

Shock Absorbers Hydraulic Buffers

SHREE SAI TECH,

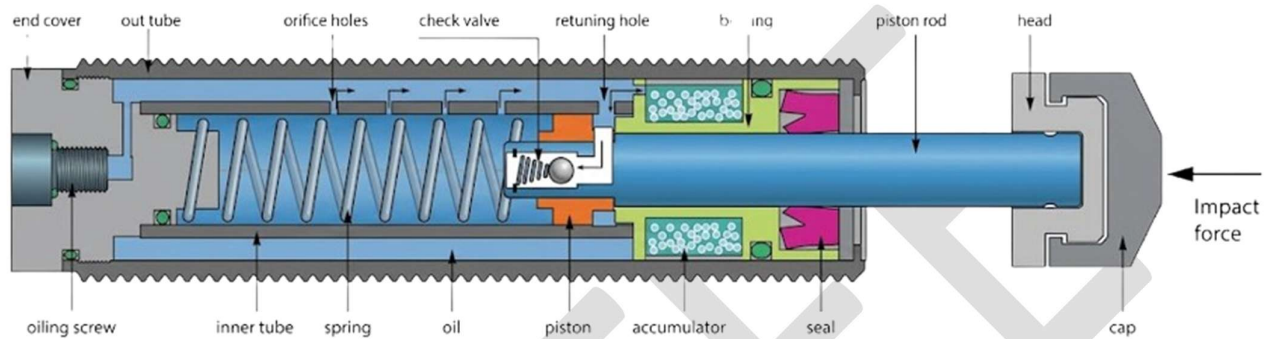
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Principle of self-compensation series: -

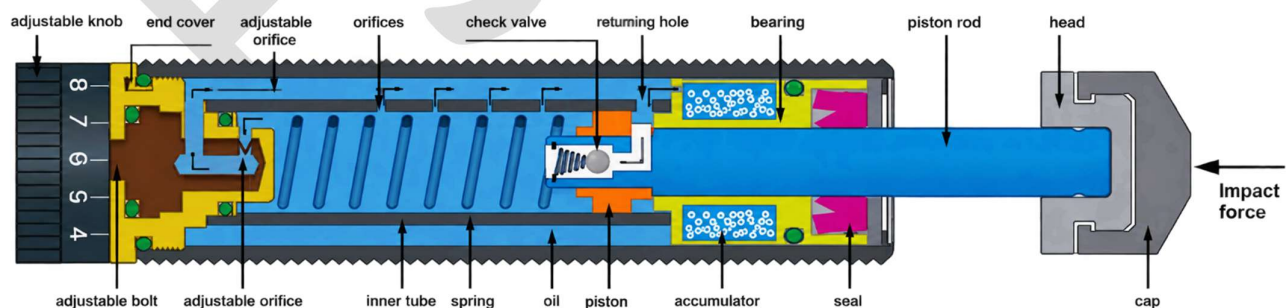
When an object impacts on the shock absorber unit, it will drive the in-piston rod - pressing the oil to pass through the orifices of the inner tube resulting the soft stop for the moving object.

After the object is retracted, the inner spring pushes the piston rod return to its original position and ready for next cycle.



Principle of adjustable series: -

The basic principle of the adjustable one is the same as the non-adjustable one, except that there is adjustable device for the area of the orifices. These are two types of adjustable one: Single orifice adjustable and multi-orifice adjustable. The figure above is the single orifice adjustable. By rotating the adjustable knob with 0-8 scale, the adjustable bolt is drive to rotate. When it is adjustable to 0, the orifice is fully open, and then the shock absorber is “the softest”; when it is adjustable to 8, the orifice is completely closed, and then the buffer is “the hardest”, and the orifice area continuously smaller from 0 to 8. The structure of multi-orifices adjustable one is relatively complex.



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How to Order for example AC2016-2CN

AC		20	16	2	C	N			
Thread or diameter		Thread or diameter		Impact velocity		Other		Impact head	
AC	Self-compensation series	4	M4*05	Blank	Standard	Blank	Standard	Blank	With cap
AD	Adjustable series	6	M6*0.75	1	High speed	S	-S series	N	Without cap
ACY	-A self-Compensation series	8	M8*1.0 or M8*0.75	2	Middle speed	C	Compact series	F	Steel cap
ADJ	-A Adjustable series	10	M10*1.0	3	Low speed	E	One orifice or one adjustable orifice		
ACD	Double acting series	12	M12*1.0	4	Lower speed	K	-K Hight energy		
ZC	For stop air cylinder, non-adjustable	14	M14*1.5 or M14.1	5	Low speed for AD series	D	High energy		
FC	For stop air cylinder, adjustable	16	M16*1.5 or M16.1			W	Adjust at side		
ZD	For stop air cylinder, adjustable	20	M20*1.5			B	Inch thread		
DC	For circuit breaker, non-adjustable	24	Ø24			M	-M series		
DD	For circuit breaker, adjustable	25	M25*1.5						
	For circuit breaker, adjustable	27	M27*1.5 or M27*3.0						
	Hydraulic speed controllers	30	M30*1.5						
		33	M33*1.5						
		36	M36*1.5						
		42	M42*1.5						
		42	M45*1.5						
		64	M62*2 or 2 1/2-12UNF						
		85	M85*2						



Selection table: shock absorbers Vs air cylinder diameter

Cylinder I.D	Ø6	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32	Ø40	Ø50	Ø63	Ø80	Ø100	Ø125	Ø160	Ø200	Ø250
force (kgf) pressure (5kg/cm ²)	1.4	3.9	5.7	10	15.7	24.5	40	62.8	98	155	251	393	613	1005	1570	2454
AC0404	●	●														
AC0604	●	●	●													
AC0806		●	●	●												
AC1005		●	●	●												
AC1007		●	●	●												
AC1008		●	●	●	●											
AC1210			●	●	●											
AC1215			●	●	●											
AC1415/ AC1612			●	●	●											
AC1416/ AC1616			●	●	●	●										
AC1420/ AC1620			●	●	●	●										
AC1425/ AC1625			●	●	●	●										
AC2016/ AC2015				●	●	●	●									
AC2020				●	●	●	●	●								
AC2025/ AC2030				●	●	●	●	●								
AC2040				●	●	●	●	●	●							
AC2050				●	●	●	●	●	●							
AC2525/ AC2725						●	●	●	●	●	●					
AC2530/ AC2750						●	●	●	●	●	●					
AC2580						●	●	●	●	●	●					
AC3035								●	●	●	●	●				
AC3325/ AC3625								●	●	●	●	●				
AC3350/ AC4525								●	●	●	●	●	●			
AC3660								●	●	●	●	●	●			
AC4225/ AC4525									●	●	●	●	●	●		
AC4250/ AC4550									●	●	●	●	●	●	●	
AC4275/ AC4575									●	●	●	●	●	●	●	
AC64100												●	●	●	●	
AC64150												●	●	●	●	●

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Cylinder I.D	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32	Ø40	Ø50	Ø63	Ø80	Ø100	Ø125	Ø160	Ø200	Ø250
force (kgf) pressure (5kg/cm ²)	3.9	5.7	10	15.7	24.5	40	62.8	98	155	251	393	613	1005	1570	2454
AD0806	●	●	●												
AD1007	●	●	●												
AD1210		●	●	●	●										
AD1410		●	●	●	●	●									
AD1412/AD1612			●	●	●	●									
AD1416/AD1616			●	●	●	●									
AD1420/AD1620			●	●	●	●									
AD1425/AD1625			●	●	●	●									
AD2016/AD2020				●	●	●	●								
AD2025				●	●	●	●								
AD2030				●	●	●	●								
AD2040				●	●	●	●	●							
AD2050				●	●	●	●	●							
AD2525/AD2725					●	●	●	●	●						
AD2530					●	●	●	●	●						
AD2540						●	●	●	●						
AD2550/AD2750						●	●	●	●						
AD2580						●	●	●	●						
AD3035						●		●	●						
AD3325/AD3625							●	●	●	●	●				
AD3350/AD3650							●	●	●	●	●				
AD4225/AD4525								●	●	●	●	●			
AD4250/AD4550								●	●	●	●	●			
AD4275/AD4575								●	●	●	●	●			
AD64050											●	●	●	●	
AD64100											●	●	●	●	
AD64150											●	●	●	●	●
AD85050												●	●	●	●
AD85090												●	●	●	●
AD85125												●	●	●	●
AD85165												●	●	●	●

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1. Definitude Device Colliding Model



2. The Necessary Items In Energy Calculating

E=Total energy (Nm)	F=Force (N)	θ, α, β =Slope angle (deg)	ω =Speed of angle (rad/s)
E1=Kinetic energy (Nm)	g=Acceleration of gravity (9.8m/s ²)	L=Colliding matter moving distance (m)	J=Inertia moment (kg · m ²)
E2=Work energy (Nm)	H=Falling height (m)	Slope free fall	D=Diameter (m)
M=Colliding mass (kg)	T=Rorsion (N · m)	R=Distance from circumgyrating center to colliding point (m)	N=Circumgyrating number (rpm)
V=Colliding speed (m/s)	Td=Rorsion when motor starts	r=Distance from circumgyrating center to the center of gravity (m)	Me=Effective weight (kg)
S=Stroke (m)	K=Deceleration	G=Center of gravity place colliding model	P=pressure
C=Times/hr	Eh=energy Per Hour	μ =friction Coefficient	

Colliding Mode Cutline

	Plane colliding			Vertical colliding		
	Simple plane colliding	With cylinder's thrust	With motor's thrust	Free falling	Cylinder lower limiter	Cylinder upper limiter
Examples in using						
Kinetic energy E _k (Nm)	$\frac{1}{2} \cdot M \cdot V^2$	$\frac{1}{2} \cdot M \cdot V^2$	$\frac{1}{2} \cdot M \cdot V^2$	$\frac{1}{2} \cdot M \cdot V^2$	$\frac{1}{2} \cdot M \cdot V^2$	$\frac{1}{2} \cdot M \cdot V^2$
Work energy E _s (Nm)	-	F · S	$2 \cdot \frac{K}{D} \cdot T \cdot g \cdot S$	M · g · S	(M · g + F) · S	(F - M · g) · S
Total energy E (Nm)	E = E _k	E = E _k + E _s	E = E _k + E _s	E = E _k + E _s	E = E _k + E _s	E = E _k + E _s
Effective Weight Me (Kg)	Me = M	$Me = \frac{2 \cdot E}{V^2}$	$Me = \frac{2 \cdot E}{V^2}$	$Me = \frac{2 \cdot E}{V^2} + \sqrt{3 \cdot g \cdot h}$	$Me = \frac{2 \cdot E}{V^2}$	$Me = \frac{2 \cdot E}{V^2}$

	Slope colliding			Shake colliding	Circumgyrate colliding	
	Free falling	When cylinder pressure existing	When cylinder pressure existing	Free falling	Torsion of motor etc.	Torsion of motor etc.
Examples in using						
Kinetic energy E _k (Nm)	$\frac{1}{2} \cdot M \cdot V^2$	$\frac{1}{2} \cdot M \cdot V^2$	$\frac{1}{2} \cdot M \cdot V^2$	M · g · H	$\frac{J \cdot \omega^2}{2} + \frac{1}{2} \cdot M \cdot V^2$	$\frac{J \cdot \omega^2}{2} + \frac{M \cdot D^2 \cdot \omega^2}{2}$
Work energy E _s (Nm)	M · g · S · sinθ	(M · g + sinθ · F) · S	(F - M · g · sinθ) · S	$\frac{F}{R} \cdot M \cdot g \cdot S$	$\frac{T}{R} \cdot S$	$\frac{T}{R} \cdot S$
Total energy E (Nm)	E = E _k + E _s	E = E _k + E _s	E = E _k + E _s	E = E _k + E _s	E = E _k + E _s	E = E _k + E _s
Effective Weight Me (Kg)	$Me = \frac{2 \cdot E}{V^2} \cdot \sqrt{3 \cdot g \cdot (L - \sin\theta)}$	$Me = \frac{2 \cdot E}{V^2}$	$Me = \frac{2 \cdot E}{V^2}$	$Me = \frac{2 \cdot E}{V^2} \cdot \sqrt{\frac{R}{V} \cdot \frac{3 \cdot g \theta + H}{2}}$	$Me = \frac{2 \cdot E}{V^2} \cdot \sqrt{V \cdot \omega - R}$	$Me = \frac{2 \cdot E}{V^2} \cdot \sqrt{V \cdot \omega \cdot R \cdot \frac{2 \cdot \omega \cdot N}{V}}$

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3. Confirming The Relative Items The Bound Of The specification Of Shock Absorber

- | | |
|-----------------------------------|---------------------------|
| a) Energy absorbing per hour [Nm] | c) Temperature) [°C] |
| b) Maximum colliding speed [m/s] | d) Reverting time) [t] |

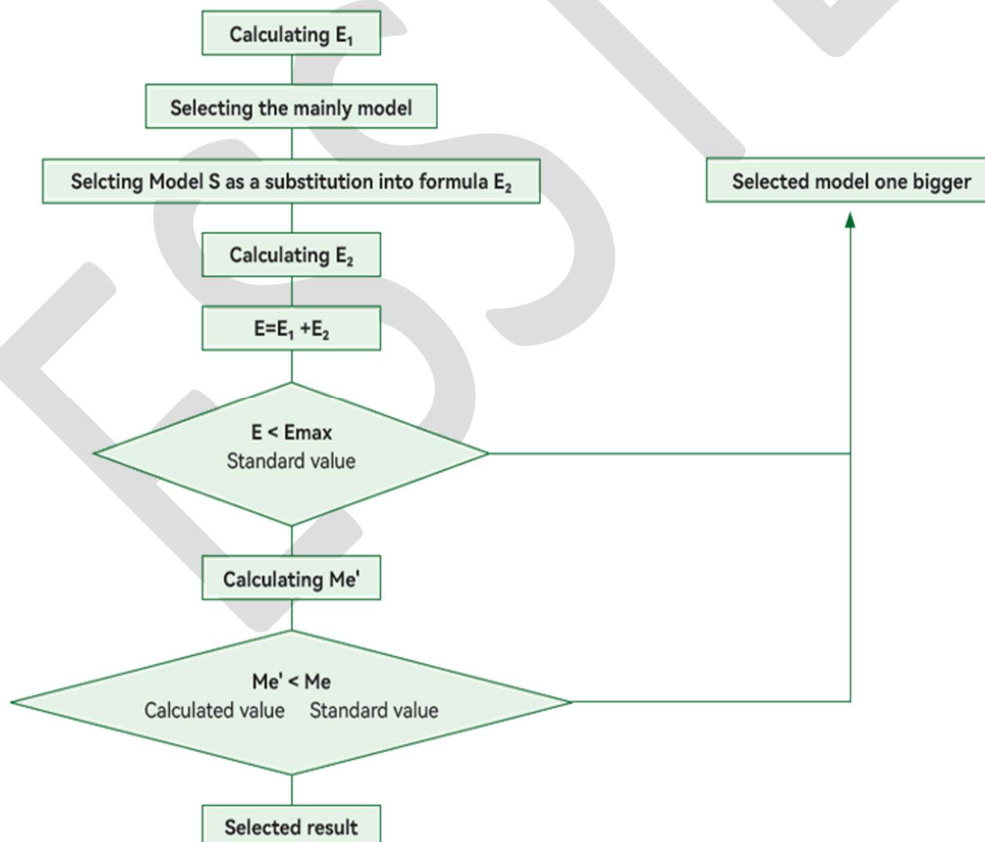
4. To Calculate The Fact Energy By Colliding Model Outline

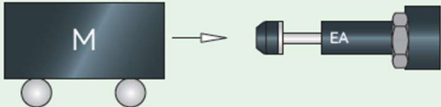
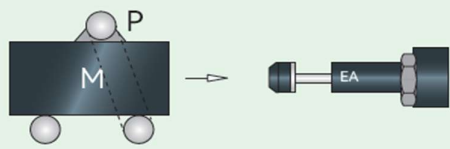
- 1) E_1 Kinetic energy To calculate the value of E_1 , by colliding model outline.
- 2) E_2 Work energy To calculate the value of E_2 , by colliding model outline.
- 3) E Total energy Then, if the calculating result is more than E_{max} , selecting the other model that bigger than before and re-calculating. Getting E 's value by calculating, re-selected model, if it is under E_{max} will be ok.

5. Confirming About Colliding Matter Of Effective Weight

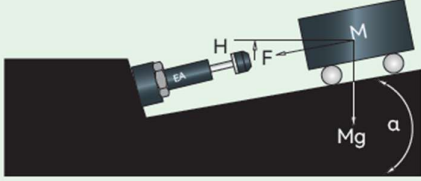
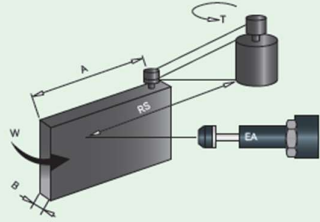
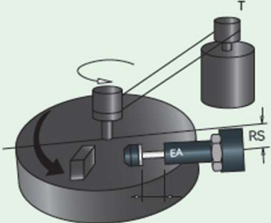
- 1) To calculate the Me 's value by colliding model outline.
- 2) We can select the conform Me with this term by selected Model 4, corresponding Me (specimen value) and the result of a. It can be used if the conform Me with this term by selected Me . (i.e.calculate value $Me < specification value Me$)
- 3) Please use bigger shock absorber if it exceeds the bound of selected Me by b, and remember to confirm them before using.

6. Flow Chart About Model Selection



COMPUTE EXAMPLE 1: horizontal impact	use condition	expressions and result
	$m=300\text{kg}$ $v=1.0\text{m/s}$ $s=0.04\text{m}$ $c=300/\text{hr}$	$E_1 = \frac{mv^2}{2} = \frac{300 \cdot 1.0^2}{2} = 150\text{Nm}$ $E = E_1 = 150\text{Nm}$ $E_h = E \cdot C = 150 \cdot 300 = 45000\text{Nm/hr}$ $M_e = \frac{2E}{V^2} = \frac{2 \cdot 150}{1.0^2} = 300\text{kg}$ According to specifications table you can use the shock absorber AD3650
COMPUTE EXAMPLE 2: horizontal impact having thrust	use condition	expressions and result
	$m=300\text{kg}$ $V=1.2\text{m/s}$ $s=0.05\text{m}$ $p=40\text{N/cm}^2$ $d=100\text{mm}$ $c=300/\text{hr}$	$E_1 = \frac{mv^2}{2} = \frac{300 \cdot 1.2^2}{2} = 216\text{Nm}$ $E_2 = F \cdot S = 0.00785 \text{Pd}^2 \cdot S$ $= 0.00785 \cdot 40 \cdot 100^2 \cdot 0.05 = 157\text{Nm}$ $E = E_1 + E_2 = 216 + 157 = 373\text{Nm}$ $E_h = E \cdot C = 373 \cdot 300 = 111900\text{Nm/hr}$ $M_e = \frac{2E}{V^2} = \frac{2 \cdot 373}{1.2^2} = 518\text{kg}$ According to specifications table you can use the shock absorber AD4250
COMPUTE EXAMPLE 3: free whereabouts	use condition	expressions and result
	$m=40\text{kg}$ $H=0.4\text{m}$ $s=0.06\text{m}$ $c=200/\text{hr}$	$V = \sqrt{2g \cdot h} = \sqrt{2 \cdot 9.8 \cdot 0.4} = 2.8\text{m/sec}$ $E_1 = \frac{mv^2}{2} = \frac{40 \cdot 2.8^2}{2} = 157\text{Nm}$ $E_2 = F \cdot s = mg \cdot s = 40 \cdot 9.8 \cdot 0.06 = 23.5\text{Nm}$ $E = E_1 + E_2 = 157 + 23.5 = 180.5\text{Nm}$ $E_h = E \cdot C = 180.5 \cdot 200 = 36100\text{Nm/hr}$ $M_e = \frac{2E}{V^2} = \frac{2 \cdot 180.5}{2.8^2} = 46\text{kg}$ According to specifications table you can use the shock absorber AD3650
COMPUTE EXAMPLE 3: free whereabouts having thrust	use condition	expressions and result
	$m=40\text{kg}$ $H=0.3\text{m}$ $s=0.025\text{m}$ $p=5\text{bar}$ $d=50\text{mm}$ $c=200/\text{hr}$ $v=1.0\text{m/sec}$	$E_1 = \frac{mv^2}{2} = \frac{40 \cdot 1.0^2}{2} = 20\text{Nm}$ $E_2 = F \cdot S = (mg + 0.0785 \text{Pd}^2) \cdot S$ $= (40 \cdot 9.8 + 0.0785 \cdot 5 \cdot 50^2) \cdot 0.025 = 33.5\text{Nm}$ $E = E_1 + E_2 = 20 + 33.5 = 53.5\text{Nm}$ $E_h = E \cdot C = 53.5 \cdot 200 = 10700\text{Nm/hr}$ $M_e = \frac{2E}{V^2} = \frac{2 \cdot 53.5}{1.0^2} = 107\text{kg}$ According to specifications table you can use the shock absorber AD2525
COMPUTE EXAMPLE 1: horizontal impact of motor drive	use condition	expressions and result
	$m=400\text{kg}$ $V=1.0\text{m/s}$ $KW=1.5\text{KW}$ $HM=2.5$ $S=0.075\text{m}$ $c=60/\text{hr}$	$E_1 = \frac{mv^2}{2} = \frac{400 \cdot 1.0^2}{2} = 200\text{Nm}$ $E_2 = F \cdot S = \frac{KW \cdot HM}{V} \cdot S = \frac{1500 \cdot 2.5}{1.0} \cdot 0.075 = 281\text{Nm}$ $E = E_1 + E_2 = 200 + 281 = 481\text{Nm}$ $E_h = E \cdot C = 481 \cdot 60 = 28860\text{Nm/hr}$ $M_e = \frac{2E}{V^2} = \frac{2 \cdot 481}{1.0^2} = 962\text{kg}$ According to specifications table you can use the shock absorber AD4275



COMPUTEEXAMPLE 6: gradient impact	use condition	expressions and result
	$m=150\text{kg}$ $H=0.3\text{m}$ $s=0.075\text{m}$ $\alpha=30^\circ$ $c=200/\text{hr}$	$V = \sqrt{2gH} = \sqrt{2 \cdot 9.8 \cdot 0.3} = 2.43\text{m/sec}$ $E_2 = F \cdot S = m \cdot g \cdot s \cdot \sin \alpha = 150 \cdot 9.8 \cdot 0.075 \cdot \sin 30^\circ = 55.2\text{Nm}$ $E = E_1 + E_2 = 443 + 55.2 = 498.2\text{Nm}$ $E_h = E \cdot C = 498.2 \cdot 200 = 99640\text{Nm/hr}$ $Me = \frac{2E}{V^2} = \frac{2 \cdot 498.2}{2.43^2} = 168.7\text{kg}$
According to specifications table you can use the shock absorber AD4275		
COMPUTE EXAMPLE 7: horizontal revolving door	use condition	expressions and result
	$m=20\text{kg}$ $\omega=2.0\text{rad/s}$ $T=20\text{Nm}$ $R_s=0.8\text{m}$ $A=1.0\text{m}$ $B=0.05\text{m}$ $S=0.016\text{m}$ $C=100/\text{hr}$	$J = \frac{m(4A^2 + B^2)}{12} = \frac{20(4 \cdot 1.0^2 + 0.05^2)}{12} = 6.67\text{kg} \cdot \text{m}^2$ $E_1 = \frac{J\omega^2}{2} = \frac{6.67 \cdot 2.0^2}{2} = 13.34\text{Nm}$ $\theta = \frac{S}{R_s} = \frac{0.04}{0.8} = 0.05\text{rad}$ $E_2 = T \cdot \theta = 20 \cdot 0.05 = 1.0\text{Nm}$ $E = E_1 + E_2 = 13.34 + 1.0 = 14.34\text{Nm}$ $E_h = E \cdot C = 14.34 \cdot 100 = 1434\text{Nm/hr}$ $v = \omega \cdot R_s = 2.0 \cdot 0.8 = 1.6\text{m/s}$ $Me = \frac{2E}{V^2} = \frac{2 \cdot 14.34}{1.6^2} = 11.2\text{kg}$
According to specifications table you can use the shock absorber AD2016		
COMPUTE EXAMPLE 8: revolving dial having thrust	use condition	expressions and result
	$m=200\text{kg}$ $\omega=1.0\text{rad/s}$ $T=100\text{Nm}$ $R=0.5\text{m}$ $R_s=0.4\text{m}$ $S=0.04\text{m}$ $C=100/\text{hr}$	$J = \frac{mR^2}{12} = \frac{200 \cdot 0.5^2}{12} = 25\text{kg} \cdot \text{m}^2$ $E_1 = \frac{J\omega^2}{2} = \frac{25 \cdot 1.0^2}{2} = 12.5\text{Nm}$ $\theta = \frac{S}{R_s} = \frac{0.04}{0.8} = 0.1\text{rad}$ $E_2 = T \cdot \theta = 100 \cdot 0.1 = 10\text{Nm}$ $E = E_1 + E_2 = 12.5 + 10 = 22.5\text{Nm}$ $E_h = E \cdot C = 22.5 \cdot 100 = 2250\text{Nm/hr}$ $v = \omega \cdot R_s = 1.0 \cdot 0.4 = 0.4\text{m/s}$ $Me = \frac{2E}{V^2} = \frac{2 \cdot 22.5}{0.4^2} = 281\text{kg}$
According to specifications table you can use the shock absorber AD4250		

