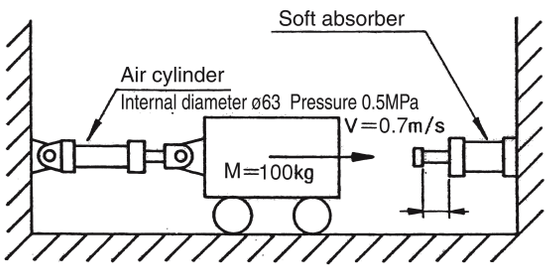
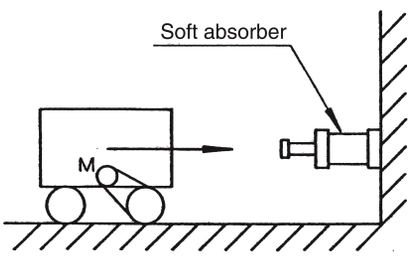
Soft Silent Safety

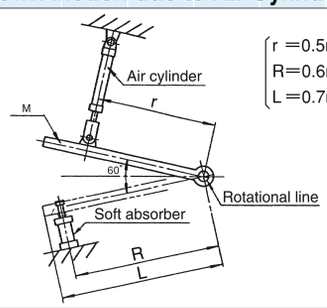
Sample Calculations for Selecting Soft Absorbers 1

	1. Thrusting Motion due to Air Cylinder Thrust	2. Thrusting Energy due to Motor-Driven Dolly
Case Examples		
Specifications	☐Mass of the colliding object M : 100kg ☐Impact rate V : 0.7m/s ☐Operation frequency C : 1 time/min ☐Ambient temperature T : 0~25°C ☐Thrust F : Varies with the air cylinder Cylinder diameter···63mm Air pressure···0.5MPa ☐Number of soft absorber receivers N : 1 unit	☐Mass of the colliding object M : 1500kg ☐Impact rate V : 0.5m/s ☐Operation frequency C : 1 time/min ☐Ambient temperature T : 0~25°C ☐Thrust F : Varies with the motor Motor output···3.7kw ☐Number of soft absorber receivers N : 1 unit
Sample Calculations	**1. Calculating kinetic energy** $E1=1/2MV^2=1/2\times100\times0.7^2$ $=24.5$ (J) **2. Calculating thrusting energy** $E2=F\times St$ Here, the soft absorber's stroke must be determined tentatively. In essence, because the absorber must have an absorption capacity larger than the calculated kinetic energy, tentatively select an absorber that has a capacity that is at least 24.5(J) higher than the catalogue specifications. Because the thrusting energy due to air cylinder must also be taken into consideration, tentatively select an absorber that has a capacity that is at least twice the kinetic energy. Here, FWM-2725FBD-* with a maximum absorption capacity of 79.4J is tentatively selected from the catalogue. Thrusting energy is determined as follows. $E2=\frac{3.14\times0.063^2\times10^6}{4}\times0.5\times0.025$ $=38.9$ (J) **3. Determine the total energy.** $E=E1+E2=24.5+38.9J$ $=63.4$ (J) **4. Feasibility check** 4-1. Using absorption energy to check As the absorption energy of FWM-2725FBD-* is 79.4(J), it does not pose a problem. 4-2. Using equivalent mass to check $Me=2E/V^2=\frac{2\times63.4}{0.7^2}$ $=259$ (kg) As the equivalent mass of FWM-2725FBD-* is 450(kg), it does not pose a problem. Based on these, FWM-2725FBD-* is selected.	**1. Calculating kinetic energy** $E1=1/2MV^2=1/2\times1500\times0.5^2$ $=187.5$ (J) **2. Calculating thrusting energy** Here, the trust is first calculated. For a motor-driven dolly, the smaller calculated value based on the following two equations is used as thrust. (1) $F=\frac{102\times kw\times2.5\times g}{V}=\frac{102\times3.7\times2.5\times9.8}{0.5}$ $=18492.6$(N) (2) $F=M\times g\times\mu\times n1/n2$ (n1: Number of driving wheels, n2: Total number of wheels) $=1500\times9.8\times0.25\times1/2$ $=1837.5$ (N) Therefore, 1837.5N is used as thrust. At this point, a tentative absorber is selected. FMA3350M is selected as the tentative soft absorber based on the kinetic energy. Thrusting energy $E2=F\times St=1837.5\times0.05$ $=91.9$ (J) **3. Determine the total energy.** $E=E1+E2=187.5+91.9$ $=279.4$ (J) **4. Feasibility check** 4-1. Using absorption energy to check As the absorption energy of FMA3350M is 310(J), it does not pose a problem. 4-2. Using equivalent mass to check $Me=2E/V^2=\frac{2\times279.4}{0.5^2}$ $=2235$ (kg) As the equivalent mass of FMA3350M is 2500(kg), it does not pose a problem. Based on these, FMA3350M is selected.

Sample Calculations for Selecting Soft Absorbers 2

3. Up-and-Down Motion due to Air Cylinder Thrust

Case Examples



Specifications

- ☐Mass of the colliding object M : 260kg
- ☐Air Cylinder rate v : 0.5m/s
- ☐Operation frequency C : 1 time/min
- ☐Ambient temperature T : 0~25°C
- ☐Thrust F : Varies with the air cylinder
  Cylinder diameter…50mm
  Air pressure…0.5MPa
- ☐Number of soft absorber receivers N : 1 unit

Sample Calculations

1. Calculating kinetic energy

$$E_1=\frac{1}{2}I\omega^2=\frac{1}{2}\times M\times\frac{L^2}{3}\times\left(\frac{v}{r}\right)^2$$

$$=\frac{1}{2}\times 260\times\frac{0.7^2}{3}\times\left(\frac{0.5}{0.5}\right)^2=21.2\ (J)$$

$$\left(\text{Impact rate } V=v\times\left(\frac{R}{r}\right)=0.5\times\frac{0.6}{0.5}=0.6\ (m/s)\right.$$

2. Calculating thrusting energy

$$E_2=T\Theta=\left(\frac{\pi D^2P}{4}\times 10^6\times r+Mg\times\frac{L}{2}\right)\times\frac{St}{R}$$

$$=\left(\frac{3.14\times 0.05^2\times 0.5}{4}\times 10^6\times 0.5+260\times 9.8\times\frac{0.7}{2}\right)$$

$$\times\frac{St}{0.6}$$

As in previous examples, the soft absorber's stroke is tentatively determined. Here, FWM-3035TBD-* with a maximum absorption capacity of 196(J) is tentatively selected from the catalogue. Thrusting energy is determined as follows.

$$E_2=\left(\frac{3.14\times 0.05^2\times 0.5}{4}\times 10^6\times 0.5+260\times 9.8\times\frac{0.7}{2}\right)$$

$$\times\frac{0.035}{0.6}=80.6\ (J)$$

3. Determine the total energy.

$E=E_1+E_2=21.2+80.6=101.8\ (J)$

4. Feasibility check

4-1. Using absorption energy to check
As the absorption energy of FWM-3035TBD-* is 196(J), it does not pose a problem.

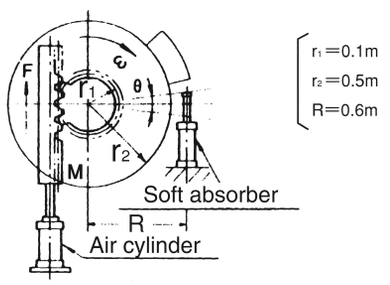
4-2. Using equivalent mass to check

$$Me=\frac{2E}{V^2}=\frac{2\times 101.8}{0.6^2}=565.6\ (kg)$$

As the equivalent mass of FWM-3035TBD-* is 1300(kg), it does not pose a problem. Based on these, FWM-3035TBD-* is selected.

4. Rotating Motion due to Air Cylinder Thrust

Case Examples



Specifications

- ☐Mass of the colliding object M : 200kg
- ☐Air Cylinder rate v : 0.5m/s
- ☐Operation frequency C : 1 time/min
- ☐Ambient temperature T : 0~25°C
- ☐Thrust F : Varies with the air cylinder
  Cylinder diameter…80mm
  Air pressure…0.5MPa
- ☐Number of soft absorber receivers N : 1 unit

Sample Calculations

1. Calculating kinetic energy

$$E_1=\frac{1}{2}I\omega^2=\frac{1}{2}\times M\times\frac{r_2^2}{2}\times\left(\frac{v}{r_1}\right)^2$$

$$=\frac{1}{2}\times 200\times\frac{0.5^2}{2}\times\left(\frac{0.5}{0.1}\right)^2=312.5(J)$$

$$\left(\text{Impact rate } V=v\times\left(\frac{R}{r_1}\right)=0.5\times\left(\frac{0.6}{0.1}\right)=3\ (m/s)\right.$$

2. Calculating thrusting energy

$$E_2=T\Theta=F\times r\times\frac{St}{R}$$

$$=\frac{3.14\times 0.08^2\times 0.5}{4}\times 10^6\times 0.1\times\frac{St}{0.6}$$

At this point, the soft absorber's stroke must be determined tentatively. FA-4250YD-C with a maximum absorption capacity of 441(J) is tentatively selected from the catalogue. Thrusting energy is determined as follows.

$$E_2=\frac{3.14\times 0.08^2\times 0.5}{4}\times 10^6\times 0.1\times\frac{0.05}{0.6}=20.9\ (J)$$

3. Determine the total energy.

$E=E_1+E_2=312.5+20.9=333.4\ (J)$

4. Feasibility check

4-1. Using absorption energy to check
As the absorption energy of FA-4250YD-C is 441(J), it does not pose a problem.

4-2. Using equivalent mass to check

$$Me=\frac{2E}{V^2}=\frac{2\times 333.4}{3^2}=37\ (kg)$$

As the equivalent mass of FA-4250YD-C is 390(kg), it does not pose a problem. Based on these, FA-4250YD-C is selected.