Shock Absorber: Short Type
Series RBQ

Allowable eccentric angle is 5°

Ideal for absorption of rotating energy

With bumper Series RBQC | **Basic type Series RBQ**

Specifications

Model / Specifications		RBQ1604 / RBQC1604	RBQ2007 / RBQC2007	RBQ2508 / RBQC2508	RBQ3009 / RBQC3009	RBQ3213 / RBQC3213
Max. energy absorption (J)		1.96	11.8	19.6	33.3	49.0
Stroke absorption (mm)		4	7	8	8.5	13
Collision speed (m/s)		0.05 to 3				
Max. operating frequency * (cycle/min)		60	60	45	45	30
Max. allowable thrust (N)		294	490	686	981	1177
Ambient temperature (C°)		–10 to 80				
Spring force (N)	Extended	6.08	12.75	15.69	21.57	24.52
	Retracted	13.45	27.75	37.85	44.23	54.23
Weight (g)		28	60	110	182	240
Option/Stopper nut		RBQ16S	RB20S	RBQ25S	RBQ30S	RBQ32S

∗ It denotes the values at the maximum energy absorption per one cycle. Therefore, the operating frequency can be increased according to the energy absorption.

How to Order

RBQ | **C** | **20** | **07** | ☐

Short type

Cushion

Nil	Basic type
C	With bumper

O.D. thread—Stroke absorption

Bumper cannot be mounted for basic type. Please place an order with bumper type from the beginning.

Option

Nil	None
S	With stopper nut
J	Add'l 1 of hex. nut (Total: 3 pcs. ∗)

Replacement part no./Bumper

RBQC | **16** | **C**

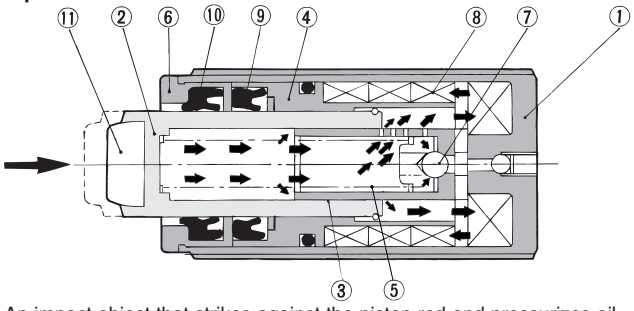
Applicable model — **Bumper**

16-RBQC1604
20-RBQC2007
25-RBQC2508
30-RBQC3009
32-RBQC3213

∗ 2 mounting hexagon nuts are attached as standard.

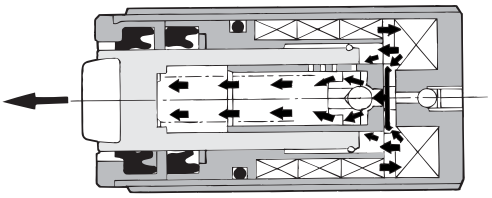
Construction

At impact



An impact object that strikes against the piston rod end pressurizes oil inside the piston. Thus, pressurized oil jets out through the orifice inside the piston, thereby generating hydraulic resistance to absorb the energy of the impacting object.
The oil jetted out through the orifice is collected inside the outer tube by means of the stretching action of the accumulator.

At returning



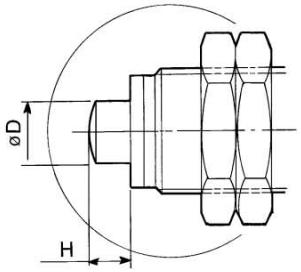
When the impact object is removed, the return spring pushes out the piston rod, and negative pressure, generated at the same time, opens the check ball to permit oil to return to the shock absorber ready for the next impact.

Component Parts

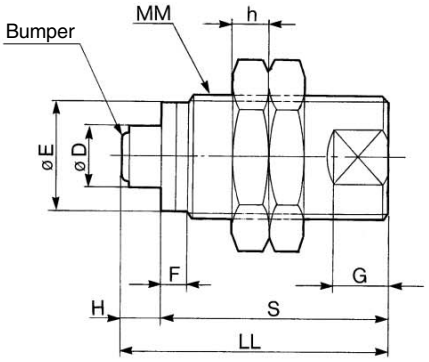
No.	Description	Material	Treatment
①	Outer tube	Rolled steel	Black nickel plated
②	Piston rod	Special steel	Heat treated, Hard chrome plated
③	Piston	Special steel	Heat treated
④	Bearing	Special bearing material	
⑤	Return spring	Piano wire	Zinc chromated
⑥	Stopper	Carbon steel	Zinc chromated

No.	Description	Material	Treatment
⑦	Check ball	Bearing steel	
⑧	Accumulator	Fluoro rubber	Foam rubber
⑨	Rod seal	NBR	
⑩	Scraper	NBR	
⑪	Bumper	Polyurethane	Only with bumper

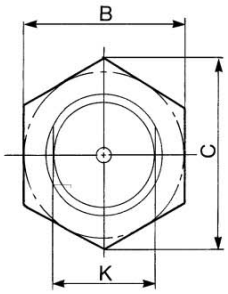
Dimensions



Series RBQ
Basic type



Series RBQC
With bumper

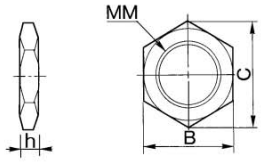


(mm)

Model		Shock absorber									Hexagon nut		
Basic type	With bumper	**D**	**E**	**F**	**H**	**K**	**G**	**LL**	**MM**	**S**	**B**	**C**	**h**
RBQ1604	**RBQC1604**	6	14.2	3.5	4	14	7	31	M16 x 1.5	27	22	25.4	6
RBQ2007	**RBQC2007**	10	18.2	4	7	18	9	44.5	M20 x 1.5	37.5	27	31.2	6
RBQ2508	**RBQC2508**	12	23.2	4	8	23	10	52	M25 x 1.5	44	32	37	6
RBQ3009	**RBQC3009**	16	28.2	5	8.5	28	12	61.5	M30 x 1.5	53	41	47.3	6
RBQ3213	**RBQC3213**	18	30.2	5	13	30	13	76	M32 x 1.5	63	41	47.3	6

Hexagon Nut

(2 pcs. standard equipment)



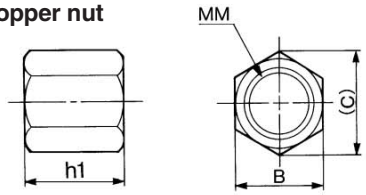
(mm)

Part no.	**MM**	**h**	**B**	**C**
RBQ16J	M16 x 1.5	6	22	25.4
RB20J (1)	M20 x 1.5	6	27	31.2
RBQ25J	M25 x 1.5	6	32	37
RBQ30J	M30 x 1.5	6	41	47.3
RBQ32J	M32 x 1.5	6	41	47.3

Note 1) In the case of RB20J, RB and RBQ are common.

Option

Stopper nut



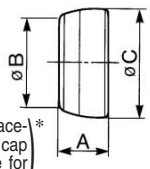
Material: Carbon steel (mm)

Part no.	**B**	**C**	**h1**	**MM**
RBQ16S	22	25.4	12	M16 x 1.5
RB20S (2)	27	31.2	16	M20 x 1.5
RBQ25S	32	37	18	M25 x 1.5
RBQ30S	41	47.3	20	M30 x 1.5
RBQ32S	41	47.3	25	M32 x 1.5

Note 2) In the case of RB20S, RB and RBQ are common.

Replacement Parts

Bumper



These are the replacement part for the cap type. Not available for the basic type. *

Material: Polyurethane (mm)

Part no.	**A**	**B**	**C**
RBQC16C	3.5	4	4.7
RBQC20C	4.5	8	8.3
RBQC25C	5	8.3	9.3
RBQC30C	6	11.3	12.4
RBQC32C	6.6	13.1	14.4

Series RBQ/Shock Absorber: Short Type
Technical Data:

Model Selection

Model Selection Step

1. Type of impact

- ■ Cylinder stroke at load (Horizontal)
- ■ Cylinder stroke at load (Downward)
- ■ Cylinder stroke at load (Upward)
- ■ Conveyor stroke at load (Horizontal)
- ■ Free dropping impact
- ■ Rotating impact (With torque)

2. Enumeration of operating conditions

Symbol	Operating conditions	Unit
m	Impacting object weight	kg
υ	Collision speed	m/sec
h	Dropping height	m
ω	Angle speed	rad/sec
r	Distance between axis of cylinder and impact point	m
d	Bore size	mm
p	Cylinder operation pressure	MPa
F	Thrust	N
T	Torque	N·m
n	Operation cycle	cycle/min
t	Ambient temperature	°C
μ	Friction coefficient	—

3. Specifications and operational instructions

Ensure that the collision speed, thrust, operation cycle, the ambient temperature and atmosphere fall within the specifications.

* Be aware of the min. installation radius in the case of rotating impacts.

4. Calculation of kinetic energy E_1

Using the equation suitable for the classification of impact.

In the case of cylinder stroke at load and free horizontal impact, substitute respective figures for **Data A** in order to calculate E_1.

5. Calculation of thrust energy E_2

Select any shock absorber as a provisional model.

In the case of thrust energy of cylinder E_2, substitute respective figures for **Data B** or **Data C**.

6. Calculation of corresponding weight of impacting object Me

Absorbed energy $E = E_1 + E_2$

Corresponding weight of impacting object $Me = \frac{2}{\upsilon^2} \cdot E$

Substitute both absorbed energy E and collision speed υ for **Data A** in order to calculate the corresponding weight of the impacting object.

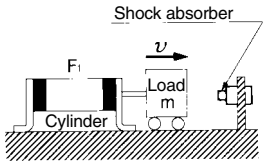
7. Selection of applicable model

Taking into consideration the corresponding weight of the impacting object Me, calculated using **Data D** and collision speed υ, check provisional model compatibility with the condition of application. If this is satisfactory, then the said provisional model will be the applicable one.

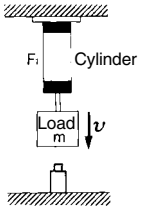
Caution on Selection

In order for the shock absorbers to operate accurately for long hours, it is necessary to select a model that is well-suited to your operating conditions. If the impact energy is smaller than **5%** of the maximum energy absorption, select a model that is one class smaller.

Selection Example

	Cylinder stroke at load (Horizontal)
1. Type of impact	
Collision speed (1) υ	υ
Kinetic energy E_1	$\frac{1}{2} \cdot m \cdot \upsilon^2$
Thrust energy E_2	$F_1 \cdot S$
Absorbed energy E	$E_1 + E_2$
Corresponding (2) **weight of impacting object Me**	$\frac{2}{\upsilon^2} \cdot E$
2. Operating conditions	m = 20 kg υ = 0.7 m/s d = 40 mm p = 0.5 MPa n = 20 cycle/min t = 25°C
3. Specifications and operational instructions	● **Confirmation of specifications** υ ··· 0.7 < 3 (max.) t ··· –10 (min.) < 25 < 80 (max.) F ··· F_1 ··628 < 686 (max.) **YES**
4. Calculation of kinetic energy E_1	● **Kinetic energy E_1** Use Formula to calculate E_1. Suitable 20 for m and 0.7 for υ. **$E_1 \cong 4.9$ J**
5. Calculation of thrust energy E_2	● **Thrust energy E_2** Provisionally select a model RBQ2508 and make the use of **Data B**. According to d = 40, E_2 is obtained. **$E_2 \cong 5.0$ J**
6. Calculation of corresponding weight of impacting object Me	● **Corresponding weight of impacting object Me** Use the formula "Absorbed energy E = E1 + E2 = 4.9 + 5.0 = 9.9 J" to calculate Me. Substitute 9.9 J for E and 0.7 for υ. **Me ≅ 40 kg**
7. Selection of applicable model	● **Selection of applicable model** According to **Data D**, the tentatively selected RBQ2508 satisfies Me = 40 kg < 60 kg at υ = 0.7. Ultimately, it will result in an operating frequency of n···30 < 45, without causing a problem. **YES** **Select RBQ2508**

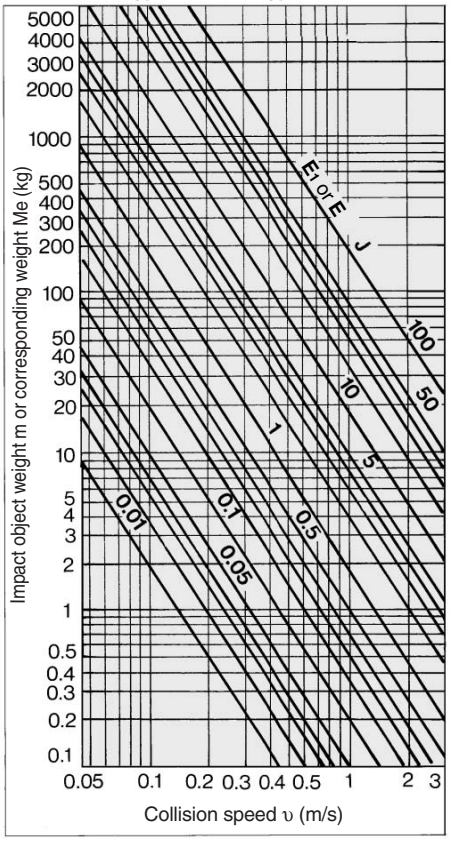
1. Type of Impact

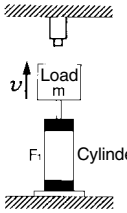
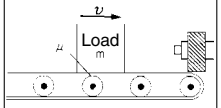
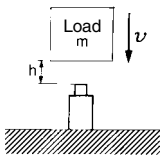
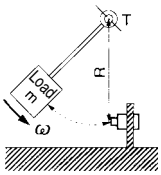
	Cylinder stroke at load (Downward)	
Type of impact		
Collision speed (1) υ	υ	
Kinetic energy E_1	$\frac{1}{2} \cdot m \cdot \upsilon^2$	
Thrust energy E2	$F_1 \cdot S + m \cdot g \cdot S$	
Absorbed energy E	$E_1 + E_2$	
Corresponding (2) **weight of impacting object Me**	$\frac{2}{\upsilon^2} \cdot E$	

Note 1) Collision speed is momentary velocity at which object is impacting against shock absorber.

Data A

Kinetic Energy E_1 or Energy Absorption E



	Cylinder stroke at load (Upward)	Conveyor stroke at load (Horizontal)	Free dropping impact	Rotating impact (Weight torque)
				
	υ	υ	$\sqrt{2gh}$	$\omega \cdot R$
	$\frac{1}{2} \cdot m \cdot \upsilon^2$	$\frac{1}{2} \cdot m \cdot \upsilon^2$	$m \cdot g \cdot h$	$\frac{1}{2} \cdot I \cdot \omega^2$
	$F_1 \cdot S - m \cdot g \cdot S$	$m \cdot g \cdot \mu \cdot S$	$m \cdot g \cdot S$	$T \cdot \frac{S}{R}$
	$E_1 + E_2$	$E_1 + E_2$	$E_1 + E_2$	$E_1 + E_2$
	$\frac{2}{\upsilon^2} \cdot E$	$\frac{2}{\upsilon^2} \cdot E$	$\frac{2}{\upsilon^2} \cdot E$	$\frac{2}{\upsilon^2} \cdot E$

Note 2) An "Impact body equivalent weight" is the weight of an impact object without involving thrust, into which an object's total energy has been converted.), refer to the catalog of rotary actuator. Hence, $E = \frac{1}{2} \cdot Me \cdot \upsilon^2$

Note 3) For the formula of moment of inertia I (kg·m²), refer to the catalog of rotary actuator.

Symbol

Symbol	Specifications	Unit
d	Bore size	mm
E	Absorbed energy	J
E_1	Kinetic energy	J
E_2	Thrust energy	J
F_1	Cylinder thrust	N
g	Acceleration of gravity (9.8)	m/s²
h	Dropping height	m
I (3)	Moment of inertia around the center of gravity	kg·m²
n	Operating frequency	cycle/min
p	Cylinder operation pressure	MPa
R	Distance between axis of cylinder and impact point	m
S	Shock absorber stroke	m
T	Torque	N·m
t	Ambient temperature	°C
υ	Collision speed	m/s
m	Impact object weight	kg
Me	Corresponding weight of impact object	kg
ω	Angle speed	rad/s
μ	Friction coefficient	—

Data B

(Operating pressure 0.5 MPa)

Thrust Energy of Cylinder $F_1 \cdot S$ (J)

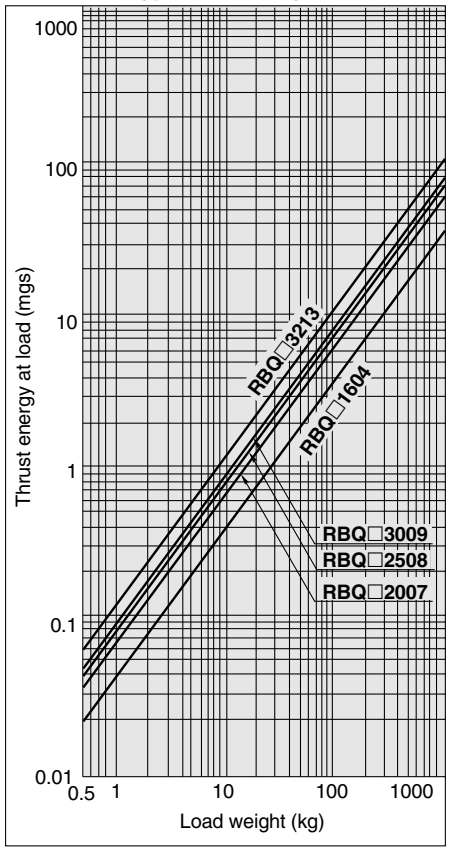
Bore size d (mm)	Model	RBQ□ 1604	RBQ□ 2007	RBQ□ 2058	RBQ□ 3009	RBQ□ 3213
	Stroke absorption (mm)	4	7	8	8.5	13
6		0.057	0.099	0.113	0.120	0.184
10		0.157	0.274	0.314	0.334	0.511
15		0.353	0.619	0.707	0.751	1.15
20		0.628	1.10	1.26	1.34	2.04
25		0.982	1.72	1.96	2.09	3.19
30		1.41	2.47	2.83	3.00	4.59
40		2.51	4.40	5.03	5.34	8.17
50		3.93	6.87	7.85	8.34	12.8
63		6.23	10.9	12.5	13.2	20.3
80		10.1	17.6	20.1	21.4	32.7
100		15.7	27.5	31.4	33.4	51.1
125		24.5	43.0	49.1	52.2	79.8
140		30.8	53.9	61.6	65.4	100
160		40.2	70.4	80.4	85.5	131
180		50.9	89.1	102	108	165
200		62.8	110	126	134	204
250		98.2	172	196	209	319
300		141	247	283	300	459

■ Operating pressure other than 0.5 MPa: Multiply by the following coefficient.

Operating pressure (MPa)	1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Coefficient	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8

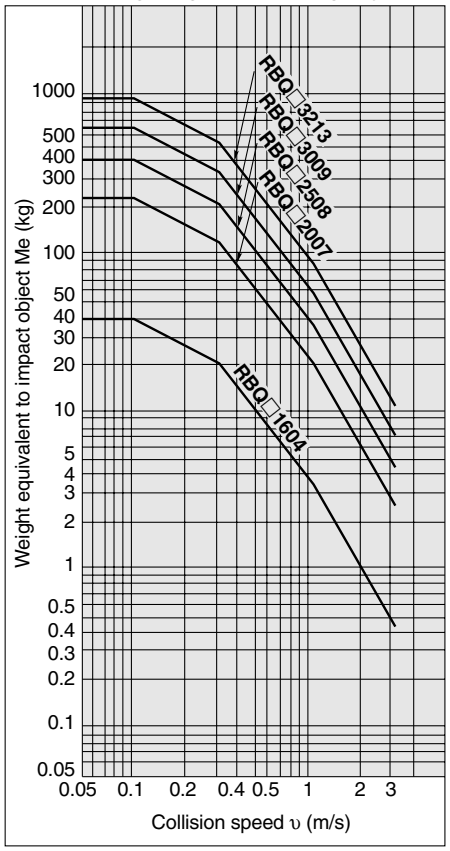
Data C

Thrust Energy at Load m·g·s



Data D

Corresponding Weight of Impacting Object Me



⚠ Precautions

Be sure to read before handling. Refer to pages 10-24-3 to 10-24-6 for Safety Instructions and Actuator Precautions.

Selection

⚠ Danger

1. Energy absorption
Select a model so that the aggregated energy of impact object should not exceed the maximum absorption energy. Otherwise, it could cause changes in properties or result in damaging the shock absorber.

2. Corresponding weight of impacting object
Make a model selection, so that the corresponding weight of impacting object does not exceed the allowable range. Pulsation will occur in buffer and deceleration force, thus making it difficult to absorb shock smoothly.

3. Collision speed
Use it in the conditions that collision speed is within the specified range. It could cause the changes in buffer characteristics or lead to damage a shock absorber.

⚠ Warning

1. Static load
Design the system, so that any other forces than the buffer capacity or impacts should not be applied to the piston rod which is stopped at the retracted state.

⚠ Caution

1. Maximum operating frequency
Design the system in the conditions under which it is not used at the frequency exceeding the specified maximum operating frequency. (But, the maximum operating frequency will vary depending on the absorbed energy.)

2. Stroke
The maximum absorption energy in the specifications cannot be exerted unless the full stroke is used.

3. Work surface of an impact object
The contact surface of the impact object with which the piston rod comes into contact must be highly rigid.
In the case without a cap, a high surface compression load is applied to the contact surface of the impact body with which the piston rod comes into contact. Therefore, the contact surface must be highly rigid (hardness of HRC35 or more).

4. Be aware of the return force of the impact object.
If used in a conveyor drive, after the shock absorber has absorbed energy, it could be pushed back by the spring that is built-in. For the spring force in the specifications, refer to the column (page 10-18-10).

5. Selection of size
As the number of operation proceeds, the maximum absorption energy of shock absorbers will be decreased by the following reasons such as abrasion, or deterioration, etc. of the internal working fluid. Taking this into consideration, selecting a size which is 20 to 40% affordable against the amount of absorption energy is recommended.

6. Drag characteristics
In general, the values of drag (reactive force generated during operation) generated by the operating speed will vary in hydraulic shock absorber. And then, by adopting “Porous orifice construction”, the RB series can adapt to such this fast/slow speed and can absorb shock smoothly in a wide range of speed.
But, the speed reduction (speed reduction G) would be larger around the stroke terminal, depending upon the operating conditions. Please note that it might be encountered that stroke time is long, motion is not smooth, etc. If this would be a problem, we recommend that stroke amount should be restricted by using our optional component like “Stopper nut”, etc.
Including this case, if the data on operational status (stroke time, reactive force, deceleration, etc.) are required, please consult with SMC.

Operating Environment

⚠ Danger

1. Operation in an environment which requires explosion-proof
- When mounting in places where static electricity is accumulated, implement a distribution of electrical energy by grounding.
- Do not use the materials for buffer face which might cause to spark by collision.

⚠ Warning

1. Pressure
Do not use it in the vacuum state, which is substantially different from the atmospheric pressure (above sea level) and in the atmosphere under being pressurized.

2. Using inside a clean room
Do not use the shock absorber in a clean room, as it could contaminate the clean room.

⚠ Caution

1. Temperature range
Do not use it, exceeding the specified allowable temperature range. Seal could be softened or hardened or worn out, or leading to leak a working fluid, deterioration, or impact characteristic changes.

2. Deterioration by atmosphere
Do not use in an atmosphere such as salt damage, sulfurous acid gas which makes the metal corroded, or having solvent, etc. which makes seal deteriorated.

3. Deterioration by ozone
Do not use it under the direct sunlight on the beach, or by the mercury lamp, or the ozone generator, because the rubber material will be deteriorated by ozone.

4. Cutting oil, water, blown dust
Do not use the product under the condition, where the liquid such as cutting oil, water, blown dust, solvent, etc. is exposed either directly or in atomized form to the piston rod, or where blown dust could be adhered around the piston rod. This could cause malfunction.

5. Vibration
When vibrations are applied on impact objects, implement a secure guide on impact objects.

Mounting

⚠ Warning

1. Before performing installation, removal, or stroke adjustment, make sure to cut the power supply to the equipment and verify that the equipment has stopped.

2. Installation of protective cover
We recommend the protective cover should be installed in the case workers might be getting close during the operation.

3. The rigidity of the mounting frame must be taken into consideration
If the mounting frame lacks strength, the shock absorber will vibrate after an impact, causing bearing wear and damage.
Load on mounting plate can be calculated as follows.

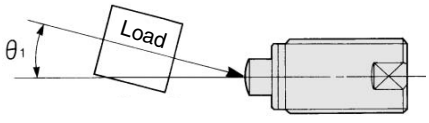
$$\text{Load on mounting plate} \quad N \cong 2\,\frac{E\ (\text{Absorbed energy J})}{S\ (\text{Stroke m})}$$

⚠ Warning

1. Tightening torque of mounting nut should be as follows.
When threading on a mounting frame in order to mount a shock absorber directly, prepared hole dimensions are referred to the table below.
For tightening torque of a nut for shock absorber, kindly abide by the table below.
If the tightening torque that is applied to the nut exceeds the value given below, the shock absorber itself could become damaged.

Model	RBQ(C)1604	RBQ(C)2007	RBQ(C)2508	RBQ(C)3009	RBQ(C)3213
O.D. thread (mm)	M16 x 1.5	M20 x 1.5	M25 x 1.5	M30 x 1.5	M32 x 1.5
Thread prepared bore (mm)	$\phi14.7\ ^{+0.1}_{0}$	$\phi18.7\ ^{+0.1}_{0}$	$\phi23.7\ ^{+0.1}_{0}$	$\phi28.7\ ^{+0.1}_{0}$	$\phi30.7\ ^{+0.1}_{0}$
Tightening torque (N·m)	14.7	23.5	34.3	78.5	88.3

2. Deviation of impact
The installation must be designed so that the impact body is perpendicular to the shock absorber's axial center. An angle of deviation that exceeds 5° will place an excessive load on the bearings, leading to oil leaks within a short period of operation.



Allowable eccentric angle $\theta_1 < 5°$

⚠ Precautions

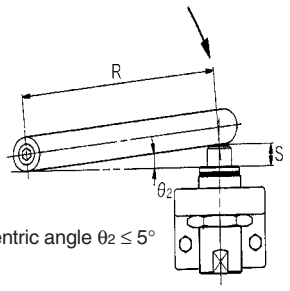
Be sure to read before handling. Refer to pages 10-24-3 to 10-24-6 for Safety Instructions and Actuator Precautions.

Mounting

3. Rotating angle

If rotating impacts are involved, the installation must be designed so that the direction in which the load is applied is perpendicular to the shock absorber's axial center.

The allowable rotating eccentric angle until the stroke end must be $\theta_2 \leq 5°$.



Allowable rotating eccentric angle $\theta_2 \leq 5°$

Installation Conditions for Rotating Impact (mm)

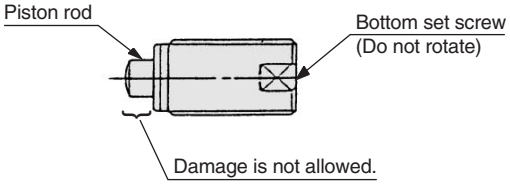
Model	S (Stroke)	θ_2 (Allowable rotating angle)	R (Min. installation radius)
RBQ□1604	4	5°	46
RBQ□2007	7		80
RBQ□2508	8		92
RBQ□3009	8.5		98
RBQ□3213	13		149

4. Do not scratch the sliding portion of the piston rod or the outside threads of the outer tube.

Failure to observe this precaution could scratch or gouge the sliding potion of the piston rod, or damage the seals, which could lead to oil leakage and malfunction. Furthermore, damage to outside threaded portion of the outer tube could prevent the shock absorber from being mounted onto the frame, or its internal components could deform, leading to a malfunction.

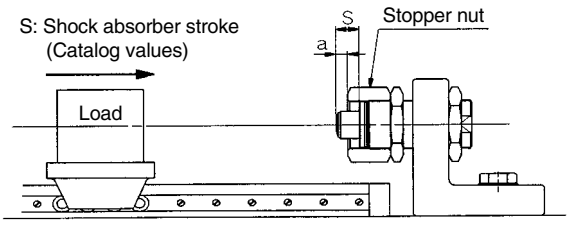
5. Never turn the screw on the bottom of the body.

This is not an adjusting screw. Turning it could result in oil leakage.



6. Adjust the stopping time through the use of the stopper nut, as follows:

Control the stopping time of the impact object by turning the stopper nut in or out (thus changing length "a"). After establishing the stopper nut position, use a hexagon nut to secure the stopper nut in place.



Maintenance

⚠ Caution

1. Check the mounting nut is not loosen.

The shock absorber could become damaged if it is used in a loose state.

2. Pay attention to any abnormal impact sounds or vibrations.

If the impact sounds or vibrations have become abnormally high, the shock absorber may have reached the end of its service life. If this is the case, replace the shock absorber. If use is continued in this state, it could lead to equipment damage.

3. Confirm that abnormality, oil leakage, etc. in the outward surface.

When a large amount of oil is leaking, replace the product, because it is believed to be happening something wrong with it. If it keeps on using, it may cause to break the equipment which is mounted by this product.

4. Inspect the bumper for any cracks or wear.

If the shock absorber comes with a bumper, the damper could wear first. To prevent bumper to the impact object, replace the bumper often.

5. How to replace bumper

The bumper inserted into the piston rod can be removed easily by a small screwdriver. When reassembling, push the smaller end of the bumper inside the piston.