NCK

Shock absorber/fixed

Related products

Overview

Compared to the SCK, the NCK shock absorber is the ideal buffering device for stopping a workpiece with thrust at medium or slow speeds. Slit orifice method that was thought difficult to realize is used. Due to this structure, high absorbing performance and linear soft stop, etc., are achieved in slow speed operation range. Furthermore, the compact, slim, space saving design contributes to the FA system configuration.

Features

Available for thrust energy

Absorbing thrust energy of cylinder, etc., is efficient. Very soft stopping is also achieved.

Smooth absorbing even if slowly operated

Superior characteristics in slow speed range enable smooth impact absorption.

Compact but large absorbing force

Compact and slim design which absorbs a lot of energy. This product is remarkably efficient at saving space.

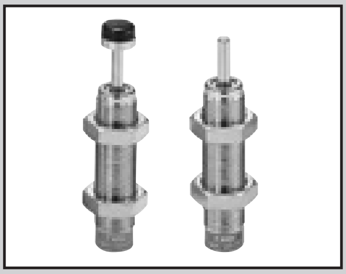
Simple mounting

Linear soft stop

Extensive models

8 types are available by absorbed energy. Select according to applications.

CONTENTS



Shock absorber

NCK Series

● Max. absorbed energy: 1 to 200 J

RoHS CAD

Specifications

Item		NCK							
Series		0.1	0.3	0.7	1.2	2.6	7	12	20
Type/Classification		Spring return without adjuster							
Max. energy absorption	J	1	3	7	12	26	70	120	200
O.D. thread size	mm	M8x0.75		M10x1.0	M12x1.0	M14x1.5	M20x1.5	M25x1.5	M27x1.5
Stroke	mm	4.5	6	8	10	15	20	25	30
Max. absorbed energy per hour	kJ/hr	4.8	6.3	12.6	21.6	39.0	84.0	86.4	108.0
Max. colliding speed	m/s	1.0	1.5		2.0		2.5	3.0	
Max. operating frequency	Cycle/min.	80	35	30		25	20	12	9
Ambient temperature	°C	-10 (14°F) to 80 (176°F)							
Max. load (resistance)	N	525	1150	2010	2750	4000	7980	10950	15380
Return time	S	0.3 or less					0.4 or less		0.5 or less
Weight	kg	0.009	0.012	0.02	0.04	0.07	0.2	0.3	0.45
Return spring force: When extended	N	2.9		2.0	2.9	5.9	9.8	16.3	
Return spring force: When compressed	N	4.5		4.3	5.9	11.8	21.6	33.3	33.9

Note: The speed and absorption capacity of the shock absorber vary depending on the ambient temperature. Values given in the above specifications are for room temperature.

How to order

NCK - 00 - 0.7 - N1

Ⓐ Mounting

Ⓑ Series

Ⓒ Option *1

Code	Description
Ⓐ Mounting	
00	Basic
FA	Flange
Ⓑ Series (max. energy absorption)	
0.1	1 J
0.3	3 J
0.7	7 J
1.2	12 J
2.6	26 J
7	70 J
12	120 J
20	200 J
Ⓒ Option	
Blank	Standard
N1	With stop nut
C	Capped

⚠ Precautions for model No. selection

*1: 3 hexagon nuts are provided for N1 specifications products.

[Example of model No.]

NCK-00-0.7-N1

Model: Shock absorber

Ⓐ Mounting : Basic
Ⓑ Series : Max. energy absorption 7 J
Ⓒ Option : With stop nut

How to order options

● Flange bracket (1 pc.)

NCK - 0.7 - FA

● Stop nut + hexagon nut (each 1 pc.)

NCK - 0.7 - N1

● Hexagon nut (1 pc.)

NCK - 0.7 - NT

Code	Series (max. energy absorption)
0.1	1 J
0.3	3 J
0.7	7 J
1.2	12 J
2.6	26 J
7	70 J
12	120 J
20	200 J

Specifications for rechargeable battery (Catalog No. CC-1226A)

NCK - ··· - P4*

● Design compatible with rechargeable battery manufacturing process

* Contact CKD for details.

Operational explanation

(1) Collision
When the workpiece collides with the piston rod, the oil in the tube pushed by the piston is simultaneously pressurized. The pressurized oil passes through grooves on CKD's original slit orifice, and flows toward the oil chamber with an air chamber. The piston is further pressed in by cylinder thrust or workpiece weight, etc., but the area of the slit orifice gradually decreases, so that even higher resistance is generated. These series of operations are done continuously to stop the workpiece smoothly.

(2) Return
When released from the workpiece, the piston returns with the integrated spring. At this time it moves from the seal to the valve stopper, so that the oil return flow path is opened by the cutoff section on the piston. Oil passes through this flow path and the slit orifice and returns to the state before the workpiece collided. In this state, the system is on standby for the next workpiece collision.

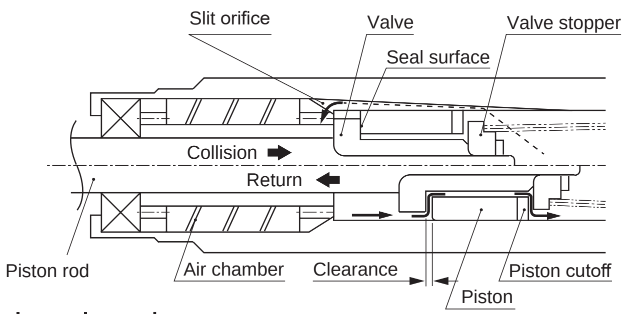
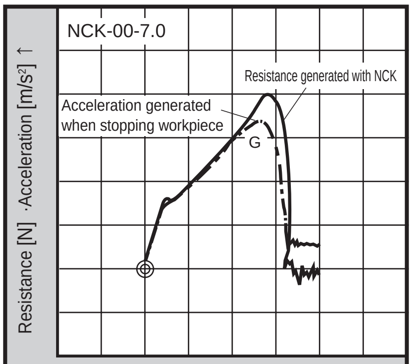
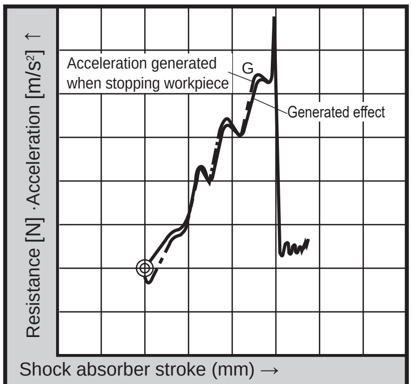


Fig. 1



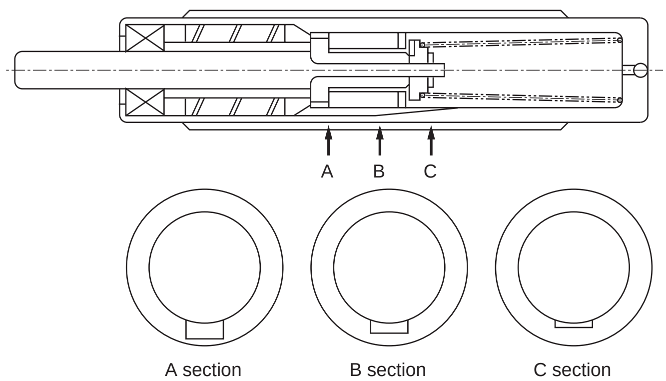
● Characteristic wave form of slit orifice integrated with NCK Series

Fig. 2

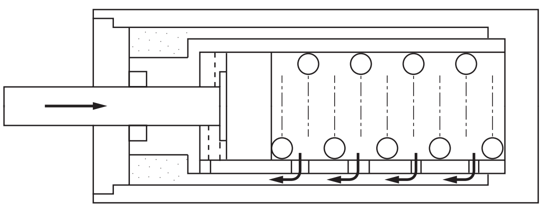


● Characteristic waveform attained with conventional porous orifice

Structural explanation

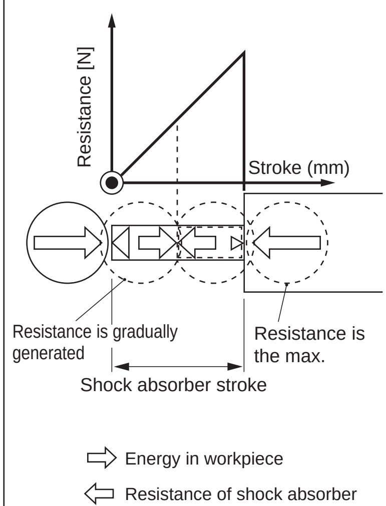


1. The slit orifice smoothly changes (decreases) as the piston moves as shown above.
This structure enables an ideal "stop" when used with a hydraulic damper, but as manufacturing is difficult, it has not been integrated in other brands. CKD has handled this tough issue with linear stopping performance as shown in Fig.1.



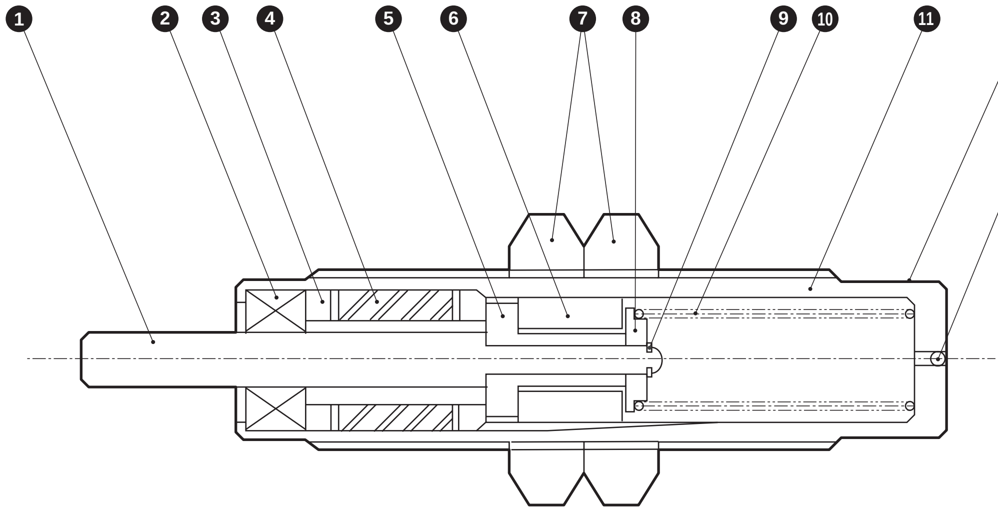
2. Generally, the dual tube shown above is used for the orifice area as a structure that changes with piston movement. Multiple small orifice holes in the inner pipe are closed as the piston moves. In this structure, performance via hole positioning precision is greatly affected, and resistance changes with each orifice, preventing smooth operation as shown in Fig. 2.

⦿: Indicates point where workpiece contacts end of shock absorber.

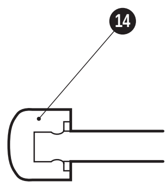


Internal structure and parts list

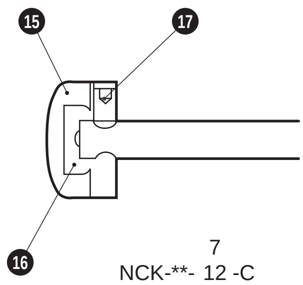
- Basic (without cap)



- Capped



0.1
0.3
NCK-**- 0.7 -C
1.2
2.6



7
NCK-**- 12 -C
20

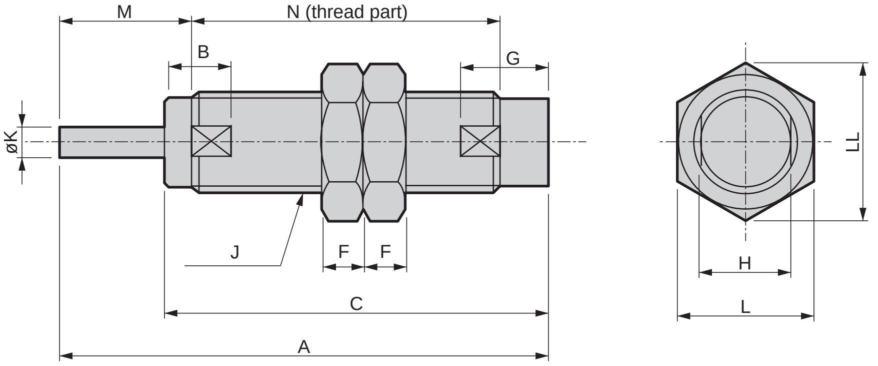
Cannot be disassembled

Parts list

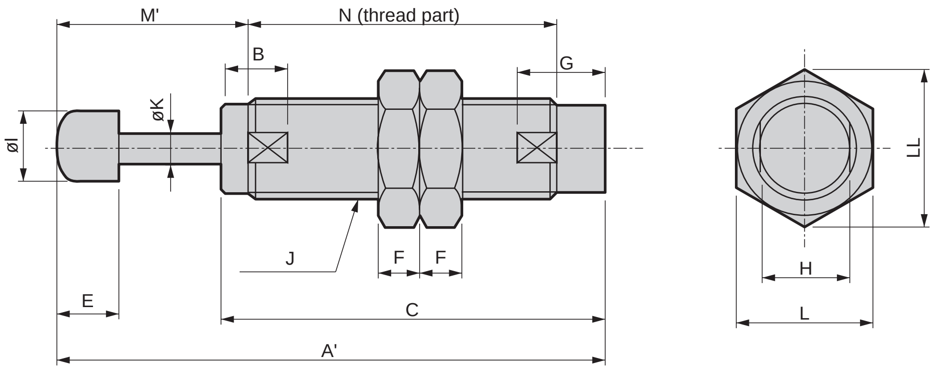
No.	Part name	Material	Remarks
1	Rod	Steel	Industrial chrome plating
2	Oil seal	Special nitrile rubber	
3	Rod guide	Copper alloy	
4	Air chamber	Nitrile rubber	
5	Valve	Steel	
6	Piston	Cast iron	
7	Hexagon nut	Steel	Zinc plated
8	Valve stopper	Steel	
9	E type snap ring	Steel for spring	Zinc plated
10	Spring	Piano wire	
11	Damper case	Steel	Chrome plating
12	Label	Polyester film	
13	Ball	Alloy steel	
14	Damper cushion	Polyamide resin	Black
15	Damper cushion	Polyester resin	Black
16	Cushion stopper	Steel	Zinc plated
17	Hexagon socket set screw	Steel	

Dimensions

● Standard (NCK-**-**)



● Capped (NCK-**-**-C)

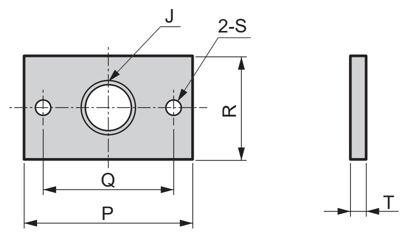


Code	Basic (00)														
Model No.	A	A'	B	C	E	F	G	H	I	J	K	L	LL	M	M'	N
NCK-00-0.1	34.5	40.5	4	29.5	6	4	7.5	7	6	M8x0.75	2.8	12	13.9	6	12	23
NCK-00-0.3	45.5	51.5	7.5	39	6	4	8	7	6	M8x0.75	2.8	12	13.9	11	16.5	29.0
NCK-00-0.7	50	57	7.5	41.5	7	4	9	9	8	M10x1.0	3	14	16.2	13	20	31
NCK-00-1.2	57.5	65	8.5	47	7.5	5	11	11	10	M12x1.0	3.5	17	19.6	15	22.5	35.5
NCK-00-2.6	86	96	10.5	70.5	10	5.5	14	13	12	M14x1.5	5	19	21.9	20	30	58
NCK-00-7	98.5	109.5	12.5	78	11	8	18	19	16	M20x1.5	6	27	31.2	25	36	63.5
NCK-00-12	129	142	15.5	103.5	13	10	23	24	22	M25x1.5	8	32	37	30	43	87
NCK-00-20	141	154	15.5	110.5	13	10	25	24	22	M27x1.5	8	32	37	35	48	92

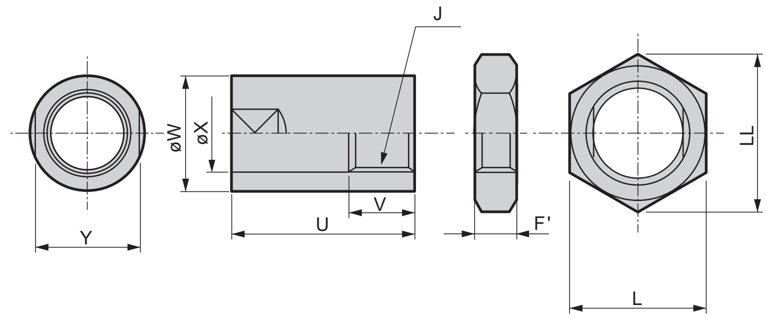
Dimensions: Option [flange (mounting bracket)]

● NCK- 0.1 / 0.3 / 0.7 / 1.2 -**

Flange (FA)
Material: Steel

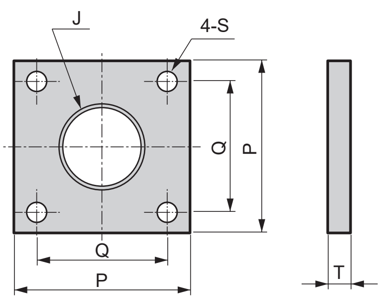


Stop nut (N1)
Material: Steel

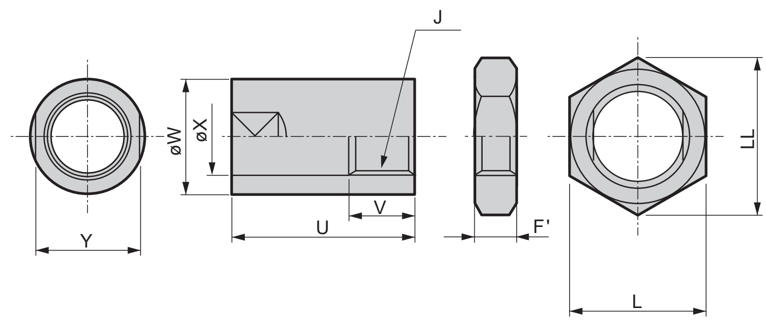


● NCK- 2.6 / 7 / 12 / 20 -**

Flange (FA)
Material: Steel



Stop nut (N1)
Material: Steel



Code / Model No.	Flange (FA) J	P	Q	R	S	T	Weight (g)	Stop nut (N1) F'	J	U	V	W	X	Y	Weight (g)
NCK-0.1-**	M8x0.75	42	30	20	5.5	2.3	14	4	M8x0.75	15	8	14	9	12	13
NCK-0.3-**	M8x0.75	42	30	20	5.5	2.3	14	4	M8x0.75	15	8	14	9	12	13
NCK-0.7-**	M10x1.0	42	30	20	5.5	2.3	14	4	M10x1.0	17	10	15	11	13	15
NCK-1.2-**	M12x1.0	46	34	20	5.5	3.6	22	5	M12x1.0	23	10	19	13	17	34
NCK-2.6-**	M14x1.5	52	38	-	6.5	6	115	5.5	M14x1.5	26.5	10	20	15	17	37
NCK-7-**	M20x1.5	52	38	-	6.5	6	108	8	M20x1.5	36.5	15	26	21	24	77
NCK-12-**	M25x1.5	52	38	-	6.5	6	100	10	M25x1.5	35	15	32	26	30	112
NCK-20-**	M27x1.5	52	38	-	6.5	6	100	10	M27x1.5	45.5	15	35	28	32	155

Shock absorber selection guide (1)

SCP*3
CMK2
CMA2
SCM
SCG
SCA2
SCS2
CKV2
CAV2/ COVP/N2
SSD2
SSG
SSD
CAT
MDC2
MVC
SMG
MSD/ MSDG
FC*
STK
SRL3
SRG3
SRM3
SRT3
MRL2
MRG2
SM-25
ShkAbs
FJ
FK
Spd Contr
Ending

1 Clarify the colliding pattern of the device

Horizontal motion
- a. Simple horizontal collision
- b. Collision with cylinder thrust
- c Collision with drive force of motor

Vertical motion
- d. Collision due to free fall
- e. Collision with cylinder thrust (downward)
- f. Collision with cylinder thrust (upward)

Slope motion
- g. Collision due to free sliding
- h. Collision with cylinder thrust (downward)
- i. Collision with cylinder thrust (upward)

Oscillation/rotation motion
- j. Collision due to free oscillating fall
- k. Colliding with torque of motor, etc., (oscillation)
- l. Colliding with torque of motor, etc., (rotation)

Note:Refer to "Example of colliding pattern".

2 Make required conditions/descriptions clear to calculate energy

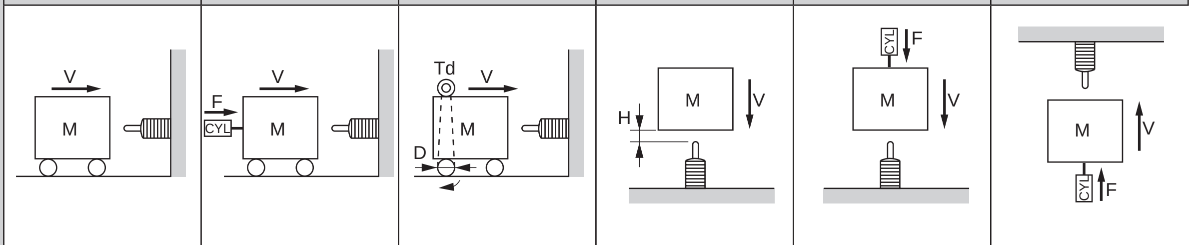
E = all absorbed energy (J)
E_1 = kinetic energy (J)
E_2 = thrust/self-weight energy (J)

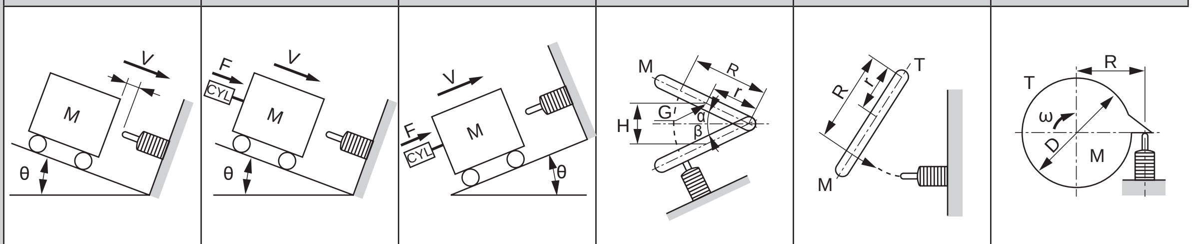
L = colliding object travel distance (m) (Slope free fall)
R = distance from center of rotation to colliding point (m)
r = distance from center of rotation to center of gravity (m)
G = position of center of gravity

M = colliding weight (kg)
V = colliding speed (m/s)
S = NCK stroke (m)
F = pushing force (N)
g = gravity acceleration 9.8 m/s^2
ω = angular speed (rad/s)
J = moment of inertia (kg/m^2)
D = diameter (m)
N = number of rotations (rpm)
Me = equivalent weight (kg)

H = drop height (m)
T = torque (N·m)
Td = motor start torque (N·m)
K = reduction ratio
θ, α, β = tilt angle (deg)

Example of colliding pattern

	Horizontal colliding			Vertical colliding		
	a. Simple horizontal collision	b. Pushing force of cylinder applies	c. Pushing force of motor applies	d. Free fall	e. Cylinder lower limit stopper	f. Cylinder upper limit stopper
Applications						
Kinetic energy E_1(J)	$\frac{1}{2}\cdot M\cdot V^2$	$\frac{1}{2}\cdot M\cdot V^2$	$\frac{1}{2}\cdot M\cdot V^2$	$\frac{1}{2}\cdot M\cdot V^2$	$\frac{1}{2}\cdot M\cdot V^2$	$\frac{1}{2}\cdot M\cdot V^2$
Thrust/self-weight energy E_2(J)	-------	F·S	$2\cdot\frac{K}{D}\cdot Td\cdot S$	M·g·S	(M·g+F)·S	(F-M·g)·S
All absorbed energy E (J)	$E=E_1$	$E=E_1+E_2$	$E=E_1+E_2$	$E=E_1+E_2$	$E=E_1+E_2$	$E=E_1+E_2$
Equivalent weight Me(kg)	Me=M	$Me=\frac{2\cdot E}{V^2}$	$Me=\frac{2\cdot E}{V^2}$	$Me=\frac{2\cdot E}{V^2}\ (V=\sqrt{2\cdot g\cdot H})$	$Me=\frac{2\cdot E}{V^2}$	$Me=\frac{2\cdot E}{V^2}$

	Slope colliding			Oscillation colliding		Rotation colliding
	g. Free fall	h. Pushing force of cylinder applies	i. When thrust of cylinder is applied	j. Free fall	k. Torque of motor, etc., applies	L. Torque of motor, etc., applies
Applications						
Kinetic energy E_1(J)	$\frac{1}{2}\cdot M\cdot V^2$	$\frac{1}{2}\cdot M\cdot V^2$	$\frac{1}{2}\cdot M\cdot V^2$	M·g·H	$\frac{J\cdot\omega^2}{2}$ or $\frac{1}{2}\cdot M\cdot V^2$	$\frac{J\cdot\omega^2}{2}=\frac{M\cdot D^2\cdot\omega^2}{16}$
Thrust/self-weight energy E_2(J)	M·g·S·sinθ	(M·g·sinθ+F)·S	(F-M·g·sinθ)·S	$\frac{r}{R}\cdot M\cdot g\cdot S$	$\frac{T}{R}\cdot S$	$\frac{T}{R}\cdot S$
All absorbed energy E (J)	$E=E_1+E_2$	$E=E_1+E_2$	$E=E_1+E_2$	$E=E_1+E_2$	$E=E_1+E_2$	$E=E_1+E_2$
Equivalent weight Me(kg)	$Me=\frac{2\cdot E}{V^2}\ (V=\sqrt{2\cdot g\cdot L\cdot\sin\theta})$	$Me=\frac{2\cdot E}{V^2}$	$Me=\frac{2\cdot E}{V^2}$	$Me=\frac{2\cdot E}{V^2}\ (V=\frac{R}{r}\sqrt{\frac{3\cdot g\cdot H}{2}})$	$Me=\frac{2\cdot E}{V^2}\ (V=\omega\cdot R)$	$Me=\frac{2\cdot E}{V^2}\ (V=\omega\cdot R,\ \omega=\frac{2\pi\cdot N}{60})$

3 Check shock absorber specifications range

a. Max. repeating cycle [cycle/min.]
b. Max. colliding speed [m/s]
c. Ambient temperature [°C]
d. Return time [s]

Note: Value of allowable energy absorption may vary depending on colliding speed. Refer to Graph 5 on page 1829.

4 Calculate actual energy per "Example of colliding pattern"

● Explanation of code

E = all absorbed energy J

E_1 = kinetic energy J

E_2 = thrust/self-weight energy J

a. Kinetic energy ……………… Calculate the E_1 value according to "Example of colliding pattern".

b. Thrust/self-weight energy … Calculate the value of E_2 according to "Example of colliding pattern". For S (stroke of NCK) in the formula, select a model whose max. absorbed energy exceeds E_1, and use S for that model No.

c. Total absorbed energy …… If after that the calculation result exceeds Emax (max. energy absorption), select one size larger NCK than the previously selected model No., and recalculate. If calculated E is lower than Emax selected model No., the selection is acceptable.

5 Confirm the equivalent weight

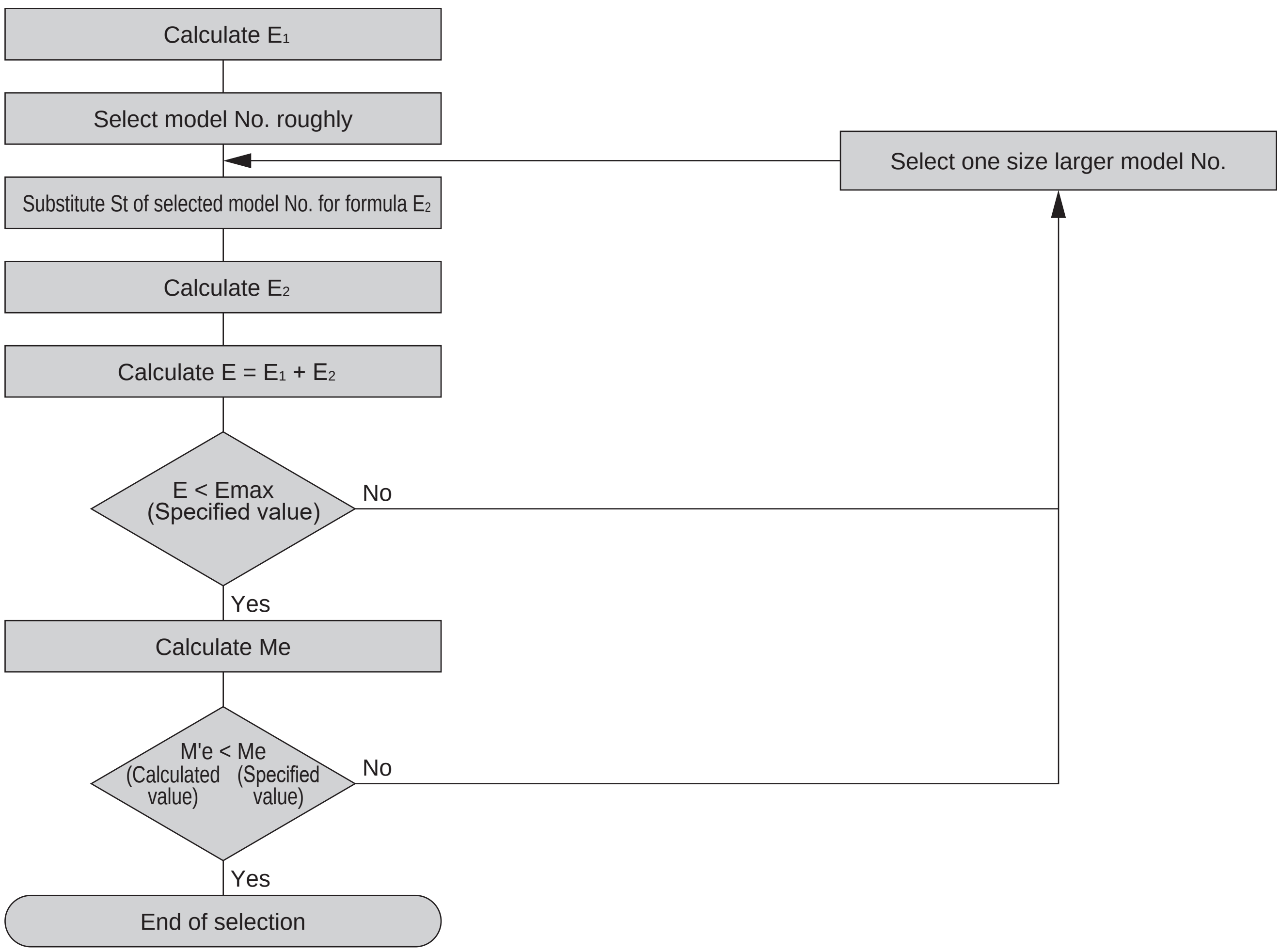
Me = Equivalent weight [kg]

Note: Equivalent weight corresponds to weight of workpiece, even for body moving with thrust, etc., if it is assumed that all of them are kinetic energy only. If only the energy formula is used, load is restricted by the equivalent weight, because the weight of workpiece will increase sharply in low speed operations.

a. Calculate value of Me according to "Example of colliding pattern".
b. Usable if Me is within Me range of selected model (calculated value of Me < specified value of Me) according to calculation of Me (catalog value) and "a" for model No. selected at 4.
c. When exceeding the Me range of the selected model at b, select an NCK one size larger, and check conditions in the same manner.

Note) Equivalent weight (Me) is listed on page 1829 (Graph 4).

6 Calculation flow chart of step 4 and 5



Shock absorber selection guide (2)

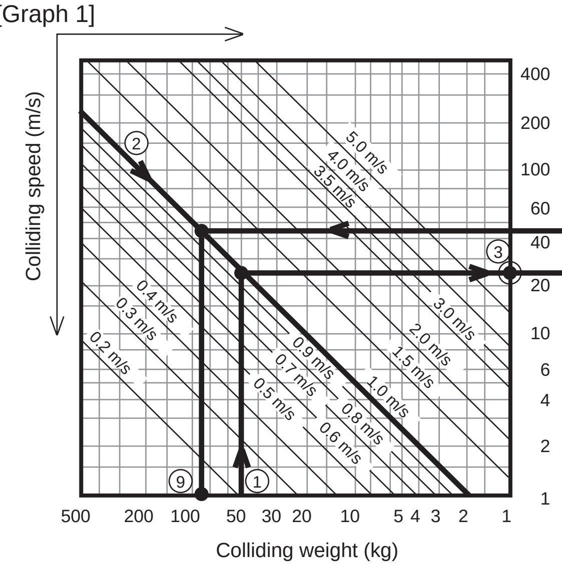
Shock absorber models can be selected either entirely by calculation, as in (1), or through the graph. If not required to grasp energy values, etc., during calculation, if this graph is used, proper model can be selected efficiently.

Condition of this figure: Horizontal colliding with thrust
m=50 kg, V=1.0 m/s
Cylinder bore size ø50
Supply pressure = 0.5 MPa

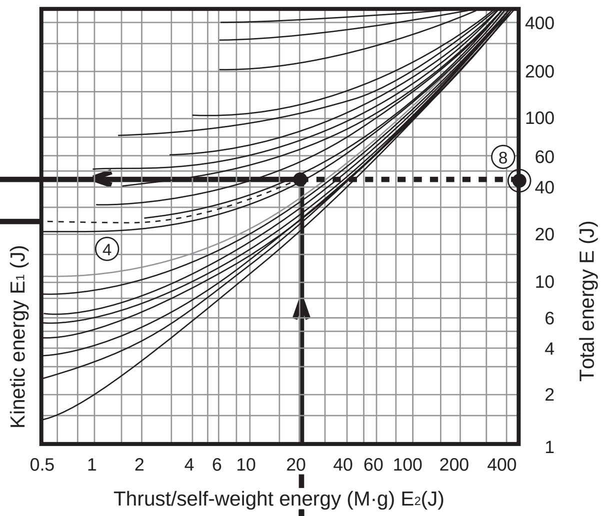
Energy calculation graph

● Thrust applies at the horizontal collision

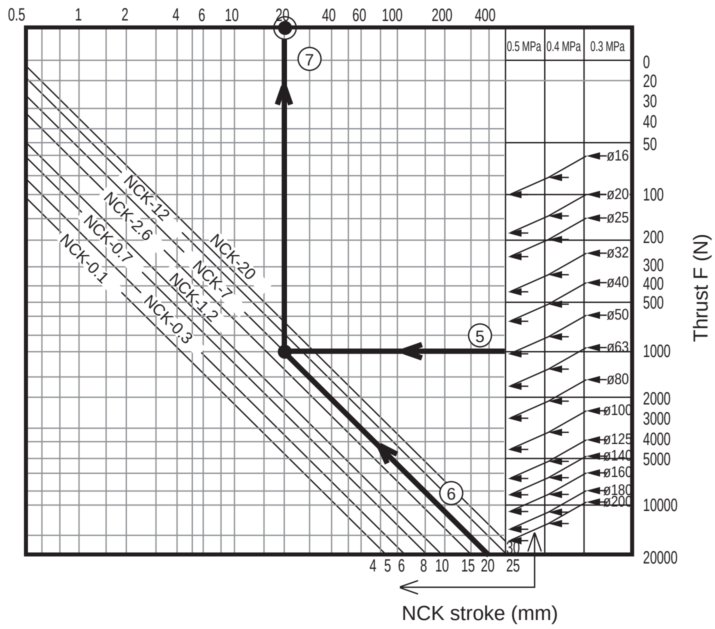
[Graph 1]



[Graph 2]



[Graph 3]

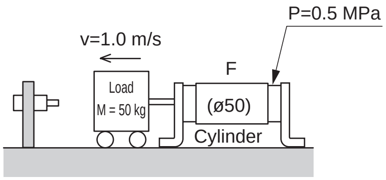


a) Determine the colliding weight M (kg)...①
b) Collision speed V (m/s) ... ②
c) Point of intersection between M and V ③ is kinetic energy E_1 (J). ... ③
d) Extend ③ to [Graph 2], and refer to the curve in the figure to draw a similar curve. (dotted line) ... ④
e) Next, if thrust applies, determine thrust F (N) (from bore and pressure of cylinder) by the right end chart of [Graph 3] ... ⑤
f) Determine model No. of NCK according to stroke and max. energy absorption. ... ⑥
(Select a model No. whose max. energy absorption exceeds E_1 calculated in step ③.)
g) The point of intersection between F and NCK model No. ⑦ shows the thrust/self-weight energy E_2 (J). ... ⑦
h) Extend point Ⓑ to [Graph 2], and point of intersection ⑧ with curve ④ shows total energy E (= E_1 + E_2) (J). ... ⑧
Here, if value E exceeds the selected NCK Emax (max. absorbed energy) at (f), select an NCK model No. one size larger again, and then find E with the same procedure.
i) Here, if "Ⓒ" and ⑧ are extended to [Graph 1], the point of intersection ⑨ with V (m/s) represents the equivalent weight Me. ... ⑨
Check that equivalent weight is within the specified value range [Graph 4].
(When Me exceeds specifications values, return to (f) and repeat the same procedures.)

Example of selection

Select shock absorber according to example.

Example Select shock absorber which stops load M smoothly under left figure conditions.



Frequency: 10 cycle/min.
(Refer to equipment indoors.)

1 The colliding pattern of the device is equivalent to "b".

2 Summarize required conditions to calculate.

a. Colliding object weight	M=50 kg
b. Colliding speed	V=1.0 m/s
c. Cylinder thrust	$F=\pi/4 \times 50^2$ mm$\times$0.5 MPa=981.7 N

3 Check specifications.

a. Frequency 10 cycles/min.	NG, since max. repeating cycle of NCK-20 is 9 cycle/min. [limited to models of NCK-12 and below]
b. Colliding speed 1.0 m/s..........	All models are available
c. Ambient temperature: Indoor equipment	All models are available
d. Return time: Not specified......	All models are available

4 Calculate actual energy.

● From pattern figure example "b"

a. Kinetic energy: $E_1 = \frac{1}{2} \cdot m \cdot V_2 = \frac{1}{2} \times 50$ (kg) x 1.0^2 (m/s) = 25 (J)
Here, since as with E_1 alone this was 25 J, NCK-2.6 [Emax = 26 J] (St = 15 mm) is provisionally selected.

b. Thrust energy: E_2 = FxS = 981.7 (N) 0.015 (m) = 14.7 (J)

c. Total absorbed energy: E = E_1 + E_2 = 25 (J) +14.7(J) = 39.7(J)
Recalculate with one size larger NCK-7, since this E = 39.7 (J) cannot be absorbed with the NCK-2.6 provisionally selected earlier.

b'. E_2 = FxS = 981.7 (N) 0.02 (m) = 19.6 (J)

c'. E = E_1 + E_2 = 25 (J) +19.6(J) = 44.6(J)
Proceed to confirmation of the colliding object equivalent weight as this E = 44.6 (J) can be absorbed by NCK-7.

5 Confirm the equivalent weight.

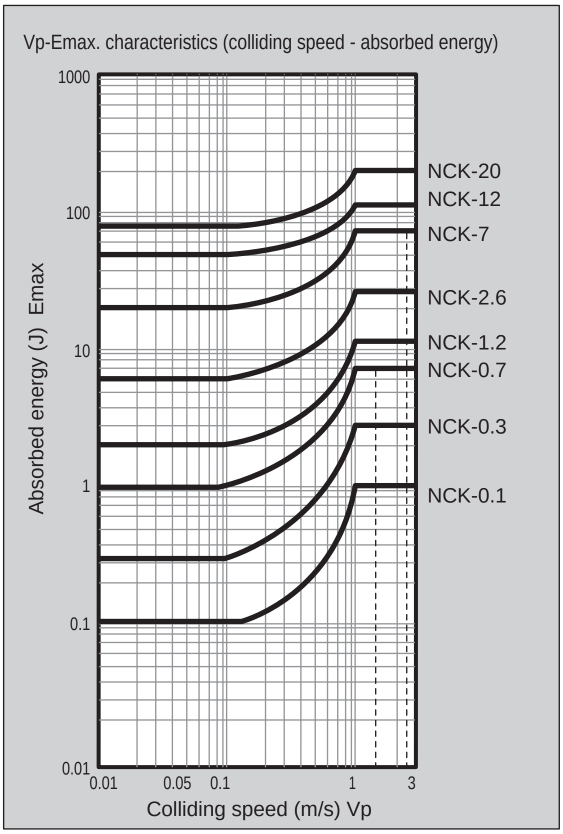
● From pattern figure example "b" the same as 4

a. Equivalent weight Me = $\frac{2 \cdot E}{V^2} = \frac{2 \times 44.6\ [J]}{1.0^2\ [m/s]}$ = 89.2 kg

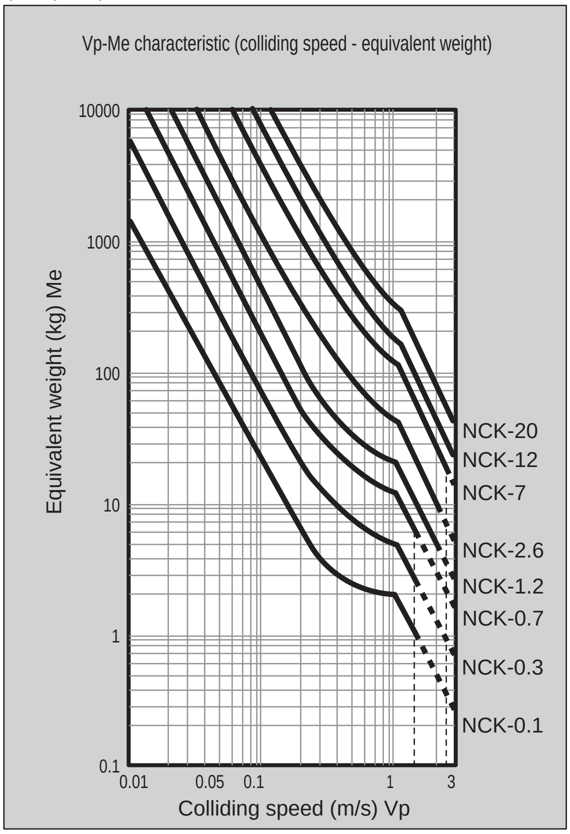
b. NCK-7 Me is 150 (kg), larger than the calculated equivalent weight. Therefore, use NCK-7 under these conditions.

Rush speed characteristics graph of equivalent weight/absorbed energy

(Graph 5)



(Graph 4)



SCP*3
CMK2
CMA2
SCM
SCG
SCA2
SCS2
CKV2
CAV2/ COVP/N2
SSD2
SSG
SSD
CAT
MDC2
MVC
SMG
MSD/ MSDG
FC*
STK
SRL3
SRG3
SRM3
SRT3
MRL2
MRG2
SM-25
ShkAbs
FJ
FK
Spd Contr
Ending