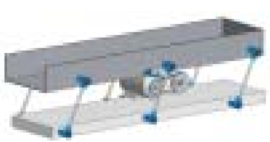
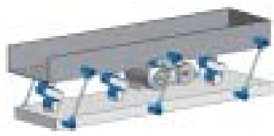
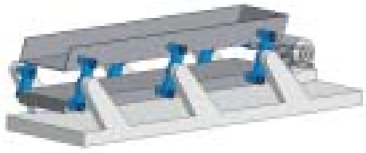
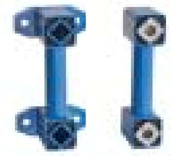
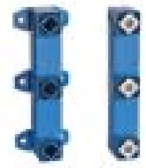
Selection table for guided systems (crank driven)

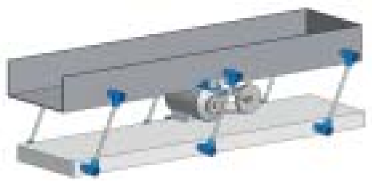
				
One mass shaker "brute-force" system	**One mass shaker** "natural frequency" system	**Two mass shaker** "fast-runner" system with reaction force-compensation		
Single Rocker with adjustable length. Models with right-hand and left-hand threads. 7 sizes up to 5'000 N per rocker suspension.			**AU** Page 2.25	
Single Rocker with decided center distance. 6 sizes up to 2'500 N for flange fixation. 6 sizes up to 2'500 N for central fixation.			**AS-P** **AS-C** Page 2.26	
		Double Rocker with decided center distance. 5 sizes up to 2'500 N for flange fixation. 4 sizes up to 1'600 N for central fixation.	**AD-P** **AD-C** Page 2.27	
Single Rocker with adjustable length. Models with right-hand and left-hand threads. 7 sizes up to 5'000 N per rocker suspension.			**AR** Page 2.28	
Drive Head for crank drive transmission in shaker conveyors. Models with right-hand and left-hand threads. 9 sizes up to 27'000 N per drive head.			**ST** Page 2.29	
	Spring Accumulator with high dynamic spring value for feeder systems running close to resonance frequency. A spring accumulator consists of 2 DO-A elements. 5 sizes up to dynamic spring value of 320 N/mm.		**DO-A** Page 2.30	

Notes regarding some special shaker systems:

– For free oscillating systems on pages 2.16–2.19
– For guided systems on pages 2.31 – 2.33
– For gyratory sifters on page 2.34

Technology

1. One mass systems without spring accumulators: Calculation



	Subject	Symbol	Example
Length, weight	Trough length	L	2.5 m
	Weight empty trough	m_0	200 kg
	Weight of feeding material		50 kg
	Material coupling factor 50% *	m_m	25 kg
	Weight of oscillating mass *	$m = m_0 + m_m$	225 kg
Drive parameter	Eccentric radius	R	12 mm
	Stroke	$sw = 2 \cdot R$	24 mm
	Rpm on trough	n_s	340 min^{-1}
	Gravity acceleration	g	9.81 m/s^2
	Oscillating machine factor	K	1.6
	Acceleration	$a = K \cdot g$	1.6 g
	Total spring value of system	c_t	285 N/mm
Rocker arms	Distance between rockers max.	L_{max}	1.5 m
	Quantity of rockers	z	6
	Load per rocker	G	368 N
	Selection osc. elements (e. g.)		**12× AU 27**
	Selection ROSTA-elements: AU, AR, AS-P, AS-C		
	Center distance of elements	A	200 mm
Drive	Acceleration force	F	3423 N
	Selection drive head		**1× ST 45**
	Drive capacity approx.	P	1.0 kW
Spring value	Dynamic torque	Md_d	2.6 Nm/°
	Dynamic spring value per rocker	c_d	7.4 N/mm
	Dynamic spring value of all rockers	$z \cdot c_d$	44.7 N/mm
	Resonant ability factor	i	0.16

Calculation formulas

Oscillating machine factor

$$K = \frac{\left(\frac{2\pi}{60} \cdot n_s\right)^2 \cdot R}{g \cdot 1000} = \frac{n_s^2 \cdot R}{894'500}$$

Total spring value (machine)

$$c_t = m \cdot \left(\frac{2\pi}{60} \cdot n_s\right)^2 \cdot 0.001$$

Quantity of rockers

$$z = \text{round up} \left(\frac{L}{L_{max}} + 1\right) \cdot 2$$

Load per rocker

$$G = \frac{m \cdot g}{z}$$

Acceleration force (ST selection)

$$F = m \cdot R \cdot \left(\frac{2\pi}{60} \cdot n_s\right)^2 \cdot 0.001 = c_t \cdot R$$

Drive capacity approx.

$$P = \frac{F \cdot R \cdot n_s}{9550 \cdot 1000 \cdot \sqrt{2}}$$

Dynamic spring value per rocker

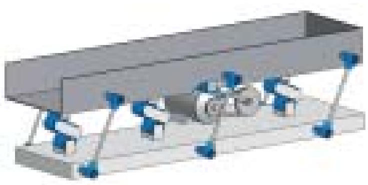
$$c_d = \frac{Md_d \cdot 360 \cdot 1000}{A^2 \cdot \pi}$$

Resonant ability factor

$$i = \frac{z \cdot c_d}{c_t}$$

* the following factors have to be considered by the definition of the material coupling:
- high coupling factor or sticking of wet and humid material
- possible stemming of the trough

2. One mass system with spring accumulators: Calculation



Calculation analog chapter 1 with following additions:

	Subject	Symbol	Example
Spring accumulators	Quantity	z_s	2
	Dyn. spring value per item	c_s	100 N/mm
	Dyn. spring value of all items	$z_s \cdot c_s$	200 N/mm
	Resonant ability factor	i_s	0.86
	Selection of accumulators		**2x cons. of 2x DO-A 45 x 80**

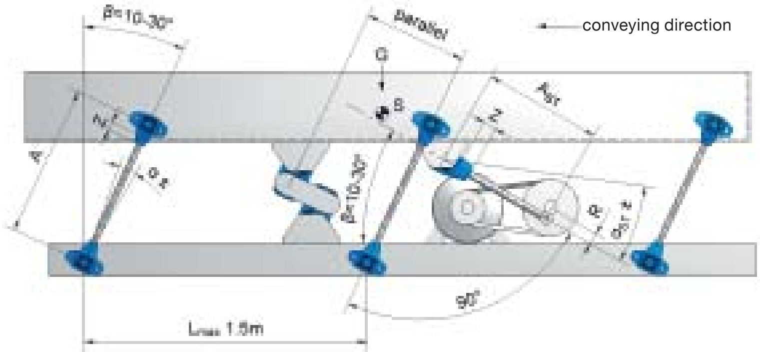
Resonant ability factor with accumulators

$$i_s = \frac{z \cdot c_d + z_s \cdot c_s}{c_t}$$

By a resonant ability factor $i_s \geq 0.8$ the system is usually titled "natural frequency shaker".

Technology

3. One mass shaker conveyor systems: Installation instructions



Distance between rockers L_{max}:

– Usually, the distance between the rocker arms on the trough alongside is up to 1.5 meters, depending on the stiffness of the trough.
– By trough widths >1.5 m we do recommend to provide the trough bottom side with a third, centrical row of rocker arms for stability reasons.

Mounting position drive head ST:

For one mass shaker systems it is recommendable to position the drive head slightly ahead of the center of gravity of the trough, towards the discharge end.

Rocker mounting angle β:

According to the relevant processing function of the shaker conveyor, the rocker arms are positioned at mounting angles between 10° to 30° in relation to the perpendicular line. (The ideal combination of fast conveying speed with high material throw is given by a rocker inclination angle of 30°.) The power input position of the drive-rod from the eccentric drive should stay at right angles to the rocker arms, this orthogonal positioning offers a harmonic course of the drive system.

Angle of oscillation α:

The machine parameters, angle of oscillation and revolutions should be determined in the admissible area of operations (see chapter 5).

Screw quality:

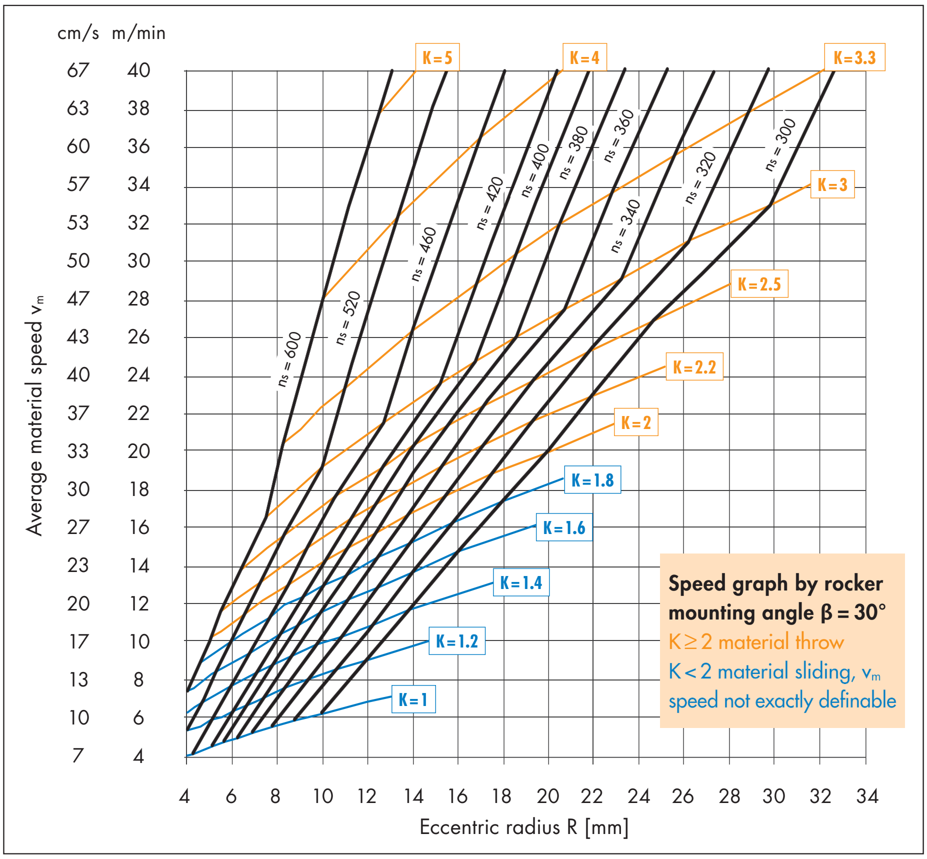
The screw quality should be grade 8.8 secured by the required tightening moment.

Depth of thread engagement Z:

The depth of engagement should be at least 1.5 x the thread nominal width.

Oscillating Mountings

4. Average material speed on shakers v_m



Main influence factors

– layer height of material
– property trough bottom (slip-resistance)
– mounting angle β of the rockers
– feeding capability of the material depending on size, form and humidity of the grains, e.g. very dry and fine grained material is submitted to slippage factors up to 30%.

Example: One mass system with eccentric drive

Out of the intersection point **R = 12 mm** and the revolutions **n_s = 340 min^{-1}** is resulting a theoretical material speed of **v_m = 12 m/min** or **20 cm/sec.**

By acceleration factors **K > 2** and rocker mounting angles of **β = 30°** (to the perpendicular line) the vertical acceleration is getting bigger than 1 g, therefore the material starts lifting from the trough bottom = material throw.

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Technology

5. Maximum rocker load G, revolutions n_s and angle of oscillation α

Size (e.g. AU **15**)	max. load capacity per rocker [N]				max. revolutions n_s [min^{-1}] *	
	K < 2	K = 2	K = 3	K = 4	$\alpha \pm 5°$	$\alpha \pm 6°$
15	100	75	60	50	640	480
18	200	150	120	100	600	450
27	400	300	240	200	560	420
38	800	600	500	400	530	390
45	1'600	1'200	1'000	800	500	360
50	2'500	1'800	1'500	1'200	470	340
60	5'000	3'600	3'000	2'400	440	320

Please contact ROSTA for the permissible load indications by higher accelerations and for rocker elements offering higher load capacities. Usually are the revolutions n_s between 300 to 600 min^{-1} and the oscillation angles max. ±6°.
* basics: "permissible frequencies" in the Technology part of the ROSTA catalogue.

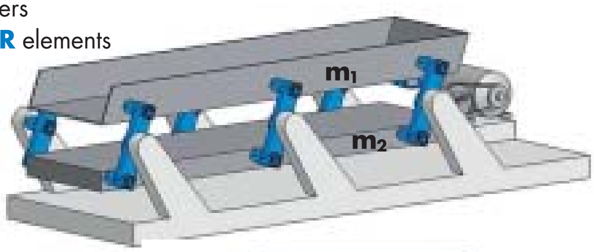
The angle of oscillation α of each oscillating component (rockers accumulators and drive head) has to be settled within the permissible range (n_s and α).

Calculation oscillation angle for rockers

Eccentric radius R [mm]
Center distance A [mm]
Oscillation angle α ± [°]

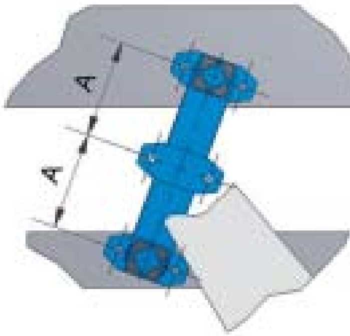
$$\alpha = \arctan\left(\frac{R}{A}\right)$$

6. Two mass shaker systems with direct reaction force-compensation



- Maximum acceleration forces of approx. 5 g, shaker lengths up to 20 meters
- Equipped with ROSTA double rockers **AD-P, AD-C** and/or made out of **AR** elements
- Ideal compensation when $m_1 = m_2$
- Element selection analogue chapter 1, but with load of the two masses:
  Actuated mass (+ material coupling of feeding mass) m_1 [kg]
  Driven mass (+ material coupling of feeding mass) m_2 [kg]
  Total oscillating mass $m = m_1 + m_2$ [kg]

  Dynamic spring value c_d per double rocker $$c_d = \frac{3 \cdot Md_d \cdot 360 \cdot 1000}{2 \cdot A^2 \cdot \pi} \text{ [N/mm]}$$



- Calculation of c_t and F based on the total mass (m_1 and m_2)
- Power input from eccentric drive with **ST arbitrary** on m_1 or m_2 at **any point** alongside m_1 or m_2
- On demand, special double rocker arms with varying center distances A are available as "customized rockers"

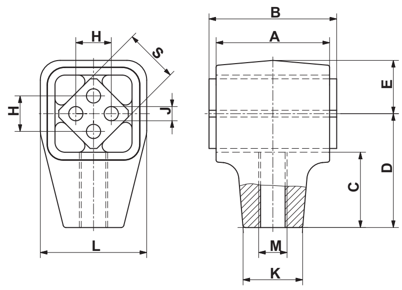
The 9 installation steps for a two mass system with double rocker arms:

1. All fixation holes for the rockers in trough, counter-mass and machine frame have to be drilled very accurately previous the final machine assembling.
2. Installation of the middle elements of the rocker arms on the central machine frame, all inclination angles duly adjusted (e.g. 30°), tightening of the screws with required fastening torque.
3. Lifting of the counter-mass with accurate horizontal alignment until the bores in the counter-mass frame stay congruent with the bore holes of the lower element. Jamming of the counter-mass with e.g. wooden chocks.
4. Tightening of the fixation screws on counter-mass with required fastening torque.
5. Inserting of the feeding trough into machine frame structure. Accurate horizontal alignment until the bores in the trough stay congruent with the bore holes of the upper element. Jamming of the trough with e.g. wooden chocks.
6. Tightening of the fixation screws on trough with required fastening torque.
7. Installation of the driving rod with drive head ST in "neutral" position i.e. eccentric drive should stay in between the two stroke ends. Length adjustment of the driving rod and tightening of the counternuts.
8. Removal of the jamming chocks under counter-mass and trough.
9. Test start of the shaker conveyor.

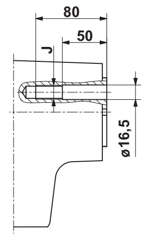
Drive Heads

Type ST

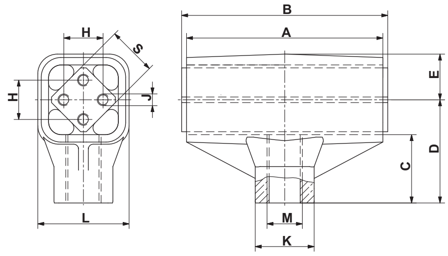
ST 18 – ST 50



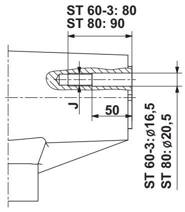
ST 60



ST 50-2



ST 60-3 and ST 80



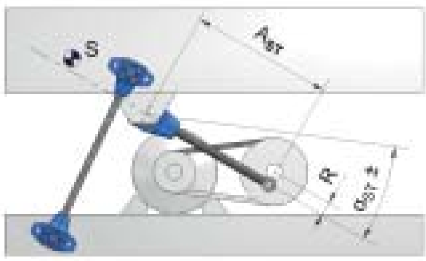
Art. No.	Type	F max. [N]	n_s [min⁻¹] max. α_{ST} ±5°	A	B	C	D	E	H	J $^{+0.5}_{0}$	□K	L	M	□S	Weight [kg]	Material structure		
07 031 001 07 041 001	**ST 18** **ST 18L**	400	600	50	$55^{\ 0}_{-0.3}$	31.5	45	20	$12^{\pm 0.3}$	6	22	39	M12 M12-LH	18	0.2	Light metal casting	Light metal profile	Housing ROSTA blue painted
07 031 002 07 041 002	**ST 27** **ST 27L**	1'000	560	60	$65^{\ 0}_{-0.3}$	40.5	60	27	$20^{\pm 0.4}$	8	28	54	M16 M16-LH	27	0.4	Light metal casting	Light metal profile	Housing ROSTA blue painted
07 031 003 07 041 003	**ST 38** **ST 38L**	2'000	530	80	$90^{\ 0}_{-0.3}$	53	80	37	$25^{\pm 0.4}$	10	42	74	M20 M20-LH	38	1.1	Light metal casting	Light metal profile	Housing ROSTA blue painted
07 031 004 07 041 004	**ST 45** **ST 45L**	3'500	500	100	$110^{\ 0}_{-0.3}$	67	100	44	$35^{\pm 0.5}$	12	48	89	M24 M24-LH	45	1.8	Light metal casting	Light metal profile	Housing ROSTA blue painted
07 031 005 07 041 005	**ST 50** **ST 50L**	6'000	470	120	$130^{\ 0}_{-0.3}$	69.5	105	47	$40^{\pm 0.5}$	M12 x 40	60	93	M36 M36-LH	50	5.5	Nodular cast iron	Light metal profile	Housing ROSTA blue painted
new 07 031 015 new 07 041 015	**ST 50-2** **ST 50-2L**	10'000	470	200	$130^{\ 0}_{-0.3}$	69.5	105	47	$40^{\pm 0.5}$	M12 x 40	60	93	M36 M36-LH	50	6.9	Nodular cast iron	Light metal profile	Housing ROSTA blue painted
new 07 031 026 new 07 041 026	**ST 60** **ST 60L**	13'000	440	200	$210^{\pm 0.2}$	85	130	59	45	M16	80	117	M42 M42-LH	60	15.6	Nodular cast iron	Steel	ROSTA blue painted
new 07 031 016 new 07 041 016	**ST 60-3** **ST 60-3L**	20'000	440	300	$310^{\pm 0.2}$	85	130	59	45	M16	75	117	M42 M42-LH	60	20.2	Nodular cast iron	Steel	ROSTA blue painted
new 07 031 027 new 07 041 027	**ST 80** **ST 80L**	27'000	380	300	$310^{\pm 0.2}$	100	160	77	60	M20	100	150	M52 M52-LH	80	36.7	Nodular cast iron	Steel	ROSTA blue painted

n_s = max. revolutions by oscillation angle ±5°; if osc. angle is below, higher rpm's are applicable, consult "permissible frequencies" in the Technology part of the ROSTA general catalogue.

$F_{max.}$ ➔ Calculation of the acceleration force F on page 2.22.

Length of driving rod A_{ST} and eccentric radius R

To follow the guidelines of the permissible frequencies the angle of oscillation α_{ST} should not exceed ±5.7°. This angle is corresponding to the ratio R : A_{ST} of 1 : 10.



Calculation of the oscillation angle for ST

Eccentric radius R [mm]
Center distance A_{ST} [mm]
Oscillation angle α_{ST} ±[°]

$$\alpha_{ST} = \arcsin\left(\frac{R}{A_{ST}}\right)$$

Installation guidelines

For the installation of the drive heads type ST under the trough-bottom it requires a stiff structure, ideally a heavy and rather long frame construction surrounding the power input from the eccentric drive. Too light and too short mounting structures for the drive heads could be submitted to early material fatigue and generate cracks on the feeding trough. The drive heads have to be installed fully free of play (frictional connection). By multiple power transmission with several drive heads, all driving rods have to be adjusted on exactly the same length. The force transmission from the eccentric drive should stay **right-angled** to the guiding rocker arms. This supports a smooth course of the shaker.

Series connection of 4 pcs. ST 50

Further basic information and calculations on pages 2.22–2.24.