H + S))$	$We = \frac{E}{0.5V^2}$ $(V = \sqrt{2g \cdot H})$ $\left( We = \frac{E}{0.051V^2} \right)$
With cylinder faced downward 	$E = \frac{mv^2}{2} + (F + m \cdot g)S$ $\left( E = \frac{W \cdot v^2}{2g} + (F + W)S \right)$	$We = \frac{E}{0.5V^2}$ $\left( We = \frac{E}{0.051V^2} \right)$
With cylinder faced upward 	$E = \frac{mv^2}{2} + (F - m \cdot g)S$ $\left( E = \frac{W \cdot v^2}{2g} + (F - W)S \right)$	$We = \frac{E}{0.5V^2}$ $\left( We = \frac{E}{0.051V^2} \right)$
Rotator 	$E = \frac{I \cdot w^2}{2}$ $\left( E = \frac{I \cdot w^2}{2} \right)$ $(w = \frac{2\pi \cdot n}{60})$	$We = \frac{E}{0.5V^2}$ $(V = l \cdot w)$ $\left( We = \frac{E}{0.051V^2} \right)$

E : Absorbing energy J (kgf·m)

m : Mass kg

W : weight (kgf)

We : Equivalent mass kg(kgf)

g : Gravity acceleration 9.8m/s²(G)

V : Collision velocity m/s

S : Shock absorbing stroke m

F : Thrust N(kgf)

w : Angular velocity rad/s

H : Falling height m

l : Radius m

n : Number of rotation rev./min

I : Moment of inertia

N·m²(kgf·m·s²)

For rotator :  $I = m \cdot \frac{d^2}{8}$

$\left( I = \frac{W}{g} \cdot \frac{d^2}{8} \right)$



# SHOCK ABSORBER

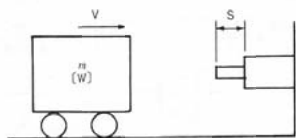


## SELECTION GUIDE

When selecting a hydraulic shock absorber, take into consideration the total energy per stroke "E", the equivalent load "We", the impact velocity "V" and the absorbing energy per minute by referring to the following example.

For any of your specific requirements, consult KURODA.

### ● Horizontal collision without thrust



#### Basic formula

Item	SI Unit	Conventional Unit
① Collision energy	$E_1 = 0.5 \cdot m \cdot V^2$ (J)	$0.051 \cdot W \cdot V^2$ (kgf·m)
② Additional energy	$E_2 = 0$	0
③ Total energy	$E = E_1 + E_2 = E_1$ (J)	$E_1 + E_2 = E_1$ (kgf·m)
④ Equivalent mass (load)	$We = \frac{E}{0.5 \cdot V^2} = m$ (kg)	$\frac{E}{0.051 \cdot V^2}$ (kgf)
⑤ Total collision energy per minute	$Et = E \cdot n$ (J/min)	$E \cdot n$ (kgf·m/min)

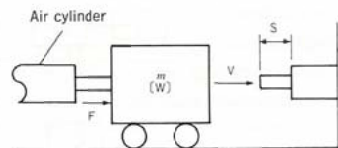
#### Example of calculation

$m = 10 \text{ kg (} W = 10 \text{ kgf)}$   $V = 0.6 \text{ m/s}$   $n = 30 \text{ cycle/min}$   
 $S = 12 \times 10^{-3} \text{ m}$

Item	SI Unit	Conventional Unit
① $E_1 =$	$0.5 \times 10 \times 0.6^2 = 1.8$ (J)	$0.051 \times 10 \times 0.6^2 = 0.1836$ (kgf·m)
② $E_2 =$	0	0
③ $E =$	1.8 (J)	0.1836 (kgf·m)
④ $We =$	10 (kg)	10 (kgf)
⑤ $Et =$	$1.8 \times 30 = 54$ (J/min)	$0.1836 \times 30 = 5.508$ (kgf·m/min)

Selected Model : SA-1210AA1, SA-1210BB1

### ● Horizontal collision with air cylinder thrust



#### Basic formula

Item	SI Unit	Conventional Unit
① Energy just before collision	$E_1 = 0.5 \cdot m \cdot V^2$ (J)	$0.051 \cdot W \cdot V^2$ (kgf·m)
② Additional energy	$E_2 = F \cdot S$ (J)	$F \cdot S$ (kgf·m)
③ Total energy	$E = E_1 + E_2$ (J)	$E_1 + E_2$ (kgf·m)
④ Equivalent mass (load)	$We = \frac{E}{0.5 \cdot V^2}$ (kg)	$\frac{E}{0.051 \cdot V^2}$ (kgf)
⑤ Total collision energy per minute	$Et = E \cdot n$ (J/min)	$E \cdot n$ (kgf·m/min)

#### Example of calculation

$m = 30 \text{ kg (} W = 30 \text{ kgf)}$   $V = 0.6 \text{ m/s}$   $F = 617.4 \text{ N (} 63 \text{ kgf)}$   
 $n = 20 \text{ cycle/min}$   $S = 16 \times 10^{-3} \text{ m}$

Item	SI Unit	Conventional Unit
① $E_1 =$	$0.5 \times 30 \times 0.6^2 = 5.4$ (J)	$0.051 \times 30 \times 0.6^2 = 0.5508$ (kgf·m)
② $E_2 =$	$617.4 \times 16 \times 10^{-3} = 9.8784$ (J)	$63 \times 16 \times 10^{-3} = 1.008$ (kgf·m)
③ $E =$	$5.4 + 9.8784 = 15.2784$ (J)	$0.5508 + 1.008 = 1.5588$ (kgf·m)
④ $We =$	$\frac{15.2784}{0.5 \times 0.6^2} = 85$ (kg)	$\frac{1.5588}{0.051 \times 0.6^2} = 85$ (kgf)
⑤ $Et =$	$15.2784 \times 20 = 305.568$ (J/min)	$1.5588 \times 20 = 31.176$ (kgf·m/min)

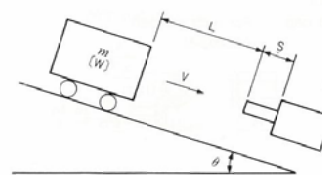
Selected Model : SA-2016BB1, SA-2016CC1

# SHOCK ABSORBER

## CONDITIONS

$m$ : Mass of colliding object (kg)	$n$ : Working frequency (cycle/min)	$d$ : Table diameter (m)
$W$ : Load of colliding object (kgf)	$S$ : Stroke (m)	$R$ : Rotative angle speed (rad/s)
$V$ : Collision velocity (m/s)	$L$ : Falling distance (m)	$R$ : Mounting distance (m)
$F$ : Thrust (N(kgf))	$\theta$ : Tilting angle (degree)	$g$ : Gravity acceleration (9.8m/s <sup>2</sup> (G))
		$I$ : Moment of inertia (N·m <sup>2</sup> (kgf·m·s <sup>2</sup> ))

### ● When rectangular parallelepiped with small friction falls and collides



#### Basic formula

Item	SI Unit	Conventional Unit
① Potential energy of mass of colliding object	$E_1 = m \cdot g \cdot L \cdot \sin \theta$ (J)	$W \cdot L \cdot \sin \theta$ (kgf·m)
② Additional energy	$E_2 = m \cdot g \cdot S \cdot \sin \theta$ (J)	$W \cdot S \cdot \sin \theta$ (kgf·m)
③ Total energy	$E = E_1 + E_2$ (J)	$E_1 + E_2$ (kgf·m)
④ Collision velocity	$V = \sqrt{2 \cdot g \cdot L \cdot \sin \theta}$ (m/s)	$\sqrt{2 \cdot g \cdot L \cdot \sin \theta}$ (m/s)
⑤ Equivalent mass (load)	$We = \frac{E}{0.5 \cdot V^2}$ (kg)	$\frac{E}{0.051 \cdot V^2}$ (kgf)
⑥ Total collision energy per minute	$Et = E \cdot n$ (J/min)	$E \cdot n$ (kgf·m/min)

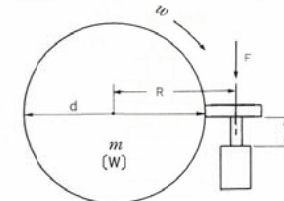
#### Example of calculation

$m = 60 \text{ kg (} W = 60 \text{ kgf)}$   $L = 1 \text{ m}$   $\theta = 2^\circ$   
 $n = 10 \text{ cycle/min}$   $S = 16 \times 10^{-3} \text{ m}$

Item	SI Unit	Conventional Unit
① $E_1 =$	$60 \times 9.8 \times 1 \times \sin 2^\circ = 20.52$ (J)	$60 \times 1 \times \sin 2^\circ = 2.094$ (kgf·m)
② $E_2 =$	$60 \times 9.8 \times 16 \times 10^{-3} \times \sin 2^\circ = 0.328$ (J)	$60 \times 16 \times 10^{-3} \times \sin 2^\circ = 0.034$ (kgf·m)
③ $E =$	$20.52 + 0.328 = 20.848$ (J)	$2.094 + 0.034 = 2.128$ (kgf·m)
④ $V =$	$\sqrt{2 \times 9.8 \times 1 \times \sin 2^\circ} = 0.827$ (m/s)	$\sqrt{2 \times 9.8 \times 1 \times \sin 2^\circ} = 0.827$ (m/s)
⑤ $We =$	$\frac{20.848}{0.5 \times 0.827^2} = 61$ (kg)	$\frac{2.128}{0.051 \times 0.827^2} = 61$ (kgf)
⑥ $Et =$	$20.848 \times 10 = 208.48$ (J/min)	$2.128 \times 10 = 21.28$ (kgf·m/min)

Selected Model : SA-2016BB1, SA-2016CC1

### ● Horizontal rotating collision (disc)



#### Basic formula

Item	SI Unit	Conventional Unit
① Velocity just before collision	$V = R \cdot \omega$ (m/s)	$R \cdot \omega$ (m/s)
② Kinetic energy by $\omega$	$E_1 = \frac{1}{2} \cdot I \cdot \omega^2 = \frac{1}{2} \cdot \frac{W}{g} \cdot \frac{d^2}{8} \cdot \omega^2$ (J)	$\frac{1}{2} \cdot I \cdot \omega^2 = \frac{1}{2} \cdot \frac{W}{g} \cdot \frac{d^2}{8} \cdot \omega^2$ (kgf·m)
③ Additional energy	$E_2 = F \cdot S$ (J)	$F \cdot S$ (kgf·m)
④ Total energy	$E = E_1 + E_2$ (J)	$E_1 + E_2$ (kgf·m)
⑤ Equivalent mass (load)	$We = \frac{E}{0.5 \cdot V^2}$ (kg)	$\frac{E}{0.051 \cdot V^2}$ (kgf)
⑥ Total collision energy per minute	$Et = E \cdot n$ (J/min)	$E \cdot n$ (kgf·m/min)

#### Example of calculation

$m = 1 \text{ kg (} W = 1 \text{ kgf)}$   $d = 2 \text{ m}$   $F = 78.4 \text{ N (} 8 \text{ kgf)}$   
 $\omega = 0.6 \text{ rad/s}$   $R = 1.25$   $n = 20 \text{ cycle/min}$   $S = 16 \times 10^{-3} \text{ m}$

Item	SI Unit	Conventional Unit
① $V =$	$1.25 \times 0.6 = 0.75$ (m/s)	$1.25 \times 0.6 = 0.75$ (m/s)
② $E_1 =$	$\frac{1}{2} \times 1 \times \frac{2^2}{8} \times 0.6^2 = 0.09$ (J)	$\frac{1}{2} \times \frac{1}{9.8} \times \frac{2^2}{8} \times 0.6^2 = 0.009$ (kgf·m)
③ $E_2 =$	$78.4 \times 16 \times 10^{-3} = 0.94$ (J)	$8 \times 12 \times 10^{-3} = 0.096$ (kgf·m)
④ $E =$	$0.09 + 0.94 = 1.03$ (J)	$0.009 + 0.096 = 0.105$ (kgf·m)
⑤ $We =$	$\frac{1.03}{0.5 \times 0.75^2} = 3.7$ (kg)	$\frac{0.105}{0.051 \times 0.75^2} = 3.7$ (kgf)
⑥ $Et =$	$1.03 \times 20 = 20.6$ (J/min)	$0.105 \times 20 = 2.1$ (kgf·m/min)

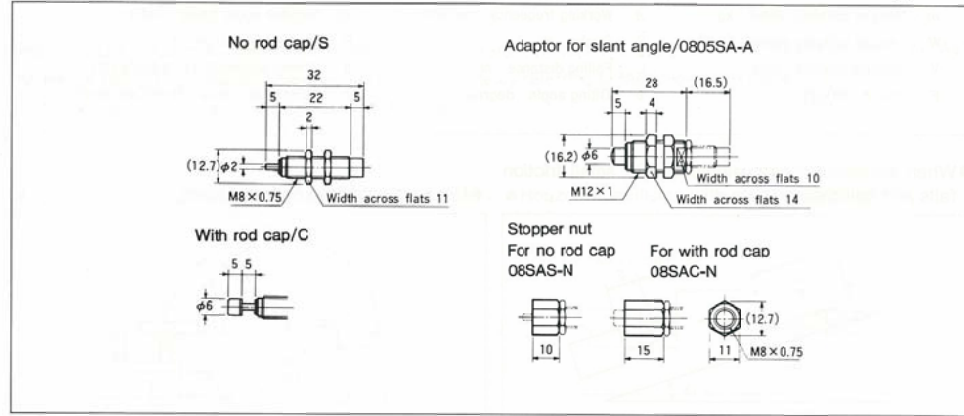
Selected Model : SA-1210AA1, SA-1210BB1

# SHOCK ABSORBER

## DIMENSIONS

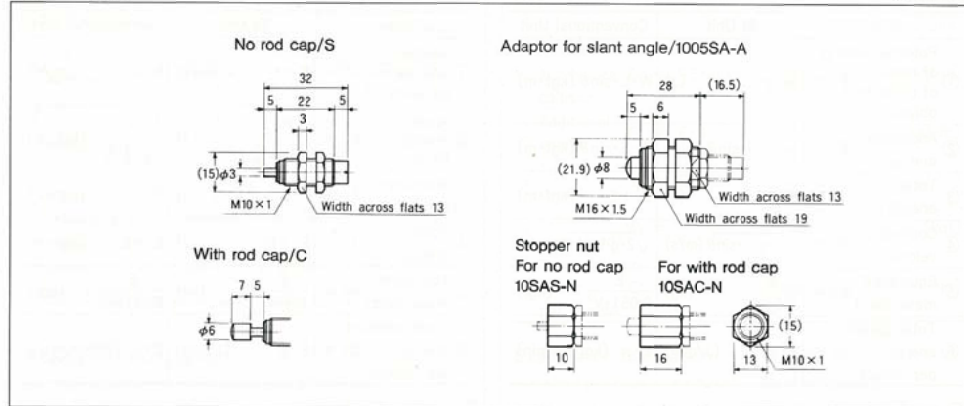
● SA-0805AA

(Unit : mm)



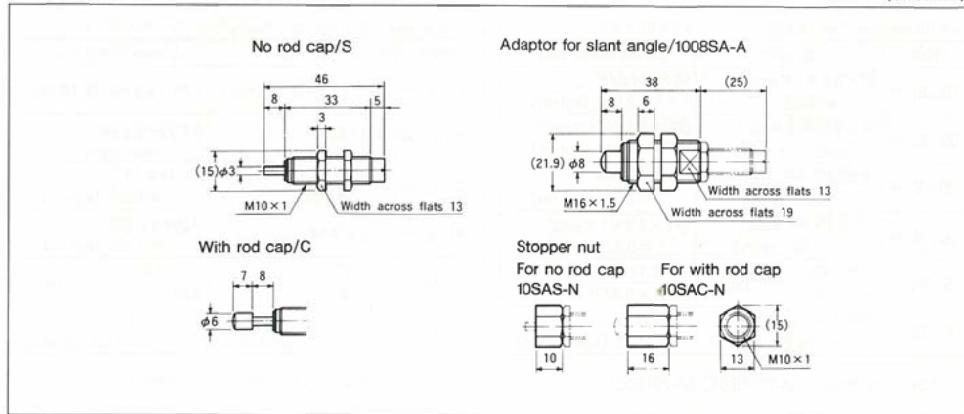
● SA-1005AA

(Unit : mm)



● SA-1008AA

(Unit : mm)

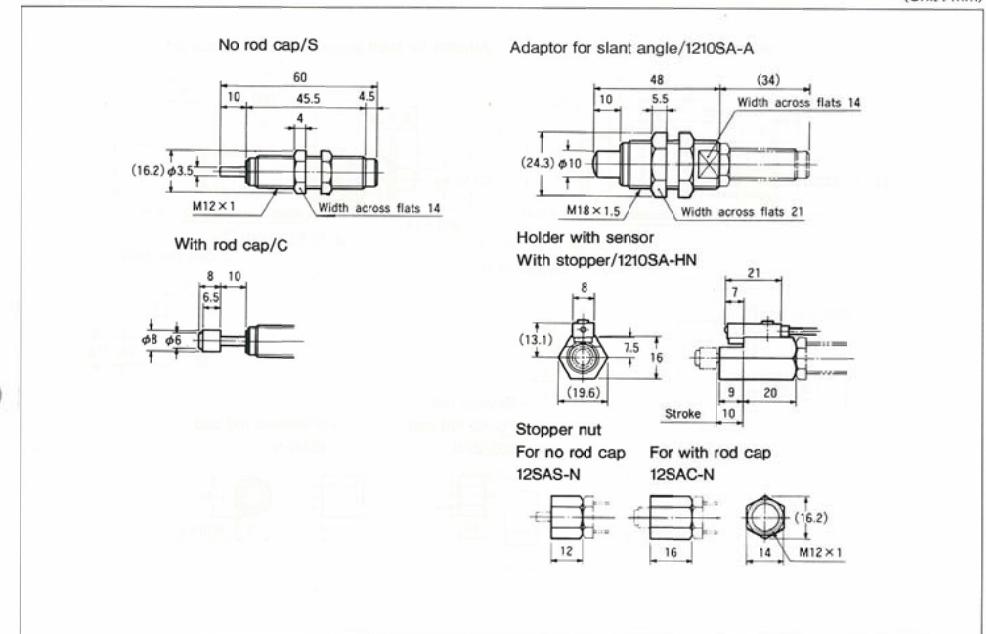


# SHOCK ABSORBER

## DIMENSIONS

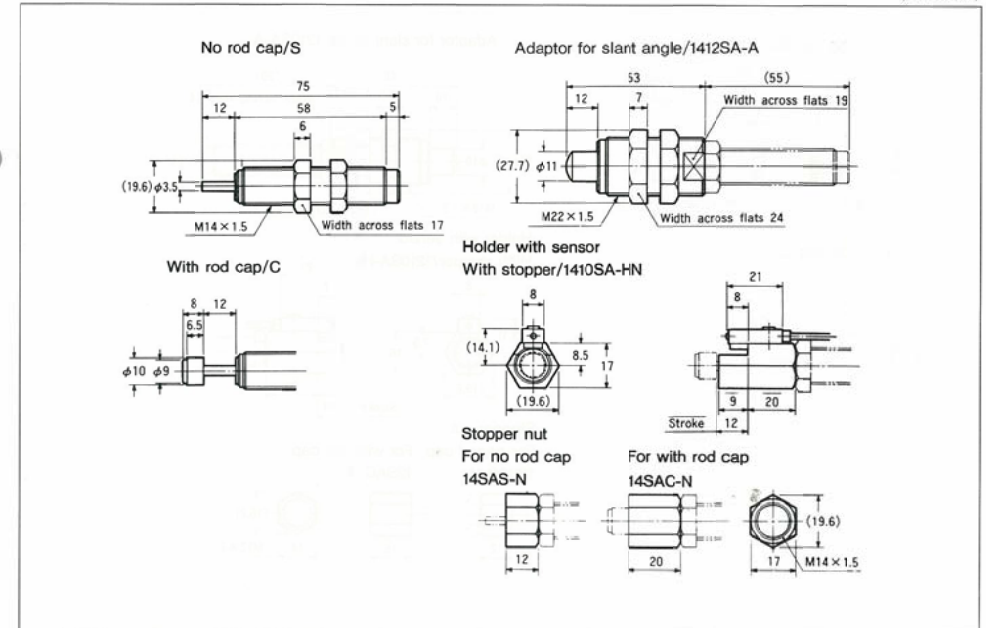
● SA-1210AA

(Unit : mm)



● SA-1412AC

(Unit : mm)



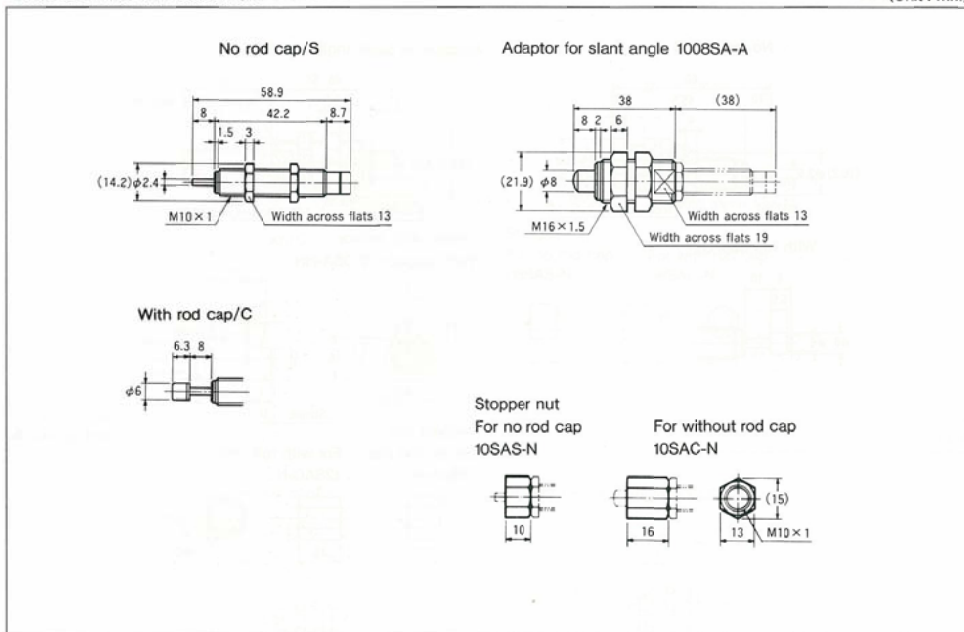


# SHOCK ABSORBER

## DIMENSIONS

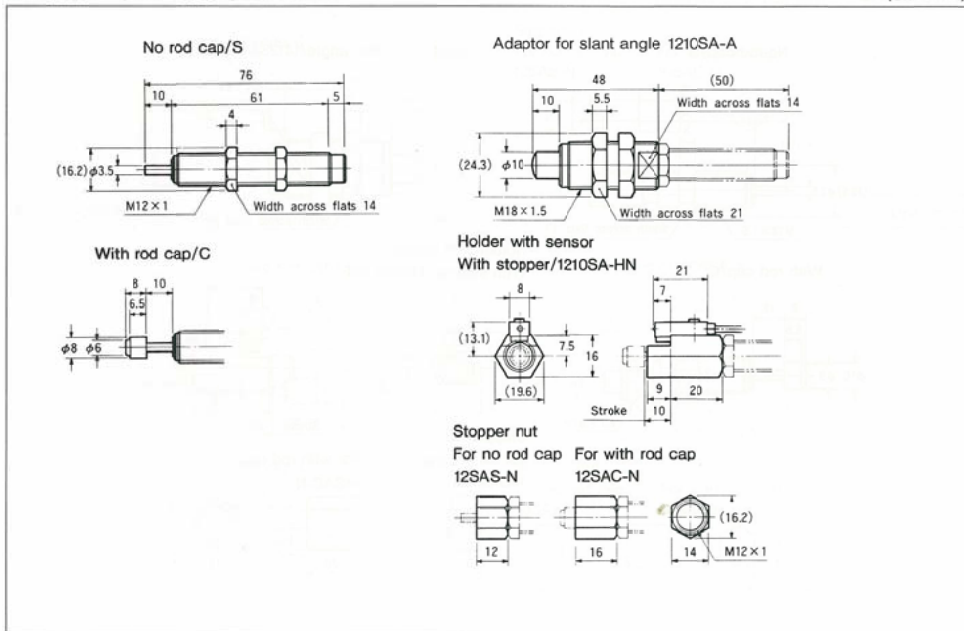
● SA-1008BB, SA-1008CC, SA-1008CD

(Unit: mm)



● SA-1210BB, SA-1210CC, SA-1210CD

(Unit: mm)

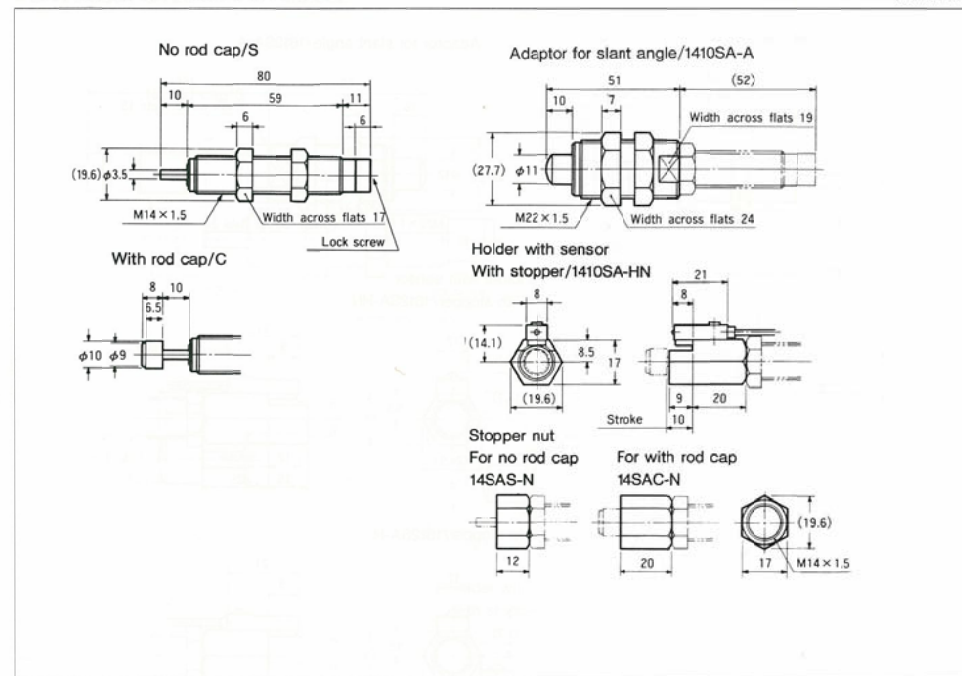


# SHOCK ABSORBER

## DIMENSIONS

● SA-1410BB, SA-1410CC, SA-1410CD

(Unit: mm)

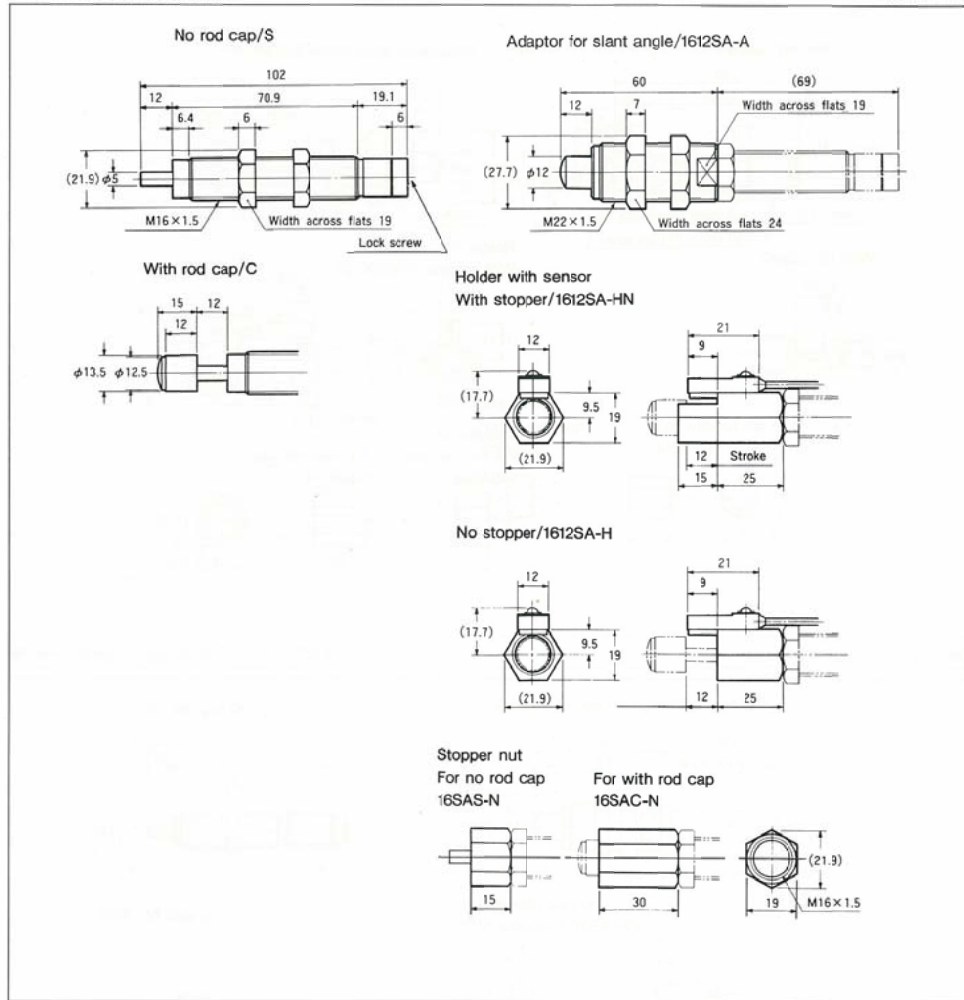


# SHOCK ABSORBER

## DIMENSIONS

● SA-1612BB, SA-1612CD

(Unit : mm)

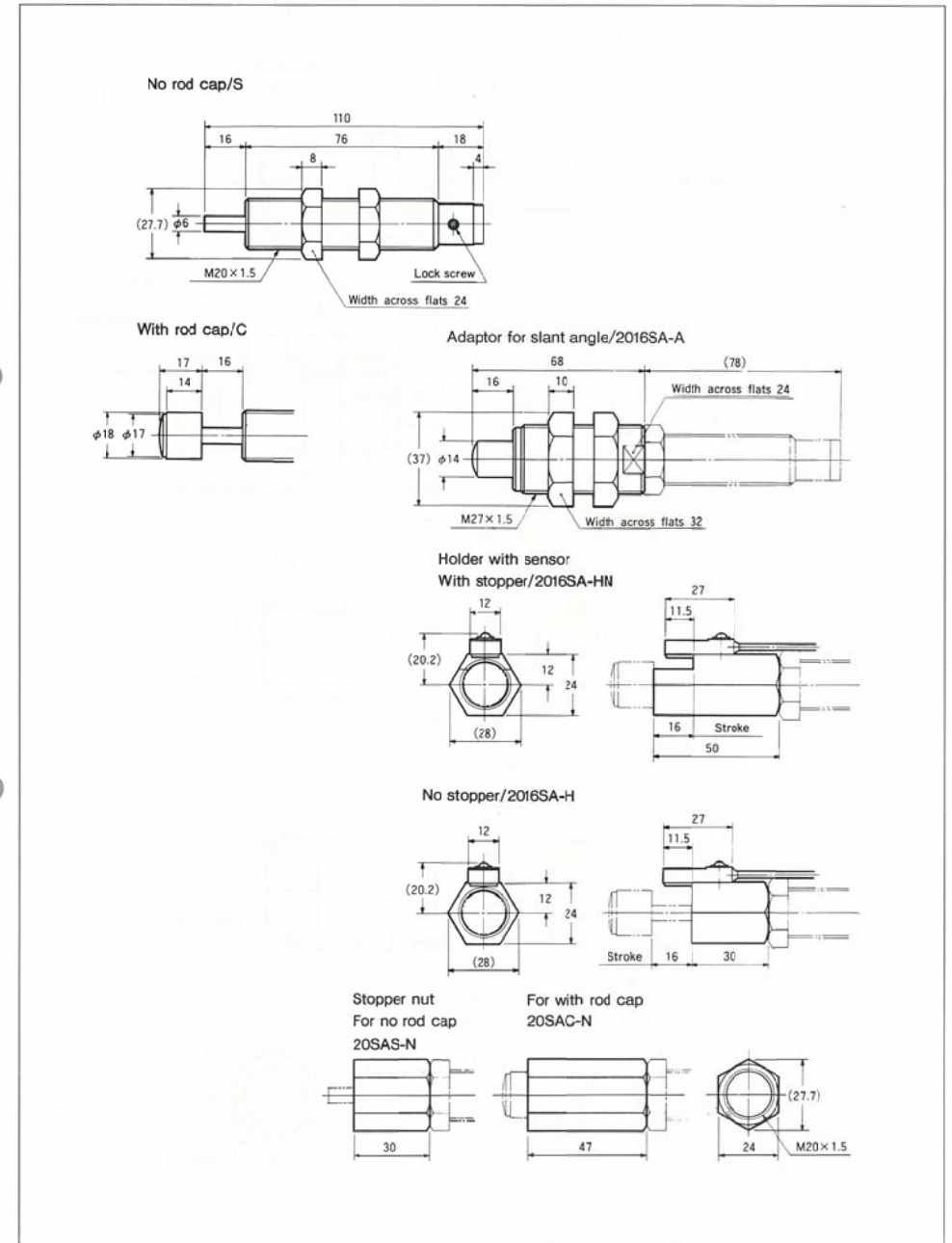


# SHOCK ABSORBER

## DIMENSIONS

● SA-2016BB, SA-2016CC, SA-2016CD

(Unit : mm)



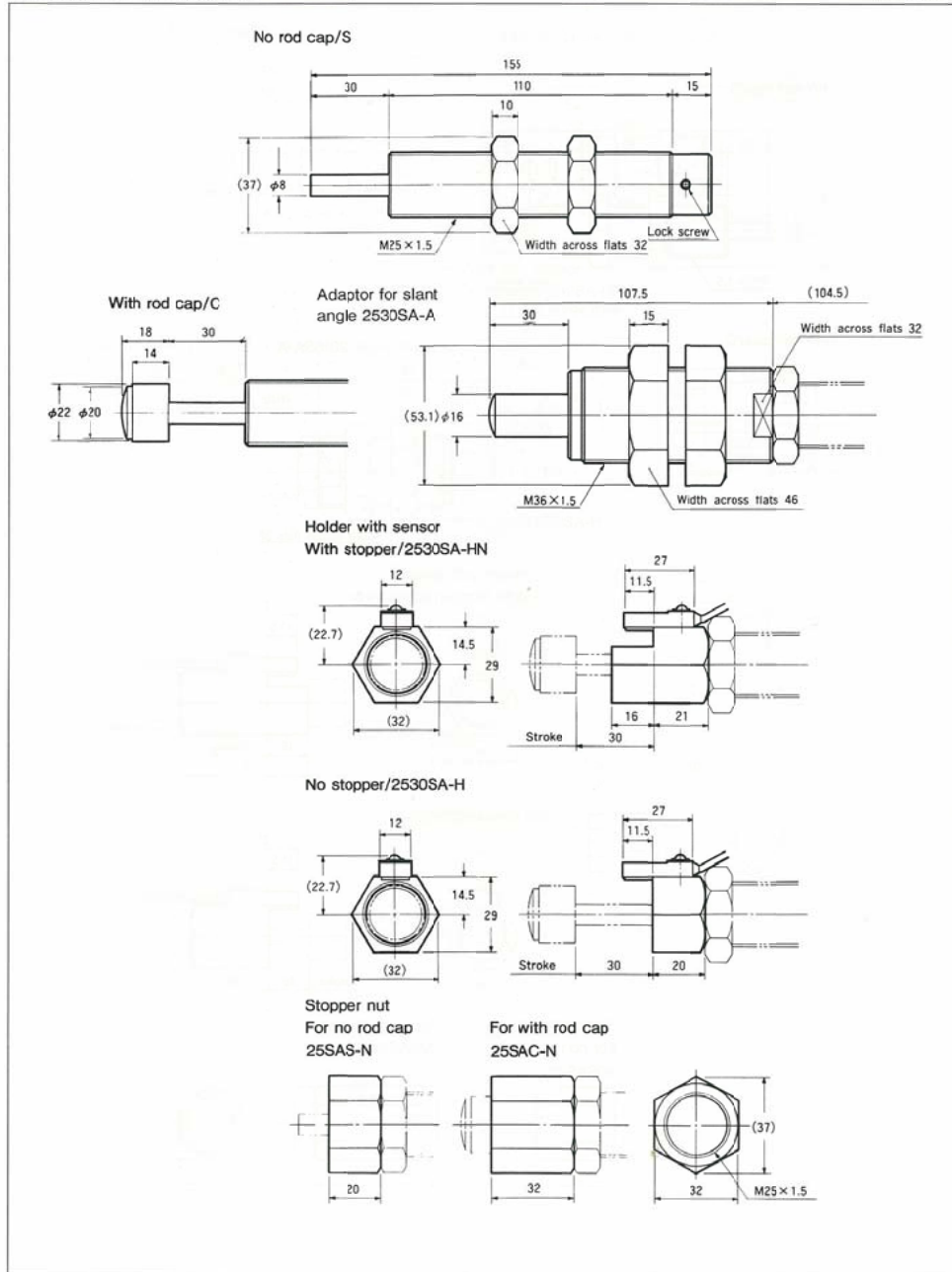


# SHOCK ABSORBER

## DIMENSIONS

● SA-2530BB, SA-2530CC, SA-2530CD

(Unit : mm)

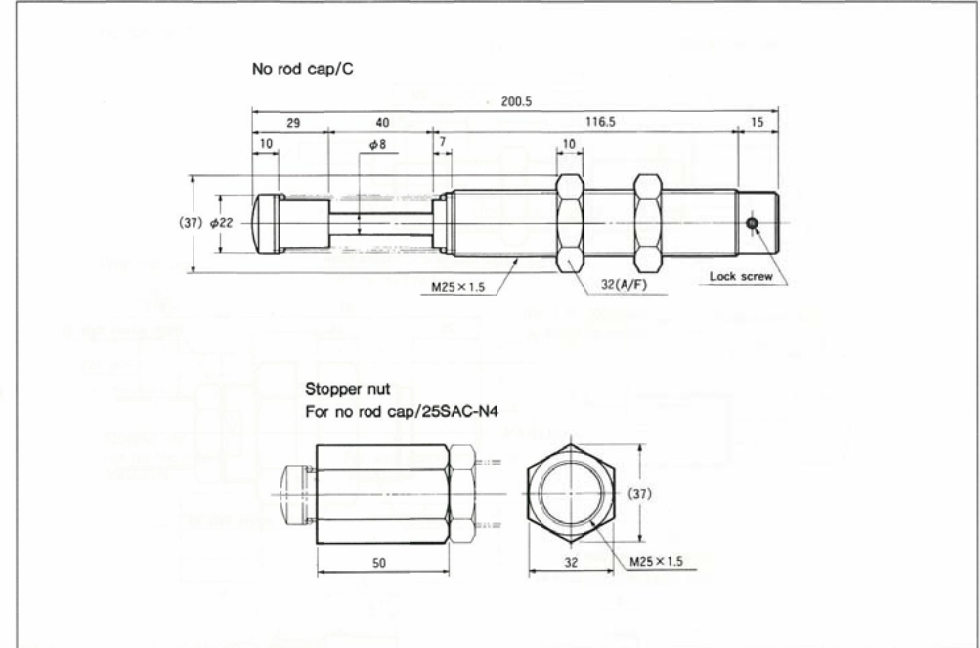


# SHOCK ABSORBER

## DIMENSIONS

● SA-2540BB, SA-2540CC, SA-2540CD

(Unit : mm)

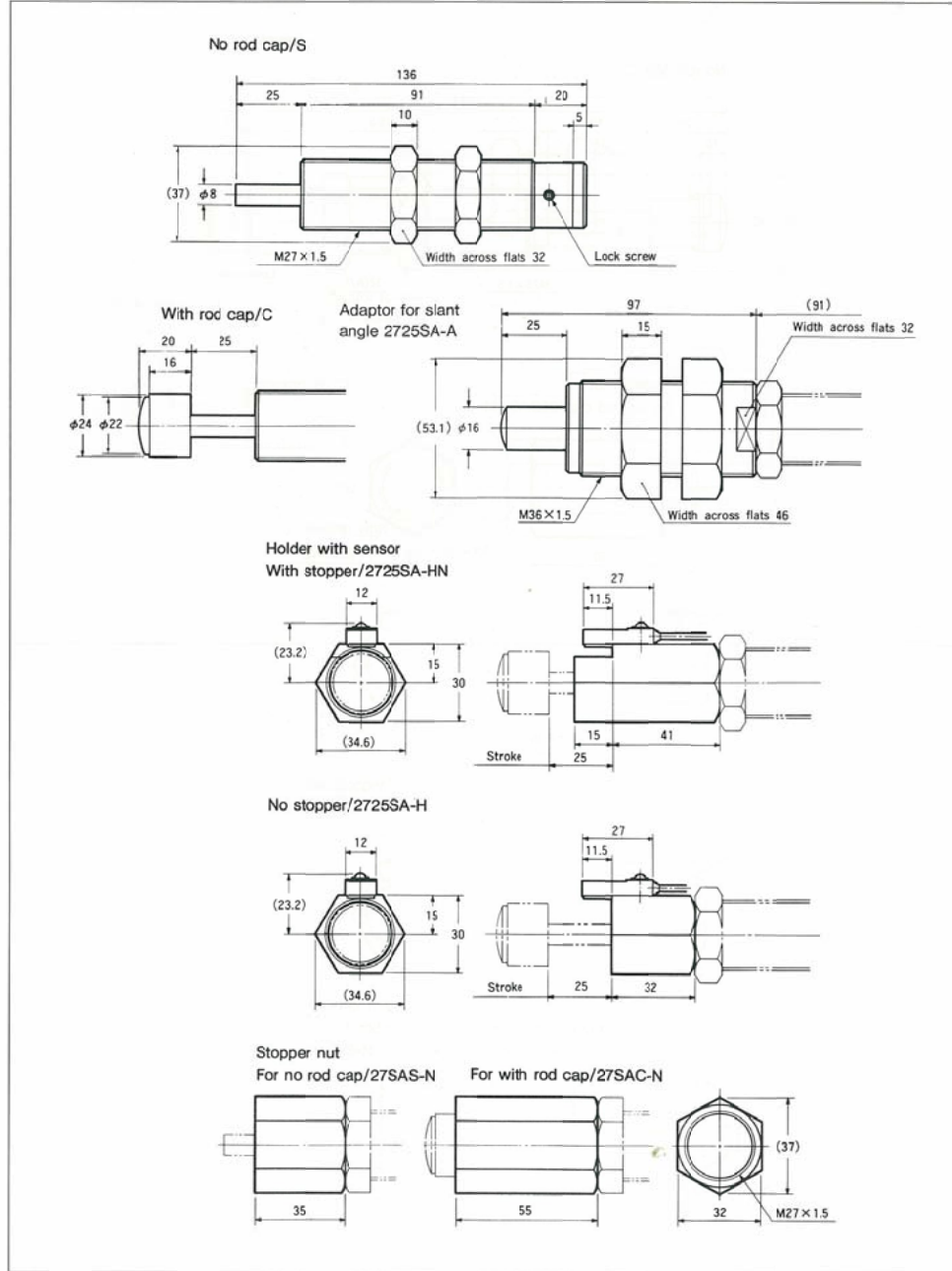


# SHOCK ABSORBER

## DIMENSIONS

● SA-2725BB, SA-2725CC, SA-2725CD

(Unit: mm)

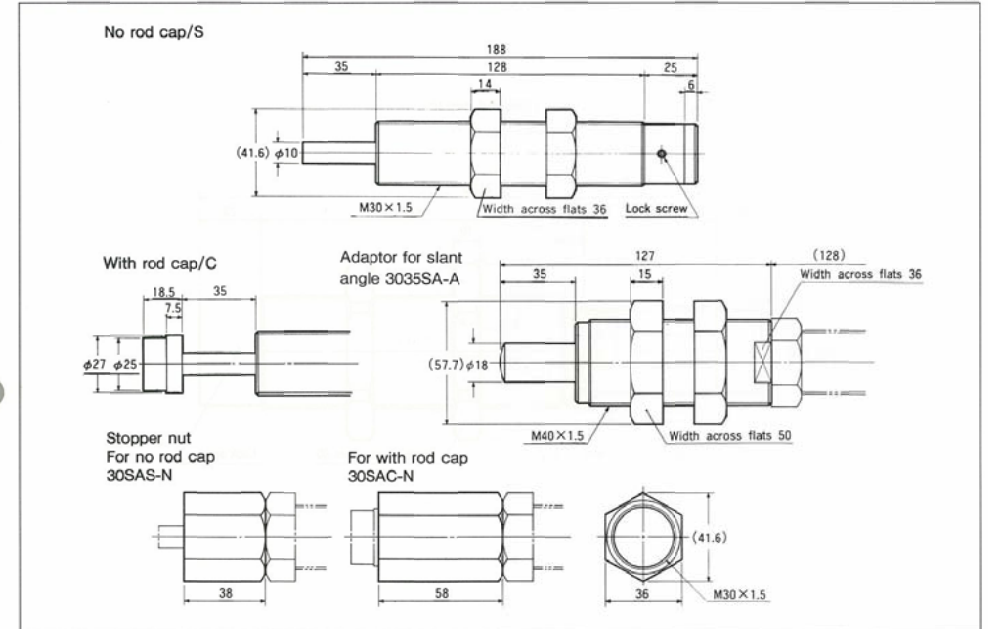


# SHOCK ABSORBER

## DIMENSIONS

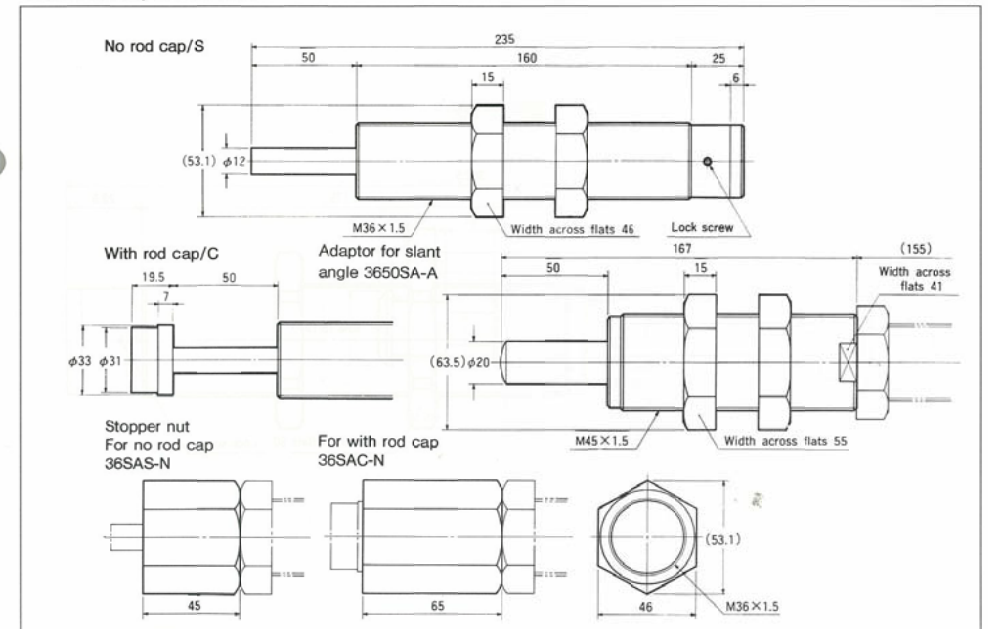
● SA-3035CC, SA-3035CD

(Unit: mm)



● SA-3650CC, SA-3650CD

(Unit: mm)



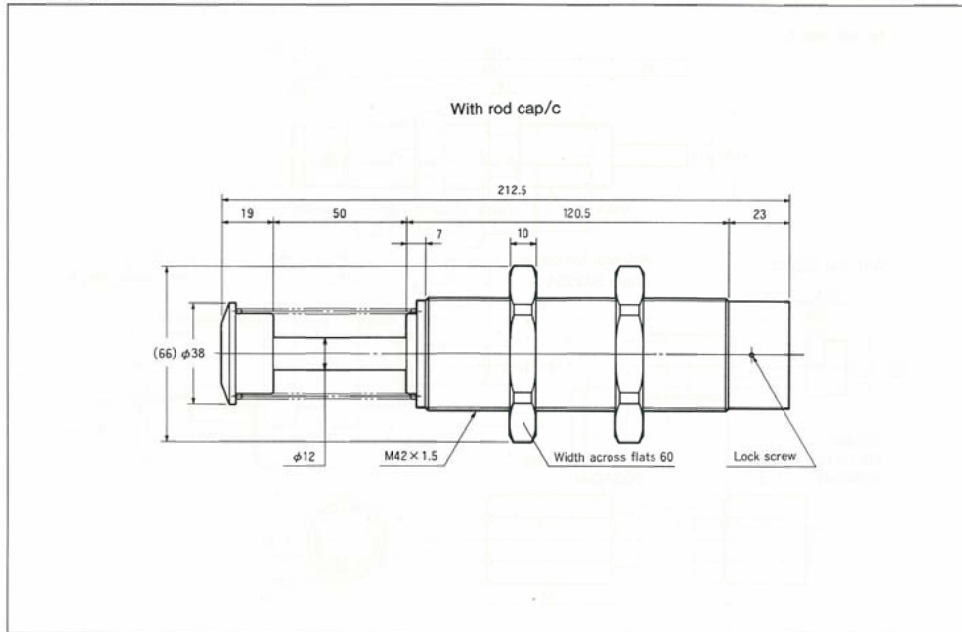


# SHOCK ABSORBER

## DIMENSIONS

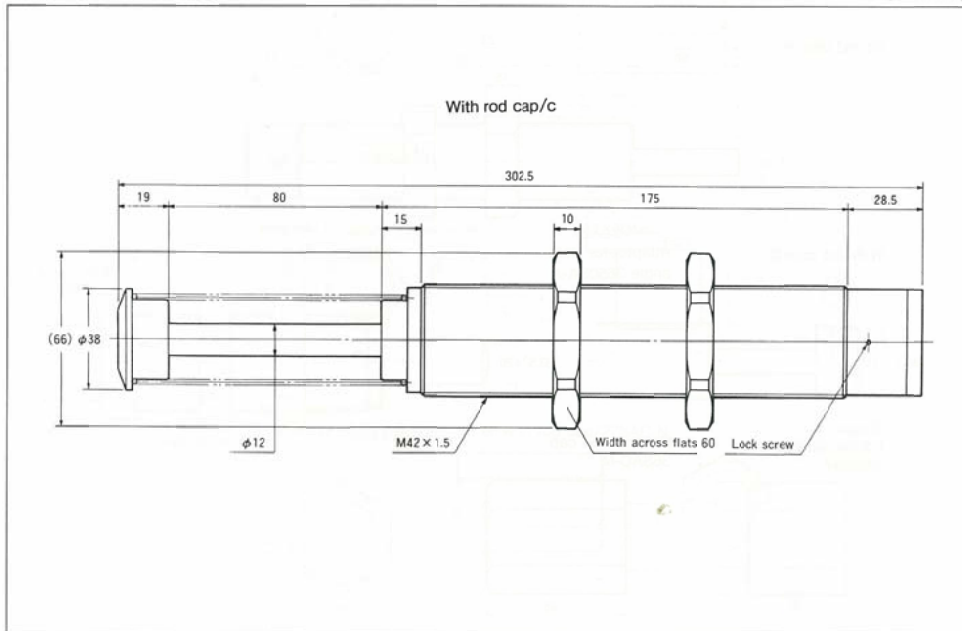
● SA-4250CC, SA-4250CD

(Unit: mm)



● SA-4280CC, SA-4280CD

(Unit: mm)

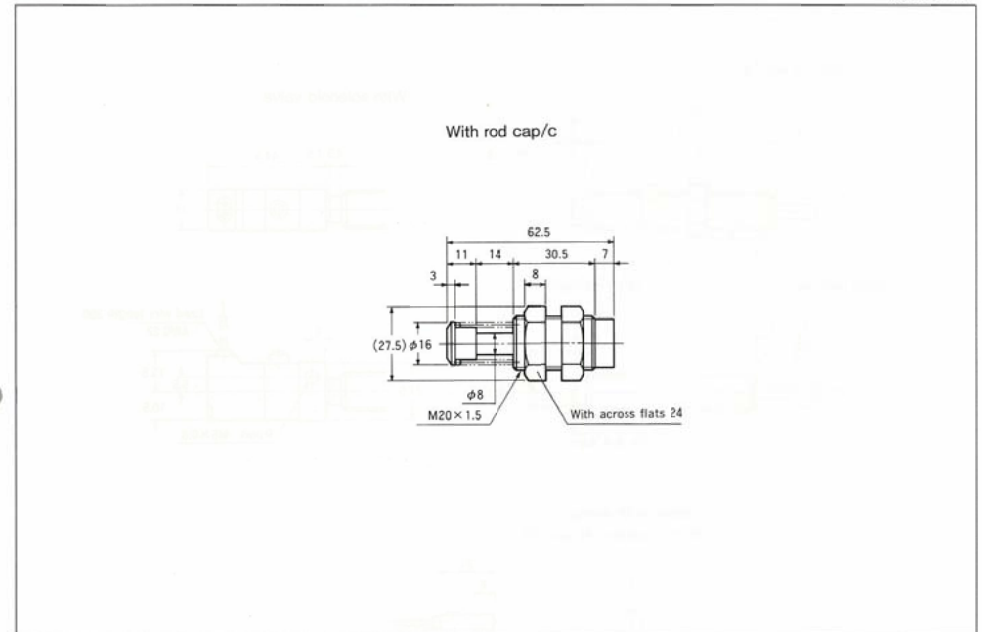


# SHOCK ABSORBER

## DIMENSIONS

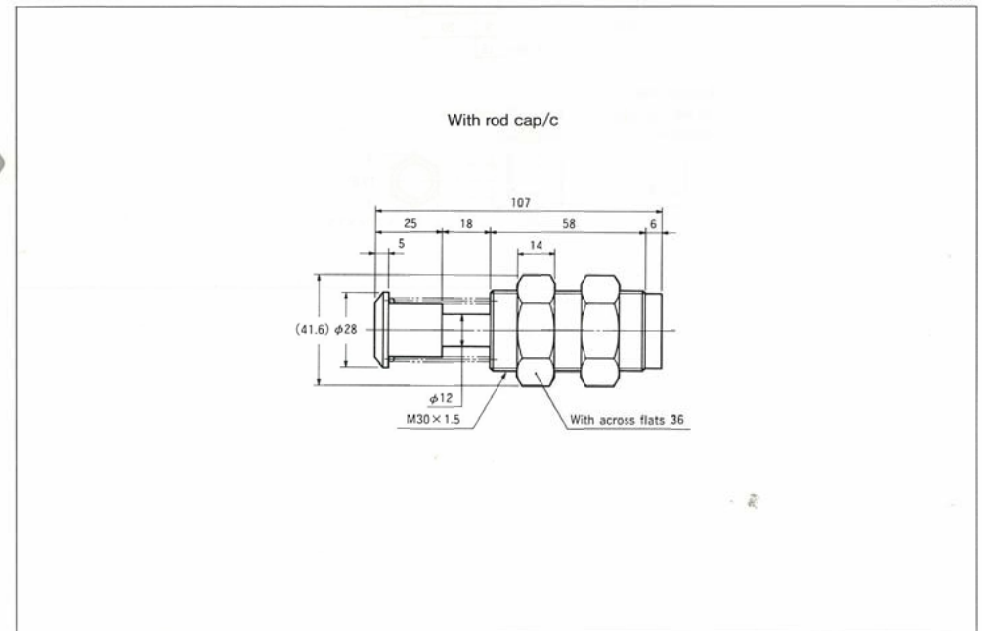
● SAE-2010

(Unit: mm)



● SAE-3020

(Unit: mm)



# SHOCK ABSORBER

## DIMENSIONS

● SAR-1415AC

(Unit: mm)

