

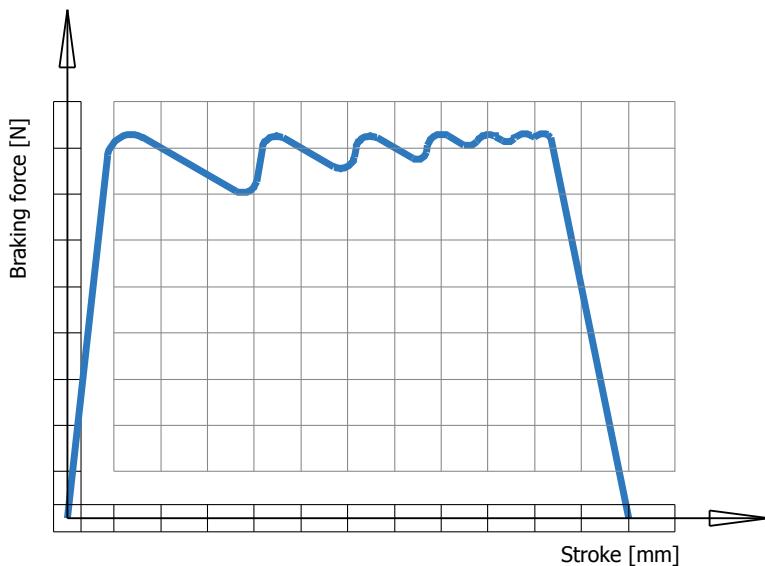
## Functioning of an industrial shock absorber



During operation the piston rod moves inside and the piston pushes the hydraulic fluid through the orifice holes, producing a resistant force. The more the piston rod enters, the more orifice holes are closed. This will reduce speed, pressure and braking remain nearly constant. This prevents the occurrence of peak power which can cause damage to products and machines.

The return spring pushes the piston rod back to the start position. A check valve supports the rapid extension so the shock absorber is ready for the next working cycle in the shortest possible time.

## Force-stroke diagram



The force-stroke diagram of a properly adjusted industrial shock absorber.

Reaction force is as low as possible so KMS shock absorbers provide linear deceleration, no destructive shock forces and reduced machine load.

### You benefit from these advantages:

- Increase the operating speed → higher productivity
- Increase the lifetime and efficiency of the machine → lower costs
- Reduced noise pollution and energy costs

## Summary SES



Product	Stroke [mm]	Thread	Energy capacity [Nm/stroke]	Effective mass [kg]	Page
<b>SES 7 x 6 A</b>	6	M10x1,0	3	4 - 12	7
<b>SES 7 x 6 B</b>	6	M10x1,0	3	1 - 6	7
<b>SES 7 x 6 AA</b>	6	M10x1,0	3	9 - 23	7
<b>SES 7 x 10 A</b>	10	M12x1,0	7	6 - 45	7
<b>SES 7 x 10 B</b>	10	M12x1,0	7	1 - 14	7
<b>SES 7 x 10 AA</b>	10	M12x1,0	7	25 - 70	7
<b>SES 14 S</b>	16	M14x1,0	30	5 - 192	8
<b>SES 14 H</b>	16	M14x1,0	30	140 - 720	8
<b>SES 7 x 15 A</b>	15	M14x1,0 or M14x1,5	19	8 - 80	9
<b>SES 7 x 15 B</b>	15	M14x1,0 or M14x1,5	19	1 - 10	9
<b>SES 7 x 15 AA</b>	15	M14x1,0 or M14x1,5	19	65 - 200	9
<b>SES 10 x 12 A</b>	12	M16x1,5	18	12 - 140	9
<b>SES 10 x 12 B</b>	12	M16x1,5	18	2,5 - 20	9
<b>SES 10 x 12 AA</b>	12	M16x1,5	18	100 - 480	9
<b>SES 10 x 20 A</b>	20	M20x1,5	30	24 - 240	10
<b>SES 10 x 20 B</b>	20	M20x1,5	30	3 - 28	10
<b>SES 10 x 20 AA</b>	20	M20x1,5	30	170 - 900	10
<b>SES 10 x 40 A</b>	40	M20x1,5	60	40 - 500	10
<b>SES 10 x 40 B</b>	40	M20x1,5	60	6 - 60	10
<b>SES 10 x 40 AA</b>	40	M20x1,5	60	300 - 1600	10
<b>SES 11 x 25 A</b>	25	M25x1,5 or M25x2,0	81	110 - 900	11
<b>SES 11 x 25 B</b>	25	M25x1,5 or M25x2,0	81	8 - 138	11
<b>SES 11 x 25 AA</b>	25	M25x1,5 or M25x2,0	81	390 - 2300	11
<b>SES 1.0 M x 40 A</b>	40	M25x1,5	116	175 - 1140	11
<b>SES 1.0 M x 40 B</b>	40	M25x1,5	116	13 - 220	11
<b>SES 1.0 M x 40 AA</b>	40	M25x1,5	116	624 - 2600	11

Please note that this review is only for pre-selection. In any case, please use our example calculations (page 32 and 33) to check whether the selected damper is suitable.

## Summary SES

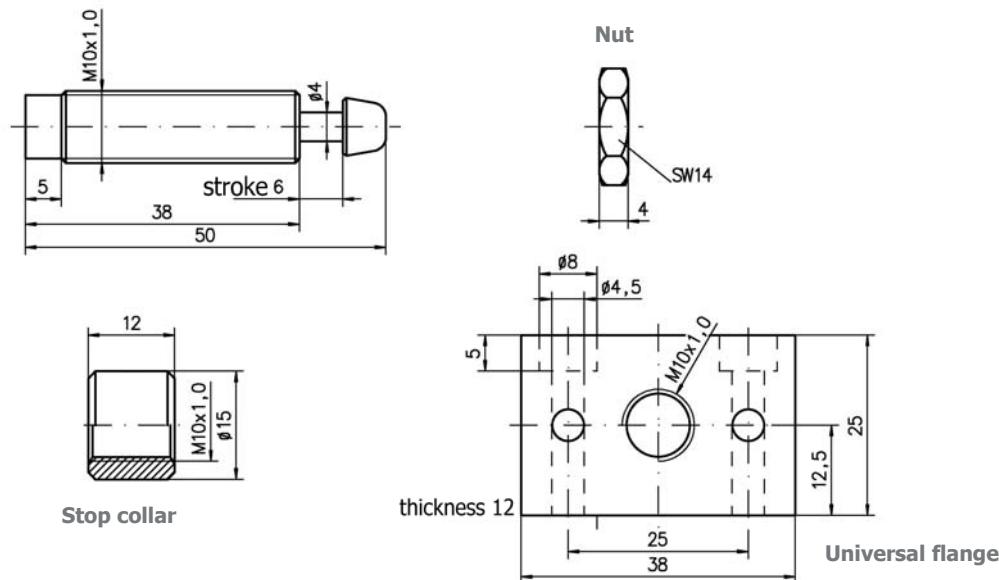


Product	Stroke [mm]	Thread	Energy capacity [Nm/stroke]	Effective mass [kg]	Page
<b>SES 1.15 M x 1 A</b>	25	M33x1,5 or 1 1/4" – 12UNF	100	25 - 110	12
<b>SES 1.15 M x 1 B</b>	25	M33x1,5 or 1 1/4" – 12UNF	100	8 - 33	12
<b>SES 1.15 M x 1 AA</b>	25	M33x1,5 or 1 1/4" – 12UNF	100	95 - 440	12
<b>SES 1.15 M x 2 A</b>	50	M33x1,5 or 1 1/4" – 12UNF	200	45 - 220	12
<b>SES 1.15 M x 2 B</b>	50	M33x1,5 or 1 1/4" – 12UNF	200	15 - 65	12
<b>SES 1.15 M x 2 AA</b>	50	M33x1,5 or 1 1/4" – 12UNF	200	190 - 890	12
<b>SES 1.1 M x 1 A</b>	25	M36x1,5	195	170 - 870	13
<b>SES 1.1 M x 1 B</b>	25	M36x1,5	195	45 - 250	13
<b>SES 1.1 M x 1 AA</b>	25	M36x1,5	195	540 - 2700	13
<b>SES 1.1 M x 2 A</b>	50	M36x1,5	390	340 - 1740	13
<b>SES 1.1 M x 2 B</b>	50	M36x1,5	390	90 - 500	13
<b>SES 1.1 M x 2 AA</b>	50	M36x1,5	390	1080 - 5400	13
<b>SES 1.5 M x 1 A</b>	25	M45x1,5	250	110 - 700	14
<b>SES 1.5 M x 1 B</b>	25	M45x1,5	250	27 - 130	14
<b>SES 1.5 M x 1 AA</b>	25	M45x1,5	250	600 - 3000	14
<b>SES 1.5 M x 2 A</b>	50	M45x1,5	500	220 - 1400	14
<b>SES 1.5 M x 2 B</b>	50	M45x1,5	500	55 - 260	14
<b>SES 1.5 M x 2 AA</b>	50	M45x1,5	500	1200 - 6000	14
<b>SES 1.5 M x 3 A</b>	75	M45x1,5	750	330 - 2100	14
<b>SES 1.5 M x 3 B</b>	75	M45x1,5	750	82 - 390	14
<b>SES 1.5 M x 3 AA</b>	75	M45x1,5	750	1800 - 9000	14
<b>SES 2.0 M x 2 A</b>	50	M64x2,0	1140	430 - 2250	15
<b>SES 2.0 M x 2 B</b>	50	M64x2,0	1140	130 - 675	15
<b>SES 2.0 M x 2 AA</b>	50	M64x2,0	1140	1600 - 9000	15
<b>SES 2.0 M x 2 BB</b>	50	M64x2,0	1140	35 - 165	15
<b>SES 2.0 M x 4 A</b>	100	M64x2,0	2280	900 - 4900	15
<b>SES 2.0 M x 4 B</b>	100	M64x2,0	2280	250 - 1300	15
<b>SES 2.0 M x 4 AA</b>	100	M64x2,0	2280	3500 - 18000	15
<b>SES 2.0 M x 4 BB</b>	100	M64x2,0	2280	70 - 350	15
<b>SES 2.0 M x 6 A</b>	150	M64x2,0	3420	1300 - 6500	15
<b>SES 2.0 M x 6 B</b>	150	M64x2,0	3420	400 - 2000	15
<b>SES 2.0 M x 6 AA</b>	150	M64x2,0	3420	5300 - 27000	15
<b>SES 2.0 M x 6 BB</b>	150	M64x2,0	3420	100 - 500	15

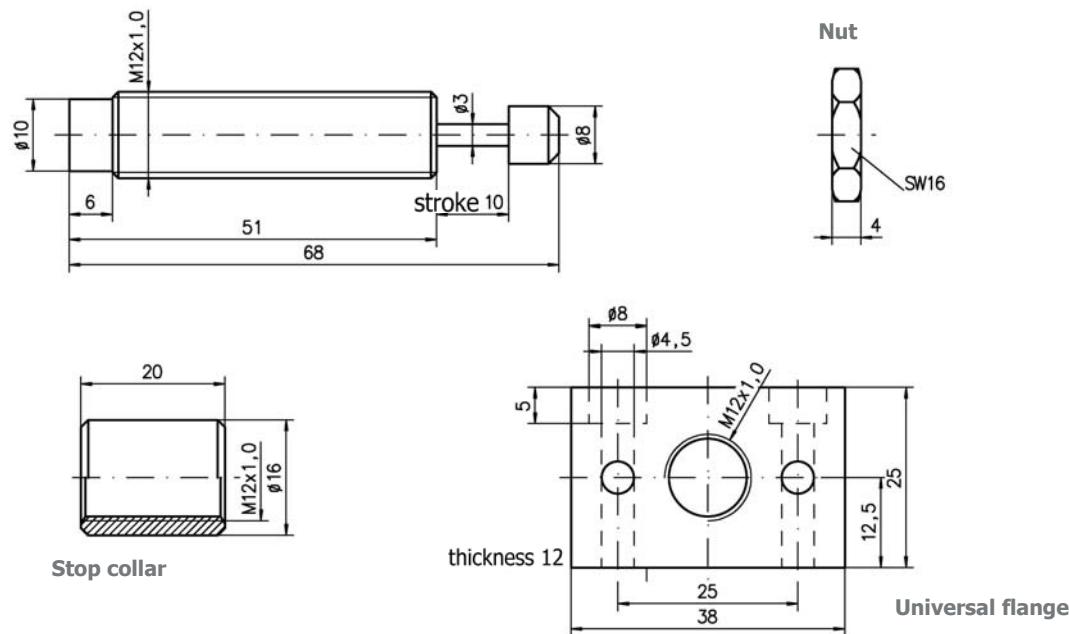
Please note that this review is only for pre-selection. In any case, please use our example calculations (page 32 and 33) to check whether the selected damper is suitable.

- Temperature range from – 10 °C to + 80 °C (higher temperature up to + 120 °C on request).
- Fitting according to your requirements.
- Nylon cap standard.
- Install a mechanical stop 1 mm before end of the stroke, do not bottoming under load to prevent damage.

### SES 7 x 6



### SES 7 x 10



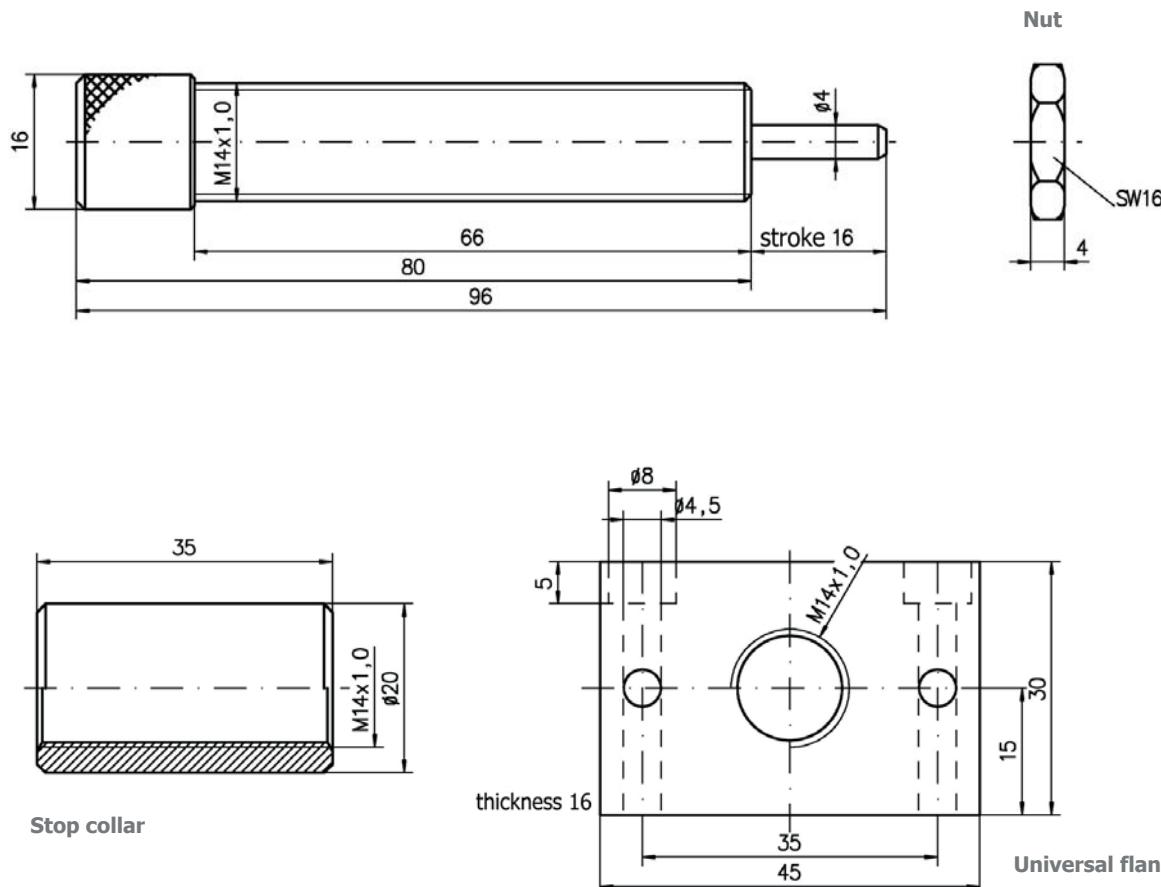
	Type	Stroke [mm]	Thread	Energy capacity		Effective mass [kg]	Spring force [N]	Weight [g]
	<b>SES 7 x 6 A</b>	6	M10x1,0	3	10,8	4 - 12	1,5 - 4	19
	<b>SES 7 x 6 B</b>	6	M10x1,0	3	10,8	1 - 6	1,5 - 4	19
	<b>SES 7 x 6 AA</b>	6	M10x1,0	3	10,8	9 - 23	1,5 - 4	19
	<b>SES 7 x 10 A</b>	10	M12x1,0	7	12	6 - 45	6 - 11	50
	<b>SES 7 x 10 B</b>	10	M12x1,0	7	12	1 - 14	6 - 11	50
	<b>SES 7 x 10 AA</b>	10	M12x1,0	7	12	25 - 70	6 - 11	50

## SES 14



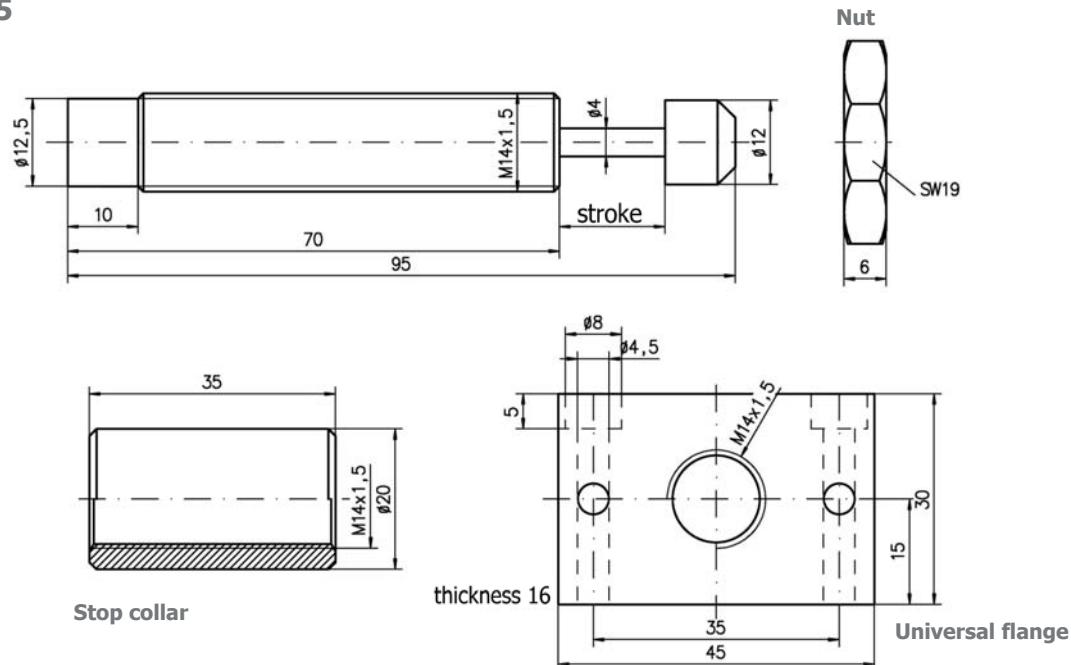
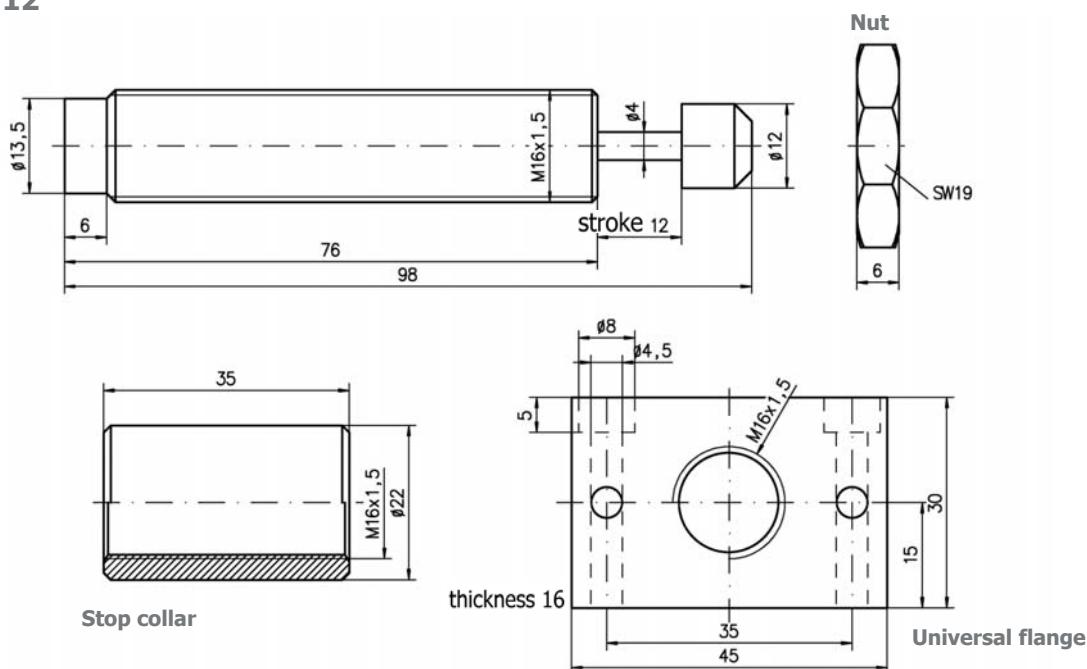
This shock absorber is designed for automatic machines, handling systems with high frequency applications. Superfine surface treatment, special seals and special oil provide a guaranteed lifetime of at least 10,000,000 strokes! The progressive characteristic ensures a smooth deceleration, even at very high driving forces.

- Temperature range from – 10 °C to + 80 °C.
- Fitting according to your requirements.
- Install a mechanical stop 1 mm before end of the stroke, do not bottoming under load to prevent damage.



Type	Stroke [mm]	Thread	Energy capacity		Effective mass [kg]	Spring force [N]	Weight [g]
			[Nm/stroke]	[kNm/h]			
<b>SES 14 S</b>	16	M14x1,0	30	45	5 - 192	8 - 19	78
<b>SES 14 H</b>	16	M14x1,0	30	45	140 - 720	8 - 19	78

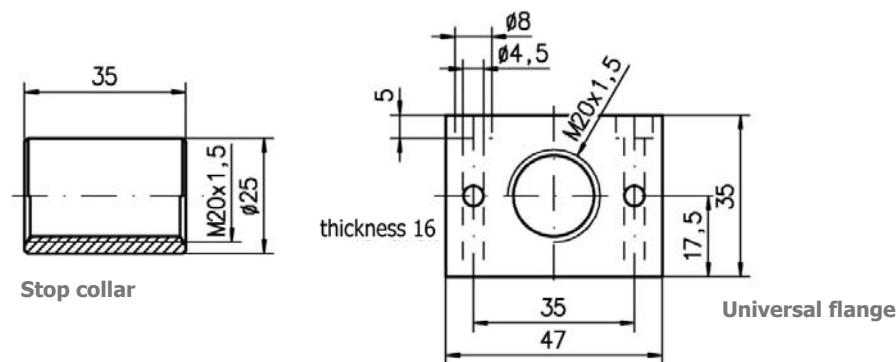
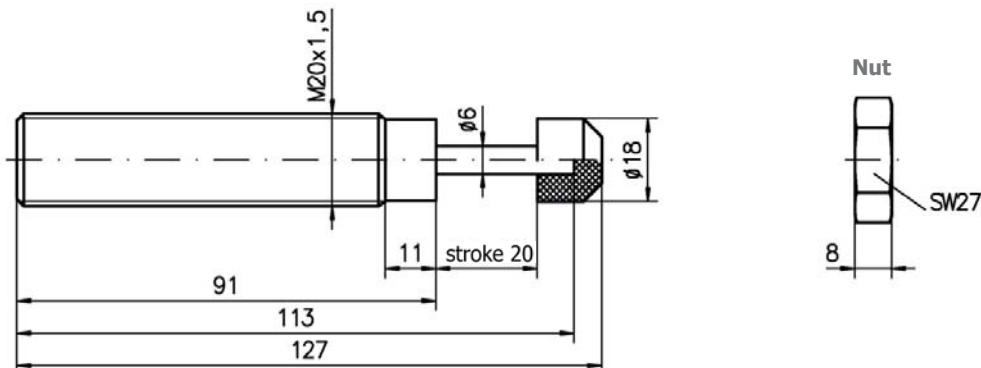
- Temperature range from – 10 °C to + 80 °C (higher temperature up to + 120 °C on request).
- Fitting according to your requirements.
- Nylon cap standard.
- Install a mechanical stop 1 mm before end of the stroke, do not bottoming under load to prevent damage.

**SES 7 x 15****SES 10 x 12**

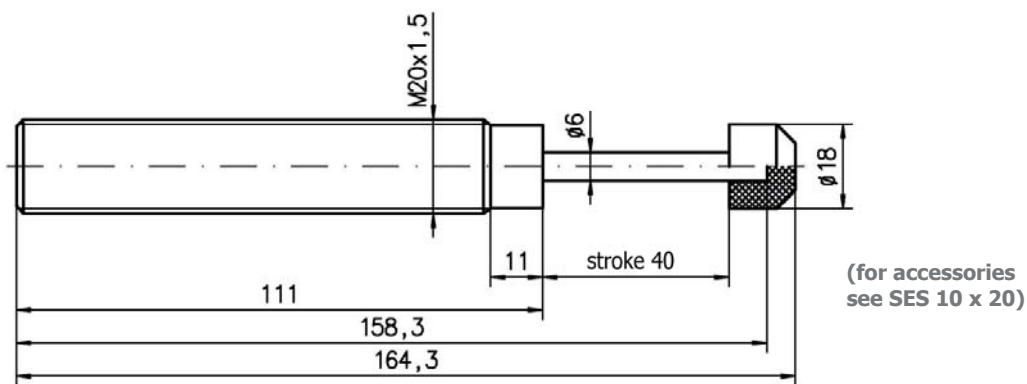
	Type	Stroke [mm]	Thread	Energy capacity [Nm/stroke] [kNm/h]		Effective mass [kg]	Spring force [N]	Weight [g]
	<b>SES 7 x 15 A</b>	15	M14x1,0	19	36	8 - 80	1,5 - 4	65
	<b>SES 7 x 15 B</b>	15	or M14x1,5	19	36	1 - 10	1,5 - 4	65
	<b>SES 7 x 15 AA</b>	15		19	36	65 - 198	1,5 - 4	65
<b>SES 10 x 12 A</b>	12	M16x1,5	18	40	12 - 140	4 - 11	90	
<b>SES 10 x 12 B</b>	12	M16x1,5	18	40	2,5 - 20	4 - 11	90	
<b>SES 10 x 12 AA</b>	12	M16x1,5	18	40	100 - 480	4 - 11	90	

- Temperature range from – 10 °C to + 80 °C (higher temperature up to + 120 °C on request).
- Fitting according to your requirements.
- Nylon cap optional.
- Install a mechanical stop 1 mm before end of the stroke, do not bottoming under load to prevent damage.

### SES 10 x 20



### SES 10 x 40



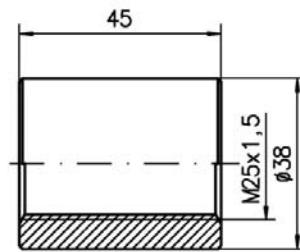
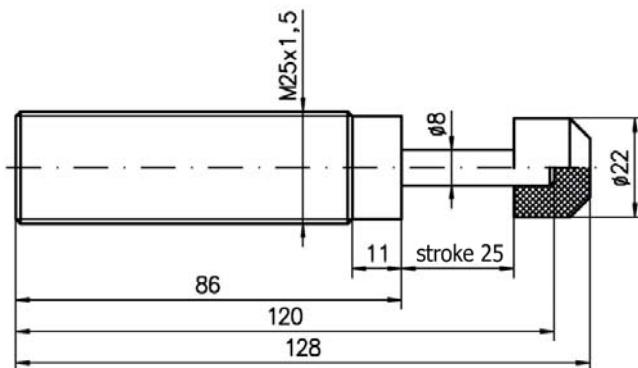
	Type	Stroke [mm]	Thread	Energy capacity		Effective mass [kg]	Spring force [N]	Weight [g]
				[Nm/stroke]	[kNm/h]			
	<b>SES 10 x 20 A</b>	20	M20x1,5	30	46	24 - 240	7 - 20	170
	<b>SES 10 x 20 B</b>	20	M20x1,5	30	46	3 - 28	7 - 20	170
	<b>SES 10 x 20 AA</b>	20	M20x1,5	30	46	176 - 960	7 - 20	170
	<b>SES 10 x 40 A</b>	40	M20x1,5	60	56	40 - 500	10 - 25	210
	<b>SES 10 x 40 B</b>	40	M20x1,5	60	56	6 - 60	10 - 25	210
	<b>SES 10 x 40 AA</b>	40	M20x1,5	60	56	300 - 1600	10 - 25	210



- Temperature range from – 10 °C to + 80 °C (higher temperature up to + 120 °C on request).
- Fitting according to your requirements.
- Nylon cap available for SES 11 x 25.
- Install a mechanical stop 1 mm before end of the stroke, do not bottoming under load to prevent damage.



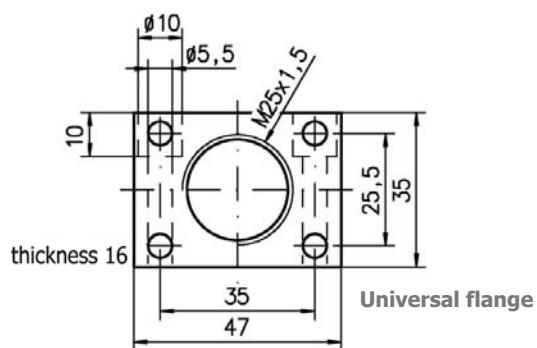
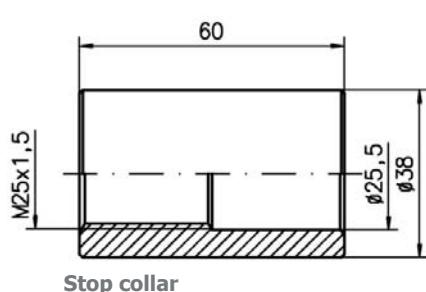
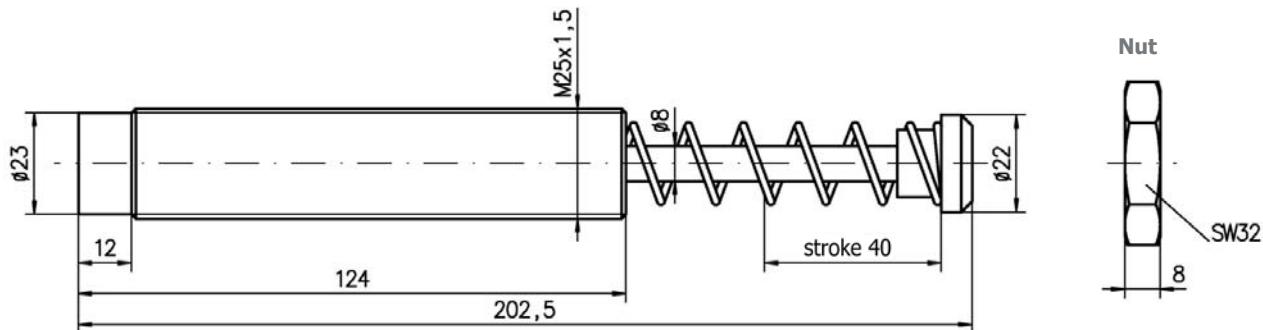
### SES 11 x 25



Stop collar

(for accessories see  
SES 1.0 M x 40)

### SES 1.0 M x 40

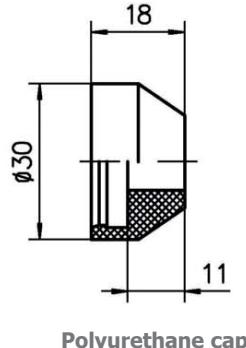
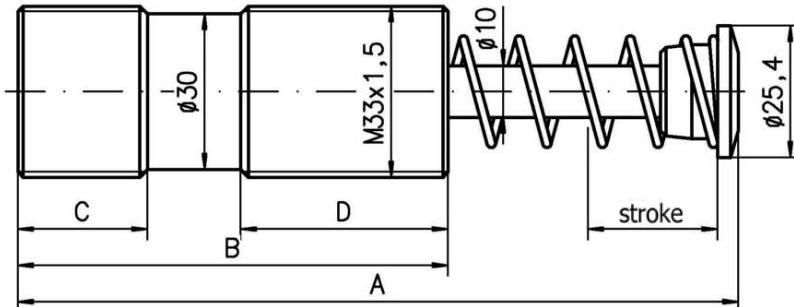


Type	Stroke [mm]	Thread	Energy capacity		Effective mass [kg]	Spring force [N]	Weight [g]
			[Nm/stroke]	[kNm/h]			
<b>SES 11 x 25 A</b>	25	M25x1,5	81	72	110 - 900	13 - 26	240
<b>SES 11 x 25 B</b>	25	or	81	72	8 - 138	13 - 26	240
<b>SES 11 x 25 AA</b>	25	M25x2,0	81	72	390 - 2300	13 - 26	240
<b>SES 1.0 M x 40 A</b>	40	M25x1,5	116	106	176 - 1140	20 - 70	360
<b>SES 1.0 M x 40 B</b>	40	M25x1,5	116	106	13 - 220	20 - 70	360
<b>SES 1.0 M x 40 AA</b>	40	M25x1,5	116	106	624 - 2600	20 - 70	360



- Temperature range from – 10 °C to + 80 °C (higher temperature up to + 120 °C on request).
- Fitting according to your requirements.
- Polyurethane cap optional.
- Install a mechanical stop 1 mm before end of the stroke, do not bottoming under load to prevent damage.

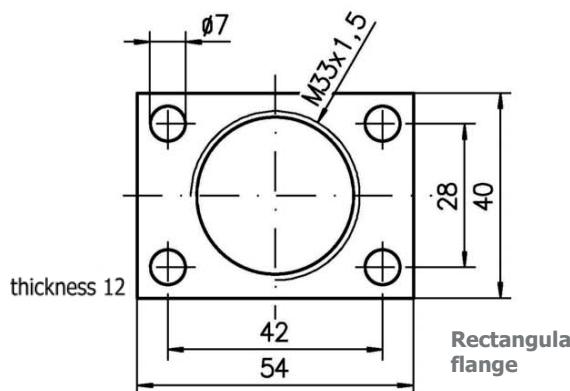
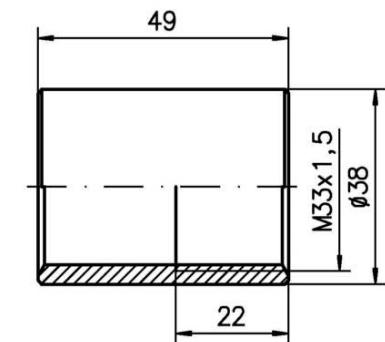
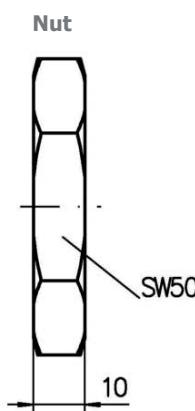
### SES 1.15 M



Polyurethane cap

#### Dimensions:

Type	Stroke	A	B [mm]	C	D
<b>SES 1.15 M x 1</b>	25	139	83	25	40
<b>SES 1.15 M x 2</b>	50	189	108	30	60



Rectangular flange

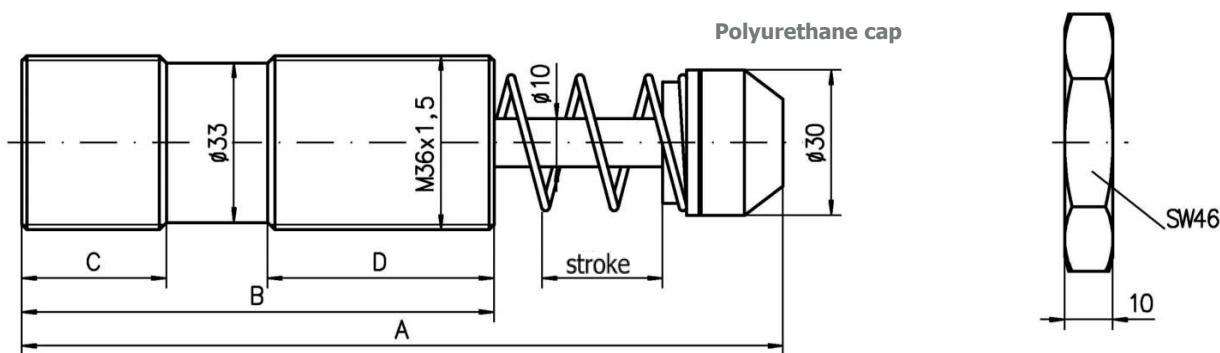
#### Technical data:

Type	Stroke [mm]	Thread	Energy capacity		Effective mass [kg]	Spring force [N]	Weight [g]
			[Nm/stroke]	[kNm/h]			
<b>SES 1.15 M x 1 A</b>	25	M33x1,5	100	76	25 - 110	40 - 70	410
<b>SES 1.15 M x 1 B</b>	25	or	100	76	3 - 28	40 - 70	410
<b>SES 1.15 M x 1 AA</b>	25	1 1/4" - 12 UNF	100	76	176 - 960	40 - 70	410
<b>SES 1.15 M x 2 A</b>	50	M33x1,5	200	86	45 - 220	45 - 80	520
<b>SES 1.15 M x 2 B</b>	50	or	200	86	15 - 65	45 - 80	520
<b>SES 1.15 M x 2 AA</b>	50	1 1/4" - 12 UNF	200	86	190 - 890	45 - 80	520



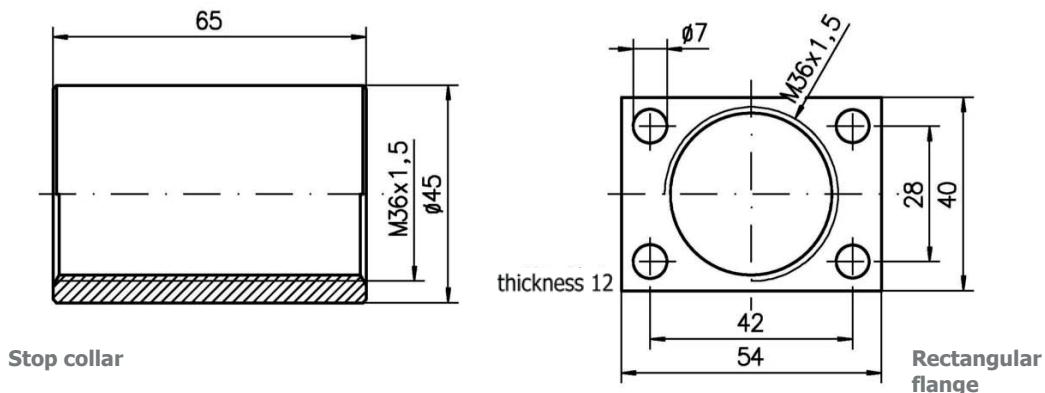
- Temperature range from – 10 °C to + 80 °C (higher temperature up to + 120 °C on request).
- Fitting according to your requirements.
- Polyurethane cap standard.
- Install a mechanical stop 1 mm before end of the stroke, do not bottoming under load to prevent damage.

### SES 1.1 M



#### Dimensions:

Type	Stroke	A [mm]	B [mm]	C	D
<b>SES 1.1 M x 1</b>	25	158	98	30	47
<b>SES 1.1 M x 2</b>	50	195	106	30	55



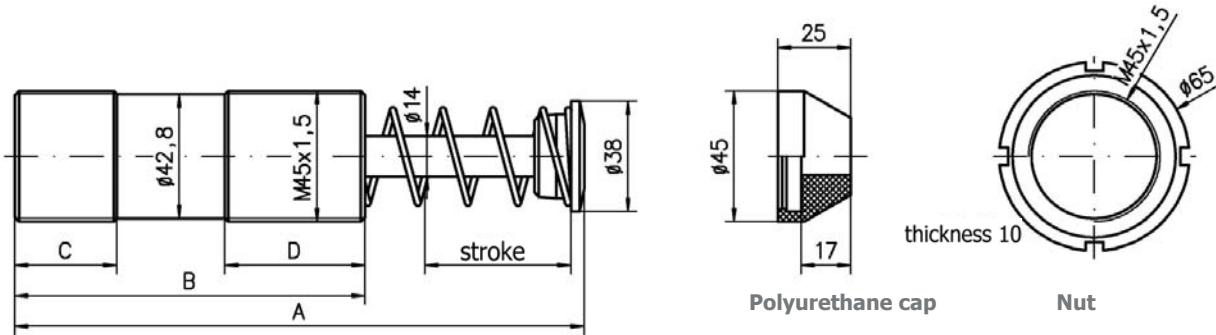
#### Technical data:

Type	Stroke [mm]	Thread	Energy capacity		Effective mass [kg]	Spring force [N]	Weight [g]
<b>SES 1.1 M x 1 A</b>	25	M36x1,5	195	94	170 - 870	35 - 80	500
<b>SES 1.1 M x 1 B</b>	25	M36x1,5	195	94	45 - 250	35 - 80	500
<b>SES 1.1 M x 1 AA</b>	25	M36x1,5	195	94	540 - 2700	35 - 80	500
<b>SES 1.1 M x 2 A</b>	50	M36x1,5	390	188	340 - 1740	35 - 85	650
<b>SES 1.1 M x 2 B</b>	50	M36x1,5	390	188	90 - 500	35 - 85	650
<b>SES 1.1 M x 2 AA</b>	50	M36x1,5	390	188	1080 - 5400	35 - 85	650



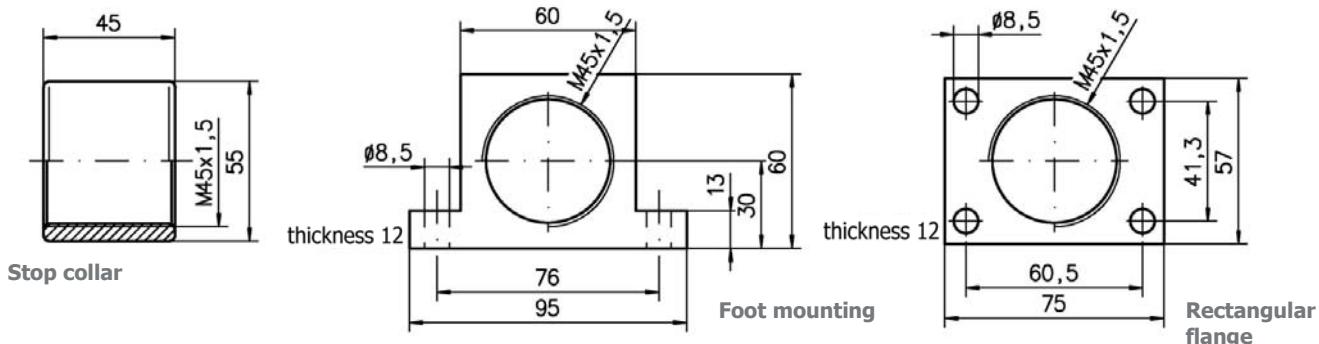
- Temperature range from - 10 °C to + 80 °C (for higher temperature up to max. 120° C on request).
- Fitting position according to your requirements.
- Polyurethane-cap optional.
- The shock absorbers in this series are equipped with an integrated stop, so that an external mechanical stop is not necessary.

### SES 1.5 M



#### Dimensions:

Type	Stroke	A	B [mm]	C	D
<b>SES 1.5 M x 1</b>	25	145	95	25	43
<b>SES 1.5 M x 2</b>	50	195	120	35	48
<b>SES 1.5 M x 3</b>	75	245	145	35	73



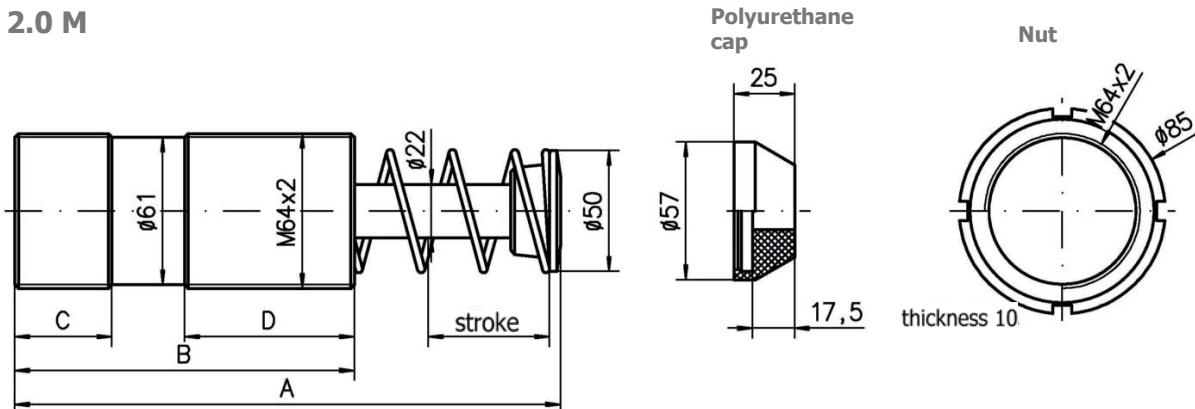
#### Technical data:

Type	Stroke [mm]	Thread	Energy capacity		Effective mass [kg]	Spring force [N]	Weight [kg]
<b>SES 1.5 M x 1 A</b>	25	M45x1,5	250	137	110 - 700	60 - 90	1,2
<b>SES 1.5 M x 1 B</b>	25	M45x1,5	250	137	27 - 130	60 - 90	1,2
<b>SES 1.5 M x 1 AA</b>	25	M45x1,5	250	137	600 - 3000	60 - 90	1,2
<b>SES 1.5 M x 2 A</b>	50	M45x1,5	500	149	220 - 1400	70 - 150	1,4
<b>SES 1.5 M x 2 B</b>	50	M45x1,5	500	149	55 - 260	70 - 150	1,4
<b>SES 1.5 M x 2 AA</b>	50	M45x1,5	500	149	1200 - 6000	70 - 150	1,4
<b>SES 1.5 M x 3 A</b>	75	M45x1,5	750	168	330 - 2100	40 - 150	1,6
<b>SES 1.5 M x 3 B</b>	75	M45x1,5	750	168	82 - 390	40 - 150	1,6
<b>SES 1.5 M x 3 AA</b>	75	M45x1,5	750	168	1800 - 9000	40 - 150	1,6



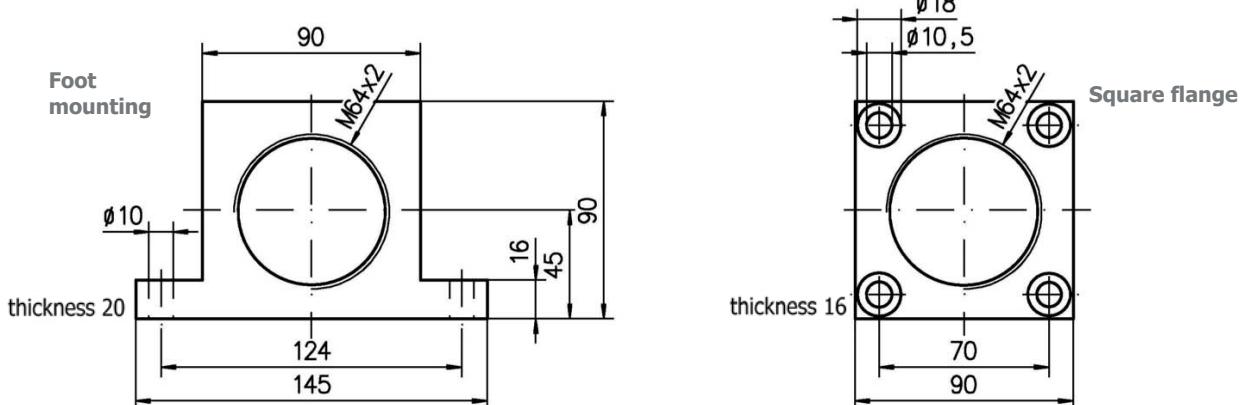
- Temperature range from – 10 °C to + 80 °C (higher temperature up to + 120 °C on request).
- Fitting according to your requirements.
- Polyurethane-cap optional.
- Install a mechanical stop 1 mm before end of the stroke, do not bottoming under load to prevent damage.

### SES 2.0 M



#### Dimensions:

Type	Stroke	A	B [mm]	C	D
<b>SES 2.0 M x 2</b>	50	225	140	40	70
<b>SES 2.0 M x 4</b>	100	327	190	50	100
<b>SES 2.0 M x 6</b>	150	455	240	50	120



#### Technical data:

Type	Stroke [mm]	Thread	Energy capacity [Nm/stroke]	Energy capacity [kNm/h]	Effective mass [kg]	Spring force [N]	Weight [kg]
<b>SES 2.0 M x 2 A</b>	50	M64x2,0	1140	165	430 - 2250	60 - 130	2,9
<b>SES 2.0 M x 2 B</b>	50	M64x2,0	1140	165	130 - 675	60 - 130	2,9
<b>SES 2.0 M x 2 AA</b>	50	M64x2,0	1140	165	1600 - 9000	60 - 130	2,9
<b>SES 2.0 M x 2 BB</b>	50	M64x2,0	1140	165	35 - 165	60 - 130	2,9
<b>SES 2.0 M x 4 A</b>	100	M64x2,0	2280	228	900 - 4900	60 - 180	3,8
<b>SES 2.0 M x 4 B</b>	100	M64x2,0	2280	228	250 - 1300	60 - 180	3,8
<b>SES 2.0 M x 4 AA</b>	100	M64x2,0	2280	228	3500 - 18000	60 - 180	3,8
<b>SES 2.0 M x 4 BB</b>	100	M64x2,0	2280	228	70 - 350	60 - 180	3,8
<b>SES 2.0 M x 6 A</b>	150	M64x2,0	3420	255	1300 - 6500	60 - 270	5,1
<b>SES 2.0 M x 6 B</b>	150	M64x2,0	3420	255	400 - 2000	60 - 270	5,1
<b>SES 2.0 M x 6 AA</b>	150	M64x2,0	3420	255	5300 - 27000	60 - 270	5,1
<b>SES 2.0 M x 6 BB</b>	150	M64x2,0	3420	255	100 - 500	60 - 270	5,1

## Capacity charts:

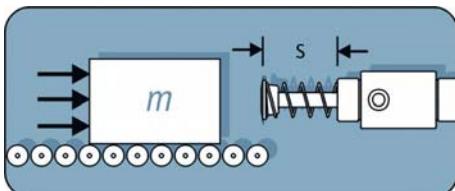
The following parameters will be needed in the energy absorption calculation:

<b>1. Mass</b>	<b>m</b> [kg]
<b>2. Impact velocity</b>	<b>v</b> [m/s]
<b>3. Propelling force</b>	<b>F</b> [N]
<b>4. Cycles per hour</b>	<b>C</b> [1/h]

The load range is calculated with those parameters. Pre-determine a stroke length and verify the calculation.

<b>1. Total energy/stroke</b>	<b>E<sub>T</sub></b> [Nm]
<b>2. Total energy/hour</b>	<b>E<sub>TC</sub></b> [Nm/h]
<b>3. Effective mass</b>	<b>m<sub>e</sub></b> [kg]

### Case 1: Mass without propelling force

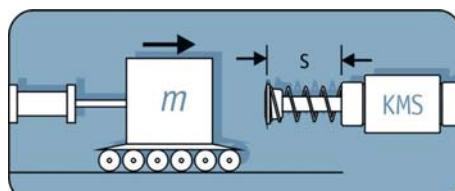


<b>m</b>	= 50 kg	Mass
<b>v</b>	= 1,5 m/s	Impact velocity
<b>C</b>	= 100 1/h	Cycles per hour

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

→ SES 11 x 25 B selected

### Case 2: Mass with propelling force

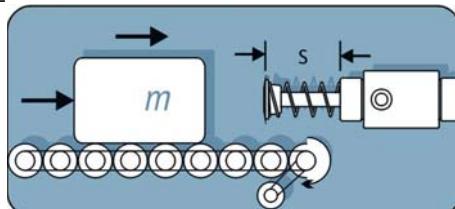


<b>m</b>	= 100 kg	Mass
<b>v</b>	= 1,5 m/s	Impact velocity
<b>F<sub>D</sub></b>	= 1000 N	Propelling force
<b>C</b>	= 200 1/h	Cycles per hour
<b>s</b>	= 0,025 m	Stroke

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

→ SES 1.1 M x 1 B selected

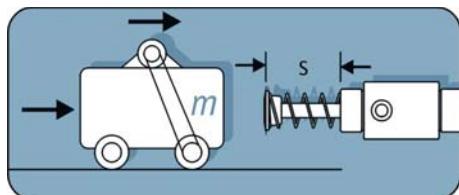
### Case 3: Mass on driven rollers



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

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

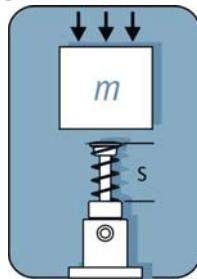
→ STD 2.0 M x 2 selected

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

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

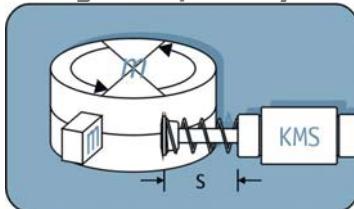
→ STD 3.0 M x 5 selected

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

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

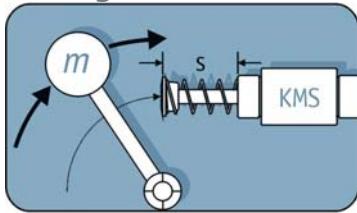
→ STD 1.5 M x 2 selected

Case 6: Rotating mass/Rotary table with driving torque

$J$	= 60 kgm <sup>2</sup>	Moment of inertia
$\omega$	= 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

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

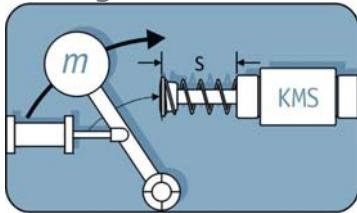
→ STD 1.0 M selected

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

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

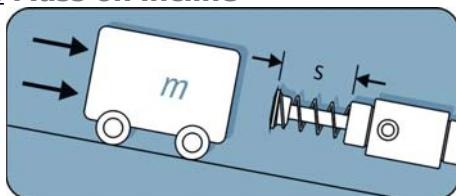
→ SES 10 x 20 A selected

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

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

→ STD 4.0 M x 4 selected

Case 9: Mass on incline

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

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

→ SES 14 S selected

### Additional sizing formulas and calculations:

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

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	<ul style="list-style-type: none"> <li>Clevis mounting</li> </ul>
Shock absorber with special characteristic line	<ul style="list-style-type: none"> <li>Very high impact velocity</li> <li>Very low impact velocity</li> </ul>
Shock absorber in stainless steel	<ul style="list-style-type: none"> <li>Hostile environment</li> <li>Outdoor application</li> </ul>
Shock absorber with alternative seals	<ul style="list-style-type: none"> <li>Hostile environment</li> <li>Deviating ambient temperatures</li> </ul>
Shock absorber with special stroke length	
Shock absorber with nickel plated outside parts	<ul style="list-style-type: none"> <li>Hostile environment</li> <li>Outdoor application</li> </ul>
Shock absorber with air/oil-tank	<ul style="list-style-type: none"> <li>High frequencies requiring an increased energy capacity/h</li> <li>Controlled return stroke of piston rod</li> </ul>
Shock absorber with special fastening thread	<ul style="list-style-type: none"> <li>Pre-determined fastening elements</li> </ul>