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KOGANEI

ACTUATORS GENERAL CATALOG

SLIT TYPE RODLESS CYLINDERS ORV SERIES

CONTENTS

⚠ **Caution** **Before use, be sure to read the "Safety Precautions" on p. 57.**

SLIT TYPE RODLESS CYLINDERS
ORV SERIES

A New World

The ORV series is developed from the ingenious oval piston configuration

Low cost

The standard price is about 50% lower than conventional slit type rodless cylinders (compared with Koganei's own standard prices in Japanese market).

Standard price-reduction ratio (compared with Koganei product in Japanese market)

50%

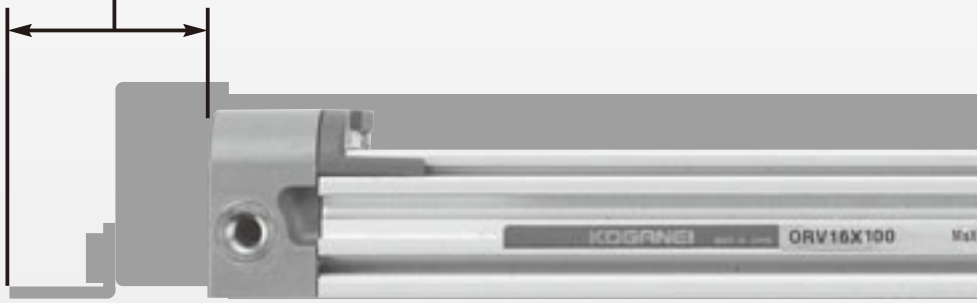
Shorter

Achieves a shorter dead stroke than conventional slit type rodless cylinders. It has reduced dead space by about 35% (Koganei product comparison), to enable large space savings.

Dead stroke-reduction ratio (compared with Koganei product)

35%

Actual dimensional comparisons of ORV 16×100 (in photograph) and ORCA 16×100 (in silhouette)

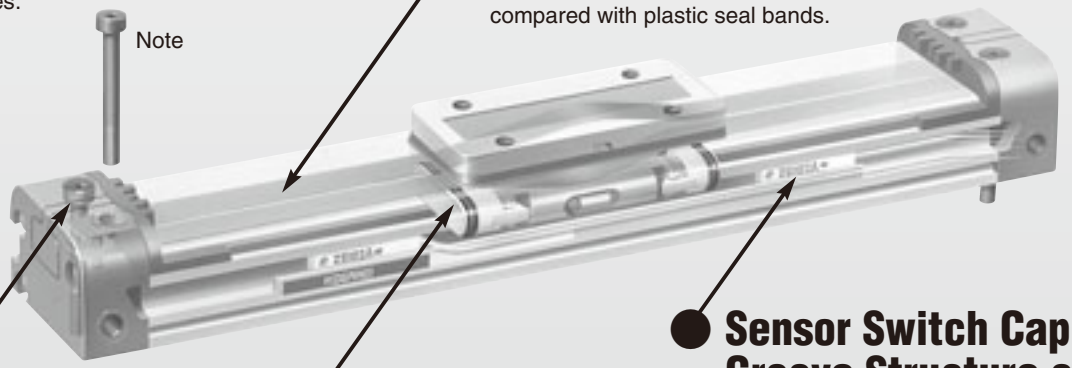


Lightweight Structure

The lightweight body of the slit type rodless cylinders ORV series places alomost no loads on either the actuator axis or the stand, even when used as a Y or Z axis. Contributes to space savings and lighter weight for the overall devices.

High-strength Stainless Seal Band

The original design stainless seal band is the result of many years of experience. Achieves long life and low leakage compared with plastic seal bands.



Direct Mount

The block type end cover allows for direct mounting without the need for mounting brackets.

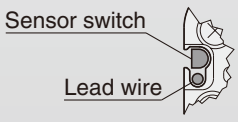
Note: The hexagon socket head bolt shown in the illustration is not provided with the product.

Oval Piston

The oval piston configuration provides an extremely thin design for the body height.

Sensor Switch Cap Groove Structure on Both Sides

Uses a cap groove that allows the lead wires for embedded sensor switches to be pulled out from a single surface.



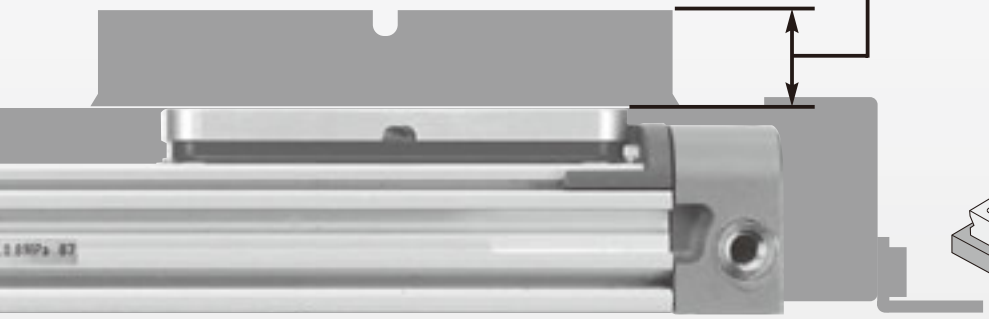
Standard for Rodless Cylinders

concept of making slit type rodless cylinders "low cost, shorter and thinner." Koganei's own design opens up new rodless cylinder applications requiring compact-working envelope areas.

Thinner

About a 40% reduction in height (Koganei product comparison).
The lower table compared to conventional rodless cylinders makes it possible for compact, simple equipment design.

40% ***Height-reduction ratio (compared with Koganei product)***



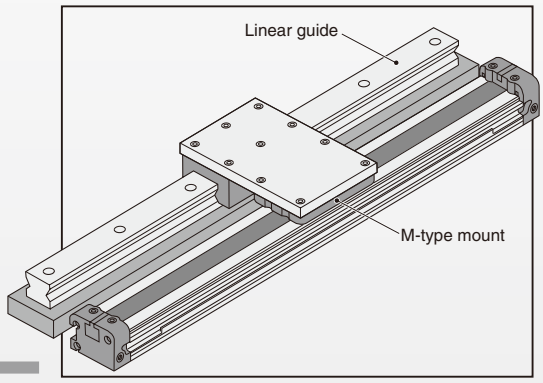
This rodless cylinder is the most compact even at the short 25mm strokes

Although conventional rodless cylinders were no more compact than regular air cylinders when the stroke was not very long, the slit type rodless cylinders ORV series is more compact than regular cylinders even at 25mm [0.984in.] strokes. And since it is a rodless cylinder, it is capable of non-rotating functions.

Best Matching with Linear Guides!

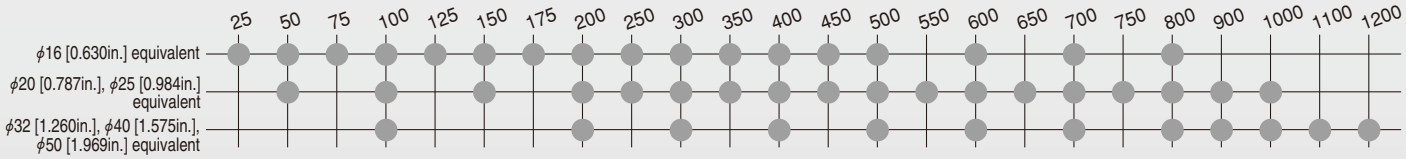
The slit type rodless cylinders ORV series can be connected to linear guides with an M-type mount (optional) that provides a low center of gravity, to achieve a slim form and smooth movement.

<Application example>



Standard Strokes Selection

The standard strokes range from the short 25mm to 1200mm. Strokes can be manufactured up to 2000mm.



Remark: Strokes other than the standard strokes are available at 1mm pitch intervals.

Options Provided to Facilitate Ease of Use

● With shock absorber unit

● M-type mount

● F-type support

General precautions

Piping

1. Always thoroughly blow off (use compressed air) the tubing before connecting it to the rodless cylinder. Entering chips, sealing tape, rust, etc., generated during piping work could result in air leaks or other defective operation.
2. When screwing piping or fittings to rodless cylinders, tighten them using the following tightening torques.

Connecting thread	Tightening torque N·m [ft·lbf]
M5×0.8	1.57 [1.16]
Rc1/8	6.77～8.63 [4.99～6.37]
Rc1/4	11.57～13.44 [8.53～9.91]
Rc3/8	21.18～23.05 [15.62～17.00]

Atmosphere

1. If using in locations subject to dripping water, dripping oil, etc., or to large amounts of dust, use a cover to protect the unit or mount with the piston yoke facing downward.
2. Do not engage in electric welding close to the slit type rodless cylinders **ORV** series. The welding spatters could damage the outer seal band.
3. The product cannot be used when the media or ambient atmosphere contains any of the substances listed below.
   Organic solvents, phosphate ester type hydraulic oil, sulphur dioxide, chlorine gas, or acids, etc.

Lubrication

1. The product can be used without lubrication, if lubrication is required, use Turbine Oil Class 1 (ISO VG32) or equivalent.

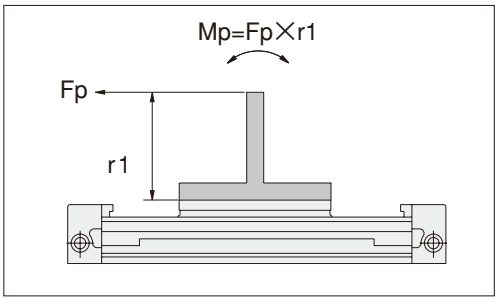
Media

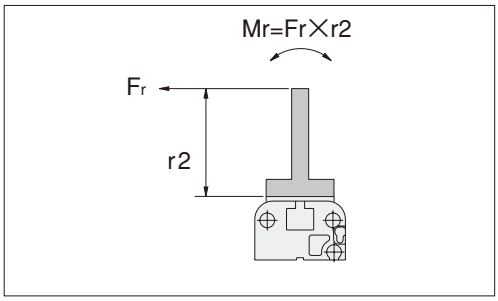
1. Use air for the media. For the use of any other media, consult us.
2. Air used for the slit type rodless cylinders **ORV** series should be clean air that contains no moisture, dust, and oxidized oil, etc. Install an air filter (filtration of a minimum 40 μm) near the slit type rodless cylinders **ORV** series or valve to remove collected liquid or dust. In addition, drain the air filter periodically.

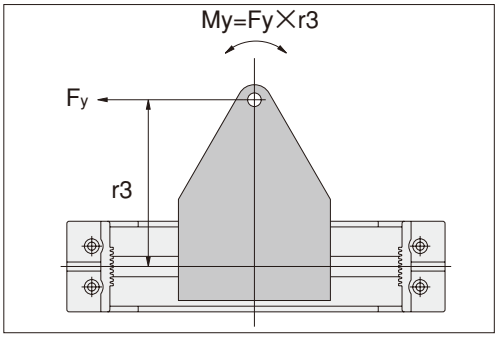
Selection

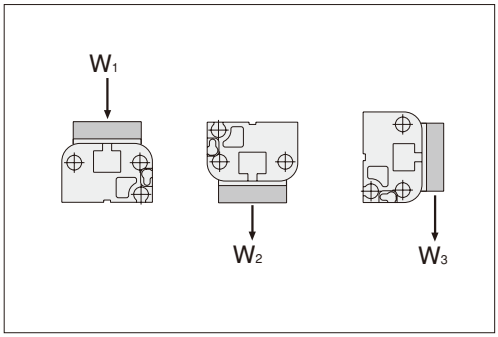
Allowable load and moment

Although the slit type rodless cylinders **ORV** series can be used with directly applying loads, make sure that the load and moment do not exceed the values in the table below. In addition, since load capacity may vary depending on the speed, confirm the rubber bumper and shock absorber absorption capacity on p.1055 before use.









Pitching moment : Mp=Fp×r1(N·m)
Rolling moment : Mr=Fr×r2 (N·m)
Yawing moment : My=Fy×r3 (N·m)
Maximum load capacity : W_1,W_2,W_3 (N)

Direction of moment / Model	Mp N·m [ft·lbf]	Mr N·m [ft·lbf]	My N·m [ft·lbf]	No shock absorber			With shock absorber		
				W_1 N [lbf]	W_2 N [lbf]	W_3 N [lbf]	W_1 N [lbf]	W_2 N [lbf]	W_3 N [lbf]
ORV16	3.2 [2.4]	0.5 [0.4]	0.5 [0.4]	20 [4.5]	20 [4.5]	20 [4.5]	40 [9.0]	40 [9.0]	20 [4.5]
ORV20	6.3 [4.6]	1.2 [0.9]	1.2 [0.9]	32 [7.2]	32 [7.2]	32 [7.2]	70 [15.7]	70 [15.7]	35 [7.9]
ORV25	12 [8.9]	1.6 [1.2]	1.6 [1.2]	50 [11.2]	50 [11.2]	50 [11.2]	120 [27.0]	120 [27.0]	60 [13.5]
ORV32	30 [22]	3.2 [2.4]	3.2 [2.4]	80 [18.0]	80 [18.0]	80 [18.0]	200 [45.0]	200 [45.0]	100 [22.5]
ORV40	60 [44]	6.3 [4.6]	6.3 [4.6]	120 [27.0]	120 [27.0]	120 [27.0]	300 [67.4]	300 [67.4]	150 [33.7]
ORV50	100 [74]	10 [7.4]	10 [7.4]	200 [45.0]	200 [45.0]	200 [45.0]	480 [107.9]	480 [107.9]	240 [54.0]

Caution: The moment including the inertial force generated when the load is moved or stopped must not exceed the values in the above table.
Keep the mass and speed within the range of the rubber bumper and shock absorber capacity graphs.

Cushioning capacity

■ Rubber bumper capacity

The slit type rodless cylinders **ORV** series comes with rubber bumpers as standard equipment. The absorbable mass and impact speed, however, lie within the “no shock absorber” range shown in the “rubber bumper and shock absorber capacity graph” below. Do not use it when the maximum impact speed exceeds 500mm/s [19.7in./sec.].

■ Shock absorber absorption capacity

The slit type rodless cylinders **ORV** series uses shock absorbers as optional equipment. The absorbable mass and impact speed, however, lie within the “with shock absorber” range shown in the “rubber bumper and shock absorber capacity graph” to the right. Do not use it when the maximum impact speed exceeds 800mm/s [31.5in./sec.].

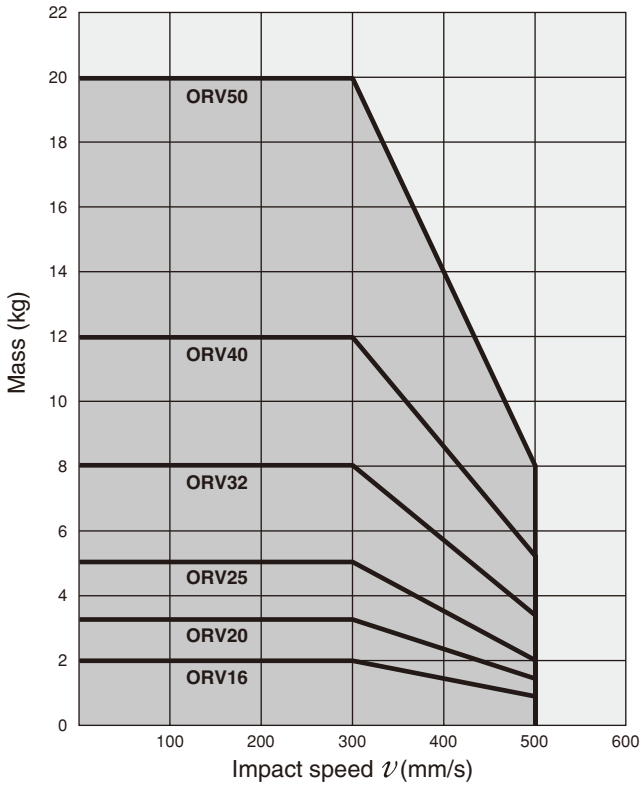
■ Rubber bumper and shock absorber capacity graph

(Horizontal use, at air pressure of 0.5MPa)

The “mass” in the graph refers to the total mass carried by the **ORV** series. “Impact speed” refers to the speed immediately before striking the rubber bumper or shock absorber. Note that this is not the same as “average speed (cylinder stroke/time required).”

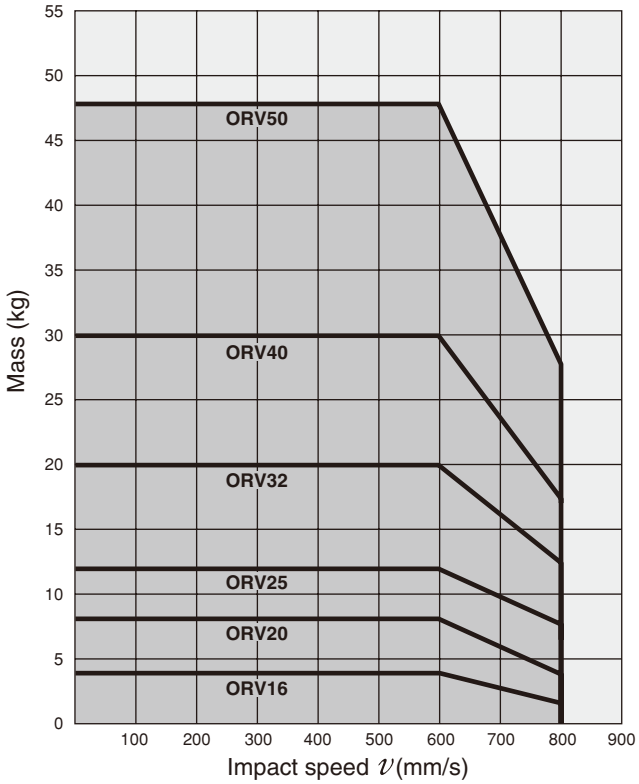
(See “Impact speed graph” to the lower right.)

●No shock absorber



1kg = 2.205lb.
1mm/s = 0.0394in./sec.

●With shock absorber

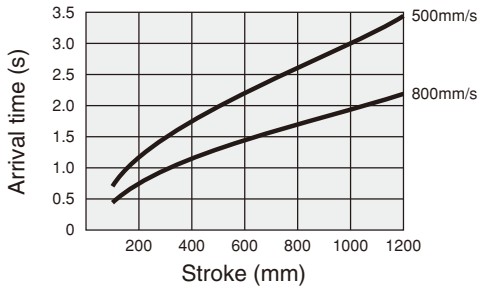


1kg = 2.205lb.
1mm/s = 0.0394in./sec.

■ Impact speed graph (Horizontal use, at air pressure of 0.5MPa)

The graph below shows the impact time at 800mm/s [31.5in./sec.] and 500mm/s [19.7in./sec.] for each stroke of the table at the end of the stroke.

For use, set the times on the upper side of the curve.

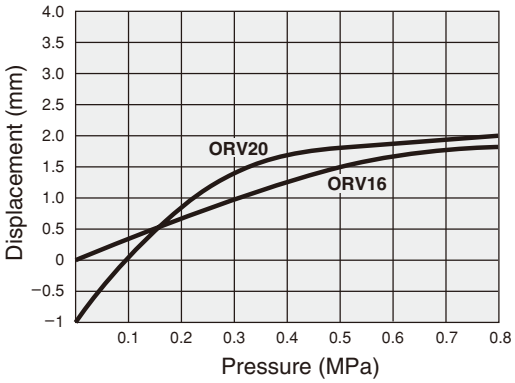


1mm = 0.0394in.

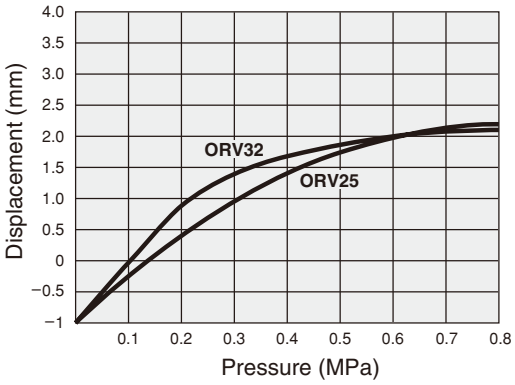
Amount of stroke change due to the rubber bumper

In the slit type rodless cylinders **ORV** series, note that use of the rubber bumper results in the stroke varying according to pressure as shown in the graphs below. (The graphs below show the displacement of the rubber bumper on one side.)

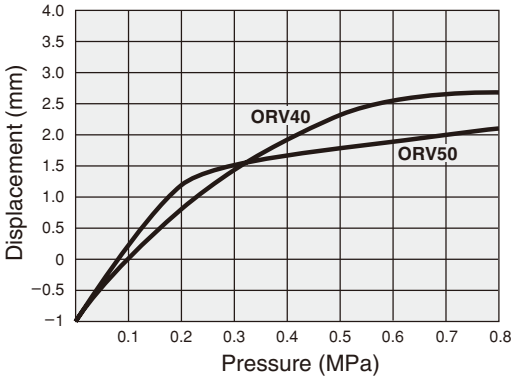
●ORV16, 20



●ORV25, 32



●ORV40, 50

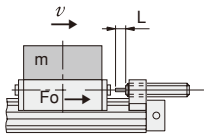


1mm = 0.0394in. 1MPa = 145psi.

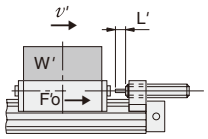
Caution: When using a rodless cylinder, select a suitable cushion and/or shock absorber to prevent rebounding. Rebound could result in such problems as breakage of the seal band.

Calculation of impact energy

Horizontal impact

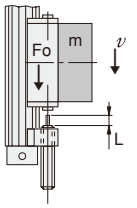
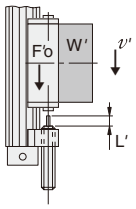
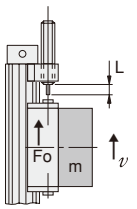
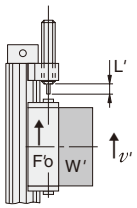


$E = E_1 + E_2 = \frac{m \cdot v^2}{2} + F_0 \cdot L$



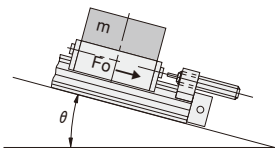
$E' = E'_1 + E'_2 = \frac{W' \cdot v'^2}{2g'} + F'_0 \cdot L'$

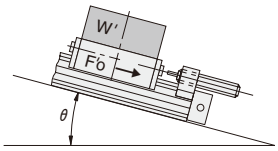
Vertical impact Note 1

When descending Note 2		When ascending	
			
$E = E_1 + E_2 + E_3 = \frac{m \cdot v^2}{2} + F_0 \cdot L + m \cdot g \cdot L$	$E' = E'_1 + E'_2 + E'_3 = \frac{W' \cdot v'^2}{2g'} + F'_0 \cdot L' + W' \cdot L'$	$E = E_1 + E_2 - E_3 = \frac{m \cdot v^2}{2} + F_0 \cdot L - m \cdot g \cdot L$	$E' = E'_1 + E'_2 - E'_3 = \frac{W' \cdot v'^2}{2g'} + F'_0 \cdot L - W' \cdot L'$

Note 1: For impact on incline, E_3 becomes $E_3' = m \cdot g \cdot L \cdot \sin\theta$.

Note 1: For impact on incline, E'_3 becomes $E''_3 = W' \cdot L' \cdot \sin\theta$.





Note 2: When descending, the operating air pressure: P, should be lower than when ascending, because heavier loads can be carried.

E : Total impact energy … [J]

E_1 : Kinetic energy … $\frac{m \cdot v^2}{2}$ [J]

E_2 : Additional energy by cylinder thrust …Fo·L [J]

E_3 : Additional energy by load mass …m·g·L [J]

m : Load mass [kg]

v : Impact speed [m/s]

g : Gravity acceleration 9.8 [m/s²]

Fo : Cylinder thrust … $= \frac{\pi}{4} \cdot D^2 \cdot P$ [N]

[D: Cylinder bore (mm) P: Operating air pressure (MPa)]

L : Absorbing stroke of shock absorber [m]

Note 2: When descending, the operating air pressure: P′, should be lower than when ascending, because heavier loads can be carried.

E′ : Total impact energy … [ft·lbf]

E'_1 : Kinetic energy … $\frac{W' \cdot v'^2}{2g'}$ [ft·lbf]

E'_2 : Additional energy by cylinder thrust …F′o·L′ [ft·lbf]

E'_3 : Additional energy by load weight …W′·L′ [ft·lbf]

W′ : Load weight [lbf]

v' : Impact speed [ft./sec.]

g′ : Gravity acceleration 32.2 [ft./sec.]

F′o : Cylinder thrust … $= \frac{\pi}{4} \cdot D'^2 \cdot P'$ [lbf]

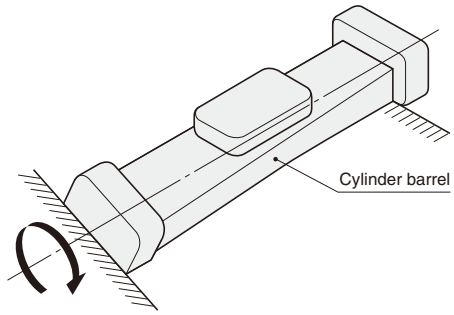
[D′: Cylinder bore [in.] P′: Operating air pressure [psi.]]

L′ : Absorbing stroke of shock absorber [ft.]

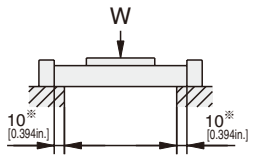
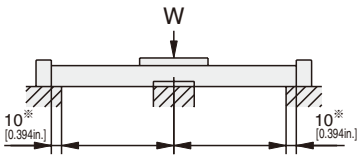
Mounting

Mounting

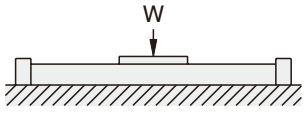
1. While any mounting direction in the slit type rodless cylinders **ORV** series is allowed, mount the piston yoke so that it faces downward or protect it with a cover, etc., when mounting in locations subject to dripping water or oil, etc., or to large amounts of dust.
2. Avoid any electric welding either during or after mounting the slit type rodless cylinders **ORV** series. Flows of welding current to the cylinder could generate arcs that result in damage or depositions of the seal band.
3. Be careful to avoid making scratches or dents, etc., on the cylinder barrel.
4. If using in locations where the cylinder can easily become smeared, clean the cylinder periodically. After cleaning, always apply grease to the sliding portion of the cylinder barrel and outer seal band surface.
5. Mount the cylinder barrel so that it cannot be twisted. Insufficient flatness of the mounting surface could result in cylinder barrel twisting, damaged bands, air leaks, and operating malfunctions.



6. Precautions for the supporting types

Two-point support at both ends	Three-point support
	

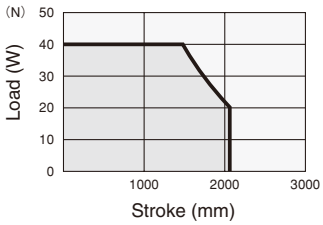
※ For 2-point support at both ends, and 3-point support, always mount so that the cylinder barrel is supported underneath both ends by at least 10mm [0.394in.] of contact area.

Support on bottom surface of barrel


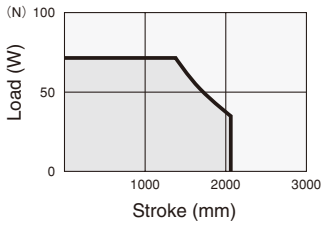
When supported directly on the bottom surface of the barrel, as shown above, the load can be applied without mounting other supports.

7. When the total cylinder length is long, the load could give a large deflection that could result in defective operation. If the relationship between the load on a 2-point support at both ends and the stroke exceeds the range shown in the graphs below, always use an F-type support at an intermediate position.

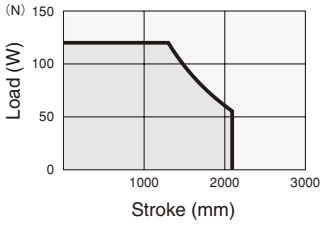
●ORV16



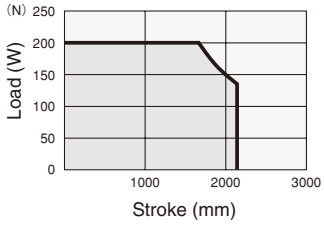
●ORV20



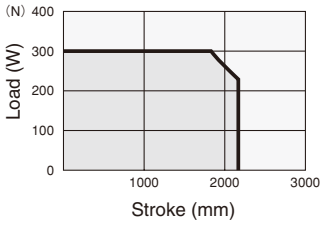
●ORV25



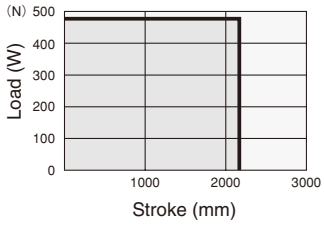
●ORV32



●ORV40

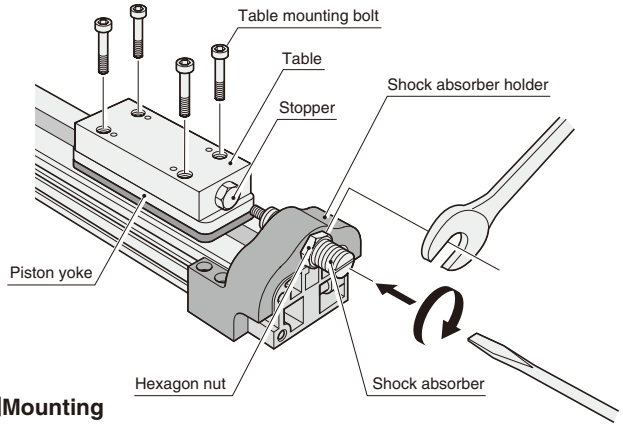


●ORV50



1N = 0.2248lbf.
1mm = 0.0394in.

Mounting the shock absorber, and stroke adjustment



■Mounting

1. There are no particular restrictions on mounting position so long as the end surface of the shock absorber holder does not protrude beyond the cylinder end surface. (Can also be used at an intermediate position.)
2. Mount so that the shock absorber and the stopper on the table are completely in contact with the entire surface.
3. Use the shock absorber within the range of the shock absorber absorption capacity (the range of its capacity graph).
4. Maximum impact speed of the shock absorber is 800mm/s [31.5in./sec.]. Note that this is not the same as the average speed. The speed at the time of impact should not exceed 800mm/s [31.5in./sec.].
5. Do not use the shock absorber in a place subject to dripping water or oil, or large amounts of dust. If using it in these places, install a cover, etc., so that the drops do not drip on it directly and it is not covered in dust. Otherwise it could lead to improper operation and may decrease the absorption energy.
6. Do not loosen the setscrew on the center of the shock absorber's back end surface. The oil inside will leak out which fail the function of the shock absorber.
7. Do not install other shock absorbers in this product without permission. Because product characteristics vary between shock absorbers, if other shock absorbers are used, damage to the cylinder etc., may occur.
8. Use the supplied table mounting bolts to secure the table to the piston yoke.

Tightening torques of the mounting bolts

Model	Tightening torque N·m [ft·lbf]	Mounting bolt
ORV16	2.0 [1.5]	M4×0.7
ORV20	2.0 [1.5]	M4×0.7
ORV25	4.0 [3.0]	M5×0.8
ORV32	7.0 [5.2]	M6×1
ORV40	7.0 [5.2]	M6×1
ORV50	15.0 [11.1]	M8×1.25

Remark: Tighten the table mounting bolt in accordance with the above values.

■Shock absorber position adjustment

① Loosen the hexagon nut holding the shock absorber.
② Use a flat blade screwdriver to rotate the shock absorber and adjust its position.
③ When the desired position has been attained, tighten the hexagon nut to secure it in place.

Hexagon nut tightening torques

Model	Tightening torque N·m [ft·lbf]	Width across flats mm [in.]
ORV16	8.0 [5.9]	13 [0.512]
ORV20	8.0 [5.9]	14 [0.551]
ORV25	10.0 [7.4]	17 [0.669]
ORV32	24.0 [17.7]	21 [0.827]
ORV40	30.0 [22.1]	24 [0.945]
ORV50	78.0 [57.5]	27 [1.063]

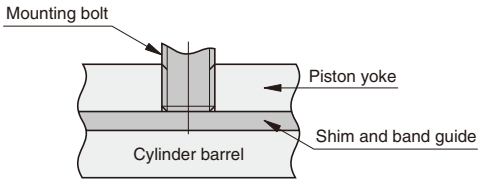
Mounting a workpiece

1. When using the piston yoke to mount a workpiece, fasten within the tightening torques shown in the table below.

Mounting bolt tightening torques

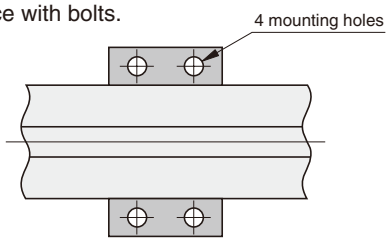
Model	Tightening torque N·m [ft·lbf]	Mounting bolt
ORV16	2.0 [1.5]	M4×0.7
ORV20	2.0 [1.5]	M4×0.7
ORV25	4.0 [3.0]	M5×0.8
ORV32	7.0 [5.2]	M6×1
ORV40	7.0 [5.2]	M6×1
ORV50	15.0 [11.1]	M8×1.25

2. Pay attention to the screw length of the mounting bolt. Screwing a bolt deeper than the tapped hole depth could result in its bumping against the shim and band guide, causing defective operation.



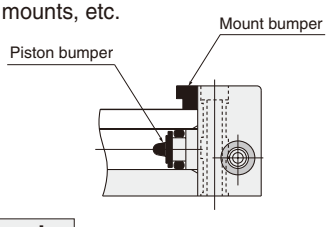
Mounting the F-type support

For the F-type support, use mounting holes in four places to secure it in place with bolts.



The bumpers

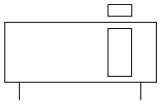
The cylinder is equipped with two types of bumpers, a mount bumper and a piston bumper. Piston stopping shocks are designed to be absorbed by the piston bumpers, while the mount bumpers are auxiliary. The mount bumpers can be removed when using M-type mounts, etc.



M-type mounts

Be sure to remove the mount bumper when using M-type mounts. If the mount bumper is left in place, the piston bumper will not function, which could drastically shorten the cylinder's operating life.

Symbol



Specifications

Item \ Model		ORV16	ORV20	ORV25	ORV32	ORV40	ORV50
Equivalent bore size	mm [in.]	16 [0.630]	20 [0.787]	25 [0.984]	32 [1.260]	40 [1.575]	50 [1.969]
Media		Air Note1					
Operation type		Double acting type					
Operating pressure range	MPa [psi.]	0.15～0.8 [22～116]					
Proof pressure	MPa [psi.]	1.2 [174]					
Operating temperature range	°C [°F]	0～60 [32～140]					
Operating speed range	mm/s [in./sec.]	Rubber bumper 80～500 [3.1～19.7], with shock absorber 80～800 [3.1～31.5] Note2					
Cushion	Standard	With rubber bumper					
	Option	Shock absorber					
Lubrication		Not required (If lubrication is required, use Turbine Oil Class 1 [ISO VG32] or equivalent.)					
Stroke adjusting range mm [in.]	With shock absorber	One side 0～–20 [0～–0.787]				One side 0～–30 [0～–1.181]	
Maximum stroke	mm	2000					
Stroke tolerance mm [in.]	Strokes 2000mm or less	$^{+5}_{+1}\left[^{+0.197}_{+0.039}\right]$ Note 3	$^{+6}_{+1}\left[^{+0.236}_{+0.039}\right]$ Note 3	$^{+6}_{0}\left[^{+0.236}_{0}\right]$ Note 3	$^{+6}_{+1}\left[^{+0.236}_{+0.039}\right]$ Note 3	$^{+7}_{+1}\left[^{+0.276}_{+0.039}\right]$ Note 3	$^{+6}_{+2}\left[^{+0.236}_{+0.078}\right]$ Note 3
Port size		M5×0.8	Rc1/8	Rc1/8	Rc1/4	Rc1/4	Rc3/8

Notes: 1. Use clean air that contains no moisture, dust, and oxidized oil.
2. Use the cushioning capacity, etc., on p.1055 to select the operating speed.
3. Since the stroke will vary depending on the air pressure, see the graphs on p.1056 showing the “Amount of stroke change due to the rubber bumper.”

Specifications of Shock Absorber

Item \ Model	KSHJV 10×10	KSHJV 12×10	KSHJV 14×12	KSHJV 18×16	KSHJV 20×16	KSHJV 22×25
Applicable cylinder	ORV16	ORV20	ORV25	ORV32	ORV40	ORV50
Maximum absorption J [ft·lbf]	3 [2.2]	6 [4.4]	10 [7.4]	20 [14.8]	30 [22.1]	50 [36.9]
Absorbing stroke mm [in.]	10 [0.394]		12 [0.472]	16 [0.630]		25 [0.984]
Maximum impact speed mm/s [in./sec.]	800 [31.5]					
Maximum operating frequency cycle/min	60		40		30	
Maximum absorption per minute J/min [ft·lbf/min.]	120 [88.5]	220 [162]	240 [177]	320 [236]	450 [332]	500 [369]
Spring return force Note N [lbf.]	8.0 [1.80]	7.6 [1.71]	9.2 [2.07]	22.0 [4.95]	22.0 [4.95]	28.5 [6.41]
Angle variation	1° or less			3° or less		
Operating temperature range °C [°F]	0～60 [32～140]					

Note: Values at retracted position.

Theoretical Thrust

N [lbf.]

Model	Pressure area mm² [in.²]	Air pressure MPa [psi.]						
		0.2 [29]	0.3 [44]	0.4 [58]	0.5 [73]	0.6 [87]	0.7 [102]	0.8 [116]
ORV16	201 [0.312]	40 [9.0]	60 [13.5]	80 [18.0]	101 [22.7]	121 [27.2]	141 [31.7]	161 [36.2]
ORV20	314 [0.487]	63 [14.2]	94 [21.1]	126 [28.3]	157 [35.3]	188 [42.3]	220 [49.5]	251 [56.4]
ORV25	490 [0.760]	98 [22.0]	147 [33.0]	197 [44.3]	245 [55.1]	294 [66.1]	343 [77.1]	392 [88.1]
ORV32	804 [1.246]	161 [36.2]	241 [54.2]	322 [72.4]	402 [90.4]	482 [108.4]	563 [126.6]	643 [144.5]
ORV40	1256 [1.947]	251 [56.4]	377 [84.7]	502 [112.8]	628 [141.2]	754 [169.5]	879 [197.6]	1005 [225.9]
ORV50	1963 [3.043]	393 [88.3]	589 [132.4]	785 [176.5]	982 [220.8]	1178 [264.8]	1374 [308.9]	1570 [352.9]

Equivalent Bore Size and Stroke

mm

Equivalent bore size	Standard strokes	Maximum available stroke
16	25, 50, 75, 100, 125, 150, 175, 200, 250, 300, 350, 400, 450, 500, 600, 700, 800	2000
20, 25	50, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 1000	
32, 40, 50	100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100, 1200	

Remark: Non-standard strokes are available at 1mm pitch intervals. For strokes beyond the maximum available stroke, or for non-standard strokes, ask the nearest Koganei office. Consult us for delivery.

Mass

kg [lb.]

Model	Zero stroke mass	Additional mass for each 25mm [0.984in.] stroke	F-type support	M-type mount	Shock absorber unit			Additional mass of 1 sensor switch Note	
					Table	One side	Both sides	**ZE□□□A**	**ZE□□□B**
ORV16	0.20 [0.44]	0.03 [0.066]	0.008 [0.018]	0.019 [0.042]	0.077 [0.17]	0.062 [0.137]	0.124 [0.273]	0.015 [0.033]	0.035 [0.077]
ORV20	0.34 [0.75]	0.04 [0.088]	0.016 [0.035]	0.03 [0.066]	0.14 [0.31]	0.105 [0.232]	0.21 [0.46]		
ORV25	0.51 [1.12]	0.05 [0.110]	0.028 [0.062]	0.038 [0.084]	0.20 [0.44]	0.18 [0.40]	0.36 [0.79]		
ORV32	1.15 [2.54]	0.085 [0.187]	0.036 [0.079]	0.095 [0.209]	0.47 [1.04]	0.31 [0.68]	0.62 [1.37]		
ORV40	1.90 [4.19]	0.125 [0.276]	0.062 [0.137]	0.13 [0.287]	0.68 [1.50]	0.46 [1.01]	0.92 [2.03]		
ORV50	3.48 [7.67]	0.19 [0.419]	0.062 [0.137]	0.23 [0.507]	1.07 [2.36]	0.74 [1.63]	1.48 [3.26]		

Note: Sensor switch types A and B show the lead wire lengths.
A: 1000mm [39in.] B: 3000mm [118in.]

Air Flow Rate and Air Consumption

While the slit type rodless cylinders **ORV** series' air flow rate and air consumption can be found through the following calculations, the quick reference table below provides the answers more conveniently.

Air flow rate: $Q_1 = \frac{\pi D^2}{4} \times L \times \frac{60}{t} \times \frac{P+0.101}{0.101} \times 10^{-6}$

Air consumption: $Q_2 = \frac{\pi D^2}{4} \times L \times 2 \times n \times \frac{P+0.101}{0.101} \times 10^{-6}$

Q_1 : Required air flow rate for cylinder	ℓ /min (ANR)
Q_2 : Air consumption of cylinder	ℓ /min (ANR)
D : Equivalent bore size	mm
L : Cylinder stroke	mm
t : Time required for cylinder to travel one stroke	s
n : Number of cylinder reciprocations per minute	times/min
P : Pressure	MPa

Air flow rate: $Q_1' = \frac{\pi D'^2}{4} \times L' \times \frac{60}{t} \times \frac{P'+14.7}{14.7} \times \frac{1}{1728}$

Air consumption: $Q_2' = \frac{\pi D'^2}{4} \times L' \times 2 \times n \times \frac{P'+14.7}{14.7} \times \frac{1}{1728}$

Q_1': Required air flow rate for cylinder	ft³/min. (ANR)※
Q_2': Air consumption of cylinder	ft³/min. (ANR)※
D′: Equivalent bore size	in.
L′: Cylinder stroke	in.
t : Time required for cylinder to travel one stroke	sec.
n : Number of cylinder reciprocations per minute	times/min
P′: Pressure	psi.

※Refer to p.54 for an explanation of ANR.

cm³ [in.³]/Reciprocation (ANR)

Equivalent bore size mm [in.]	Air pressure MPa [psi.]						
	0.2 [29]	0.3 [44]	0.4 [58]	0.5 [73]	0.6 [87]	0.7 [102]	0.8 [116]
16 [0.630]	1.198 [0.07311]	1.596 [0.09739]	1.993 [0.1216]	2.391 [0.1459]	2.789 [0.1702]	3.187 [0.1945]	3.585 [0.2188]
20 [0.787]	1.871 [0.1142]	2.493 [0.1521]	3.115 [0.1901]	3.737 [0.2280]	4.358 [0.2659]	4.980 [0.3039]	5.602 [0.3419]
25 [0.984]	2.924 [0.1784]	3.896 [0.2377]	4.867 [0.2970]	5.838 [0.3563]	6.810 [0.4156]	7.781 [0.4748]	8.753 [0.5341]
32 [1.260]	4.791 [0.2924]	6.382 [0.3895]	7.974 [0.4866]	9.566 [0.5838]	11.16 [0.6810]	12.75 [0.7781]	14.34 [0.8751]
40 [1.575]	7.486 [0.4568]	9.973 [0.6086]	12.46 [0.7604]	14.95 [0.9123]	17.43 [1.064]	19.92 [1.216]	22.41 [1.368]
50 [1.969]	11.70 [0.7140]	15.58 [0.9508]	19.47 [1.188]	23.35 [1.425]	27.24 [1.662]	31.13 [1.900]	35.01 [2.136]

The figures in the table show the air flow rate and air consumption when a rodless cylinder makes 1 reciprocation with stroke of 1mm [0.0394in.]. The air flow rate and air consumption actually required is found by the following calculations.

●Finding the air flow rate (for selecting F.R.L., valves, etc.)

Example: When operating a slit type rodless cylinder **ORV** series with an equivalent bore size of 40mm [1.575in.] at a speed of 300mm/s [118in./sec.] and under air pressure of 0.5MPa [73psi.]

$14.95 \times \frac{1}{2} \times 300 \times 10^{-3} = 2.24$ ℓ/s [0.0791ft³/sec.] (ANR)

(At this time, the flow rate per minute is $14.95 \times \frac{1}{2} \times 300 \times 60 \times 10^{-3} = 134.55$ ℓ/min [4.75ft³/min.] (ANR))

●Finding the air consumption

Example 1. When operating a slit type rodless cylinder **ORV** series with an equivalent bore size of 40mm [1.575in.] and a stroke of 100mm [3.94in.], and under air pressure of 0.5MPa [73psi.], for 1 reciprocation

$14.95 \times 100 \times 10^{-3} = 1.495$ ℓ [0.0528ft³]/Reciprocation (ANR)

Example 2. When operating a slit type rodless cylinder **ORV** series with an equivalent bore size of 40mm [1.575in.] and a stroke of 100mm [3.94in.], and under air pressure of 0.5MPa [73psi.], for 10 reciprocations per minute

$14.95 \times 100 \times 10 \times 10^{-3} = 14.95$ ℓ/min [0.528ft³/min.] (ANR)

Note: To find the actual air consumption required when using the slit type rodless cylinders **ORV** series, add the air consumption of the piping to the air consumption obtained from the above calculation.

Order Codes

ORV | **16×200** | - | | - | | | - | | | - | | | |

Slit type rodless cylinder ORV series

Equivalent bore size × Stroke

M-type mounting bracket Note
Blank : No bracket
M : With M-type mount

F-type supporting bracket
Blank : No bracket
F : With F-type support

Number of supporting brackets
1: With 1 set (With 2 brackets)
2: With 2 sets (With 4 brackets)
⋮

Shock absorber Note
Blank : No shock absorber
K : With shock absorber

Number of shock absorbers (with holders)
1: With 1 set
2: With 2 sets

Sensor switch
Blank : No sensor switch
ZE135: 2-lead wire solid state type with indicator lamp DC10～28V
ZE155: 3-lead wire solid state type with indicator lamp DC4.5～28V
ZE101: 2-lead wire reed switch type without indicator lamp DC5～28V, AC85～115V
ZE102: 2-lead wire reed switch type with indicator lamp DC10～28V, AC85～115V

Lead wire length
A : 1000mm [39in.]
B : 3000mm [118in.]

Number of sensor switches
1: With 1 sensor switch
2: With 2 sensor switches
3: With 3 sensor switches
⋮

Note: The combination of M-type mount and shock absorber not allowed.

Additional Parts

●Shock absorber unit
(with shock absorber, table, and holder)

K-ORV | |

Equivalent bore size
16 : For **ORV16**, **20 :** For **ORV20**
25 : For **ORV25**, **32 :** For **ORV32**
40 : For **ORV40**, **50 :** For **ORV50**

●M-type mounting brackets

M-ORV | |

Equivalent bore size
16 : For **ORV16**, **20 :** For **ORV20**
25 : For **ORV25**, **32 :** For **ORV32**
40 : For **ORV40**, **50 :** For **ORV50**

●F-type supporting brackets (with 2 units)

F-ORV | |

Equivalent bore size
16 : For **ORV16**, **20 :** For **ORV20**
25 : For **ORV25**, **32 :** For **ORV32**
40 : For **ORV40**, **50 :** For **ORV50**

●Shock absorber

KSHJV | **10×10**

Mounting thread size×Stroke
10×10 —— For **ORV16**
12×10 —— For **ORV20**
14×12 —— For **ORV25**
18×16 —— For **ORV32**
20×16 —— For **ORV40**
22×25 —— For **ORV50**

Linear orifice type shock absorber

●Shock absorber holder

C-ORV | |

Equivalent bore size
16 : For **ORV16**, **20 :** For **ORV20**
25 : For **ORV25**, **32 :** For **ORV32**
40 : For **ORV40**, **50 :** For **ORV50**

●Table for shock absorber (with bolt)

T-ORV | |

Equivalent bore size
16 : For **ORV16**, **20 :** For **ORV20**
25 : For **ORV25**, **32 :** For **ORV32**
40 : For **ORV40**, **50 :** For **ORV50**

● For the sensor switches, see p.1065.

Repair Kit

●Seal kit Note

MK1-ORV | |

Equivalent bore size
16 : For **ORV16**, **20 :** For **ORV20**
25 : For **ORV25**, **32 :** For **ORV32**
40 : For **ORV40**, **50 :** For **ORV50**

●Seal band kit

MK2-ORV | **16×200**

Equivalent bore size×Stroke

●End cap assembly, R side

MK3-ORV | |

Equivalent bore size
16 : For **ORV16**, **20 :** For **ORV20**
25 : For **ORV25**, **32 :** For **ORV32**
40 : For **ORV40**, **50 :** For **ORV50**

Note: The fewest order unit of the seal kit is every 5 sets.

●End cap assembly, L side

MK4-ORV | |

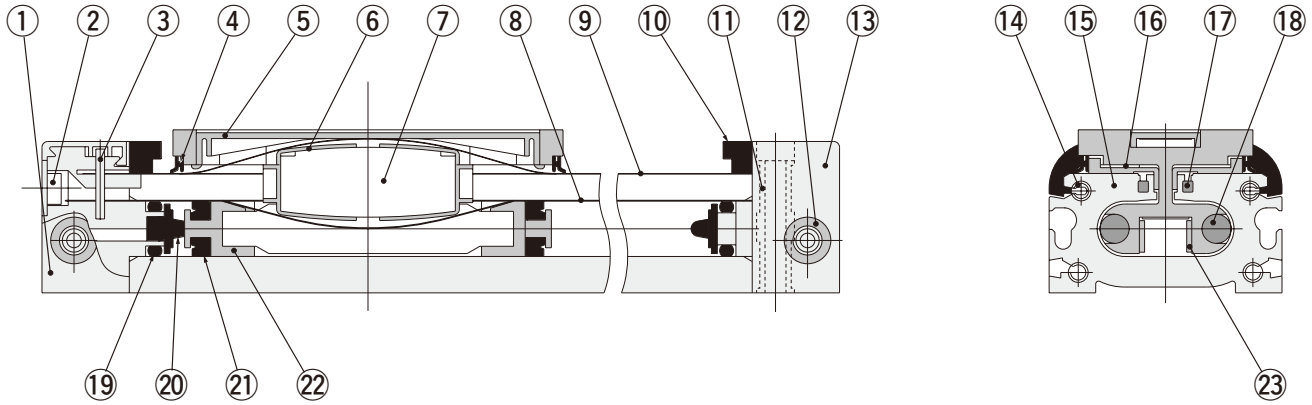
Equivalent bore size
16 : For **ORV16**, **20 :** For **ORV20**
25 : For **ORV25**, **32 :** For **ORV32**
40 : For **ORV40**, **50 :** For **ORV50**

●Piston assembly

MK5-ORV | |

Equivalent bore size
16 : For **ORV16**, **20 :** For **ORV20**
25 : For **ORV25**, **32 :** For **ORV32**
40 : For **ORV40**, **50 :** For **ORV50**

Inner Construction



Major Parts and Materials

No.	Name	Material	Quantity	Remarks
①	End cap R	Polybutylene terephthalate	1	
②	Cap cover	Polypropylene	2	
③	Band set pin	Stainless steel	2	Parallel pins
④	Scraper	Nylon	1	
⑤	Mount cover	Polybutylene terephthalate	1	
⑥	Band guide	Special plastic	2	
⑦	Piston yoke	Aluminum alloy	1	Anodized
⑧	Inner seal band	Stainless chrome steel	1	
⑨	Outer seal band	Stainless chrome steel	1	
⑩	Mount bumper	Urethane rubber	2	
⑪	Thread insert B	Brass	4	Nickel plated
⑫	Thread insert A	Brass	2	Nickel plated

No.	Name	Material	Quantity	Remarks
⑬	End cap L	Polybutylene terephthalate	1	
⑭	Hexagon socket button head screw	Alloy steel	6	Zinc plated
⑮	Cylinder barrel	Aluminum alloy	1	Anodized
⑯	Shim	Polyester	—	
⑰	Magnet strip	Rubber magnet	2	
⑱	Magnet	Rare earth magnet	2	Aluminum coated
⑲	Cylinder gasket	Synthetic rubber (NBR)	2	
⑳	Piston bumper	Synthetic rubber (NBR)	2	
㉑	Piston seal	Synthetic rubber (NBR)	2	
㉒	Piston	Polyacetal	2	
㉓	Inner band guide	Hard polyvinyl chloride	2	

Maintenance Kit Order Codes, and Parts Composition

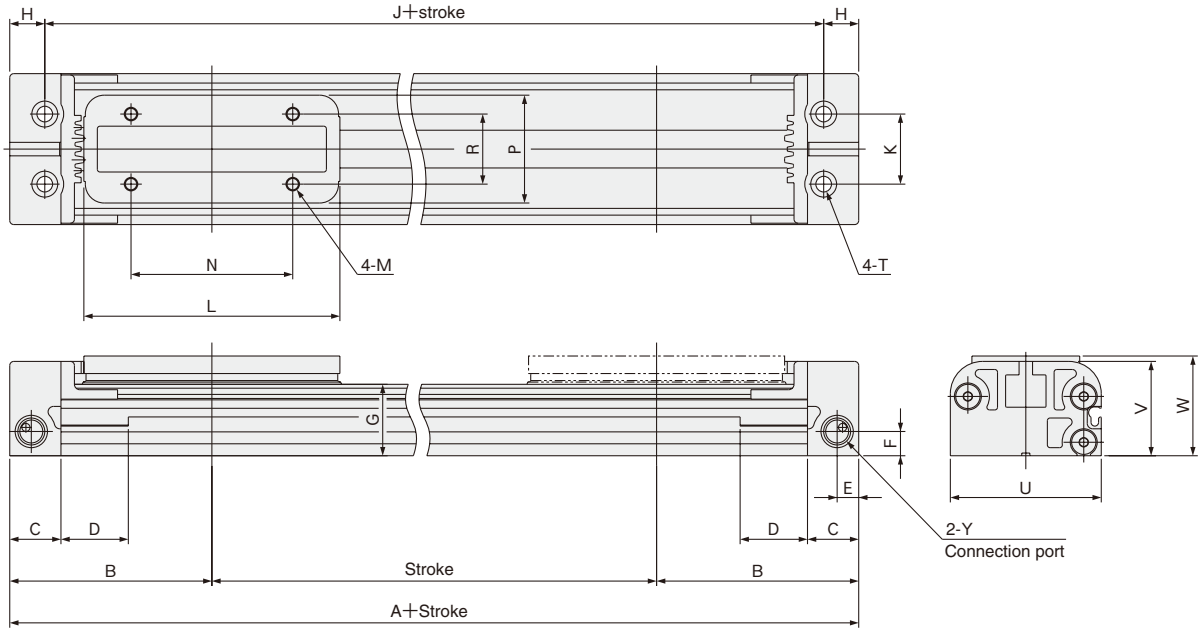
●**Seal kit**	**MK1-ORV**	**Equivalent bore size**	: ④**-1**, ⑤**-1**, ⑥**-2**, ⑲**-2**, ㉑**-2**
●**Sealing band kit**	**MK2-ORV**	**Equivalent bore size×Stroke**	: ③**-1**, ⑧**-1**, ⑨**-1**
●**End cap assembly, R side**	**MK3-ORV**	**Equivalent bore size**	: ①**-1**, ②**-1**, ③**-1**, ⑩**-1**, ⑪**-2**, ⑫**-1**, ⑭**-3**, ⑲**-1**, ⑳**-1**
●**End cap assembly, L side**	**MK4-ORV**	**Equivalent bore size**	: ②**-1**, ③**-1**, ⑩**-1**, ⑪**-1**, ⑫**-1**, ⑬**-1**, ⑭**-1**, ⑲**-1**, ⑳**-1**
●**Piston assembly**	**MK5-ORV**	**Equivalent bore size**	: ④**-1**, ⑤**-1**, ⑥**-2**, ⑦**-1**, ⑯**-2**, ⑱**-2**, ㉑**-2**, ㉒**-2**, ㉓**-2**

Remark ④ **- 1**
Quantity
Inner construction part No.

Dimensions (mm)

●ORV Equivalent bore size × Stroke

CAD ORV Bore size



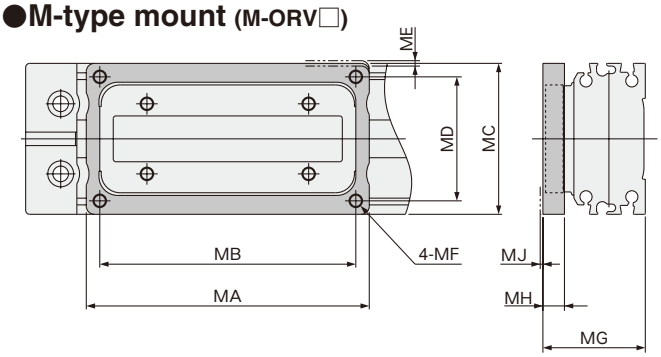
Note: For M-type mounts and F-type supports, see "Optional Parts Dimensions'" below.

Model \ Code	A	B	C	D	E	F	G	H	J	K	L
ORV16	112	56	15	25	5.5	9	20.5	11	90	18	67
ORV20	136	68	17	25	8	8.5	23	12	112	22	85
ORV25	152	76	19	25	8	9	26.5	13	126	26	95
ORV32	206	103	24	25	11.5	13	35	17	172	32	136
ORV40	242	121	26	25	11.5	18	43	19	204	36	165
ORV50	276	138	31	25	14	23	53	22	232	44	184

Model \ Code	N	M	P	R	T	U	V	W	Y
ORV16	40	M4×0.7 Depth 6	30	20	ϕ3.6 ϕ6.5 Counterbore, Depth 3.3	40	26	28	M5×0.8
ORV20	50	M4×0.7 Depth 7	35	24	ϕ4.8 ϕ8 Counterbore, Depth 4.5	48	30	32	Rc1/8
ORV25	60	M5×0.8 Depth 9	40	26	ϕ5.8 ϕ9.5 Counterbore, Depth 5.5	56	35	37	Rc1/8
ORV32	80	M6×1 Depth 11	50	32	ϕ7 ϕ11 Counterbore, Depth 6.5	70	46	48	Rc1/4
ORV40	100	M6×1 Depth 12	60	40	ϕ7 ϕ11 Counterbore, Depth 6.5	84	54	58	Rc1/4
ORV50	120	M8×1.25 Depth 16	70	48	ϕ9 ϕ14 Counterbore, Depth 8.5	102	68	72	Rc3/8

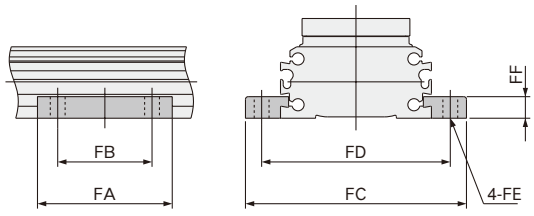
Optional Parts Dimensions (mm)

●M-type mount (M-ORV□)



Note: Always remove the mount bumpers when using M-type mounts.

●F-type support (F-ORV□)



M-type mount

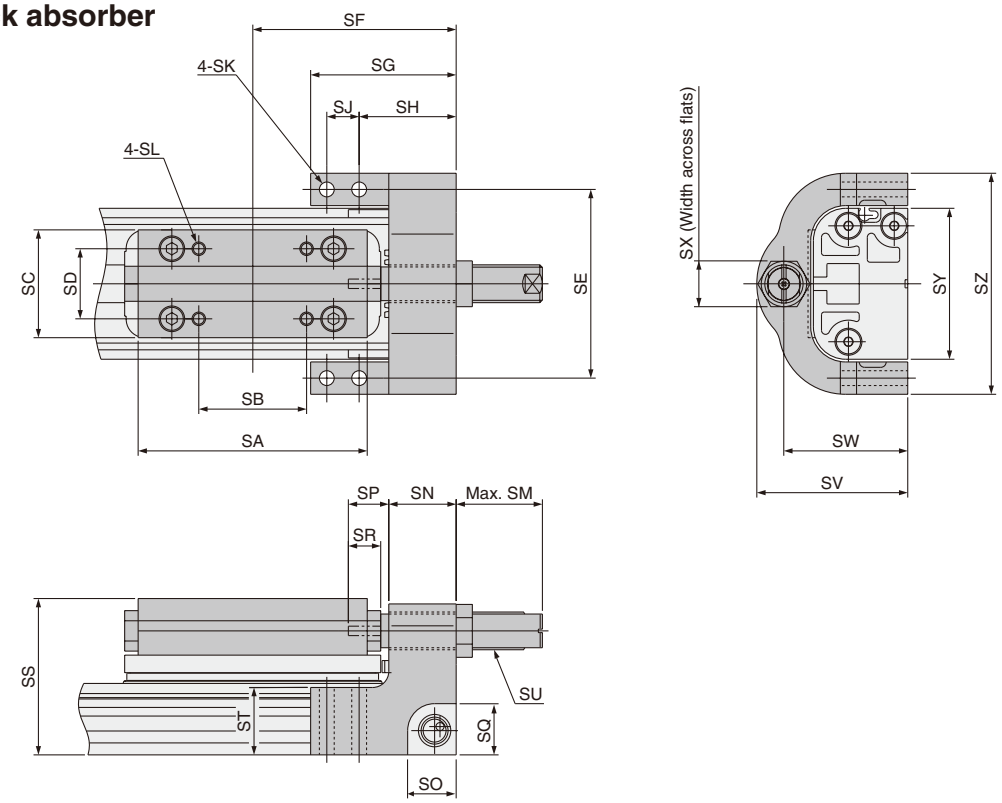
Model \ Code	MA	MB	MC	MD	ME	MF	MG	MH	MJ
ORV16	75	66	46	38	2	M4×0.7 Depth 6	29	6	1
ORV20	94	85	51	42	2	M4×0.7 Depth 7	33	7	1
ORV25	105	95	56	46	2	M5×0.8 Depth 8	38	8	1
ORV32	150	138	70	58	3	M6×1 Depth 11	49	11	1
ORV40	181	166	80	68	3	M6×1 Depth 12	59	12	2
ORV50	205	188	94	78	3	M8×1.25 Depth 15	73	15	2

F-type support

Model \ Code	FA	FB	FC	FD	FE	FF
ORV16	40	28	54	47	ϕ3.4	5
ORV20	50	35	66	57	ϕ4.5	6.3
ORV25	50	35	82	70	ϕ5.5	8
ORV32	65	45	96	84	ϕ6.6	8
ORV40	75	55	116	100	ϕ9	10
ORV50	75	55	134	118	ϕ9	10

Optional Dimensions (mm)

●With shock absorber



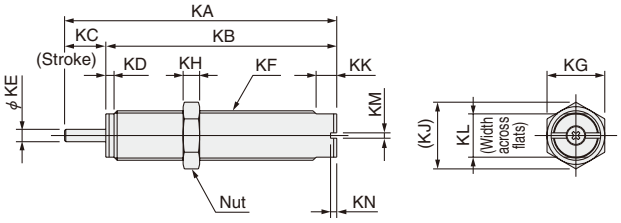
Note: For M-type mounts and F-type supports, see p.1063.

Model \ Code	SA	SB	SC	SD	SE	SF	SG	SH	SJ	SK	SL
ORV16	60	25	30	20	48	56	42	30	8	ϕ3.4	M4×0.7 Depth 12
ORV20	78	30	35	24	57	68	48	35	8	ϕ4.5	M4×0.7 Depth 12
ORV25	85	40	40	26	70	76	54	36	12	ϕ5.5 ϕ9.5 Counterbore, Depth 5.5	M5×0.8 Depth 14
ORV32	123	55	50	32	84	103	68	46	14	ϕ6.6	M6×1 Depth 16
ORV40	150	75	60	40	100	121	74	48	18	ϕ6.6 ϕ11 Counterbore, Depth 6.5	M6×1 Depth 16
ORV50	167	88	70	48	118	138	90	62	17	ϕ9	M8×1.25 Depth 18

Model \ Code	SM	SN	SO	SP	SQ	SR	SS	ST	SU	SV	SW	SX	SY	SZ
ORV16	27.5	20	14	12.5	16.5	10	44	16	M10×1	42	34.5	12	40	54
ORV20	30.5	22.5	17	13	17	10	50	18.5	M12×1	48	39.5	14	48	66
ORV25	31.5	25	19	15.5	19	12	58	25	M14×1.5	56	46	17	56	82
ORV32	37	31.5	24	19.5	25	16	74	28	M18×1.5	72	59.5	21	70	96
ORV40	38.5	35	27	19.5	32	16	85	40	M20×1.5	83	69	24	84	116
ORV50	54	42.5	31	28.5	39	25	103	44	M22×1.5	101	85	27	102	134

Dimensions of Shock Absorber (mm)

●KSHJV Mounting thread size × Stroke

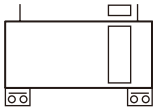


Model \ Code	KA	KB	KC	KD	KE	KF	KG	KH	KJ	KK	KL	KM	KN
KSHJV10×10 (For ORV16)	60	50	10	2	3	M10×1	12	3	13.9	5	8.5	1.3	1.5
KSHJV12×10 (For ORV20)	66	56	10	2	3	M12×1	14	4	16.2	5	10.5	1.3	1.5
KSHJV14×12 (For ORV25)	72	60	12	2	4	M14×1.5	17	5	19.6	5	12	1.3	1.5
KSHJV18×16 (For ORV32)	88	72	16	3	5	M18×1.5	21	8	24.2	7	15	1.8	2
KSHJV20×16 (For ORV40)	93	77	16	3	5	M20×1.5	24	8	27.7	7	17	1.8	2
KSHJV22×25 (For ORV50)	125	100	25	3	6	M22×1.5	27	9	31.2	10	19	1.8	2

SENSOR SWITCHES

Solid State Type, Reed Switch Type

Symbol



Order Codes

□ -ORV

Lead wire length
A：1000mm [39in.]
B：3000mm [118in.]

Sensor switch model

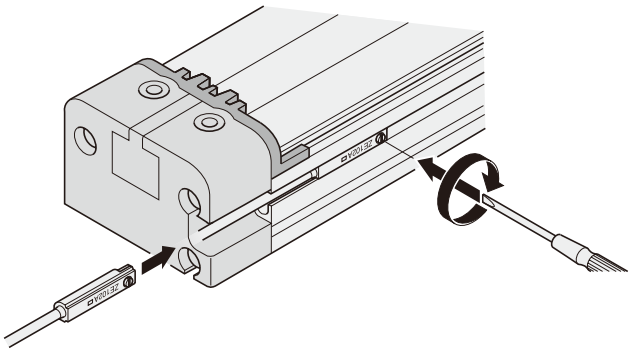
ZE135：Solid state type	with indicator lamp	DC10V～28V	Horizontal lead wire
ZE101：Reed switch type	without indicator lamp	DC5V～28V AC85～115V	Horizontal lead wire

ZE155：Solid state type	with indicator lamp	DC4.5V～28V	Horizontal lead wire
ZE102：Reed switch type	with indicator lamp	DC10V～28V AC85～115V	Horizontal lead wire

●For details of sensor switches, see p.1544.

Moving Sensor Switch

Loosening the mounting screw allows the sensor switch to be moved along the switch mounting groove on the barrel. In addition, the lead wires can be inserted into the groove of the end cap.

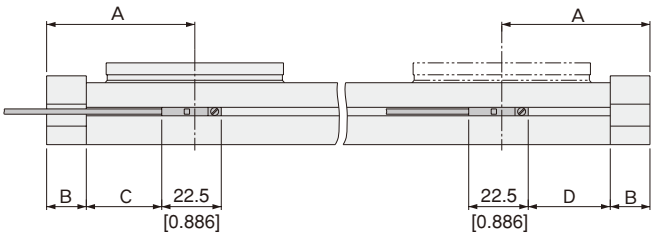


● Tighten the mounting screw with a tightening torque of 20～30N·cm [1.8～2.7in·lbf].

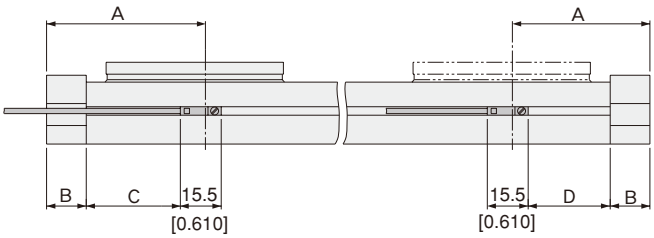
Mounting Location of End of Stroke Detection Sensor Switch

When the sensor switch is mounted in the locations shown below, the magnet comes to the maximum sensing location of the sensor switch at the end of the stroke.

●Reed switch type (ZE101, ZE102)



●Solid state type (ZE135, ZE155)



●Reed switch type **(ZE101, ZE102)**

mm [in.]

Model	A	B	C	D
ORV16	56 [2.20]	15 [0.59]	28.5 [1.122]	31 [1.22]
ORV20	68 [2.68]	17 [0.67]	38.5 [1.516]	41 [1.61]
ORV25	76 [2.99]	19 [0.75]	44.5 [1.752]	47 [1.85]
ORV32	103 [4.06]	24 [0.94]	66.5 [2.618]	69 [2.72]
ORV40	121 [4.76]	26 [1.02]	82.5 [3.248]	85 [3.35]
ORV50	138 [5.43]	31 [1.22]	94.5 [3.720]	97 [3.82]

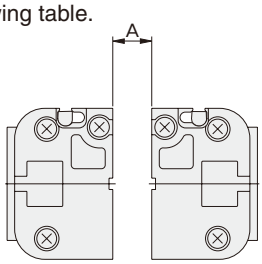
●Solid state type **(ZE135, ZE155)**

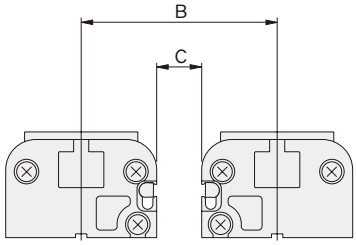
mm [in.]

Model	A	B	C	D
ORV16	56 [2.20]	15 [0.59]	31.5 [1.240]	35 [1.38]
ORV20	68 [2.68]	17 [0.67]	41.5 [1.634]	45 [1.77]
ORV25	76 [2.99]	19 [0.75]	47.5 [1.870]	51 [2.01]
ORV32	103 [4.06]	24 [0.94]	69.5 [2.736]	73 [2.87]
ORV40	121 [4.76]	26 [1.02]	85.5 [3.366]	89 [3.50]
ORV50	138 [5.43]	31 [1.22]	97.5 [3.839]	101 [3.98]

When Mounting ORV Series with Sensor Switches in Close Proximity

When mounting the ORV series with sensor switches in close proximity, install the cylinders so that they should not be below the values shown in the following table.





mm [in.]

Code	type \ Model	ORV16	ORV20	ORV25	ORV32	ORV40	ORV50
A	Solid state type	0	0	0	0	0	0
	Reed switch type	0	0	0	0	0	0
B	Solid state type	44 [1.73]	52 [2.05]	61 [2.40]	77 [3.03]	91 [3.58]	111 [4.37]
	Reed switch type	49 [1.93]	58 [2.28]	69 [2.72]	86 [3.39]	102 [4.02]	119 [4.69]
C	Solid state type	4 [0.16]	4 [0.16]	5 [0.20]	7 [0.28]	7 [0.28]	9 [0.35]
	Reed switch type	9 [0.35]	10 [0.39]	13 [0.51]	16 [0.63]	16 [0.63]	17 [0.67]