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KOGANEI

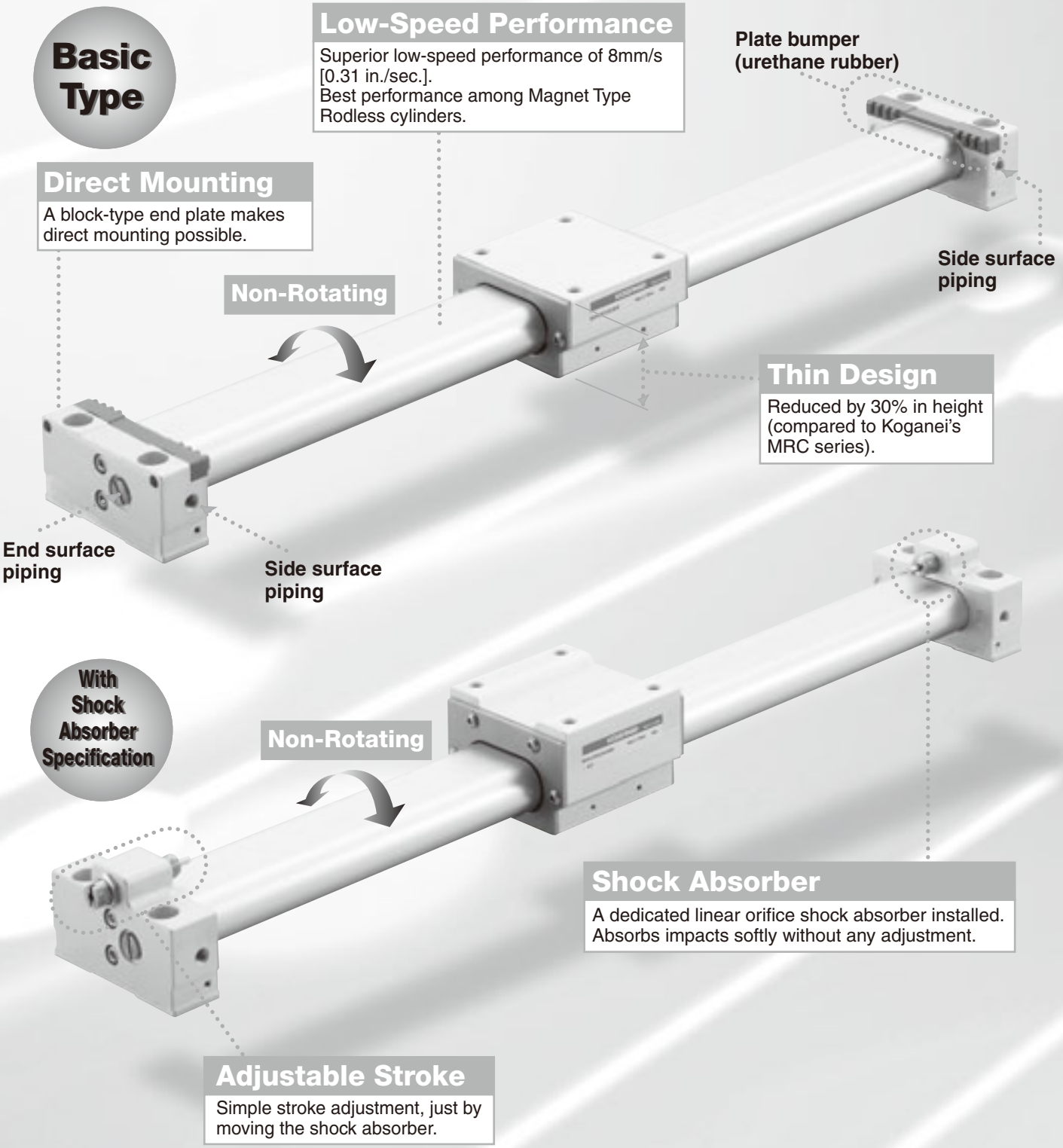
ACTUATORS GENERAL CATALOG

MAGNET TYPE FLAT RODLESS CYLINDERS

CONTENTS

Magnet Type
Flat Rodless Cylinders

Unique oval barrel design enables good low-speed performance, low center of gravity, and non-rotating.



Clean System Cylinders

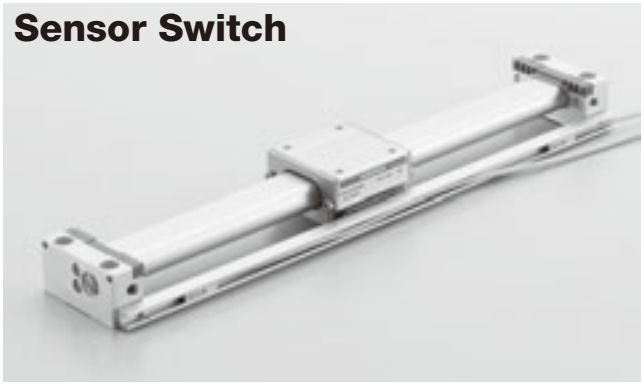
JIS and ISO class 5 Equivalent (FED-STD Class 100 Equivalent)

Basic Type

With Shock Absorber Specification

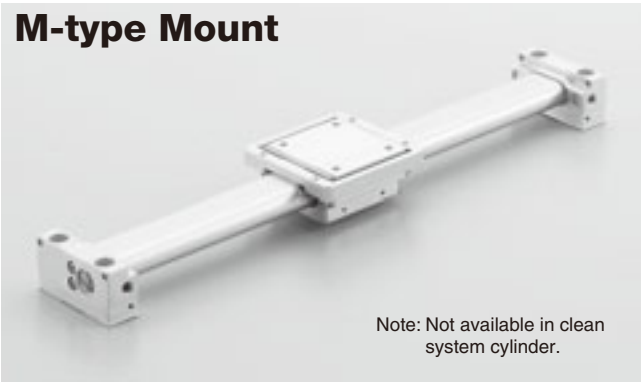
Options

Sensor Switch



By installing a sensor rail and sensor magnet, positioning detection across the full stroke range is possible.

M-type Mount



Note: Not available in clean system cylinder.

Combines with linear guide to reduce the height to a minimum, and also offers various connection with equipment.

Standard Strokes

Model / Stroke (mm)	(CS-)MRV14	(CS-)MRV22	(CS-)MRV28
100	●		
150	●		
200	●	●	●
250	●	●	●
300	●	●	●
350	●	●	●
400	●	●	●
450	●	●	●
500	●	●	●
600		●	●
700		●	●
800		●	●
Available stroke	1～1000	1～1500	1～1500

General precautions

Media

1. Use air for the media. For the use of any other media, consult us.
2. Air used for the Flat Rodless cylinders should be clean air that contains no deteriorated compressor oil, etc. Install an air filter (filtration of a minimum 40 μm) near the Flat Rodless cylinders or valve to remove collected liquid or dust. In addition, drain the air filter periodically. Collected liquid or dust entering the Flat Rodless cylinder may cause improper operation.

Piping

1. In piping connection with the Flat Rodless cylinders, flush the tube completely (by blowing compressed air) before piping. Intrusion of machining chips, sealing tape, rust, etc., generated during plumbing could result in air leaks and other defective operations.
2. When screwing in piping or fittings to the Flat Rodless cylinders, tighten to the appropriate tightening torque shown below.

Connecting thread	Tightening torque N·m [ft·lbf]
M5×0.8	1.6 [1.2]
Rc1/8	6.9～8.8 [5.1～6.5]

Atmosphere

1. When using in locations subject to dripping water, dripping oil, etc., or to large amounts of dust, use a cover to protect the unit.
2. 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

The Flat Rodless cylinders can be used without lubrication. If lubrication is required, however, always consult us first. Do not use turbine oil.

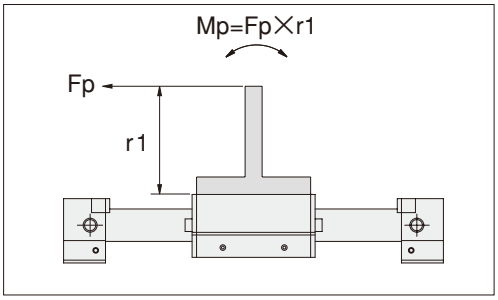
Others

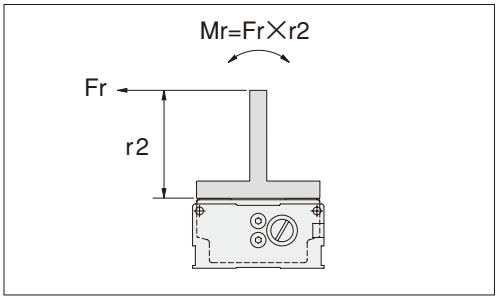
1. When the Flat Rodless cylinder is moved manually, its movement may not feel smooth. This is not a problem, however, since it is normally operated using air pressure. Always apply air to the system to check its operation.
2. The Flat Rodless cylinder has a strong magnet integrated into its body. Do not place magnetic media, recording devices, magnetic detection devices, etc., within 1 meter [3.28ft.] of the product. This could result in lost data or erratic operation.

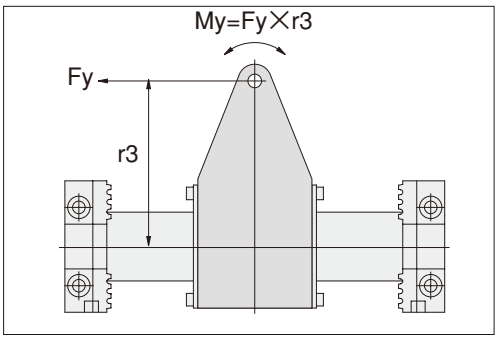
Selection

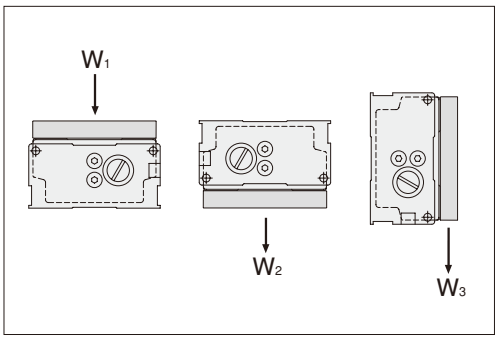
Allowable load and moment

Although the Flat Rodless cylinders 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.1137 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)

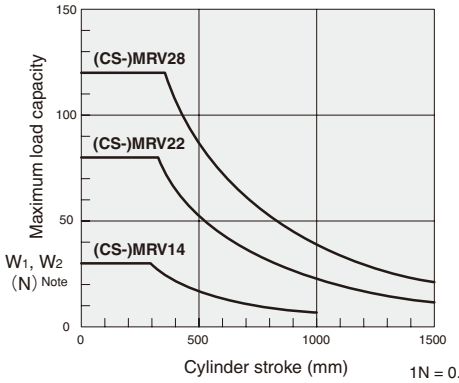
Note: External forces Fp and Fy should be restricted to 60% or less of the magnet retaining force.

Direction of moment / Model	Mp N·m [ft·lbf]	Mr N·m [ft·lbf]	My N·m [ft·lbf]	W_1 Note N [lbf.]	W_2 Note N [lbf.]	W_3 Note N [lbf.]
(CS-)MRV14	1.2 [0.9]	0.3 [0.2]	1.2 [0.9]	30 [6.7]	30 [6.7]	10 [2.2]
(CS-)MRV22	4 [3.0]	1 [0.7]	4 [3.0]	80 [18.0]	80 [18.0]	30 [6.7]
(CS-)MRV28	8 [5.9]	2 [1.5]	8 [5.9]	120 [27.0]	120 [27.0]	45 [10.1]

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.

Note: W is the maximum value. Since W varies depending on the stroke, use it within the "Maximum load capacity and stroke" ranges shown in the graph below.

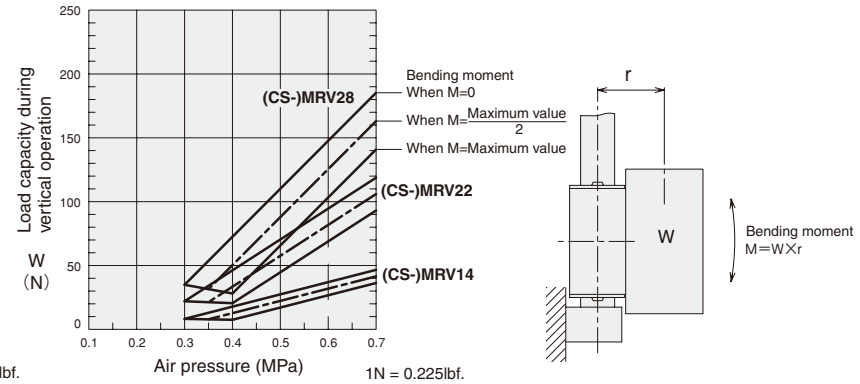
●Maximum load capacity and stroke



Note: The value for W_3 is 1/3 that of W_1 and W_2.

1N = 0.225lbf.
1mm= 0.0394in.

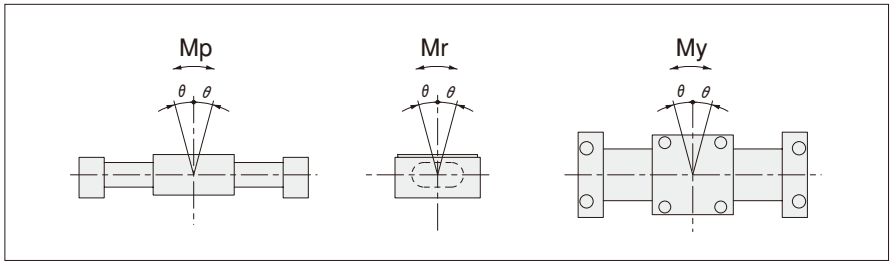
●Relationship between load capacity and air pressure during vertical operation (reference)



1N = 0.225lbf.
1MPa= 145psi.

Slider deflection

The reference values of the amount of slider deflection due to clearance is shown in the table below. Since the slider portion of the Flat Rodless cylinder allows a certain amount of play as shown below, use the cylinder with a linear guide in high-precision applications.



Model	Slider deflection θ (±°)		
	Mp direction	Mr direction	My direction
(CS-)MRV14	0.8	1.8	0.8
(CS-)MRV22	0.6	1.2	0.6
(CS-)MRV28	0.7	1.3	0.7

Cushioning capacity

■ Rubber bumper capacity

The Flat Rodless cylinders come with rubber bumpers as standard equipment. The maximum load capacity and impact speed, however, should lie within the “With rubber bumper” 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.].

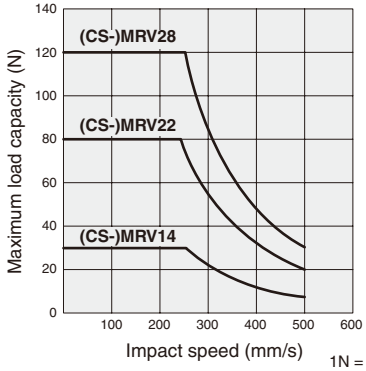
■ Shock absorber absorption capacity

The Flat Rodless cylinders use shock absorbers as optional equipment. The maximum load capacity and impact speed, however, should lie within the “With shock absorber” range shown in the “Rubber bumper and shock absorber capacity graph” below. Do not use it when the maximum impact speed exceeds 800mm/s [31.5in./sec.].

■ Rubber bumper and shock absorber capacity graph

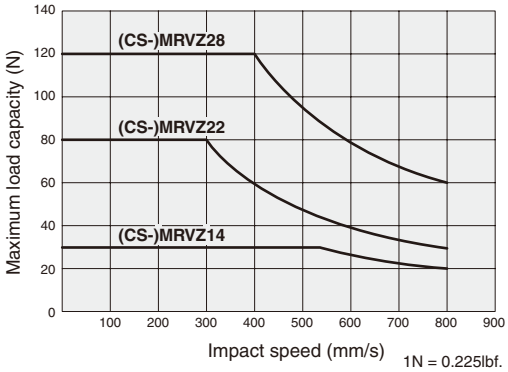
(Horizontal operation, at air pressure of 0.5MPa [73psi.])

● **With rubber bumper**



1N = 0.225lbf.
1mm/s= 0.0394in./sec.

● **With shock absorber**

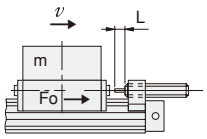


1N = 0.225lbf.
1mm/s= 0.0394in./sec.

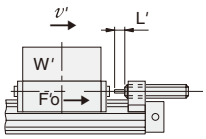
In the graphs, “Impact speed” refers to the speed immediately before the slider impacts the rubber bumper or shock absorber. This is not the same as “average speed (cylinder stroke/travel time)”.

Calculation of impact energy

Horizontal impact



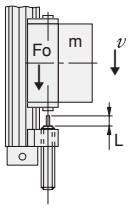
$E = E_1 + E_2 = \frac{m \cdot v^2}{2} + F_o \cdot L$



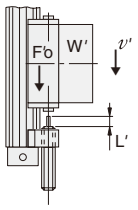
$E' = E'_1 + E'_2 = \frac{W' \cdot v'^2}{2g'} + F'_o \cdot L'$

Vertical impact Note 1

When descending Note 2

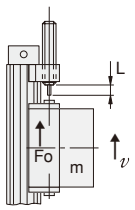


$E = E_1 + E_2 + E_3 = \frac{m \cdot v^2}{2} + F_o \cdot L + m \cdot g \cdot L$

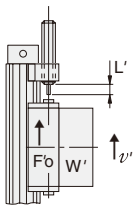


$E' = E'_1 + E'_2 + E'_3 = \frac{W' \cdot v'^2}{2g'} + F'_o \cdot L' + W' \cdot L'$

When ascending



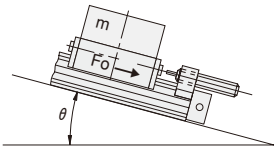
$E = E_1 + E_2 - E_3 = \frac{m \cdot v^2}{2} + F_o \cdot L - m \cdot g \cdot L$

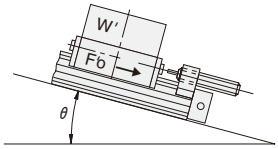


$E' = E'_1 + E'_2 - E'_3 = \frac{W' \cdot v'^2}{2g'} + F'_o \cdot L - W' \cdot L'$

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, heavier loads can be carried using lower operating air pressure (P) than when ascending.

E : Total impact energy … [J]

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

E_2 : Additional energy by cylinder thrust …$F_o \cdot L$ [J]

E_3 : Additional energy by load mass …$m \cdot g \cdot L$ [J]

m : Load mass [kg]

v : Impact speed [m/s]

g : Gravity acceleration 9.8 [m/s²]

F_o : 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, heavier loads can be carried using lower operating air pressure (P′) than when ascending.

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 …$F'_o \cdot L'$ [ft·lbf]

E'_3 : Additional energy by load weight …$W' \cdot L'$ [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.]

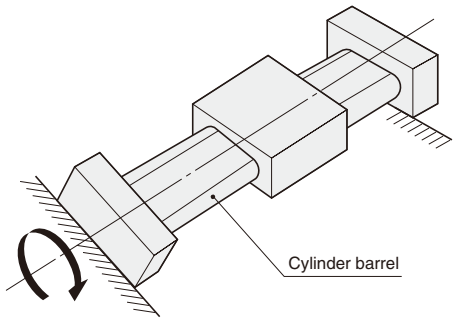
[D′: Cylinder bore [in.] P′: Operating air pressure [psi.]]

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

Mounting

Mounting

1. Because the Flat Rodless cylinders have strong magnets built into the cylinder bodies, they cannot be used in locations with magnetized cutting oil or powder.
2. Be careful to avoid making scratches, dents, etc., on the cylinder barrel.
3. If an external force larger than the magnetic retaining force is applied, causing the slider and piston to deviate or completely separate, return the piston to the stroke end and then apply external force to the slider to restore it to the correct position.
4. When using in locations where the cylinder can easily become smeared, clean the cylinder periodically.
   After cleaning, always apply grease to the surface of the cylinder barrel. For the type of grease to be applied, consult us.
5. Mount the cylinder barrel so that it cannot be twisted. Insufficient flatness of the mounting surface could result in cylinder barrel twisting and malfunctions.

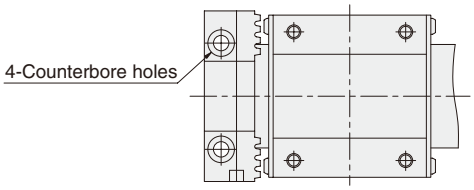


6. When mounting the body, always secure it by mounting bolts at 4 counterbore holes on the end plate (left and right).

Tightening torque

N·m [ft·lbf]

Model	(CS-)MRV14	(CS-)MRV22	(CS-)MRV28
Tightening torque	2.8 [2.1] (M4)	6 [4.4] (M5)	10 [7.4] (M6)



Mounting the shock absorber

Tightening torque for shock absorber hexagon nuts

N·m [ft·lbf]

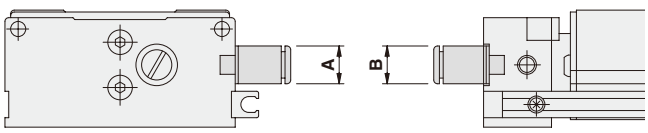
Model	For (CS-)MRV14 KSHJM8×5-14	For (CS-)MRV22 KSHJM8×5-22	For (CS-)MRV28 KSHJM10×10-28
Tightening torque	2.5 [1.8]		6.5 [4.8]

1. Use the shock absorber within its absorption capacity range (from its capacity graph).
2. The maximum impact speed to the shock absorber is 800mm/s [31.5 in./sec.]. Note that this is not the same as the average speed. The speed at time of impact should not exceed 800mm/s [31.5 in./sec.].
3. Do not use the shock absorber in a place subject to large amounts of dripping water, dripping oil, or dust. If using it in these places, install a cover, etc., so that the liquid drops etc. do not drip on it directly. This could lead to improper operation and might decrease the absorption energy.
4. Do not loosen the set screw on the center of the shock absorber's back end surface. The oil sealed inside will leak out, which will cause the shock absorber to fail.
5. Do not install other shock absorbers in this product. Because product characteristics vary among shock absorbers, if other shock absorbers are used, damage to the cylinder, etc., may occur.

Size of piping materials

For the side surface port with a sensor rail type, the distance to the sensor rail determines the outer diameter of the attached piping fitting, while for an end surface port, the diameter of the counterbore determines the outer diameter. Use the outer diameters shown in the table below or smaller for piping fittings.

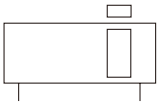
Model	Side surface (with sensor rail)	End surface
	A	B
(CS-)MRV14	ϕ 10 [0.394in.]	ϕ 10 [0.394in.]
(CS-)MRV22	ϕ 13 [0.512in.]	ϕ 10 [0.394in.]
(CS-)MRV28	ϕ 16 [0.630in.]	—



FLAT RODLESS CYLINDERS

Standard Cylinders

Symbol



Specifications

Item \ Model		MRV14	MRV22	MRV28
Equivalent bore size mm [in.]		14 [0.551]	22 [0.866]	28 [1.102]
Media		Air Note1		
Operation type		Double acting type		
Operating pressure range MPa [psi.]		0.2～0.7 [29～102]		
Proof pressure MPa [psi.]		1.05 [152]		
Operating temperature range °C [°F]		0～60 [32～140]		
Operating speed range mm/s [in./sec.]	Basic type	8～500 [0.31～19.7] Note2		
	With shock absorber specification	8～800 [0.31～31.5] Note2		
Cushion	Basic type	Rubber bumper		
	With shock absorber specification	Shock absorber		
Lubrication		Not required Note3		
Stroke adjusting range (with shock absorber specification only) (per side in specification stroke) mm [in.]		0～−10 [0～−0.394]	0～−6 [0～−0.236]	0～−15 [0～−0.591]
Maximum stroke mm		1000	1500 Note4	
Stroke tolerance mm [in.]		$^{+2}_{0}$ $\left[^{+0.079}_{0}\right]$		
Port size		M5×0.8		Rc1/8

Notes: 1. Use clean air that contains no moisture, dust, and oxidized oil.
2. For the relationship between the maximum load capacity and the impact speed, see the “Rubber bumper and shock absorber capacity graph” on p.1137.
3. This product can be used without lubrication. If lubrication is required, however, always consult us. Do not use turbine oil.
4. The maximum stroke of the cylinder with sensor rail is 1000mm.

Magnet Retaining Force

N [lbf.]

Item \ Model	MRV14	MRV22	MRV28
Retaining force	115 [25.9]	310 [69.7]	500 [112]

Specifications of Shock Absorber

Item \ Model	MRVZ14	MRVZ22	MRVZ28
Applicable shock absorber	KSHJM 8×5-14	KSHJM 8×5-22	KSHJM 10×10-28
Maximum absorption J [ft·lbf]	1 [0.7]	1.5 [1.1]	3 [2.2]
Absorbing stroke mm [in.]	5 [0.197]		10 [0.394]
Maximum impact speed mm/s [in./sec.]	800 [31.5]		
Maximum operating frequency cycle/min	60		
Spring return force (compressed) N [lbf.]	6 [1.3]		8 [1.8]
Angle variation	1° or less		
Operating temperature range °C [°F]	0～60 [32～140]		

Note: The life of the shock absorber may vary from the Flat Rodless cylinder, depending on its operating condition.

Equivalent Bore Size and Stroke

mm

Model \ Item	Standard strokes	Maximum available stroke	Maximum available stroke with sensor rail
MRV(Z)14	100, 150, 200, 250, 300, 350, 400, 450, 500	1～1000	1～1000
MRV(Z)22	200, 250, 300, 350, 400, 450, 500, 600, 700, 800	1～1500	
MRV(Z)28	200, 250, 300, 350, 400, 450, 500, 600, 700, 800	1～1500	

Remark: Non-standard strokes are available at 1mm pitch intervals.

Mass

kg [oz.]

Model		Zero stroke mass	Additional mass for each 1mm [0.0394in.] stroke	Shock absorber unit		M-type mount	Sensor magnet	Zero stroke mass of sensor rail	Additional mass for each 1 mm [0.0394in.] sensor rail	Sensor switch	
				One side	Both sides					Lead wire 1m [39in.] or ZE175G	Lead wire 3m [118in.]
MRV(Z)14	Basic type	0.22 [7.76]	0.000267 [0.00942]	—	—	0.017 [0.60]	0.004 [0.14]	0.007 [0.25]	0.0001 [0.0035]	0.015 [0.53]	0.035 [1.23]
	With shock absorber	0.27 [9.52]		0.01 [0.35]	0.02 [0.71]	—					
MRV(Z)22	Basic type	0.50 [17.64]	0.000491 [0.01732]	—	—	0.03 [1.06]		0.008 [0.28]			
	With shock absorber	0.59 [20.81]		0.01 [0.35]	0.02 [0.71]	—					
MRV(Z)28	Basic type	0.86 [30.34]	0.000656 [0.02314]	—	—	0.052 [1.83]		0.010 [0.35]			
	With shock absorber	1.00 [35.27]		0.022 [0.78]	0.044 [1.55]	—					

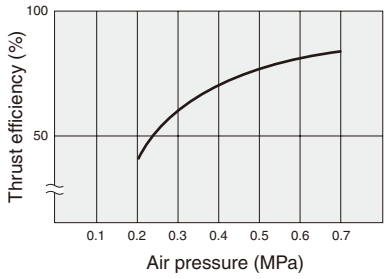
Theoretical Thrust

N [lbf.]

Model	Pressure area mm² [in.²]	Air pressure MPa					
		0.2 [29]	0.3 [44]	0.4 [58]	0.5 [73]	0.6 [87]	0.7 [102]
MRV14	157 [0.243]	31 [7.0]	47 [10.6]	63 [14.2]	79 [17.8]	94 [21.1]	110 [24.7]
MRV22	402 [0.623]	80 [18.0]	121 [27.2]	161 [36.2]	201 [45.2]	241 [54.2]	281 [63.2]
MRV28	628 [0.973]	126 [28.3]	188 [42.3]	251 [56.4]	314 [70.6]	377 [84.7]	440 [98.9]

The figures in the table are theoretical values. There may be some difference from these for practical applications.
For actual selection, see the thrust efficiency at right.
Note that thrust efficiency tends to be lower at low pressure.

Thrust efficiency



1MPa = 145psi.

Air Flow Rate and Air Consumption

While the Flat Rodless cylinder's 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 : Cylinder equivalent bore size	mm
L : Cylinder stroke	mm
t : Time required for cylinder to travel 1 stroke	s
n : Number of cylinder reciprocations per minute	times/min
P : Pressure	MPa

Air flow rate: $Q_1' = \frac{\pi D'^2}{4} \times L' \times \frac{60}{t} \times \frac{P'+14.70}{14.70} \times \frac{1}{1728}$

Air consumption: $Q_2' = \frac{\pi D'^2}{4} \times L' \times 2 \times n \times \frac{P'+14.70}{14.70} \times \frac{1}{1728}$

Q_1': Required air flow rate for cylinder	ft³/min. (ANR)
Q_2': Air consumption of cylinder	ft³/min. (ANR)
D′ : Cylinder equivalent bore size	in.
L′ : Cylinder stroke	in.
t : Time required for cylinder to travel 1 stroke	sec.
n : Number of cylinder reciprocations per minute	times/min
P′ : Pressure	psi.

Air consumption for each 1 mm [0.0394in.] stroke

cm³ [ft³]/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]
14 [0.551]	0.936 [3.31 ×10⁻⁵]	1.246 [4.40 ×10⁻⁵]	1.558 [5.50 ×10⁻⁵]	1.868 [6.60 ×10⁻⁵]	2.180 [7.70 ×10⁻⁵]	2.490 [8.79 ×10⁻⁵]
22 [0.866]	2.396 [8.46 ×10⁻⁵]	3.192 [1.127×10⁻⁴]	3.988 [1.408×10⁻⁴]	4.784 [1.689×10⁻⁴]	5.580 [1.971×10⁻⁴]	6.378 [2.252×10⁻⁴]
28 [1.102]	3.744 [1.322×10⁻⁴]	4.988 [1.761×10⁻⁴]	6.232 [2.20 ×10⁻⁴]	7.476 [2.640×10⁻⁴]	8.720 [3.079×10⁻⁴]	9.966 [3.519×10⁻⁴]

The figures in the table are for computing the air flow rate and air consumption when a Flat Rodless cylinder makes 1 reciprocation with stroke of 1mm [0.0394in.]. The air flow rate and air consumption actually required are found by the following calculations.

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

Example: When operating a Flat Rodless cylinder of an equivalent bore size of 22mm [0.866in.] at a speed of 300mm/s [11.8in./sec.] under air pressure of 0.5MPa [73psi.]

$4.784 \times \frac{1}{2} \times 300 \times 10^{-3} = 0.71$ ℓ/s [0.025ft³/sec.] (ANR)

(At this time, the flow rate per minute is $4.784 \times \frac{1}{2} \times 300 \times 60 \times 10^{-3} = 43.05$ ℓ/min [1.52ft³/min.] (ANR))

●Finding the air consumption

Example 1. When operating a Flat Rodless cylinder of an equivalent bore size of 22mm [0.866in.] and a stroke of 100mm [3.94in.] under air pressure of 0.5MPa [73psi.], for 1 reciprocation

$4.784 \times 100 \times 10^{-3} = 0.478$ ℓ [0.0169ft³]/Reciprocation (ANR)

Example 2. When operating a Flat Rodless cylinder of an equivalent bore size of 22mm [0.866in.] and a stroke of 100mm [3.94in.] under air pressure of 0.5MPa [73psi.], for 10 reciprocations per minute

$4.784 \times 100 \times 10 \times 10^{-3} = 4.78$ ℓ/min [0.169ft³/min.] (ANR)

Note: To find the actual air consumption required when using the Flat Rodless cylinder, add the air consumption of the piping to the air consumption obtained from the above calculation.

Order Codes

●Basic type

MRV [ ] **14×200** - [ ] - [ ] [ ] [ ]

Flat Rodless cylinder with rubber bumper

Equivalent bore size
×
Stroke

Sensor rail
Blank : No sensor rail
S : With sensor rail
(Including sensor magnet)

M-type mount
Blank : No M-type mount
M : With M-type mount

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

Lead wire length
A : 1000mm [39in.]
B : 3000mm [118in.]
G : 300mm [11.8in.] with M8 connector, only for ZE175

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 NPN output 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
ZE175: 3-lead wire solid state type PNP output with indicator lamp DC4.5～28V

●With shock absorber specification

MRVZ [ ] **14×200** - [ ] - [ ] [ ] [ ]

Flat Rodless cylinder with shock absorber specification Note

Equivalent bore size
×
Stroke

Sensor rail
Blank : No sensor rail
S : With sensor rail
(Including sensor magnet)

Number of shock absorbers
K1 : With 1 shock absorber
K2 : With 2 shock absorbers

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

Lead wire length
A : 1000mm [39in.]
B : 3000mm [118in.]
G : 300mm [11.8in.] with M8 connector, only for ZE175

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 NPN output 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
ZE175: 3-lead wire solid state type PNP output with indicator lamp DC4.5～28V

Note: An M-type mount cannot be installed on a cylinder with shock absorber specification.

Additional Parts

●M-type mount

M-MRV [ ]

Equivalent bore size
14 : For **MRV14**
22 : For **MRV22**
28 : For **MRV28**

●Sensor rail

S-MRV **14×100**

Equivalent bore size×stroke
(Sensor rail 1pc., bolt 2pcs.)

●Magnet set

MG-MRV [ ]

Equivalent bore size
14 : For **MRV14**
22 : For **MRV22**
28 : For **MRV28**
(Sensor magnet 1pc., magnet holder 1pc., bolt 2pcs.)

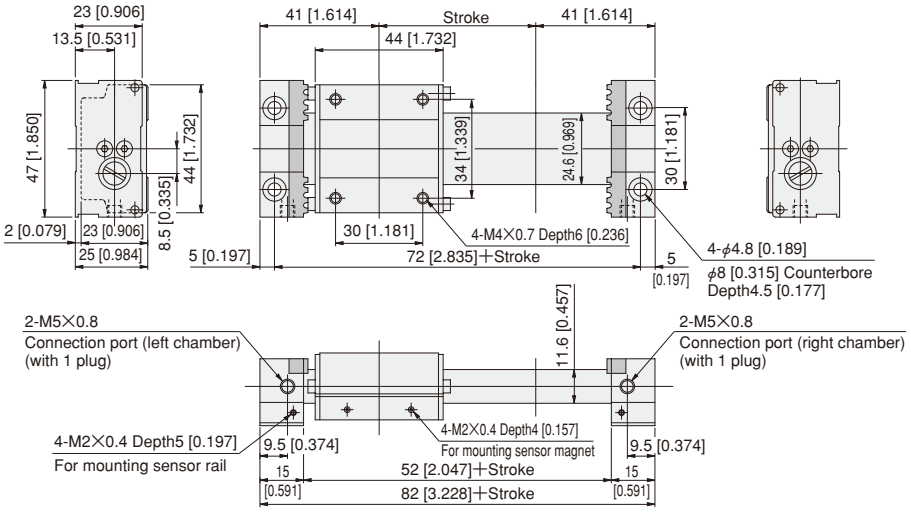
●Shock absorber

KSHJM [ ]

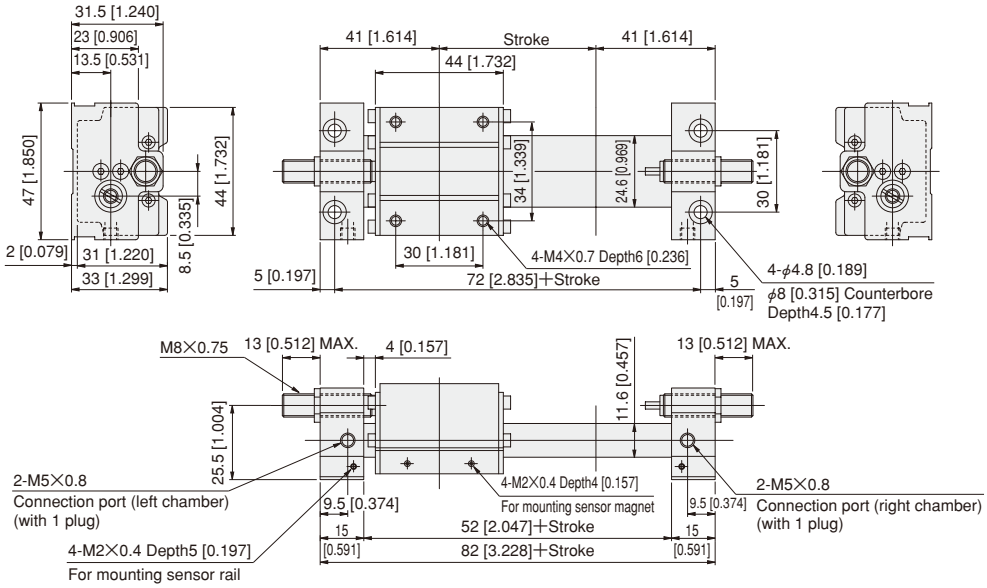
Size
8×5-14 : For **MRVZ14**
8×5-22 : For **MRVZ22**
10×10-28 : For **MRVZ28**

Dimensions of MRV14 mm [in.]

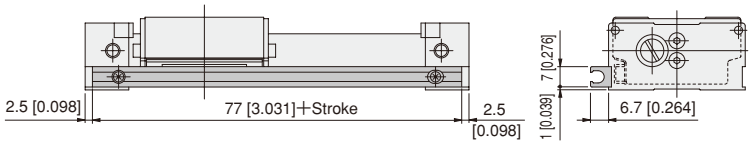
●Basic type MRV14× Stroke



●With shock absorber specification MRVZ14× Stroke

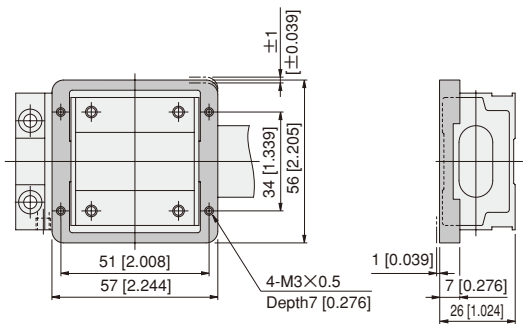


●With sensor rail MRV□S14× Stroke



The “With sensor rail” model is shipped with the sensor rail and sensor magnet assembled on the piping port side.

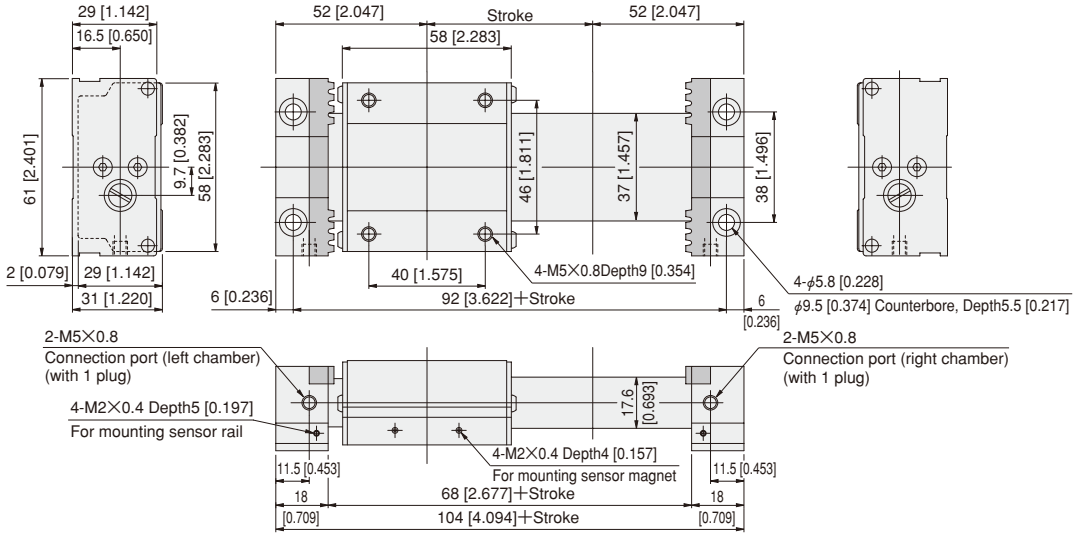
●M-type mount



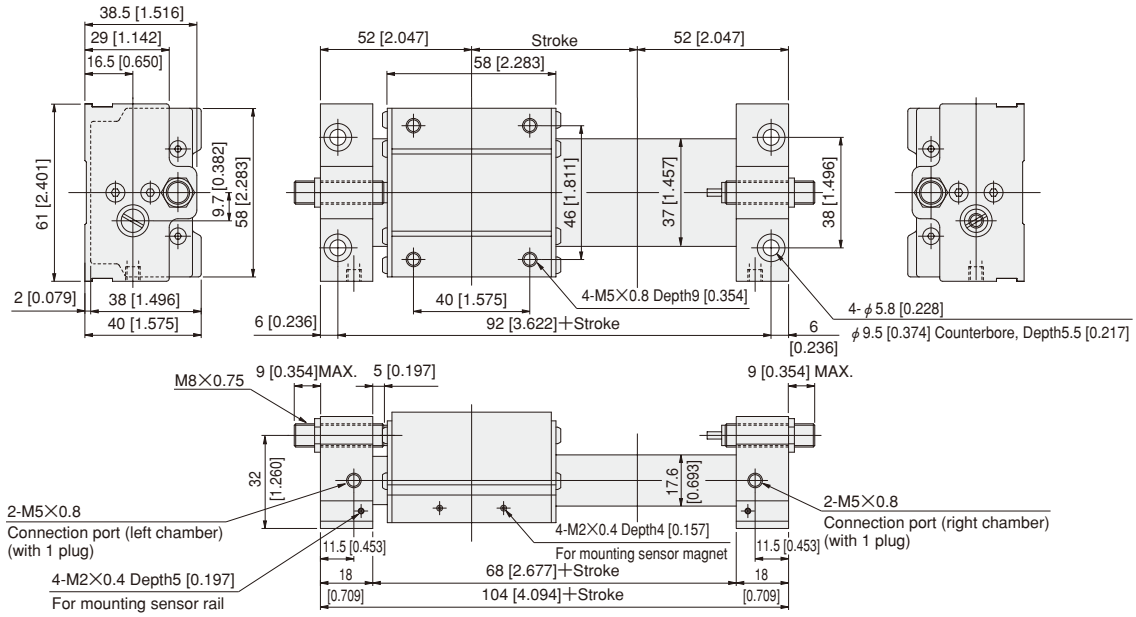
Note: When using an M-type mount, be sure to remove the plate bumper.

Dimensions of MRV22 mm [in.]

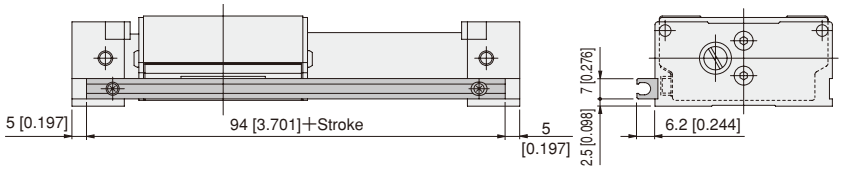
●Basic type MRV22× Stroke



●With shock absorber specification MRVZ22× Stroke

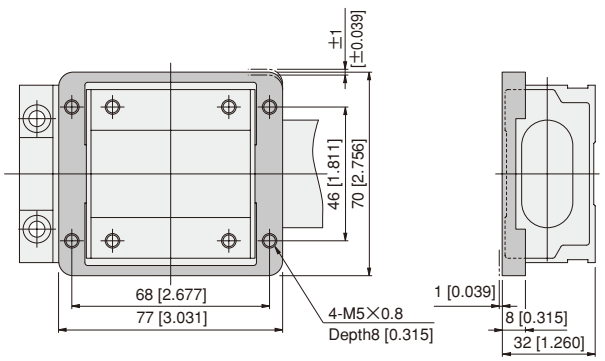


●With sensor rail MRV□S22× Stroke



The “With sensor rail” model is shipped with the sensor rail and sensor magnet assembled on the piping port side.

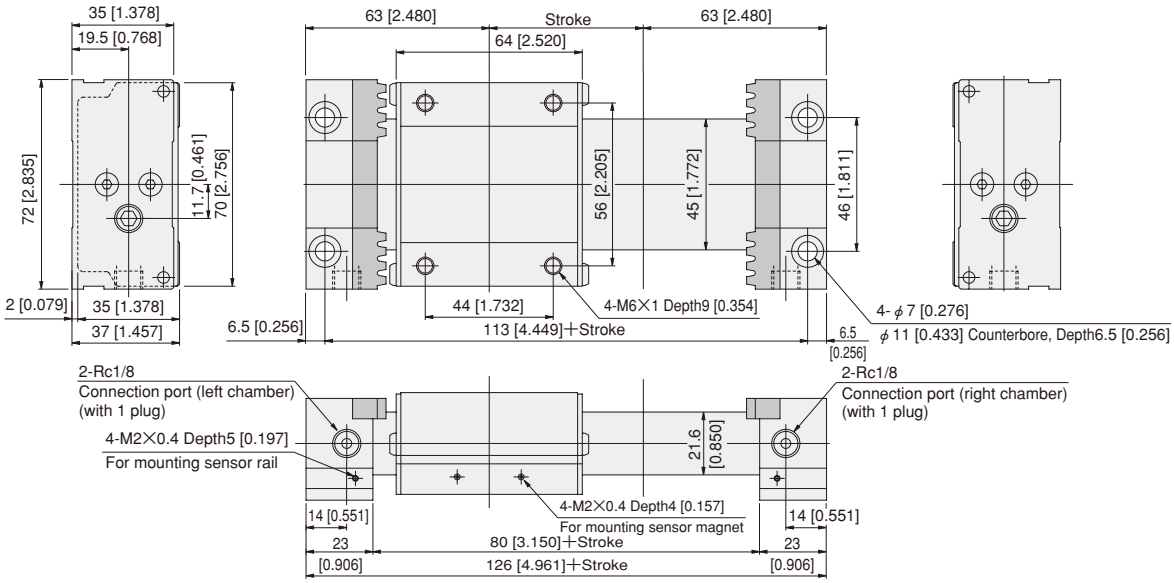
●M-type mount



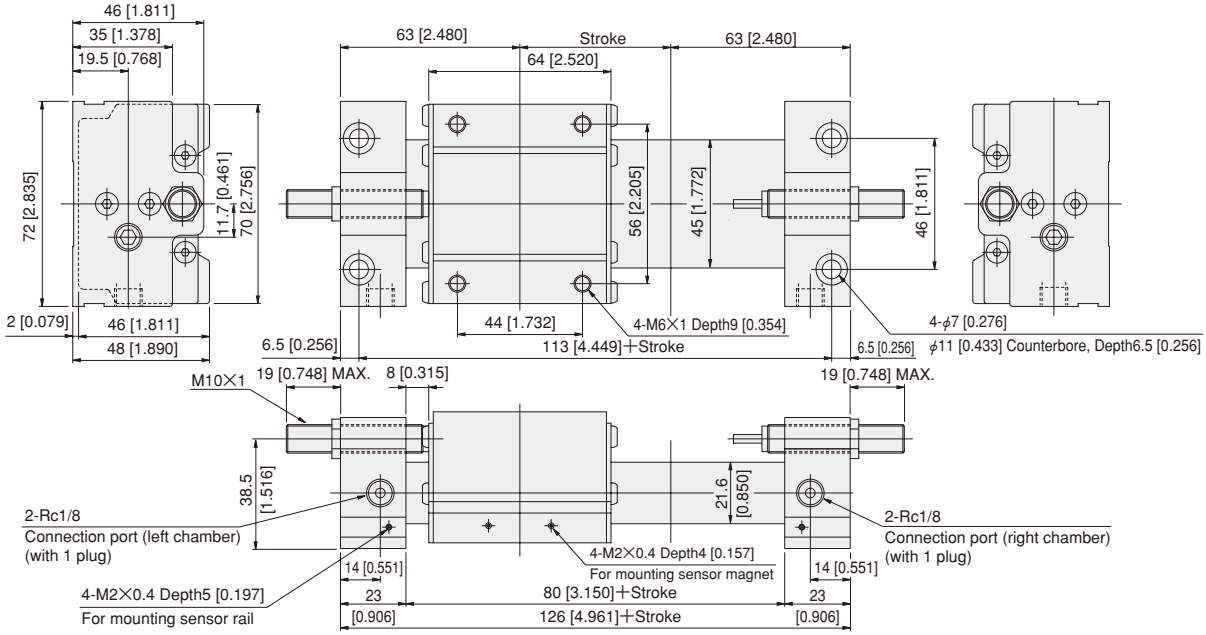
Note: When using an M-type mount, be sure to remove the plate bumper.

Dimensions of MRV28 mm [in.]

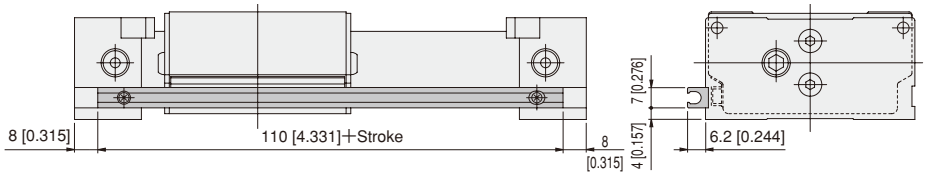
●Basic type MRV28× Stroke



●With shock absorber specification MRVZ28× Stroke

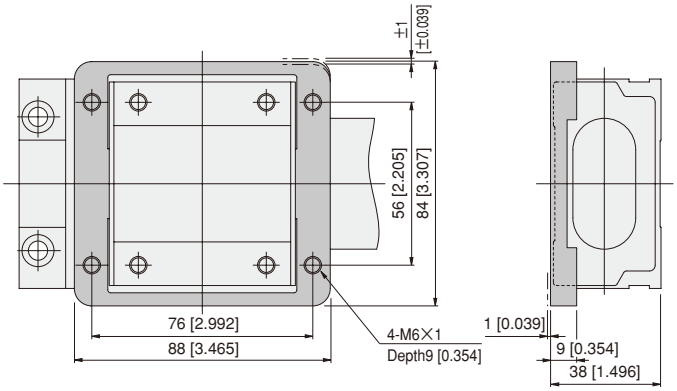


●With sensor rail MRV□S28× Stroke



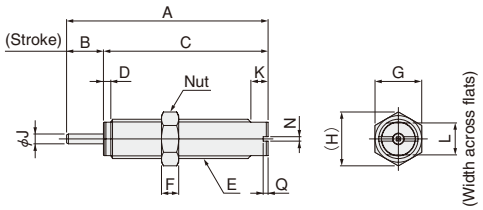
The "With sensor rail" model is shipped with the sensor rail and sensor magnet assembled on the piping port side.

●M-type mount



Note: When using an M-type mount, be sure to remove the plate bumper.

Dimensions of Shock Absorber mm [in.]

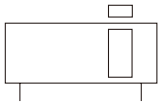


Model	A	B	C	D	E	F	G	H	J	K	L	N	Q
KSHJM8×5-14 (For **MRVZ14**)	37 [1.457]	5 [0.197]	32 [1.260]	1.2 [0.047]	M8×7.5	2 [0.079]	10 [0.394]	11.5 [0.453]	2.5 [0.098]	3 [0.118]	7 [0.276]	1.3 [0.051]	1.5 [0.059]
KSHJM8×5-22 (For **MRVZ22**)													
KSHJM10×10-28 (For **MRVZ28**)	60 [2.362]	10 [0.394]	50 [1.969]	2 [0.079]	M10×1	3 [0.118]	12 [0.472]	13.9 [0.547]	3 [0.118]	5 [0.197]	8.5 [0.335]	1.3 [0.051]	1.5 [0.059]

FLAT RODLESS CYLINDERS

Clean System Cylinders

Symbol



Specifications

Item \ Model		CS-MRV14	CS-MRV22	CS-MRV28
Equivalent bore size mm [in.]		14 [0.551]	22 [0.866]	28 [1.102]
Media		Air Note1		
Operation type		Double acting type		
Operating pressure range MPa [psi.]		0.2～0.7 [29～102]		
Proof pressure MPa [psi.]		1.05 [152]		
Operating temperature range °C [°F]		0～60 [32～140]		
Operating speed range mm/s [in./sec.]	Basic type	8～500 [0.31～19.7] Note2		
	With shock absorber specification	8～800 [0.31～31.5] Note2		
Cushion	Basic type	Rubber bumper		
	With shock absorber specification	Shock absorber		
Lubrication		Not required Note3		
Stroke adjusting range (with shock absorber specification only) (per side in specification stroke) mm [in.]		0～−10 [0～−0.394]	0～−6 [0～−0.236]	0～−15 [0～−0.591]
Maximum stroke mm		1000	1500 Note4	
Stroke tolerance mm [in.]		$^{+2}_{0}$ $\left[^{+0.079}_{0}\right]$		
Port size		M5×0.8		Rc1/8

Notes: 1. Use clean air that contains no moisture, dust, and oxidized oil.
2. For the relationship between the maximum load capacity and the impact speed, see the “Rubber bumper and shock absorber capacity graph” on p.1137.
3. This product can be used without lubrication. If lubrication is required, however, always consult us. Do not use turbine oil.
4. The maximum stroke of the cylinder with sensor rail is 1000mm.

Magnet Retaining Force

N [lbf.]

Item \ Model	CS-MRV14	CS-MRV22	CS-MRV28
Retaining force	115 [25.9]	310 [69.7]	500 [112]

Specifications of Shock Absorber

Item \ Model	CS-MRVZ14	CS-MRVZ22	CS-MRVZ28
Applicable shock absorber	KSHJM 8×5-14	KSHJM 8×5-22	KSHJM 10×10-28
Maximum absorption J [ft·lbf]	1 [0.7]	1.5 [1.1]	3 [2.2]
Absorbing stroke mm [in.]	5 [0.197]		10 [0.394]
Maximum impact speed mm/s [in./sec.]	800 [31.5]		
Maximum operating frequency cycle/min	60		
Spring return force (compressed) N [lbf.]	6 [1.3]		8 [1.8]
Angle variation	1° or less		
Operating temperature range °C [°F]	0～60 [32～140]		

Note: The life of the shock absorber may vary from the Flat Rodless cylinder, depending on its operating condition.

Equivalent Bore Size and Stroke

mm

Model \ Item	Standard strokes	Maximum available stroke	Maximum available stroke with sensor rail
CS-MRV(Z)14	100, 150, 200, 250, 300, 350, 400, 450, 500	1～1000	1～1000
CS-MRV(Z)22	200, 250, 300, 350, 400, 450, 500, 600, 700, 800	1～1500	
CS-MRV(Z)28	200, 250, 300, 350, 400, 450, 500, 600, 700, 800	1～1500	

Remark: Non-standard strokes are available at 1mm pitch intervals.

Mass

kg [oz.]

Model		Zero stroke mass	Additional mass for each 1mm [0.0394in.] stroke	Shock absorber unit		Sensor magnet	Zero stroke mass of sensor rail	Additional mass for each 1 mm [0.0394in.] sensor rail	Sensor switch	
				One side	Both sides				Lead wire 1m [39in.] or ZE175G	Lead wire 3m [118in.]
CS-MRV(Z)14	Basic type	0.22 [7.76]	0.000267 [0.00942]	—	—	0.004 [0.14]	0.007 [0.25]	0.0001 [0.0035]	0.015 [0.53]	0.035 [1.23]
	With shock absorber	0.27 [9.52]		0.01 [0.35]	0.02 [0.71]					
CS-MRV(Z)22	Basic type	0.50 [17.64]	0.000491 [0.01732]	—	—		0.008 [0.28]			
	With shock absorber	0.59 [20.81]		0.01 [0.35]	0.02 [0.71]					
CS-MRV(Z)28	Basic type	0.86 [30.34]	0.000656 [0.02314]	—	—		0.010 [0.35]			
	With shock absorber	1.00 [35.27]		0.022 [0.78]	0.044 [1.55]					

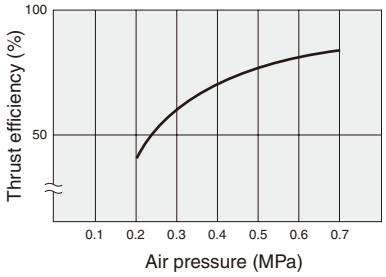
Theoretical Thrust

N [lbf.]

Model	Pressure area mm² [in.²]	Air pressure MPa					
		0.2 [29]	0.3 [44]	0.4 [58]	0.5 [73]	0.6 [87]	0.7 [102]
CS-MRV14	157 [0.243]	31 [7.0]	47 [10.6]	63 [14.2]	79 [17.8]	94 [21.1]	110 [24.7]
CS-MRV22	402 [0.623]	80 [18.0]	121 [27.2]	161 [36.2]	201 [45.2]	241 [54.2]	281 [63.2]
CS-MRV28	628 [0.973]	126 [28.3]	188 [42.3]	251 [56.4]	314 [70.6]	377 [84.7]	440 [98.9]

The figures in the table are theoretical values. There may be some difference from these for practical applications.
For actual selection, see the thrust efficiency at right.
Note that thrust efficiency tends to be lower at low pressure.

Thrust efficiency



1MPa = 145psi.

Air Flow Rate and Air Consumption

While the Clean System Flat Rodless cylinder's 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 : Cylinder equivalent bore size	mm
L : Cylinder stroke	mm
t : Time required for cylinder to travel 1 stroke	s
n : Number of cylinder reciprocations per minute	times/min
P : Pressure	MPa

Air flow rate: $Q_1' = \frac{\pi D'^2}{4} \times L' \times \frac{60}{t} \times \frac{P'+14.70}{14.70} \times \frac{1}{1728}$

Air consumption: $Q_2' = \frac{\pi D'^2}{4} \times L' \times 2 \times n \times \frac{P'+14.70}{14.70} \times \frac{1}{1728}$

Q_1': Required air flow rate for cylinder	ft³/min. (ANR)
Q_2': Air consumption of cylinder	ft³/min. (ANR)
D′: Cylinder equivalent bore size	in.
L′: Cylinder stroke	in.
t : Time required for cylinder to travel 1 stroke	sec.
n : Number of cylinder reciprocations per minute	times/min
P′: Pressure	psi.

Air consumption for each 1 mm [0.0394in.] stroke

cm³ [ft³]/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]
14 [0.551]	0.936 [3.31 ×10⁻⁵]	1.246 [4.40 ×10⁻⁵]	1.558 [5.50 ×10⁻⁵]	1.868 [6.60 ×10⁻⁵]	2.180 [7.70 ×10⁻⁵]	2.490 [8.79 ×10⁻⁵]
22 [0.866]	2.396 [8.46 ×10⁻⁵]	3.192 [1.127×10⁻⁴]	3.988 [1.408×10⁻⁴]	4.784 [1.689×10⁻⁴]	5.580 [1.971×10⁻⁴]	6.378 [2.252×10⁻⁴]
28 [1.102]	3.744 [1.322×10⁻⁴]	4.988 [1.761×10⁻⁴]	6.232 [2.20 ×10⁻⁴]	7.476 [2.640×10⁻⁴]	8.720 [3.079×10⁻⁴]	9.966 [3.519×10⁻⁴]

The figures in the table are for computing the air flow rate and air consumption when a Clean System Flat Rodless cylinder makes 1 reciprocation with stroke of 1mm [0.0394in.]. The air flow rate and air consumption actually required are found by the following calculations.

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

Example: When operating a Clean System Flat Rodless cylinder of an equivalent bore size of 22mm [0.866in.] at a speed of 300mm/s [11.8in./sec.] under air pressure of 0.5MPa [73psi.]

$4.784 \times \frac{1}{2} \times 300 \times 10^{-3} = 0.71$ ℓ/s [0.025ft³/sec.] (ANR)

(At this time, the flow rate per minute is $4.784 \times \frac{1}{2} \times 300 \times 60 \times 10^{-3} = 43.05$ ℓ/min [1.52ft³/min.] (ANR))

●Finding the air consumption

Example 1. When operating a Clean System Flat Rodless cylinder of an equivalent bore size of 22mm [0.866in.] and a stroke of 100mm [3.94in.] under air pressure of 0.5MPa [73psi.], for 1 reciprocation

$4.784 \times 100 \times 10^{-3} = 0.478$ ℓ [0.0169ft³]/Reciprocation (ANR)

Example 2. When operating a Clean System Flat Rodless cylinder of an equivalent bore size of 22mm [0.866in.] and a stroke of 100mm [3.94in.] under air pressure of 0.5MPa [73psi.], for 10 reciprocations per minute

$4.784 \times 100 \times 10 \times 10^{-3} = 4.78$ ℓ/min [0.169ft³/min.] (ANR)

Note: To find the actual air consumption required when using the Clean System Flat Rodless cylinder, add the air consumption of the piping to the air consumption obtained from the above calculation.

Order Codes

●Basic type

CS-MRV [ ] **14×200** - [ ] [ ] [ ]

Clean System
Flat Rodless cylinder
with rubber bumper

Sensor rail
Blank : No sensor rail
S : With sensor rail
(Including sensor magnet)

Equivalent bore size
×
Stroke

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

Lead wire length
A : 1000mm [39in.]
B : 3000mm [118in.]
G : 300mm [11.8in.] with M8 connector, only for ZE175

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 NPN output 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
ZE175: 3-lead wire solid state type PNP output with indicator lamp DC4.5～28V

Remark: The packaging is the same as for standard products with use a single package.

●With shock absorber specification

CS-MRVZ [ ] **14×200** - [ ] - [ ] [ ] [ ]

Clean System
Flat Rodless cylinder
with shock absorber
specification

Sensor rail
Blank : No sensor rail
S : With sensor rail
(Including sensor magnet)

Equivalent bore size
×
Stroke

Number of shock absorbers
K1 : With 1 shock absorber
K2 : With 2 shock absorbers

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

Lead wire length
A : 1000mm [39in.]
B : 3000mm [118in.]
G : 300mm [11.8in.] with M8 connector, only for ZE175

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 NPN output 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
ZE175: 3-lead wire solid state type PNP output with indicator lamp DC4.5～28V

Remark: The packaging is the same as for standard products with use a single package.

Additional Parts

●Sensor rail

S-MRV **14×100**

Equivalent bore size×stroke
(Sensor rail 1pc., bolt 2pcs.)

●Magnet set

MG-MRV [ ]

Equivalent bore size
14 : For **CS-MRV14**
22 : For **CS-MRV22**
28 : For **CS-MRV28**
(Sensor magnet 1pc., magnet holder 1pc., bolt 2pcs.)

●Shock absorber

KSHJM [ ]

Size
8×5-14 : For **CS-MRVZ14**
8×5-22 : For **CS-MRVZ22**
10×10-28 : For **CS-MRVZ28**

Remark: Additional parts are the same ones for standard specification.

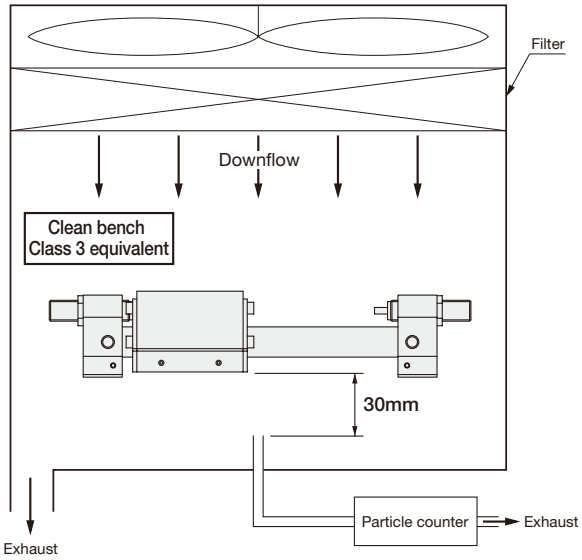
About Evaluations of Clean Level

No standard, including JIS, has officially stipulated a method for evaluating the clean level of the equipment for the cleanroom specifications. KOGANEI has established its own measurement method for evaluating the clean level. The particle generation level of the Clean System Flat Rodless Cylinder is measured using the method below.

1. Measuring Sample Products

① CS-MRVZ14 × 500 (no load)
② CS-MRVZ22 × 500 (1 kg [2.2 lb.] load)
③ CS-MRVZ28 × 500 (1.5 kg [3.3 lb.] load)

Clean room class 7 equivalent
(FED–STD Class 10000 equivalent)



2. Measuring Conditions

2-1 Testing circuit
Measuring area : Center of the cylinder, lower section
Measuring position : 30 mm [1.18 in] from the slider
2-2 Operating condition of the sample product
Operating frequency : 10 times/minute*
Operating Speed : CS-MRVZ14 500 mm/s [19.7 in/sec]
CS-MRVZ22, CS-MRVZ28 } 250 mm/s [7.87 in/sec]
Applied pressure : 0.5 MPa [73 psi]
Mounting direction : Horizontal

Caution : The particle generation level is an average of 10 repetitions of the test taken 10 times/minute.
The particle generation level is also the actual measured value based on the above conditions.
In your applications, we would like to ask for your evaluations based upon your operating conditions.

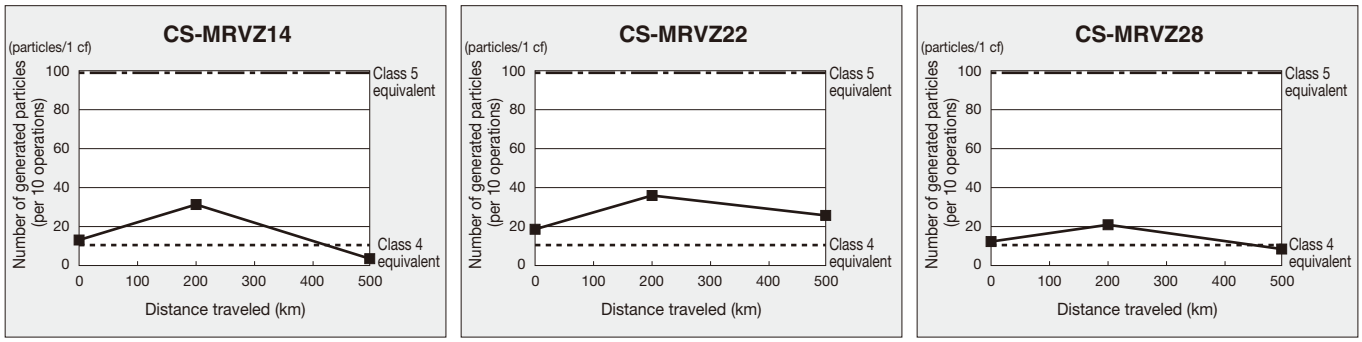
3. Particle counter

Maker/Model ····· Rion Co., Ltd. /KM-20
Suction flow rate ····· 28.3 ℓ/min [1 ft³/min]
Possible particle diameter ····· 0.1 μm, 0.2 μm, 0.3 μm, 0.5 μm, 0.7 μm, 1.0 μm

4. Measuring methodology

4-1 Verification of the particle generation level in the measurement system
Before measuring, measure the background for 9 minutes and verify that the particle generation of the measurement system is at zero.
4-2 Measurement
4-3 Re-verification
Repeat the measurement in step 4-1 and verify that the particle generation of the measurement system is at zero.

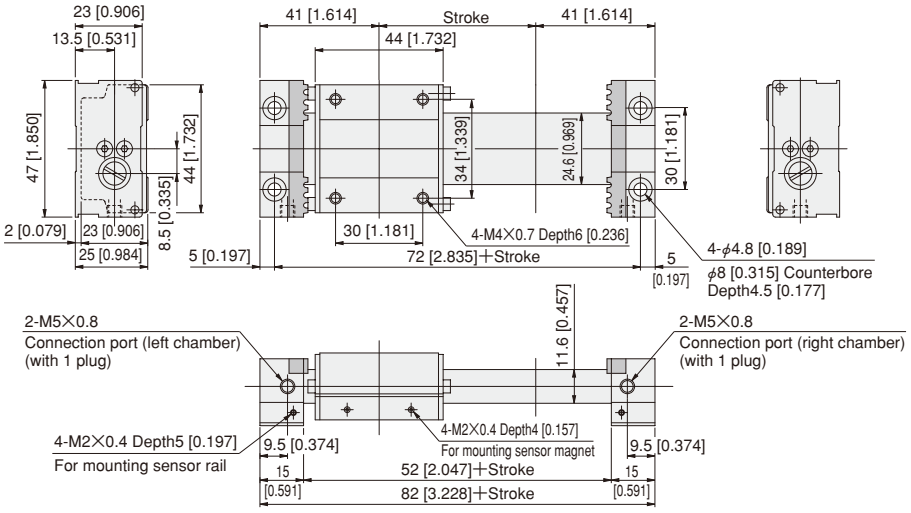
5. Measurement Results (average particle generation level of over 0.1 μm particles)



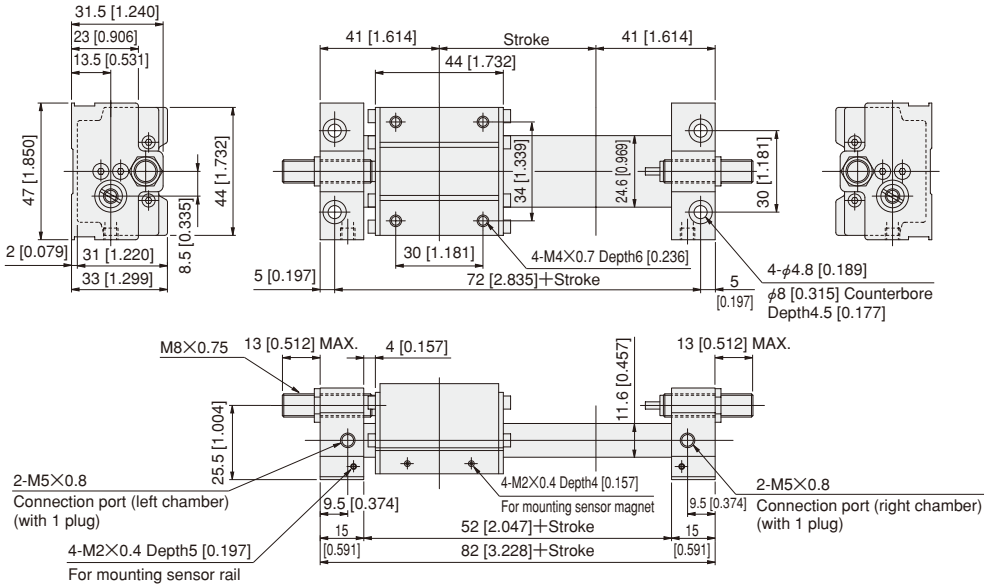
Caution : The number of generated particles in the graphs above are based on measured values under conditions established at KOGANEI and are not guaranteed values.

Clean System Dimensions of CS-MRV14 mm [in.]

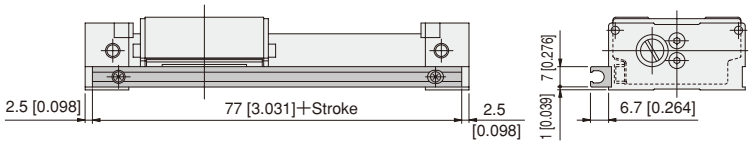
●Basic type CS-MRV14× Stroke



●With shock absorber specification CS-MRVZ14× Stroke



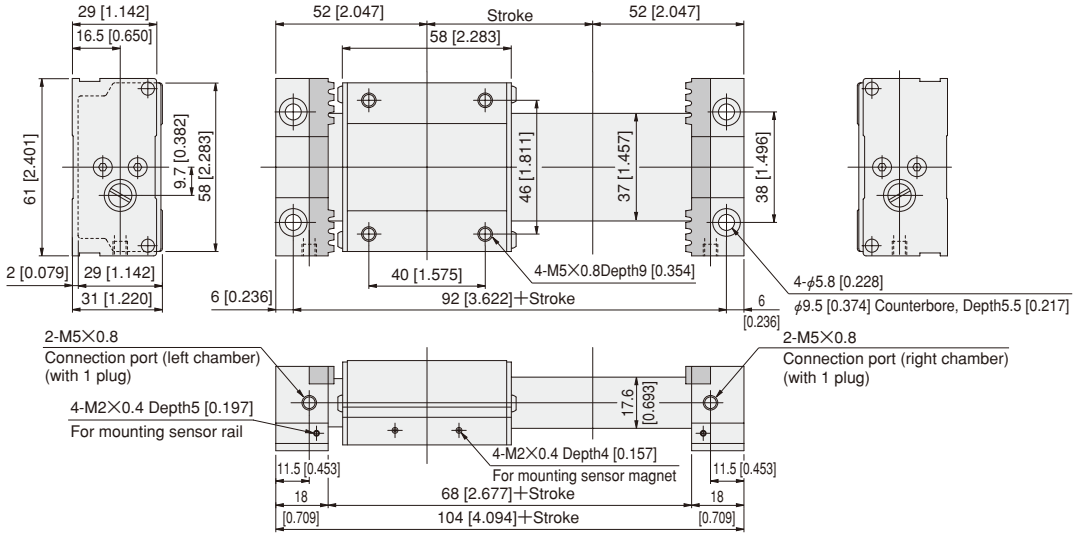
●With sensor rail CS-MRV□S14× Stroke



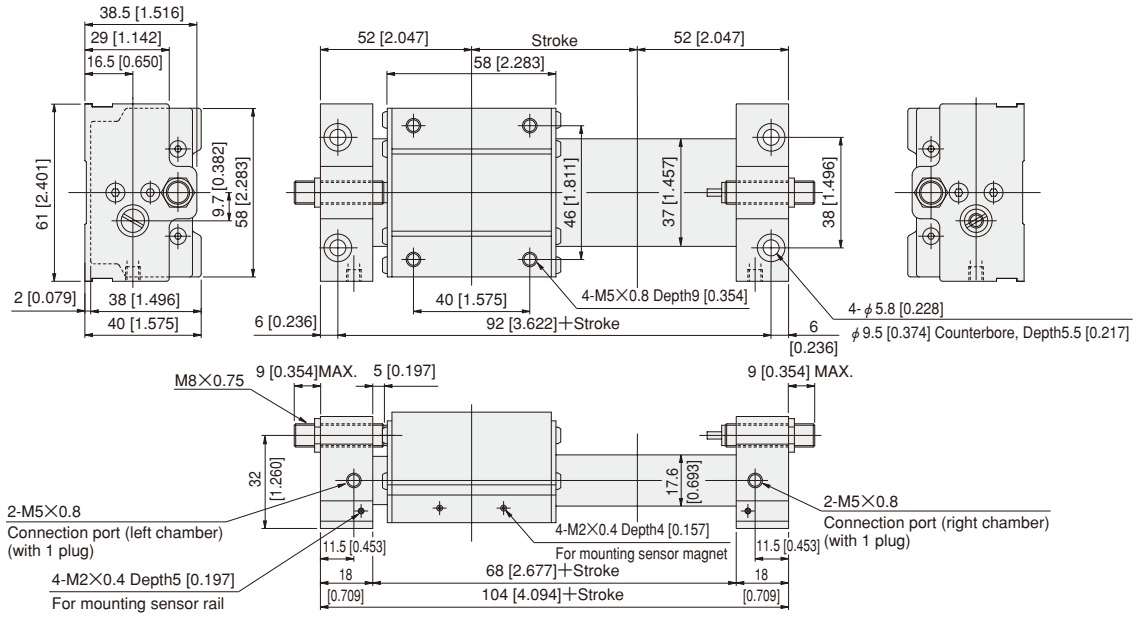
The “With sensor rail” model is shipped with the sensor rail and sensor magnet assembled on the piping port side.

Clean System Dimensions of CS-MRV22 mm [in.]

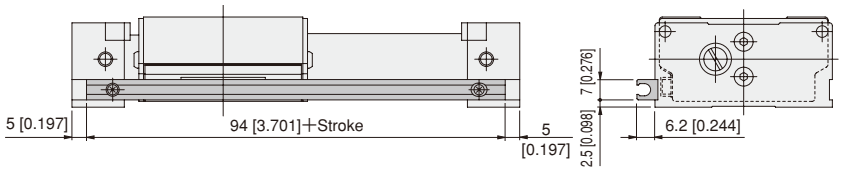
●Basic type CS-MRV22× Stroke



●With shock absorber specification CS-MRVZ22× Stroke



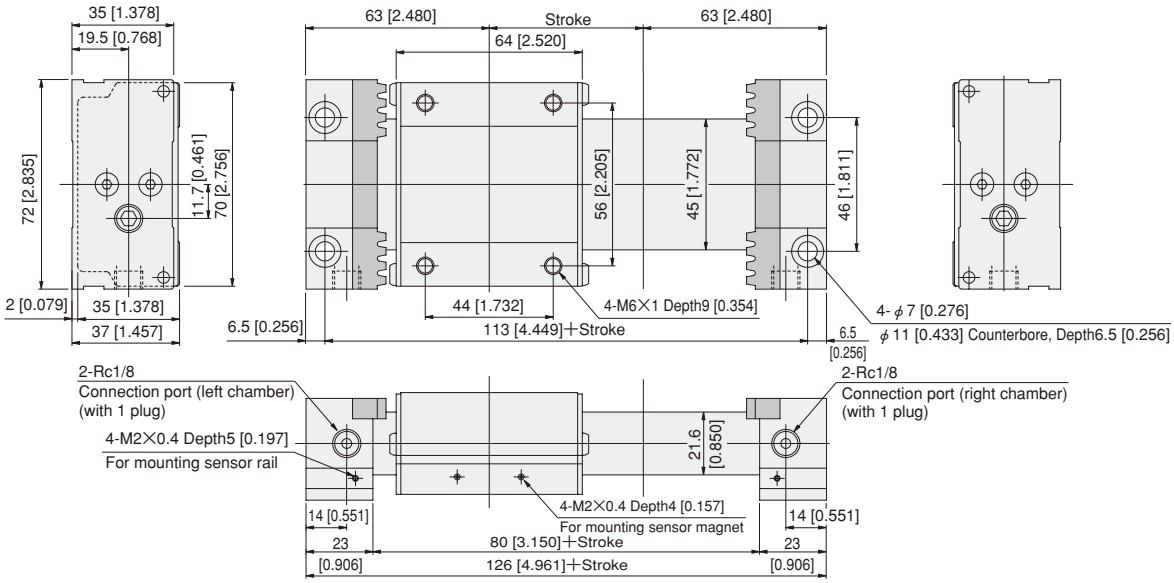
●With sensor rail CS-MRV□S22× Stroke



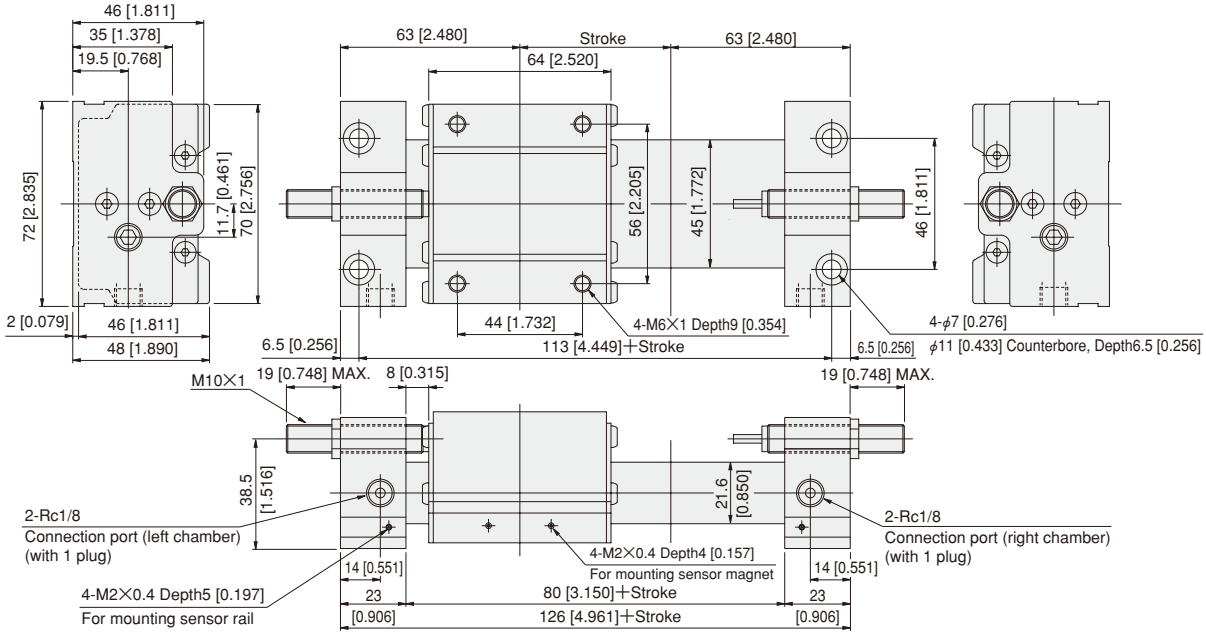
The “With sensor rail” model is shipped with the sensor rail and sensor magnet assembled on the piping port side.

Clean System Dimensions of CS-MRV28 mm [in.]

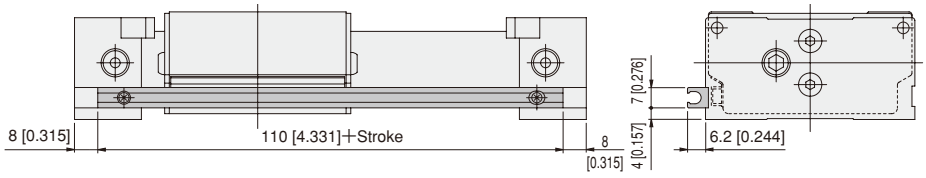
●Basic type CS-MRV28× Stroke



●With shock absorber specification CS-MRVZ28× Stroke

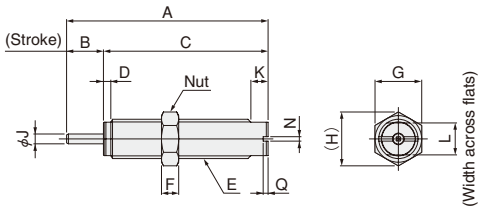


●With sensor rail CS-MRV□S28× Stroke



The “With sensor rail” model is shipped with the sensor rail and sensor magnet assembled on the piping port side.

Dimensions of Clean System Shock Absorber mm [in.]

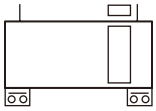


Model	A	B	C	D	E	F	G	H	J	K	L	N	Q
KSHJM8×5-14 (For **CS-MRVZ14**)	37 [1.457]	5 [0.197]	32 [1.260]	1.2 [0.047]	M8×7.5	2 [0.079]	10 [0.394]	11.5 [0.453]	2.5 [0.098]	3 [0.118]	7 [0.276]	1.3 [0.051]	1.5 [0.059]
KSHJM8×5-22 (For **CS-MRVZ22**)													
KSHJM10×10-28 (For **CS-MRVZ28**)	60 [2.362]	10 [0.394]	50 [1.969]	2 [0.079]	M10×1	3 [0.118]	12 [0.472]	13.9 [0.547]	3 [0.118]	5 [0.197]	8.5 [0.335]	1.3 [0.051]	1.5 [0.059]

SENSOR SWITCHES

Solid State Type, Reed Switch Type

Symbol



Order Codes

□ - MRV

Lead wire length
A：1000mm [39in.]
B：3000mm [118in.]
G：300mm [11.8in.] with M8 connector, only for ZE175

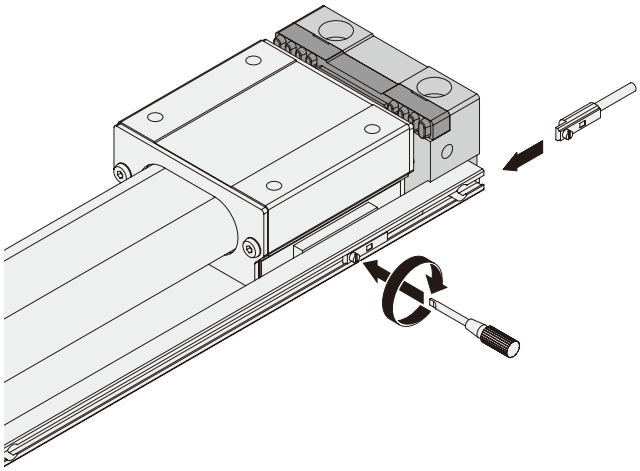
Sensor switch
ZE135 : Solid state type with indicator lamp DC10～28V Horizontal lead wire
ZE101 : Reed switch type without indicator lamp DC5～28V Horizontal lead wire
AC85～115V
ZE175 : 3-lead wire solid state type PNP output with indicator lamp DC4.5～28V
Horizontal lead wire
ZE155 : 3-lead wire solid state type NPN output with indicator lamp DC4.5～28V Horizontal lead wire
ZE102 : Reed switch type with indicator lamp DC10～28V Horizontal lead wire
AC85～115V

●For sensor switch details, see p.1544.

Moving Sensor Switch

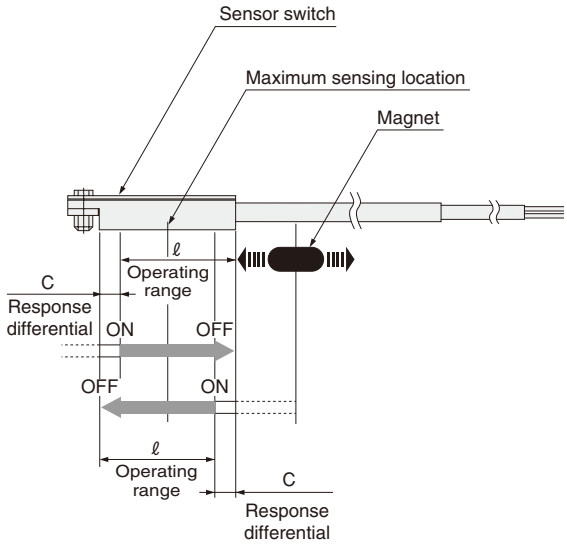
Loosening the mounting screw allows the sensor switch to be moved along the switch mounting groove on the barrel.

● Tighten the mounting screw with tightening torque of 0.1N･m～0.2N･m [0.9in･lbf～1.8in･lbf].



Sensor Switch Operating Range, Response Differential, and Maximum Sensing Location

● Operating range : ℓ
The distance the piston travels in one direction, while the switch is in the ON position.
● Response differential : C
The distance between the point where the piston turns the switch ON and the point where the switch is turned OFF as the piston travels in the opposite direction.



●Reed switch type

mm [in.]

Model	(CS-)MRV14	(CS-)MRV22	(CS-)MRV28
Operating range : ℓ	7～8.6 [0.276～0.339]	7.5～8.6 [0.295～0.339]	6.8～8.5 [0.268～0.335]
Response differential : C	1.2 [0.047] or less	1.2 [0.047] or less	1 [0.039] or less
Maximum sensing location※	10 [0.394]		

Remark: The values in the above table are reference values.
※ : It is a value measured from the other end side of the lead wire.

●Solid state type

mm [in.]

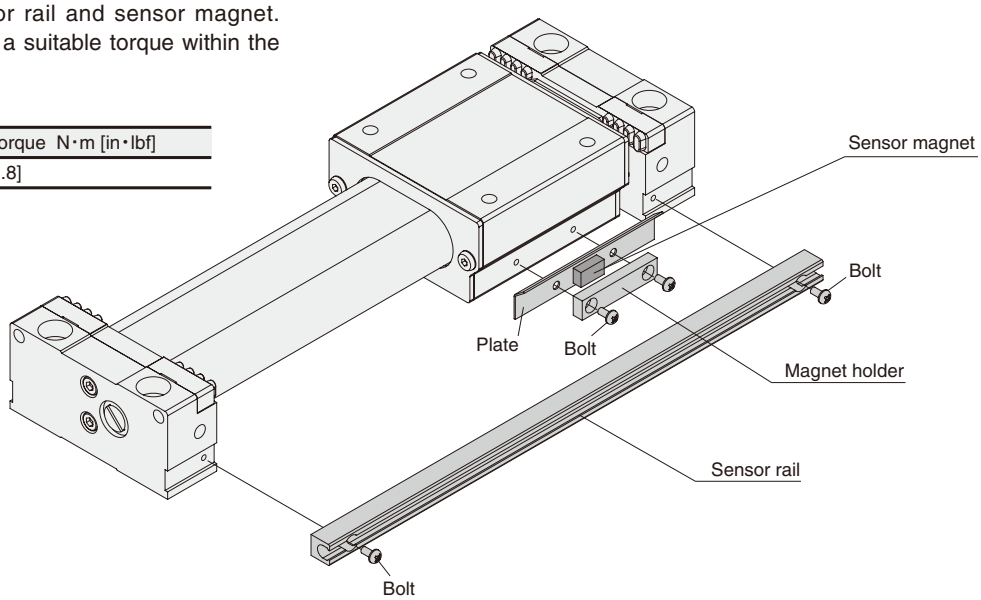
Model	(CS-)MRV14	(CS-)MRV22	(CS-)MRV28
Operating range : ℓ	2.6～3.5 [0.102～0.138]	2.8～3.7 [0.110～0.146]	2.6～4.0 [0.102～0.157]
Response differential : C	0.9 [0.035] or less	1.1 [0.043] or less	1.2 [0.047] or less
Maximum sensing location※	6 [0.236]		

Remark: The values in the above table are reference values.
※ : This is the length measured from the switch's opposite end side to the lead wire.

Mounting the Sensor Rail and Sensor Magnet

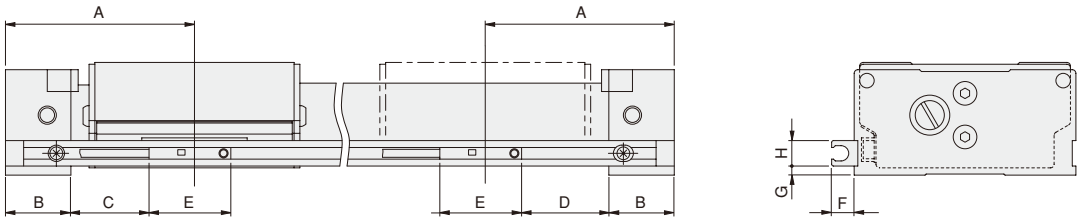
The Flat Rodless cylinder has tapped holes on the cylinder's both sides for mounting the sensor rail and sensor magnet. When securing the bolts, tighten to a suitable torque within the allowed range limits.

Bolt	Maximum tightening torque N·m [in·lbf]
M2×0.4	0.2 [1.8]



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□**)

mm [in.]

Model	A	B	C	D	E	F	G	H
(CS-)MRV14	41 [1.614]	15 [0.591]	13.5 [0.531]	16 [0.630]	22.5 [0.886]	6.7 [0.264]	1 [0.039]	7 [0.276]
(CS-)MRV22	52 [2.047]	18 [0.709]	21.5 [0.846]	24 [0.945]		6.2 [0.244]	2.5 [0.098]	
(CS-)MRV28	63 [2.480]	23 [0.906]	27.5 [1.083]	30 [1.181]			4 [0.157]	

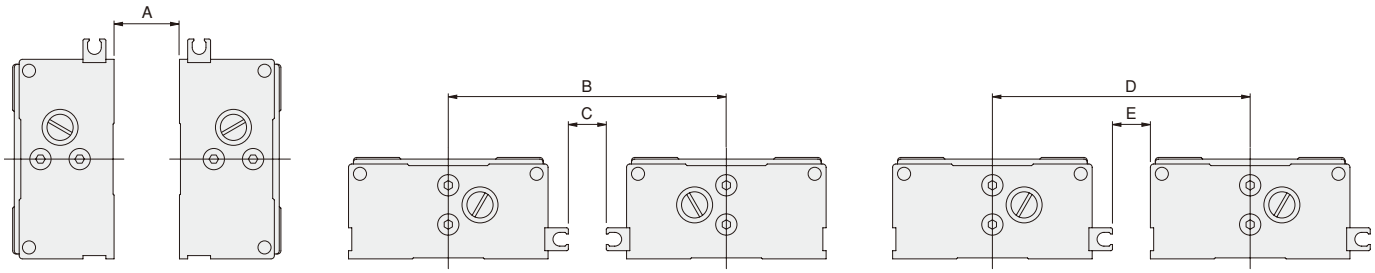
●Solid state type (**ZE135□, ZE155□, ZE175□**)

mm [in.]

Model	A	B	C	D	E	F	G	H
(CS-)MRV14	41 [1.614]	15 [0.591]	16.5 [0.650]	20 [0.787]	15.5 [0.610]	6.7 [0.264]	1 [0.039]	7 [0.276]
(CS-)MRV22	52 [2.047]	18 [0.709]	24.5 [0.965]	28 [1.102]		6.2 [0.244]	2.5 [0.098]	
(CS-)MRV28	63 [2.480]	23 [0.906]	30.5 [1.201]	34 [1.339]			4 [0.157]	

When Mounting the Cylinders with Sensor Switches in Close Proximity

When mounting Flat Rodless cylinders in close proximity, use them at the values shown in the table below, or larger.



●Reed switch type

mm [in.]

Model	A	B	C	D	E
(CS-)MRV14	0	59.4 [2.339]	0	53.2 [2.094]	0
(CS-)MRV22	0	73.4 [2.890]	0	67.2 [2.646]	0
(CS-)MRV28	0	84.4 [3.323]	0	78.2 [3.079]	0

●Solid state type

mm [in.]

Model	A	B	C	D	E
(CS-)MRV14	3 [0.118]	61.4 [2.417]	2 [0.079]	55.2 [2.173]	2 [0.079]
(CS-)MRV22	0	76.4 [3.008]	3 [0.118]	69.2 [2.724]	2 [0.079]
(CS-)MRV28	0	87.4 [3.441]	3 [0.118]	84.2 [3.315]	6 [0.236]