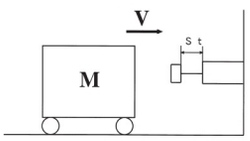
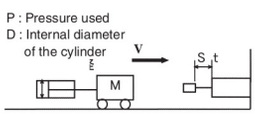
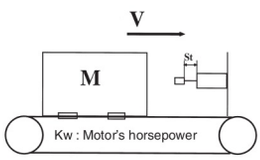
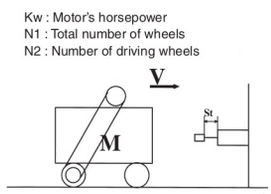
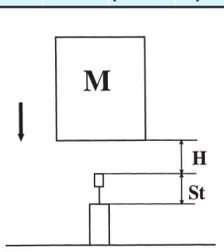
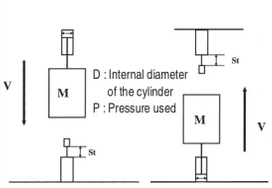
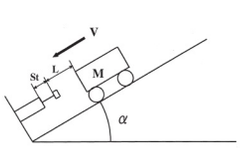
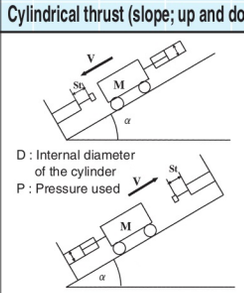
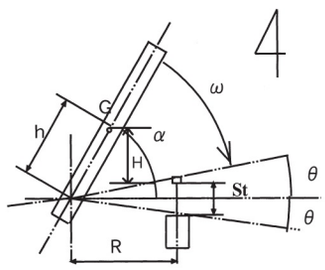
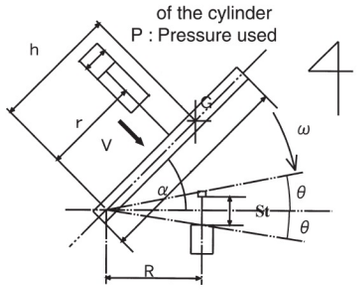
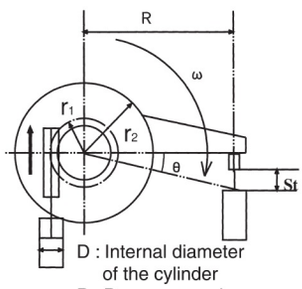
Equations for the Selection of Soft Absorbers (1)

	Inertial impact (horizontal)	Cylindrical thrust (horizontal)	Motor-driven dolly (horizontal)	Friction-driven dolly (horizontal)
Impact (examples)				
Mass of the colliding object (kg)	M	M	M	M
Impact rate (m/s)	V	V	V	V
Kinetic energy (J)	$E_1 \quad \frac{1}{2} M V^2$	$E_1 \quad \frac{1}{2} M V^2$	$E_1 \quad \frac{1}{2} M V^2$	$E_1 \quad \frac{1}{2} M V^2$
Thrust (N)		$F = \frac{D^2}{4} P \quad 10^6$ *1	$F = \frac{kw \quad 2.5 \quad 10^3}{V}$ *2	$F=0.25 \; M \; g \; N1/N2$ *3 $F = \frac{kw \quad 2.5 \quad 10^3}{V}$
Thrusting energy (J)		$E_2 \quad F \; St$	$E_2 \quad F \; St$	$E_2 \quad F \; St$
Total energy (J)	$E \quad \frac{E_1}{N}$ (N: Number of soft absorber receivers)	$E \quad \frac{E_1 \quad E_2}{N}$ (N: Number of soft absorber receivers)	$E \quad \frac{E_1 \quad E_2}{N}$ (N: Number of soft absorber receivers)	$E \quad \frac{E_1 \quad E_2}{N}$ (N: Number of soft absorber receivers)
Equivalent mass (kg)	$Me \quad \frac{M}{N}$	$Me \quad \frac{2 \quad E}{V^2}$	$Me \quad \frac{2 \quad E}{V^2}$	$Me \quad \frac{2 \quad E}{V^2}$
	Free-fall (vertical)	**Cylindrical thrust (up and down)**	**Free-fall (slope)**	**Cylindrical thrust (slope; up and down)**
Impact (examples)				
Mass of the colliding object (kg)	M	M	M	M
Impact rate (m/s)	$V \quad \sqrt{19.6H}$	V	$V \quad \sqrt{19.6L \sin}$	V
Kinetic energy (J)	$E_1 \quad M \; g \; H$	$E_1 \quad \frac{1}{2} M V^2$	$E_1 \quad M \; g \; L \sin$	$E_1 \quad \frac{1}{2} M V^2$
Thrust (N)	$F \quad M \; g$	$F=F_1 \quad M \; g$ (Descending) $F=F_1 \quad M \; g$ (Ascending) (F_1: Cylindrical thrust)	$F=M \; g \sin$	$F=F_1 \quad M \; g \sin$ (Descending) $F=F_1 \quad M \; g \sin$ (F_1: Cylindrical thrust)
Thrusting energy (J)	$E_2 \quad M \; g \; St$	$E_2 \quad F \; St$	$E_2 \quad F \; St$	$E_2 \quad F \; St$
Total energy (J)	$E \quad \frac{E_1 \quad E_2}{N}$ (N: Number of soft absorber receivers)	$E \quad \frac{E_1 \quad E_2}{N}$ (N: Number of soft absorber receivers)	$E \quad \frac{E_1 \quad E_2}{N}$ (N: Number of soft absorber receivers)	$E \quad \frac{E_1 \quad E_2}{N}$ (N: Number of soft absorber receivers)
Equivalent mass (kg)	$Me \quad \frac{2 \quad E}{V^2}$	$Me \quad \frac{2 \quad E}{V^2}$	$Me \quad \frac{2 \quad E}{V^2}$	$Me \quad \frac{2 \quad E}{V^2}$

Equations for the Selection of Soft Absorbers (2)

	Free-fall (rotating)	Cylindrical thrust (rotating)	Cylindrical thrust (horizontally rotating)
Impact (examples)		D : Internal diameter of the cylinder P : Pressure used 	 D : Internal diameter of the cylinder P : Pressure used
Mass of the colliding object (kg)			
Impact rate (m/s)	$\sqrt{\quad}$		
Kinetic energy (J)		—	—
Thrust (N)	———	——— —	— ———
Thrusting energy (J)			
Total energy (J)	——— (N: Number of soft absorber receivers)	——— (N: Number of soft absorber receivers)	——— (N: Number of soft absorber receivers)
Equivalent mass (kg)	———	———	———

Explanation of the symbols

Symbol	Unit	Explanation	Symbol	Unit	Explanation
E	J	Total energy (per soft absorber)		rad	Sloping angle
E_1	J	Kinetic energy		rad	Vibrational angle within the soft absorber stroke
E_2	J	Thrusting energy	R	m	Distance between the centre of rotation and absorber
P	MPa	Pressure used by the driving cylinder	r_1	m	Pitch circle radius of pinion gear
D	m	Internal diameter of the driving cylinder	r_2	m	Radius of turntable
M	kg	Mass of the colliding object	h	m	Distance between the centre of rotation and centre of gravity
V	m/s	Impact rate	T	N·m	Driving torque
F	N	Thrust		rad/s	Angular velocity
F_1	N	Air cylinder's thrust	I	kg·m²	Moment of inertia around the rotating shaft
St	m	Soft absorber stroke	N	Units	Number of soft absorber receivers
H	m	The distance an object falls until it hits the soft absorber	kw	kw	Motor capacity
L	m	Travelling distance on slope	N_1		Total number of wheels
g	m/s²	Acceleration due to gravity: 9.8m/s²	N_2		Number of driving wheels
G		Centre of gravity			

*1 Includes empty weight and external force of a cylinder, etc.
*2 Includes torque due to empty weight and torque due to motor, etc.
*3 Use whichever value is smaller.