MRL2 Series selection guide

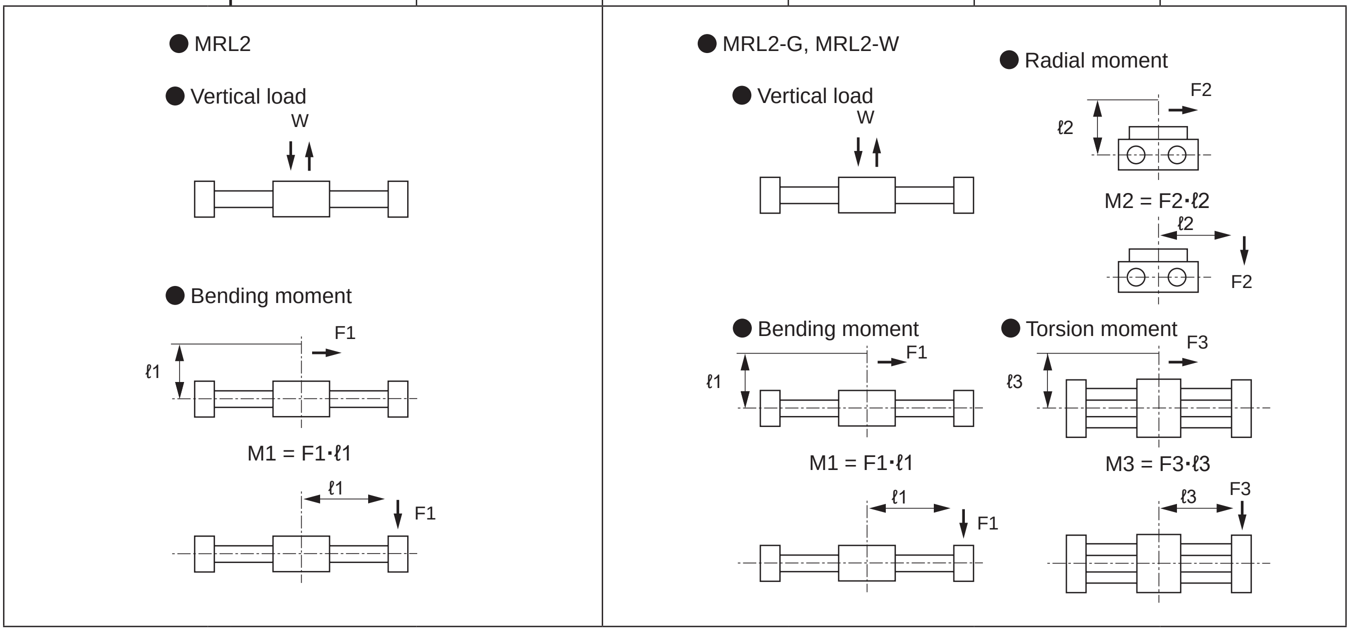
STEP-1 Determination of allowable load

(1) Calculate all load (W) and moment (M1, M2, and M3) per load.
(2) Divide each load by the max. value shown in the table below to find load/moment ratio, and confirm that the total is 1.0 or less.

$$\frac{W}{W max} + \frac{M1}{M1 max} + \frac{M2}{M2 max} + \frac{M3}{M3 max} \leq 1.0$$

Max.allowable load weight

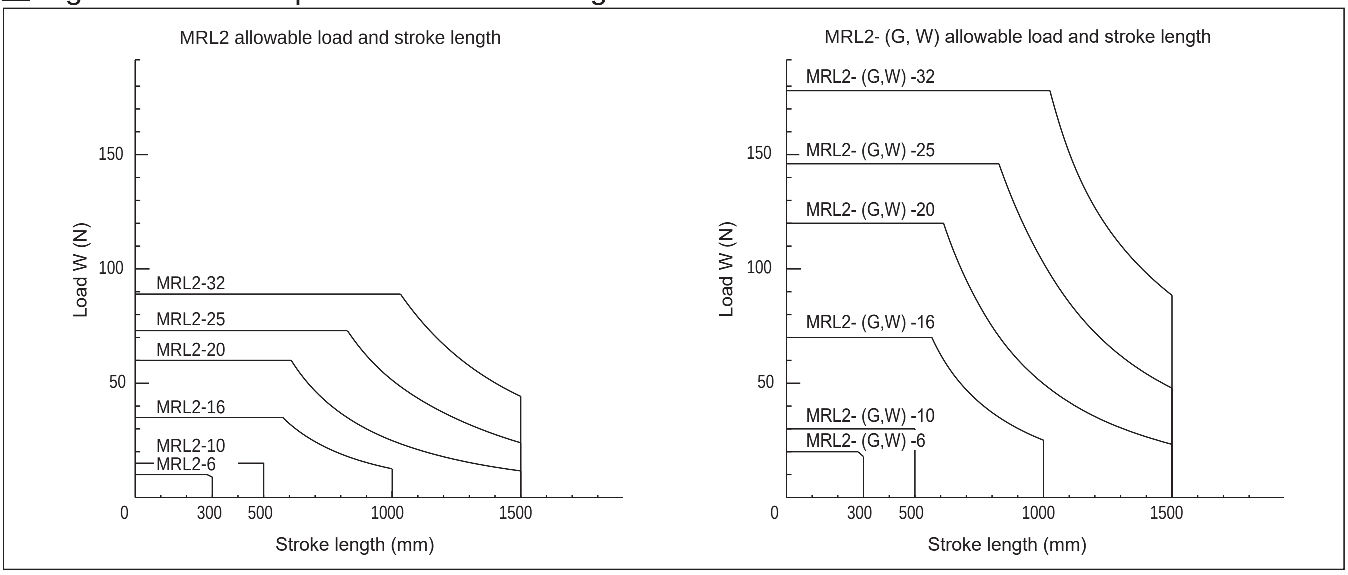
Descriptions / Bore size (mm)	MRL2		MRL2-G/MRL2-W			
	Vertical load W (N)	Bending moment M1 (N·m)	Vertical load W (N)	Bending moment M1 (N·m)	Radial moment M2 (N·m)	Torsion moment M3 (N·m)
ø6	10	0.1	20	0.2	0.1	0.2
ø10	15	0.3	30	0.6	0.2	0.6
ø16	35	1.2	70	2.4	0.5	2.4
ø20	60	2.5	120	5.0	1.0	5.0
ø25	73	3.3	146	6.6	3.7	6.6
ø32	89	4.5	178	9.0	5.3	9.0



Note: Give sufficient consideration to inertia when the load moves or stops.

The value of the allowable vertical load W will vary depending on the stroke length.
Make a selection so that the value falls within the graph of Fig. 1.

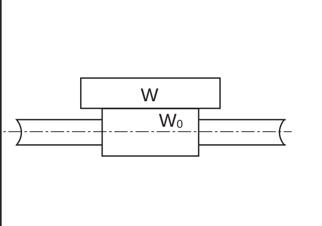
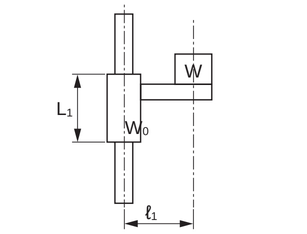
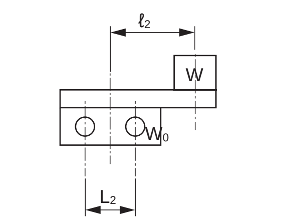
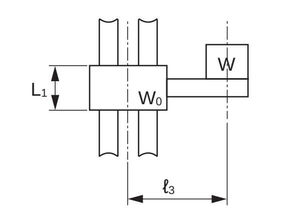
Fig. 1. Relationship between stroke length and allowable vertical load



STEP-2 Calculation of load factor

1. Depending on the size and direction of the load as well as the mounting orientation, calculate the required thrust while using the 2, 3 in the table below as a guide.

Table 2

	Vertical load	Bending moment	Radial moment	Torsion moment
Size and direction of load				
Mounting orientation	Horizontal	Vertical	Horizontal	Vertical
Required thrust	$F_N = 0.2\ (W + W_0)$	$F_N = \frac{0.2\ W\ell_1}{L_1} + W + W_0$	$F_N = 0.2\left(\frac{W\ell_2}{L_2} + W + W_0\right)$	$F_N = \frac{0.2\ W\ell_3}{L_1} + W + W_0$

As the slider will rotate with the single it will not be possible to apply a radial moment or a torsion moment.

F_N : Required thrust (N)
W : Load (N)
W_0 : Slider self-weight (N)
ℓ_n (n = 1, 2, 3) : Overhang (mm)
L_1 : Slider bearing pitch (mm)
L_2 : Pitch of guide (mm)

Table 3

Model No.	W_0	L_1	L_2
MRL2-6	0.4	27	–
10	0.6	27	–
16	1.2	39	–
20	2.4	58	–
25	3.8	70	–
32	5.2	78	–
MRL2-$^{G}_{W}$-6	0.9	27	26
10	1.7	27	34
16	3.0	39	38
20	5.9	58	46
25	8.5	70	50
32	11.9	78	60

Calculate the load factor from the required thrust calculated in 2.1 and ■ Table 4, Fig. 2. (Make sure that the load factor is less than or equal to approximately 50%.)

$$\text{Load factor } \alpha = \frac{F_N}{\frac{a}{100}\cdot A} \times 100$$

$$B = \frac{a}{100}\cdot A$$

F_N: Required thrust (N) a: Thrust efficiency (%)
A : Theoretical thrust (N) B: Effective thrust (N)

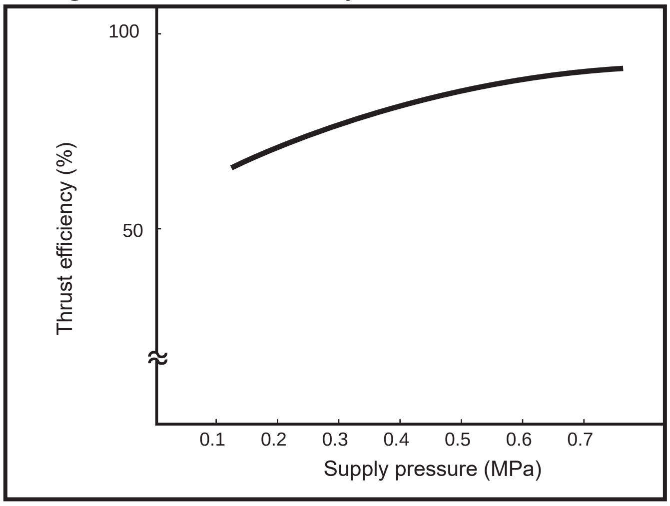
Table 4 Theoretical thrust table

N

Model No.	Code					
	Working pressure MPa					
	0.2	0.3	0.4	0.5	0.6	0.7
MRL2, MRL2-G-6	–	8	11	14	17	20
10	–	24	31	39	47	54
16	40	60	80	101	121	139
20	63	94	126	157	188	217
25	98	147	196	245	295	344
32	161	241	322	402	483	563
MRL2-W-6	11	17	23	28	34	39
10	31	47	63	79	94	108
16	80	121	161	201	241	277
20	126	188	251	314	377	434
25	196	294	392	490	590	688
32	322	482	644	804	966	1126

* Please be careful as the difference between the effectiveness thrust and theoretical thrust will be greater with a lower pressure due to the thrust efficiency being lower.

Fig. 2 Thrust efficiency



STEP-3 Formula for kinetic energy calculation

Calculate the kinetic energy from the load weight (m) and speed (V) and make sure that this is less than or equal to the allowed value listed in ■ Table 5. When exceeding the allowable absorbed energy value, increase the cylinder size so that the value falls under the allowable absorbed energy or consider the use of an external shock absorber. This speed is the velocity just before cushion entry and not the average speed, if it is unknown, calculate the cushion entry velocity by using formula (1).

$$E = \frac{1}{2} mV^2$$

$$Va = \frac{L}{t}$$

$$V = Va \times \left(1 + 1.5\frac{\alpha}{100}\right) \text{ —— } (1)$$

E : Kinetic energy (J)
m : Weight (kg)
V : Cushion entry speed (m/s)
Va : Average speed (m/s)
L : Stroke length (m)
t : Moving time (s)
α : Load factor (%)

■ Table 5 Allowable absorbed energy value

Bore size	Allowable energy absorption (J)	
	MRL2	MRL2-G/W
ø6	0.006	0.12
ø10	0.028	0.12
ø16	0.100	0.25
ø20	0.265	0.58
ø25	0.283	0.74
ø32	0.523	0.74

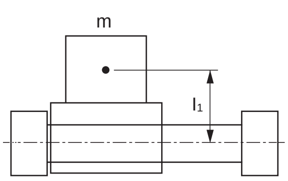
STEP-4 Confirmation of inertia load

Confirm that the weight (m), overhang (l_n (n = 1, 3)), and cushion entry speed (V) multiplied together and then divided by the value of A shown in the table below is less than or equal to 1.
When this value exceeds 1, increase the cylinder size so that this value becomes 1 or less or review the usage conditions.

Bore size	A	
	MRL2	MRL2-G/W
ø6	5.6	11.2
ø10	17	34
ø16	68	136
ø20	142	284
ø25	187	374
ø32	255	510

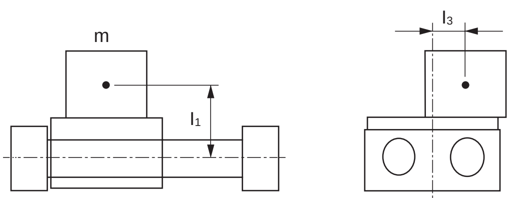
m : Weight (kg)
l_n (n = 1, 3) : Overhang (mm)
V : Cushion entry speed (m/s)

● MRL2



$$\frac{m \cdot l_1 \cdot V}{A} \leqq 1$$

● MRL2-G, MRL2-W

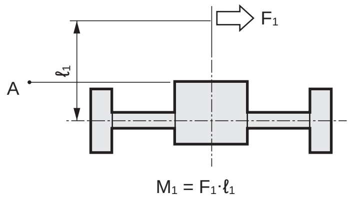


$$\frac{m \cdot (l_1 + l_3) \cdot V}{A} \leqq 1$$

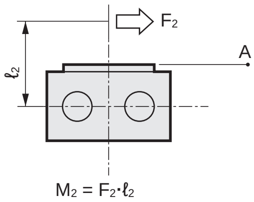
SCPD3
SCM
SSD2
MDC2
SMG
LCM
LCR
LCG
LCX
STM
STG
STR2
MRL2
GRC
Cylinder switch
MN3E MN4E
4GA/B
M4GA/B
MN4GA/B
F.R (module unit)
Clean F.R
Precision R
Press gauge Diff. press gauge
Electro-pneumatic R
Speed controller
Auxiliary valve
Fitting/ tube
Clean air unit
Pressure sensor
Flow rate sensor
Valve for air blow
Ending

MRL2-G/MRL2-W slider runout amount

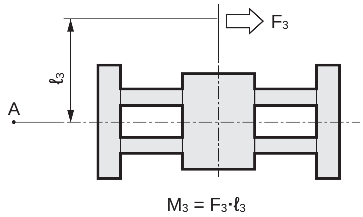
● Bending moment



● Radial moment



● Torsion moment



Port size	Moment load	Table runout amount at point A (± mm)		
	MRL2 MRL2-G, W	M1 direction	M2 direction	M3 direction
ø6	M1, M3: 0.2 N·m M2: 0.1 N·m	1.5	1.46	1.05
ø10	M1, M3: 0.6 N·m M2: 0.2 N·m	1.61	1.12	0.92
ø16	M1, M3: 2.5 N·m M2: 0.5 N·m	1.3	1.16	0.87
ø20	M1, M2, M3: 2.5 N·m	0.89	0.96	0.65
ø25	M1, M2, M3: 5 N·m	1.1	0.92	0.7
ø32	M1, M2, M3: 5 N·m	1.0	0.77	0.6

Note 1: Point A is a point that is 200 mm away from the center of the slider.

Rubber cushion and rubber-air cushion comparison data (reference values)

Measurement of the noise level (dB) generated when the piston collides at the end of the stroke length.

Measuring conditions

1. Sample cylinder : MRL2 basic stroke length 200 mm
2. Piston speed upon collision at end of stroke length : V = 300 mm/S
3. Distance between noise level meter and cylinder : 0.25 m
4. Load : No load

Representative example Unit: dB

Bore size	Rubber cushion	Rubber-air cushion
ø6	51.2	44.7
ø10	51.2	45.6
ø16	63.4	48.2
ø20	75.9	59.3