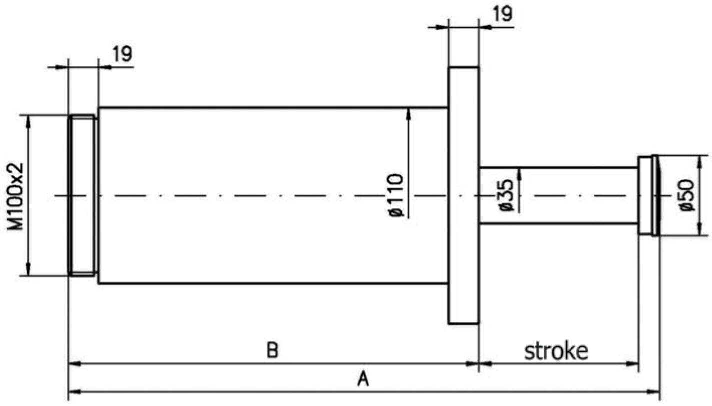
SDN 45

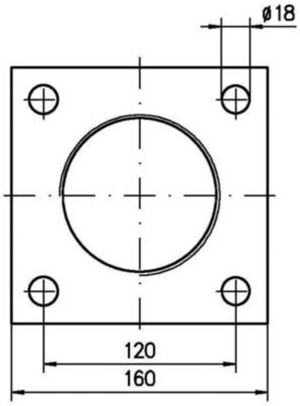
Safety shock absorbers SDN are a low cost alternative to industrial shock absorbers appropriate to customers requirements.
Typical applications: cranes, storage and retrieval unit for highbay warehouse, heavy machinery, etc.

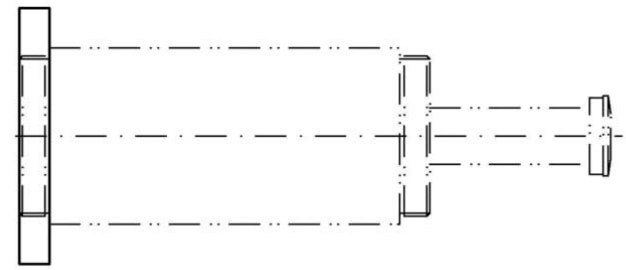
- Impact velocity 0,9 – 4,5 m/s.
- Brake force max.: 80 kN (max. energy capacity).
- Spring force: 400 – 500 N.
- Temperature range: - 10° C to + 80° C.

Front flange
FLV

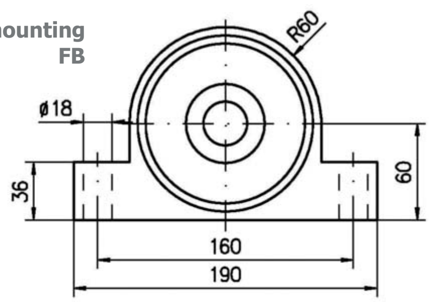


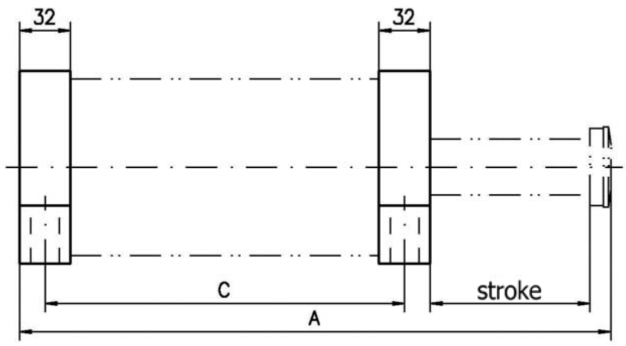
Rear flange
FLH





Foot mounting
FB





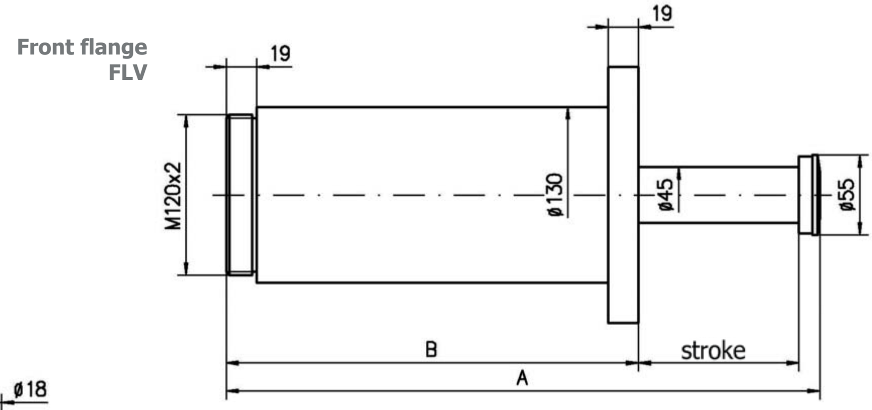
Dimensions: **Technical data:**

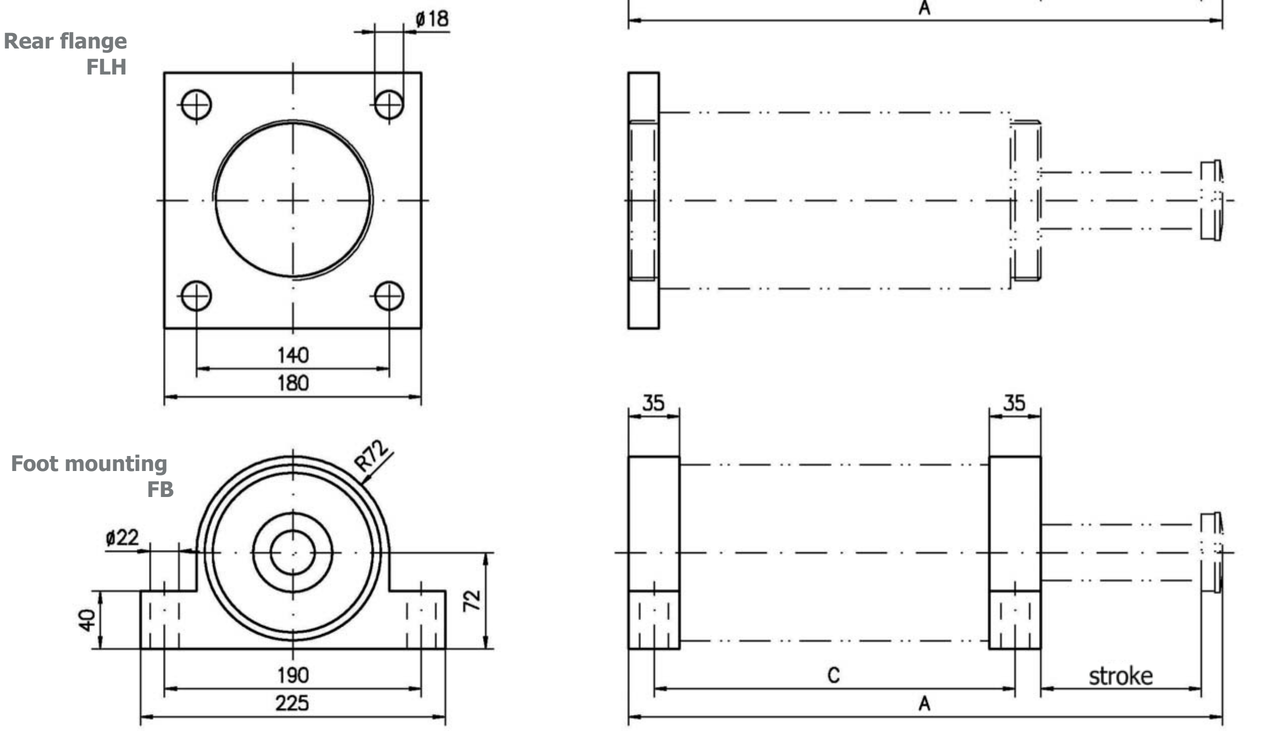
Type	Stroke	A [mm]	B [mm]	C [mm]	Energy capacity Max. [kNm/stroke]	Allowed angular deviation FLV + FB [°]	Allowed angular deviation FLH [°]	Weight [kg]
SDN 45-50	50	270	207	175	3,6	5	4	13
SDN 45-100	100	370	257	225	7,2	5	4	15
SDN 45-150	150	470	307	275	10,8	5	4	17
SDN 45-200	200	570	357	325	14,4	5	4	19
SDN 45-250	250	670	407	375	18,0	4,5	3,5	21
SDN 45-300	300	785	472	440	21,6	4	3	23
SDN 45-350	350	885	522	490	25,2	3,5	2,5	25
SDN 45-400	400	1000	587	555	28,8	3	2	27
SDN 45-500	500	1215	702	670	36,0	2,5	1,5	31
SDN 45-600	600	1430	817	785	43,2	2	1	35
SDN 45-700	700	1645	932	900	50,4	1,5	0,5	39

SDN 60

Safety shock absorbers SDN are a low cost alternative to industrial shock absorbers appropriate to customers requirements.
Typical applications: cranes, storage and retrieval unit for highbay warehouse, heavy machinery, etc.

- Impact velocity 0,5 – 4,5 m/s.
- Brake force max.: 160 kN (max. energy capacity).
- Spring force: 600 – 800 N.
- Temperature range: - 10° C to + 80° C.





Dimensions: **Technical data:**

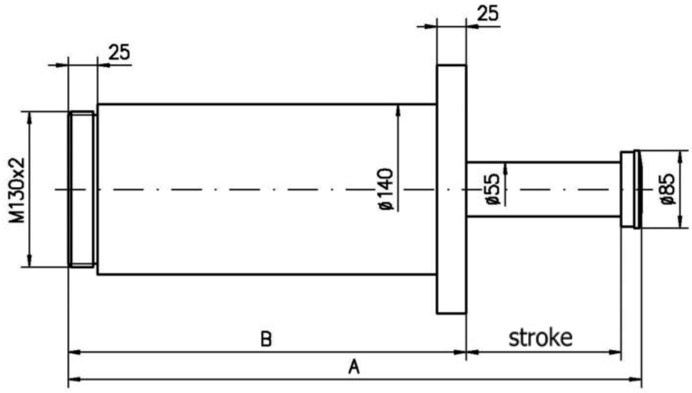
Type	Stroke	A	B	C	Energy capacity Max. [kNm/stroke]	Allowed angular deviation FLV + FB [°]	FLH [°]	Weight [kg]
	[mm]							
SDN 60-100	100	390	270	235	14	5	4	23
SDN 60-150	150	490	320	285	21	5	4	26
SDN 60-200	200	590	370	335	28	5	4	28
SDN 60-250	250	690	420	385	35	4,5	3,5	31
SDN 60-300	300	805	485	450	42	4	3	34
SDN 60-350	350	905	535	500	49	3,5	2,5	37
SDN 60-400	400	1020	600	565	56	3	2	40
SDN 60-500	500	1235	715	680	70	2,5	1,5	45
SDN 60-600	600	1450	830	795	84	2	1	51
SDN 60-700	700	1665	945	910	98	1,5	0,5	57
SDN 60-800	800	1880	1060	1025	112	1	0	63

SDN 75

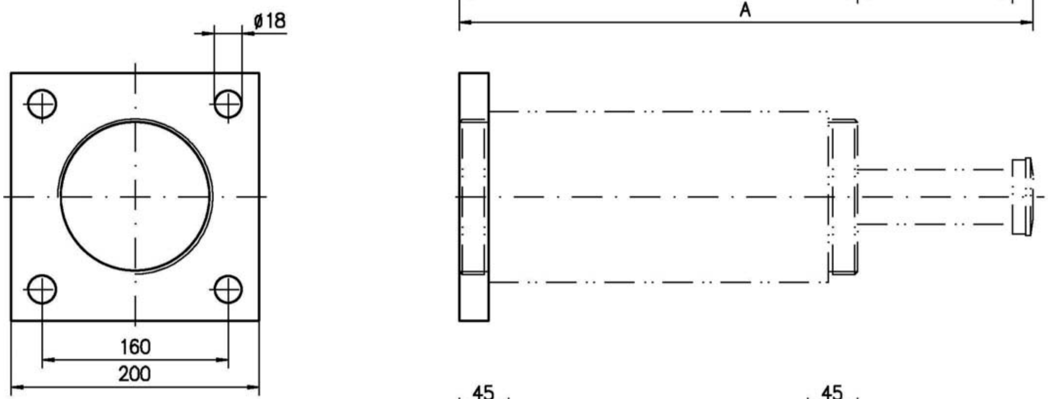
Safety shock absorbers SDN are a low cost alternative to industrial shock absorbers appropriate to customers requirements.
Typical applications: cranes, storage and retrieval unit for highbay warehouse, heavy machinery, etc.

- Impact velocity 0,5 – 4,5 m/s.
- Brake force max.: 210 kN (max. energy capacity).
- Spring force: 1000 – 1300 N.
- Temperature range: - 10° C to + 80° C.

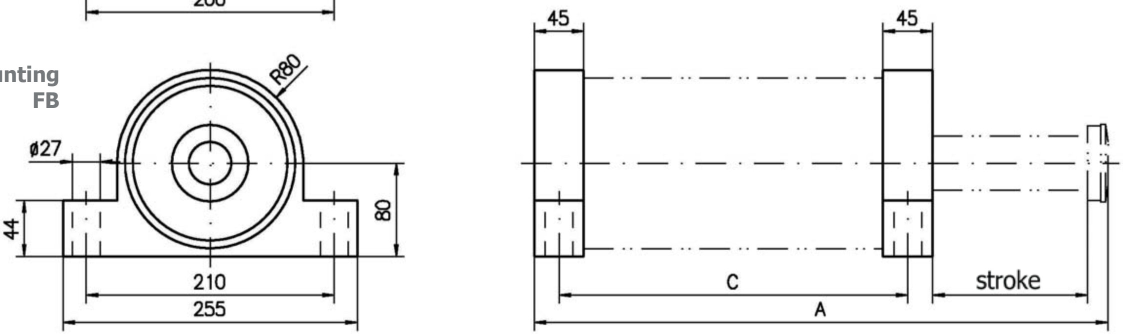
Front flange
FLV



Rear flange
FLH



Foot mounting
FB



Dimensions: **Technical data:**

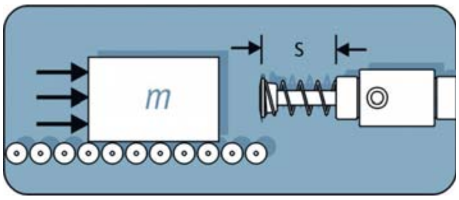
Type	Stroke	A	B	C	Energy capacity Max. [kNm/stroke]	Allowed angular deviation FLV + FB [°]	Allowed angular deviation FLH [°]	Weight [kg]
	[mm]							
SDN 75-100	100	405	285	240	18	5	4	30
SDN 75-150	150	505	335	290	27	5	4	33
SDN 75-200	200	605	385	340	36	5	4	36
SDN 75-250	250	705	435	390	45	4,5	3,5	39
SDN 75-300	300	805	485	440	54	4	3	42
SDN 75-350	350	925	555	510	63	3,5	2,5	45
SDN 75-400	400	1025	605	560	72	3	2	48
SDN 75-500	500	1245	725	680	90	2,5	1,5	56
SDN 75-600	600	1445	825	780	108	2	1	63
SDN 75-700	700	1665	945	900	126	1,5	0,5	70
SDN 75-800	800	1865	1045	1000	144	1	0	76
SDN 75-1000	1000	2285	1265	1220	180	1,5	0,5	90
SDN 75-1200	1200	2705	1485	1440	216	1	0	104

Capacity charts:

The following parameters will be needed in the energy absorption calculation:		
1. Mass	**m**	[kg]
2. Impact velocity	**v**	[m/s]
3. Propelling force	**F**	[N]
4. Cycles per hour	**C**	[1/h]

The load range is calculated with those parameters. Pre-determine a stroke length and verify the calculation.		
1. Total energy/stroke	E_T	[Nm]
2. Total energy/hour	E_{TC}	[Nm/h]
3. Effective mass	m_e	[kg]

Case 1: Mass without propelling force

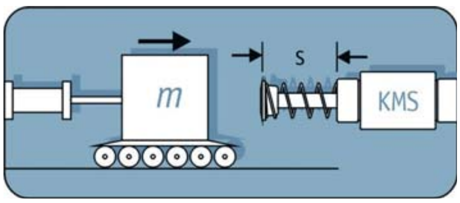


m	= 50 kg	*Mass*
v	= 1,5 m/s	*Impact velocity*
C	= 100 1/h	*Cycles per hour*

E_K/E_T	$= \frac{1}{2} \cdot m \cdot v^2$	$= \frac{1}{2} \cdot 50\ \text{kg} \cdot (1{,}5\ \text{m/s})^2$	= **56 Nm**
E_{TC}	$= E_T \cdot C$	$= 56\ \text{Nm} \cdot 100\ \text{1/h}$	= **5600 Nm/h**
m_e	$= 2 \cdot E_T / v^2$	$= 2 \cdot 56\ \text{Nm} / (1{,}5\ \text{m/s})^2$	= **50 kg**

→ **SES 11 x 25 B selected**

Case 2: Mass with propelling force

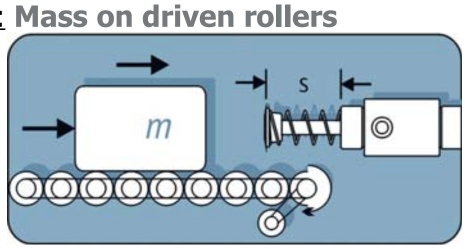


m	= 100 kg	*Mass*
v	= 1,5 m/s	*Impact velocity*
F_D	= 1000 N	*Propelling force*
C	= 200 1/h	*Cycles per hour*
s	= 0,025 m	*Stroke*

E_K	$= \frac{1}{2} \cdot m \cdot v^2$	$= \frac{1}{2} \cdot 100\ \text{kg} \cdot (1{,}5\ \text{m/s})^2$	= **112,5 Nm**
E_W	$= F_D \cdot s$	$= 1000\ \text{N} \cdot 0{,}025\ \text{m}$	= **25 Nm**
E_T	$= E_K + E_W$	$= 112{,}5\ \text{Nm} + 25\ \text{Nm}$	= **137,5 Nm**
E_{TC}	$= E_T \cdot C$	$= 137{,}5\ \text{Nm} \cdot 200\ \text{1/h}$	= **27500 Nm/h**
m_e	$= 2 \cdot E_T / v^2$	$= 2 \cdot 137{,}5\ \text{Nm} / (1{,}5\ \text{m/s})^2$	= **122 kg**

→ **SES 1.1 M x 1 B selected**

Case 3: Mass on driven rollers

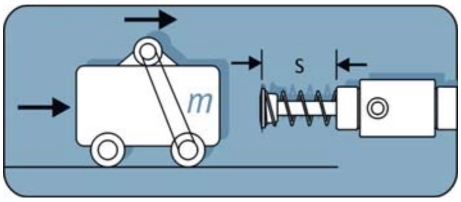


m	= 900 kg	*Mass*
v	= 1,0 m/s	*Impact velocity*
C	= 200 1/h	*Cycles per hour*
s	= 0,05 m	*Stroke*
µ	= 0,3	*Coefficient of friction steel/steel*

E_K	$= \frac{1}{2} \cdot m \cdot v^2$	$= \frac{1}{2} \cdot 900\ \text{kg} \cdot (1{,}0\ \text{m/s})^2$	= **450 Nm**
E_W	$= m \cdot \mu \cdot g \cdot s$	$= 900\ \text{kg} \cdot 0{,}3 \cdot 9{,}81\ \text{m/s}^2 \cdot 0{,}05\ \text{m}$	= **132 Nm**
E_T	$= E_K + E_W$	$= 450\ \text{Nm} + 137{,}5\ \text{Nm}$	= **582 Nm**
E_{TC}	$= E_T \cdot C$	$= 582\ \text{Nm} \cdot 200\ \text{1/h}$	= **116400 Nm/h**
m_e	$= 2 \cdot E_T / v^2$	$= 2 \cdot 582\ \text{Nm} / (1{,}0\ \text{m/s})^2$	= **1164 kg**

→ **STD 2.0 M x 2 selected**

Case 4: Mass with motor drive

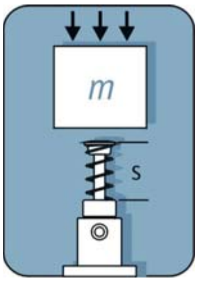


m	= 3000 kg	*Mass*
v	= 1,4 m/s	*Impact velocity*
HM	= 2,5	*Arresting torque factor for motors*
P	= 3 kW	*Drive power*
C	= 1/h	*Cycles per hour*
s	= 0,125 m	*Stroke*

E_K	$= ½ \cdot m \cdot v^2$	$= ½ \cdot 3000\ kg \cdot (1{,}4\ m/s)^2$	**= 2940 Nm**
E_W	$= 1000 \cdot P \cdot s \cdot HM / v$	$= 1000 \cdot 3\ kW \cdot 0{,}125\ m \cdot 2{,}5 / 1{,}4\ m/s$	**= 670 Nm**
E_T	$= E_K + E_W$	$= 2940\ Nm + 670\ Nm$	**= 3610 Nm**
E_{TC}	$= E_T \cdot C$	$= 3610\ Nm \cdot 1\ 1/h$	**= 3610 Nm/h**
m_e	$= 2 \cdot E_T / v^2$	$= 2 \cdot 3610\ Nm / (1{,}4\ m/s)^2$	**= 3684 kg**

→ STD 3.0 M x 5 selected

Case 5: Free falling mass

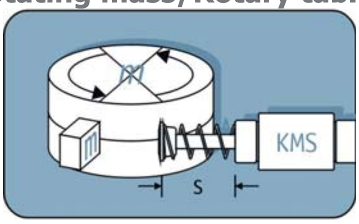


m	= 50 kg	*Mass*
h	= 0,5 m	*Height of fall*
C	= 300 1/h	*Cycles per hour*
s	= 0,05 m	*Stroke*

v	$= \sqrt{2 \cdot g \cdot h}$	$= \sqrt{2 \cdot 9{,}81\ m/s^2 \cdot 0{,}5\ m}$	**= 3,1 m/s**
E_K	$= m \cdot g \cdot h$	$= 50\ kg \cdot 9{,}81\ m/s^2 \cdot 0{,}5\ m$	**= 245 Nm**
E_W	$= m \cdot g \cdot s$	$= 50\ kg \cdot 9{,}81\ m/s^2 \cdot 0{,}05\ m$	**= 24,5 Nm**
E_T	$= E_K + E_W$	$= 245\ Nm + 24{,}5\ Nm$	**= 269,5 Nm**
E_{TC}	$= E_T \cdot C$	$= 269{,}5\ Nm \cdot 300\ 1/h$	**= 80850 Nm/h**
m_e	$= 2 \cdot E_T / v^2$	$= 2 \cdot 269{,}5\ Nm / (3{,}1\ m/s)^2$	**= 55 kg**

→ STD 1.5 M x 2 selected

Case 6: Rotating mass/Rotary table with driving torque

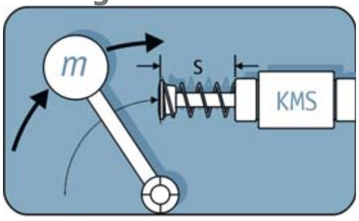


J	= 60 kgm²	*Moment of inertia*
ω	= 1,2 1/s	*Angular velocity*
r	= 0,5 m	*Radius (shock absorber)*
M	= 200 Nm	*Driving torque*
C	= 1000 1/h	*Cycles per hour*
s	= 0,025 m	*Stroke*

v	$= \omega \cdot r$	$= 1{,}2\ 1/s \cdot 0{,}5\ m$	**= 0,6 m/s**
E_K	$= ½ \cdot J \cdot \omega^2$	$= ½ \cdot 60\ kgm^2 \cdot (1{,}2\ 1/s)^2$	**= 43,2 Nm**
E_W	$= M \cdot s / r$	$= 200\ Nm \cdot 0{,}025\ m / 0{,}5\ m$	**= 10 Nm**
E_T	$= E_K + E_W$	$= 43{,}2\ Nm + 10\ Nm$	**= 53,2 Nm**
E_{TC}	$= E_T \cdot C$	$= 53{,}2\ Nm \cdot 1000\ 1/h$	**= 53200 Nm/h**
m_e	$= 2 \cdot E_T / v^2$	$= 2 \cdot 53{,}2\ Nm / (0{,}6\ m/s)^2$	**= 296 kg**

→ STD 1.0 M selected

Case 7: Swivelling mass with driving torque

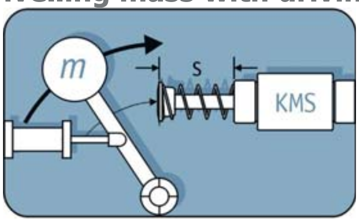


m	= 30 kg	*Mass*
v_m	= 1,0 m/s	*Impact velocity*
r	= 0,4 m	*Radius (shock absorber)*
R_m	= 0,6 m	*Radius (mass)*
M	= 40 Nm	*Driving torque*
C	= 1500/h	*Cycles per hour*
s	= 0,02 m	*Stroke*

E_K	$= \frac{1}{2} \cdot m \cdot v^2$	$= \frac{1}{2} \cdot 30\ kg \cdot (1{,}0\ m/s)^2$	**= 15 Nm**
E_W	$= M \cdot s / r$	= 40 Nm · 0,02 m / 0,4 m/s	**= 2 Nm**
E_T	$= E_K + E_W$	= 15 Nm + 2 Nm	**= 17 Nm**
E_{TC}	$= E_T \cdot C$	= 17 Nm · 1500 1/h	**= 25500 Nm/h**
v	$= v_m \cdot r / R_m$	= 1,0 m/s · 0,4 m / 0,6 m	**= 0,67 m/s**
m_e	$= 2 \cdot E_T / v^2$	$= 2 \cdot 17\ Nm / (0{,}67\ m/s)^2$	**= 76 kg**

→ SES 10 x 20 A selected

Case 8: Swivelling mass with driving force

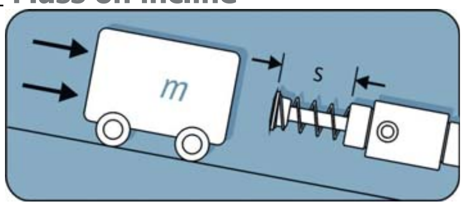


m	= 3000 kg	*Mass*
v_m	= 1,5 m/s	*Impact velocity*
r	= 1,0 m	*Radius (shock absorber)*
R_m	= 1,3 m	*Radius (mass)*
R_F	= 0,5 m	*Radius (force)*
F_D	= 4000 N	*Driving force*
C	= 150/h	*Cycles per hour*
S	= 0,1 m	*Stroke*

E_K	$= \frac{1}{2} \cdot m \cdot v^2$	$= \frac{1}{2} \cdot 3000\ kg \cdot (1{,}5\ m/s)^2$	**= 3375 Nm**
E_W	$= F_D \cdot s \cdot R_F / r$	= 4000 N · 0,1 m · 0,5 m/1,0 m	**= 200 Nm**
E_T	$= E_K + E_W$	= 3375 Nm + 200 Nm	**= 3575 Nm**
E_{TC}	$= E_T \cdot C$	= 3575 Nm · 150 1/h	**= 536,25 kNm/h**
v	$= v_m \cdot r / R_m$	= 1,5 m/s · 1,0 m/1,3 m	**= 1,15 m/s**
m_e	$= 2 \cdot E_T / v^2$	$= 2 \cdot 3575\ Nm / (1{,}15\ m/s)^2$	**= 1352 kg**

→ STD 4.0 M x 4 selected

Case 9: Mass on incline



m	= 10 kg	*Mass*
h	= 0,2 m	*Height*
α	= 20°	*Angle of inclination*
C	= 500 1/h	*Cycles per hour*
s	= 0,016 m	*Stroke*

E_K	$= m \cdot g \cdot h$	$= 10\ kg \cdot 9{,}81\ m/s^2 \cdot 0{,}2\ m$	**= 19,62 Nm**
E_W	$= m \cdot g \cdot s \cdot \sin \alpha$	$= 10\ kg \cdot 9{,}81\ m/s^2 \cdot 0{,}016\ m \cdot \sin 20°$	**= 0,54 Nm**
E_T	$= E_K + E_W$	= 19,62 Nm + 0,54 Nm	**= 20,16 Nm**
E_{TC}	$= E_T \cdot C$	= 20,16 Nm · 500 1/h	**= 53200 Nm/h**
v	$= \sqrt{2 \cdot g \cdot h}$	$= \sqrt{2 \cdot 9{,}81\ m/s^2 \cdot 0{,}2\ m}$	**= 1,98 m/s**
m_e	$= 2 \cdot E_T / v^2$	$= 2 \cdot 20{,}16\ Nm / (1{,}98\ m/s)^2$	**= 10,3 kg**

→ SES 14 S selected

Additional sizing formulas and calculations:

Effective mass m_e [kg] $$m_e = 2 \cdot E_T / v^2$$	Brake force F_B [N] $$F_B = 1{,}2 \cdot E_T / s$$
Deceleration a [m/s²] $$a = 0{,}6 \cdot v^2 / s$$	Deceleration time t_B [s] $$t_B = 2{,}5 \cdot s / v$$

The above formulas apply to correctly selected and adjusted shock absorbers. Please take more precautions than may be necessary to be on the safe side.

Special versions are available on request:

Description	Application
Shock absorber with swivelling fixing	• Clevis mounting
Shock absorber with special characteristic line	• Very high impact velocity • Very low impact velocity
Shock absorber in stainless steel	• Hostile environment • Outdoor application
Shock absorber with alternative seals	• Hostile environment • Deviating ambient temperatures
Shock absorber with special stroke length	
Shock absorber with nickel plated outside parts	• Hostile environment • Outdoor application
Shock absorber with air/oil-tank	• High frequencies requiring an increased energy capacity/h • Controlled return stroke of piston rod
Shock absorber with special fastening thread	• Pre-determined fastening elements

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