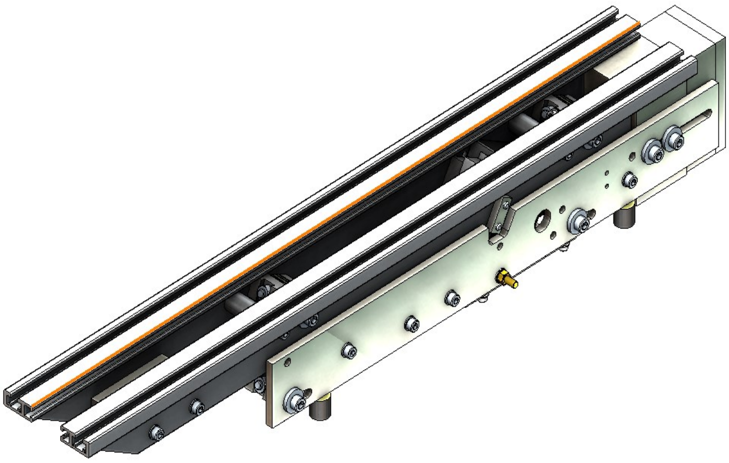
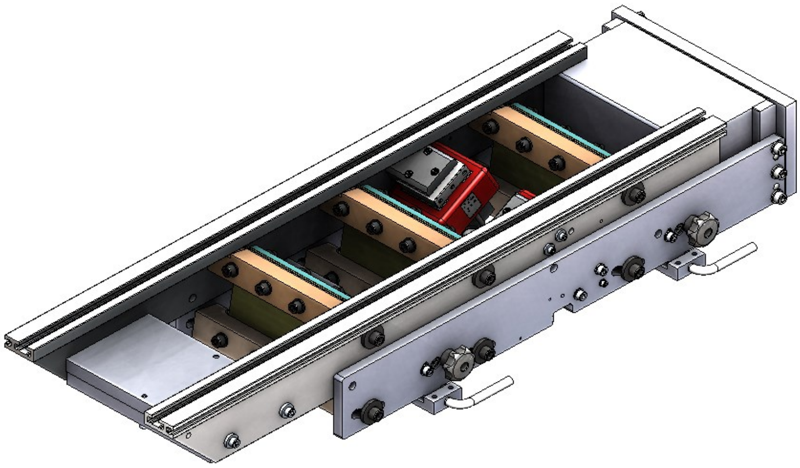




Operating Instructions

Linear feeder

SLL 175
SLL 400
SLL 800
SLL 804
SLF 1000

Table of Contents

Declaration of Conformity

within the meaning of Low-Voltage Directive 2006/95/EC

We hereby declare that the product meets the following requirements:

Low-Voltage Directive 2006/95/EC

Applied harmonised standards: DIN EN 60204 T1

Remarks:

We assume that our product will be incorporated into a stationary machine.

Rhein-Nadel Automation GmbH

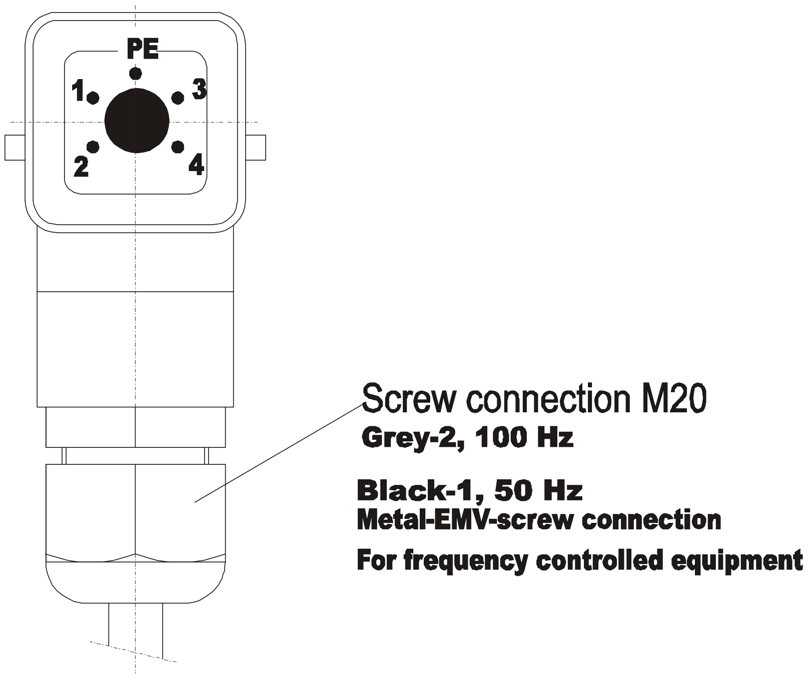
Managing Director
Jack Grevenstein

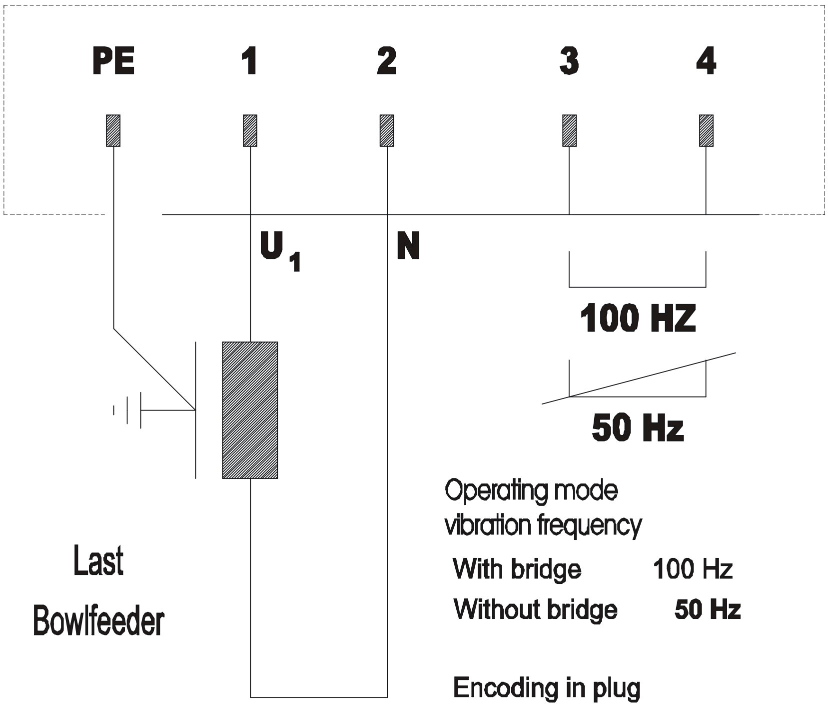
CE

1. Technical data

Notice
All linear feeders listed in this table shall be operated only in conjunction with an RNA controller and with a mains voltage of 230 V / 50 Hz. For special voltages and frequencies please refer to the separate data sheet.

Pin assignment





With jumper: The jumper must be inserted between connections 3 + 4.

Linear feeder SLL 175

Linear Feeder Type	SLL175-175	SLL175-250
Dimensions L x W [2)]x H (mm)	200x62x63	275x62x63
Weight	1.2	1.4
Degree of protection	IP54	IP54
Connecting cable length (m)	1,800	1,800
Power input[1)] (VA)	16	16
Current [1)] (A)	70 mA	70 mA
Nominal magnet voltage [1)] / frequency (V / Hz)	200/50	200/50
Number of magnets	1	1
Magnet type/ Article number	WZAW010 35005804	
Magnet colour	black	
Air gap (mm)	1.0	1.0
Vibration frequency (Hz)	100	
Number of spring packs	2	2
Standard spring set Total number of springs (all spring packs)	1x1.25 / 1x1.5/ 1x1.0 / 1x0.75	2x1.25 / 1x1.5/ 1x1.0 / 1x0.75
Spring dimensions (mm) Length (borehole gauge) x width (borehole gauge)	44.3 (35) x 26.7 (12)	44.3 (35) x 26.7 (12)
Spring thickness (mm)	0.75 - 1.5	0.75 - 1.5
Property classes of spring fastening bolts	8.8	8.8
Tightening torque of spring fastening bolts	3.5 Nm	3.5 Nm
Tightening torque of lateral spring fastening bolts	3.5 Nm	3.5 Nm
Max. weight of linear rail, depending on mass moment of inertia and desired feeder speed	1300 g	1500 g
Maximum rail length (mm)	325	400
Max. useful weight of the linear feeder unit, depending on mass moment of inertia and desired feeder speed	400 – 500 g	500 – 600 g

Linear feeder SLL 400

Linear Feeder Type	SLL 400 - 400	SLL 400 - 600	SLL 400 - 800	SLL 400-1000
Dimensions L x W [2)]x H (mm)	430 x 84 x 103	630 x 84 x 103	830 x 84 x 103	1030x84x103
Weight	6.5	8	10	12.5
Degree of protection	IP 54	IP 54	IP 54	IP 54
Connecting cable length (m)	1.5	1.5	1.5	1.5
Power input[1)] (VA)	120	120	120	120
Current [1)] (A)	0.6	0.6	0.6	0.6
Nominal magnet voltage [1)] / frequency (V / Hz)	200 / 50	200 / 50	200 / 50	200 / 50
Number of magnets	1	1	1	1
Magnet type/ Article number	WZAW 040 35000760			
Magnet colour	black			
Air gap (mm)	1.0	1.0	1.0	1.0
Vibration frequency (Hz)	100 Hz			
Number of spring packs	2	2	3	4
Standard spring set Total number of springs (all spring packs)	2 x 2.0 3 x 3.0	2 x 2.0 4 x 3.0	2 x 2.0 4 x 3.0	3 x 2.0 5 x 3.0
Spring dimensions (mm) Length (borehole gauge) x width (borehole gauge)	70 (56) x 40 (18)	70 (56) x 40 (18)	70 (56) x 40 (18)	70 (56) x 40 (18)
Spring thickness (mm)	2.0 and 3.0	2.0 and 3.0	2.0 and 3.0	2.0 and 3.0
Property classes of spring fastening bolts	8.8	8.8	8.8	8.8
Tightening torque of spring fastening bolts	12.5 Nm	12.5 Nm	12.5 Nm	12.5 Nm
Tightening torque of lateral spring fastening bolts	12.5 Nm	12.5 Nm	12.5 Nm	12.5 Nm
Max. weight of linear rail, depending on mass moment of inertia and desired feeder speed	approx. 5 kg	approx. 6 kg	approx. 7 kg	approx. 8 kg
Maximum rail length (mm)	700	900	1,100	1,300
Max. useful weight of the linear feeder unit, depending on mass moment of inertia and desired feeder speed	1.5 - 2 kg	1.5 - 2 kg	1 - 1.5 kg	1 - 1.5 kg

Linear feeder SLL 800

Linear Feeder Type	SLL 800 - 800	SLL 800 - 1000	SLL 800 - 1200	SLL 800 - 1400
Dimensions L x W [2)]x H (mm)	850 x 120 x 162	1,050 x 120 x 162	1,250 x 120 x 162	1,450 x 120 x 162
Weight	18.5 kg	20.5 kg	23.5 kg	24.0 kg
Degree of protection	IP 54	IP 54	IP 54	IP 54
Connecting cable length (m)	2	2	2	2
Power input[1)] (VA)	251	251	251	251
Current [1)] (A)	1.26	1.26	1.26	1.26
Nominal magnet voltage [1)] / frequency (V / Hz)	200 / 50	200 / 50	200 / 50	200 / 50
Number of magnets	1	1	1	1
Magnet type/ Article number	YZAW 080 35000763			
Magnet colour	red			
Air gap (mm)	3.0	3.0	3.0	3.0
Vibration frequency (Hz)	50 Hz			
Number of spring packs	2	2	2	2
Standard spring set Total number of springs	1 x 2.5 5 x 3.5	1 x 2.5 5 x 3.5	1 x 2.5 6 x 3.5	1 x 2.5 6 x 3.5
Spring dimensions (mm) Length (borehole gauge) x width (borehole gauge)	108 (90) x 55 (25)	108 (90) x 55 (25)	108 (90) x 55 (25)	108 (90) x 55 (25)
Spring thickness (mm)	2.5; 3.5	2.5; 3.5	2.5; 3.5	2.5; 3.5
Property classes of spring fastening bolts	8.8	8.8	8.8	8.8
Tightening torque of spring fastening bolts	30 Nm	30 Nm	30 Nm	30 Nm
Tightening torque of lateral spring fastening bolts	30 Nm	30 Nm	30 Nm	30 Nm
Max. weight of linear rail, depending on mass moment of inertia and desired feeder speed	approx. 11 kg	approx. 13 kg	approx. 15 kg	approx. 17 kg
Maximum rail length (mm)	1,100	1,300	1,500	1,700
Max. useful weight of the linear feeder unit, depending on mass moment of inertia and desired feeder speed	4 - 8 kg	4 - 8	6 - 10	6 - 10

Linear Feeder Type	SLL 800 - 1600	SLL 800 - 1800	SLL 800 - 2000
Dimensions L x W [2)]x H (mm)	1,650 x 120 x 162	1,850 x 120 x 162	2,050 x 120 x 162
Weight	31.5	34.0	39.5
Degree of protection	IP 54	IP 54	IP 54
Connecting cable length (m)	2	2	2
Power input[1)] (VA)	251	251	251
Current [1)] (A)	1.26	1.26	1.26
Nominal magnet voltage [1)] / frequency (V / Hz)	200 / 50	200 / 50	200 / 50
Number of magnets	1	1	1
Magnet type/ Article number	YZAW 080 35000763		
Magnet colour	red		
Air gap (mm)	3.0	3.0	3.0
Vibration frequency (Hz)	50 Hz		
Number of spring packs	3	3	3
Standard spring set Total number of springs	2 x 2.5 7 x 3.5	2 x 2.5 7 x 3.5	2 x 2.5 9 x 3.5
Spring dimensions (mm) Length (borehole gauge) x width (borehole gauge)	108 (90) x 55 (25)	108 (90) x 55 (25)	108 (90) x 55 (25)
Spring thickness (mm)	2.5; 3.5	2.5; 3.5	2.5; 3.5
Property classes of spring fastening bolts	8.8	8.8	8.8
Tightening torque of spring fastening bolts	30 Nm	30 Nm	30 Nm
Tightening torque of lateral spring fastening bolts	30 Nm	30 Nm	30 Nm
Max. weight of linear rail, depending on mass moment of inertia and desired feeder speed	approx. 19 kg	approx. 21 kg	approx. 23 kg
Maximum rail length (mm)	1,900	2,100	2,300
Max. useful weight of the linear feeder unit, depending on mass moment of inertia and desired feeder speed	6 - 10 kg	6 - 10 kg	6 - 10 kg

Linear feeder SLL 804

Linear Feeder Type	SLL 804 - 800	SLL 804 - 1000	SLL 804 - 1200	SLL 804 - 1400
Dimensions L x W 2)x H (mm)	850 x 120 x 172	1,050 x 120 x 172	1,250 x 120 x 172	1,450 x 120 x 172
Weight	21.5	24.5	27.5	29.5
Degree of protection	IP 54	IP 54	IP 54	IP 54
Connecting cable length (m)	2	2	2	2
Power input1) (VA)	251	251	251	251
Current 1) (A)	1.26	1.26	1.26	1.26
Nominal magnet voltage 1) / frequency (V / Hz)	200 / 50	200 / 50	200 / 50	200 / 50
Number of magnets	1	1	1	1
Magnet type/ Article number	YZAW 080 35000763			
Magnet colour	red			
Air gap (mm)	3.0	3.0	3.0	3.0
Vibration frequency (Hz)	50 Hz			
Number of spring packs	2	2	2	2
Standard spring set Total number of springs	1 x 2.5 6 x 3.5	2 x 2.5 5 x 3.5	4 x 2.5 6 x 3.5	2 x 2.5 8 x 3.5
Spring dimensions (mm) Length (borehole gauge) x width (borehole gauge)	108 (90) x 55 (25)	108 (90) x 55 (25)	108 (90) x 55 (25)	108 (90) x 55 (25)
Spring thickness (mm)	2.5 / 3.5	2.5 / 3.5	2.5 / 3.5	2.5 / 3.5
Property classes of spring fastening bolts	8.8	8.8	8.8	8.8
Tightening torque of spring fastening bolts	30 Nm	30 Nm	30 Nm	30 Nm
Tightening torque of lateral spring fastening bolts	30 Nm	30 Nm	30 Nm	30 Nm
Max. weight of linear rail, depending on mass moment of inertia and desired feeder speed	21 kg	25 kg	28 kg	32 kg
Maximum rail length (mm)	1,100	1,300	1,500	1,700
Max. useful weight of the linear feeder unit, depending on mass moment of inertia and desired feeder speed	12 - 15 kg	12 - 15 kg	12 - 15 kg	12 - 15 kg

Linear Feeder Type	SLL 804 - 1600	SLL 804 - 1800	SLL 804 - 2000
Dimensions L x W 2)x H (mm)	1,650 x 120 x 172	1,850 x 120 x 172	2,050 x 120 x 172
Weight	39.5	43.0	49.5
Degree of protection	IP 54	IP 54	IP 54
Connecting cable length (m)	2	2	2
Power input1) (VA)	502	502	502
Current 1) (A)	2.51	2.51	2.51
Nominal magnet voltage 1) / frequency (V / Hz)	200 / 50	200 / 50	200 / 50
Number of magnets	2	2	2
Magnet type/ Article number	YZAW 080 35000763		
Magnet colour	red		
Air gap (mm)	3.0	3.0	3.0
Vibration frequency (Hz)	50 Hz		
Number of spring packs	3	3	3
Standard spring set Total number of springs	4 x 2.5 9 x 3.5	4 x 2.5 9 x 3.5	4 x 2.5 11 x 3.5
Spring dimensions (mm) Length (borehole gauge) x width (borehole gauge)	108 (90) x 55 (25)	108 (90) x 55 (25)	108 (90) x 55 (25)
Spring thickness (mm)	2.5; 3.5	2.5; 3.5	2.5; 3.5
Property classes of spring fastening bolts	8.8	8.8	8.8
Tightening torque of spring fastening bolts	30 Nm	30 Nm	30 Nm
Tightening torque of lateral spring fastening bolts	30 Nm	30 Nm	30 Nm
Max. weight of linear rail, depending on mass moment of inertia and desired feeder speed	36 kg	40 kg	44 kg
Maximum rail length (mm)	1,900	2,100	2,300
Max. useful weight of the linear feeder unit, depending on mass moment of inertia and desired feeder speed	12 - 15 kg	12 - 15 kg	12 - 15 kg

Linear Feeder Type	**SLL 804 - 2400**	**SLL 804 - 2800**
Dimensions L x W [2)]x H (mm)	2,450 x 120 x 172	2,850 x 120 x 172
Weight	63	76
Degree of protection	IP 54	IP 54
Connecting cable length (m)	2	2
Power input[1)] (VA)	502	502
Current [1)] (A)	2.51	2.51
Nominal magnet voltage [1)] / frequency (V / Hz)	200 / 50	200 / 50
Number of magnets	2	4
Magnet type/ Article number	YZAW 080 35000763	
Magnet colour	red	
Air gap (mm)	3.0	3.0
Vibration frequency (Hz)	50 Hz	
Number of spring packs	4	4
Standard spring set Total number of springs (all spring packs)	2 x 2.5 14 x 3.5	2 x 2.5 14 x 3.5
Spring dimensions (mm) Length (borehole gauge) x width (borehole gauge)	108 (90) x 55 (25)	108 (90) x 55 (2)
Spring thickness (mm)	2.5; 3.5	2,53,5
Property classes of spring fastening bolts	8.8	8.8
Tightening torque of spring fastening bolts	30 Nm	30 Nm
Tightening torque of lateral spring fastening bolts	30 Nm	30 Nm
Max. weight of linear rail, depending on mass moment of inertia and desired feeder speed	approx. 51 kg	approx. 62 kg
Maximum rail length (mm)	2,700	3,100
Max. useful weight of the linear feeder unit, depending on mass moment of inertia and desired feeder speed	10 - 12 kg	10 - 12 kg

Linear feeder SLF 1000

Linear Feeder Type	**SLF 1000-1000**	**SLF 1000-1500**
Dimensions L x W [2)]x H (mm)	1,100 x 244 x 178	1,600 x 244 x 178
Weight	62	80
Degree of protection	IP 54	IP 54
Connecting cable length (m)	2	2
Power input[1)] (VA)	504	1,004
Current [1)] (A)	2.51	5.0
Nominal magnet voltage [1)] / frequency (V / Hz)	200 / 50	200 / 50
Number of magnets	2	4
Magnet type/ Article number	YZAW 080 35000763	
Magnet colour	red	
Air gap (mm)	2.5	2.5
Vibration frequency (Hz)	50 Hz	
Number of spring packs	2	3 (4)[3]
Standard spring set Total number of springs (all spring packs)	8 x 3.5	12 x 3.5
Spring dimensions (mm) Length (borehole gauge) x width (borehole gauge)	128(108) x 160(2x60)	128(108) x 160(2x60)
Spring thickness (mm)	3.5	3.5
Property classes of spring fastening bolts	8.8	8.8
Tightening torque of spring fastening bolts	60 Nm	60 Nm
Tightening torque of lateral spring fastening bolts	80 Nm	80 Nm
Max. weight of linear rail, depending on mass moment of inertia and desired feeder speed	approx. 40 kg	approx. 70 kg
Maximum rail length (mm)	2,000	2,500
Max. useful weight of the linear feeder unit, depending on mass moment of inertia and desired feeder speed	20 - 30 kg	40 - 50 kg

[1)] For special connected loads (voltage / frequency) see rating plate on the magnet
[2)] Width indication for version b (= breit/wide)

2. Safety directives

We have taken great care in design and manufacture of our linear feeder in order to ensure smooth and safe operation. You, too, can make an important contribution towards safety at work. We therefore ask you to read the brief operating instructions completely prior to commissioning the system. Observe the safety directives at all times!

Make sure that all persons working with or at the equipment also read the following safety directives carefully and follow them!

These Operating Instructions only apply to the equipment types indicated on the cover page.

Notice
This hand indicates useful tips for operation of the linear feeder.

Attention
This warning triangle indicates safety notices. Non-observance of such warnings may cause serious injury or even death.

Machine hazards

- Hazards arise mainly from the electrical components of the linear feeder. If the linear feeder comes into contact with moisture or liquids there is risk of electric shock.
- Make sure that protective earthing of the power supply system is in perfect condition!

Intended use
The intended use of the linear feeder is the driving of feed rails. They serve for linear transfer as well as correctly oriented and metered supply of bulk products.
Intended use also includes observance of the operating instructions and compliance with the maintenance rules.
For the technical data of your linear feeder please refer to 'Technical Data' in Section 1. Make sure that the rating data of the linear feeder, control system and power supply are compatible.

Notice
Operate the linear feeder in perfect condition only.

Never operate the linear feeder in areas subject to explosion hazards or in wet areas.

Operate the linear feeder only in the configuration of drive unit, control unit and vibratory system agreed with the manufacturer.

The linear feeder must never be subjected to any loads other than the parts for which this special type has been rated and dimensioned.

Attention
It is strictly forbidden to disable any guards or safety devices!

Equipment user's duties

- Observe the directives given in the operating instructions for any kind of work (operation, maintenance, repairs, etc.).
- Refrain from any working practice that affects the safety at the linear feeder.
- Make sure that only authorised personnel work at the linear feeder.
- Give immediate notice to the management of any changes that have occurred on the linear feeder affecting safety.

Attention

The linear feeder must be installed, put into operation and maintained by professional personnel only. Observe the legally binding provisions for the qualifications of qualified electrical workers and instructed workers as defined by standards IEC 364 and DIN VDE 0105, part 1.

Caution: Electromagnetic field

Magnetic fields may affect a cardiac pacemaker. Therefore, persons wearing a cardiac pacemaker are recommended to keep a distance of at least 25 cm. Continuous operation of the feeding system is permitted only with the protective enclosure closed.

Noise emission

The noise level at the place of use depends on the complete line into which the hopper will be incorporated and on the material to be conveyed. For this reason, sound pressure levels in accordance with the 'Machinery' directive can only be determined at the place of installation.
If the noise level at the place of use exceeds the permissible, sound-insulating hoods can be installed which we can offer on request.

2.1. Applicable directives and standards

The linear feeder has been manufactured in accordance with the following directives:

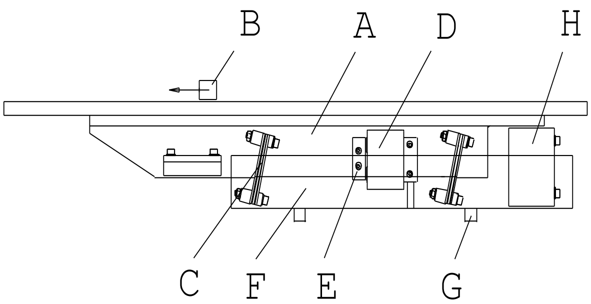
- EC Low-Voltage Directive 2006/95/EC
- EMC Directive 2004/108/EC

We assume that our product will be incorporated into a stationary machine.

The applicable standards are specified in the Declaration of Conformity.

3. Design and functional description of linear feeder

Linear feeder drive units serve to power feeder systems. The driving force is provided by an electromagnet. The figure below is a schematic representation of a linear feeder:



A Feed rail and vibrating mass
B Parts handled
C Spring pack
D Drive magnet
E Armature
F Exciter mass
G Shock absorber
H Counter-balance weight

The linear feeder belongs to the family of vibratory feeders, but produces a straight-line motion. Electromagnetic oscillations are converted into mechanical vibrations that are used for conveying a material B. When current is applied to magnet D which is rigidly connected to counter mass F, the magnet exerts a force which attracts and releases armature E in synchronism with the mains frequency. Within each period of the 50 Hz A.C. mains supply, the magnet will achieve its maximum power of attraction twice as this force builds up independently of the current flow direction. Accordingly, the vibration frequency is 100 Hz in this case. If one half-wave is removed, the vibration frequency is 50 Hz. The vibration frequency of your linear feeder is indicated in the ‘Technical data’ table in Section 1.

A linear feeder is a resonant system (spring-mass system). As a result, its factory set-up will rarely meet your on-site requirements. Section 5 describes in detail how you can adapt the feeder to your specific requirements.
The linear feeder is controlled by a low-loss electronic control unit (type ESG1000 or ESG/ESK2000). The linear feeder controller is supplied loose (not installed). The controller has a 5-pin connector on its front panel for connection to the linear feeder.
For assignment of the socket pins refer to the technical data in Section 1.

Notice

For comprehensive information on the full range of control devices please refer to the 'Control Units' operating instructions.

All control devices have two essential operating elements:

- The **power switch** is used to energize and de-energize the linear feeder.
- A **rotary knob** (or buttons) can be used to set the feed rate of the system.

Frequency controller
Tuning of the linear feeders can also be done by means of frequency controllers. For detailed description of the tuning procedure refer to the frequency controller operating instructions.

4. Shipment and installation

4.1. Shipment

Notice
Take care that the linear feeder cannot collide with other objects and is not subjected to pressure during handling operations.

For the weight of the linear feeder please refer to the table titled 'Technical Data' in Section 1.

4.2. Installation

The linear feeder should be mounted on a stable substructure (available as an accessory) at the point of use. This substructure must be dimensioned to ensure that no vibrations from the linear feeder can be transmitted.

Fix the linear feeder to the shock absorbers (part G in overview drawing of Section 3) from below. Following table gives an overview of the drilling data for the drive units used:

Linear Feeder Type	Length in mm	Width in mm	Shock absorber thread
SLL 175-175	125	37	M3
SLL 175-250	175	37	M3
SLL 400 - 400	200	60	M 4
SLL 400 - 600	300	60	M 4
SLL 400 - 800	450	60	M 4
SLL 400 - 1000	500	60	M 4
SLL 800 - 800	300	83	M 6
SLL 800 - 1000	450	83	M 6
SLL 800 - 1200	600	83	M 6
SLL 800 - 1400	750	83	M 6
SLL 800 - 1600	900	83	M 6
SLL 800 - 1800	1,050	83	M 6
SLL 800 - 2000	1,200	83	M 6
SLL 804 - 800	300	87	M 8
SLL 804 - 1000	450	87	M 8
SLL 804 - 1200	600	87	M 8
SLL 804 - 1400	750	87	M 8
SLL 804 - 1600	900	87	M 8
SLL 804 - 1800	1050	87	M 8
SLL 804 - 2000	1200	87	M 8
SLL 804 - 2400	1500	87	M 8
SLL 804 - 2800	1800	87	M 8
SLF 1000-1000	370	130	M 10
SLF 1000-1500	870	130	M 10

Table: Drilling data

Make sure that the linear feeder cannot touch other devices during operation.
For further details on the control unit (drilling template, etc.), please refer to the separate operating instructions manual of the controller.

5. Commissioning

Attention
Make sure that the machine frame (rack, substructure, etc.) is connected to the protective earth conductor (PE). Protective earthing has to be provided by user as necessary.

Attention
It is imperative that the vibrating motor be connected to the equipotential bonding system of the overall equipment before commissioning.
The adaptation points are marked with earth symbols.
See also: DIN EU 60204 / VDE 0100-540

Attention
Electrical connection of the linear feeder must be made by trained professional electricians only! When making any change to the electrical connection make absolutely sure that the 'Control Units' operating instructions are duly observed.

Verify that

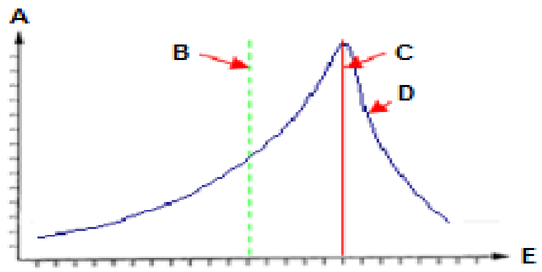
- the linear feeder is arranged freely without contact to any solid body
- the linear rail is properly aligned and firmly bolted in place
- the linear feeder connecting cable is plugged into the control unit.
- The available electricity supply (frequency, voltage, power) corresponds to the connection data of the controller system (see rating plate on controller).
  Plug the cable of the control unit into a power socket and operate the power switch to energize the control unit.

Notice
For linear feeders that are supplied as a completely set-up system the optimum feed rate has been factory-set. It is marked with a red arrow on the dial of the rotary knob. In this case set the rotary knob to this mark.

5.1. Tuning

The following graph shows the resonance curve of a linear feeder. This information is fundamental for understanding the workings of a vibration system which is essentially made up of the vibrating masses, of a **spring constant**, and of the resulting **resonance frequency**. In operation, the **driving frequency of the current** causes the system to vibrate. These vibrations propel the parts to be conveyed at the feed rate (A). In the case of a linear feeder, there are four possibilities to tune the vibration system:

1. Changing the masses of the vibratory unit and the counter mass. This changes the resonance frequency (C)
2. Changing the spring constant by adding or removing springs This changes the resonance frequency (C)
3. The driving frequency can be changed via the frequency controller (point on the curve)
4. Adjustment of spring angle to obtain uniform feeder speed.



A	*Feed rate*
B	*Desired feeder speed*
C	*Resonance frequency of the system*
D	*Resonance curve*
E	*Spring force (number of springs) increasing*

Notice
The resonance frequency of the linear feeder must not coincide with the mains frequency (driving frequency). In most cases, it should be lower than this driving frequency.

When changing springs, take into account that leaves of different thicknesses have different spring forces. As the spring force increases to the square of spring thickness, please note the following examples:

* 2.5 mm spring thickness = 6.25 spring force
* 3.0 mm spring thickness = 9.0 spring force
* 3.5 mm spring thickness = 12.25 spring force

One 3.5-mm thick leaf spring produces approximately the same spring force as two 2.5 mm thick leaf springs. It is always recommended, therefore, to perform the final adjustment / fine-tuning with thin leaf springs.

Notice
Changing the counter mass or the vibrating mass (by adding or removing counterweights or add-on weights) will change the conveying speed or the natural frequency, respectively, of the linear feeder. If necessary, leaf springs must be added or removed.

Optimum tuning is achieved when the desired feed rate is obtained with a controller setting of 80 %. In case of larger deviations (> +/- 15%) you should re-tune the system.
The feeder sizes come factory-equipped with a spring set designed for a feed rail weight that is approx. 25% lower than the maximum rail weight specified in the Technical Data (Section 1), and for a feeder speed of approx. 2 - 6 m/min.
If heavier or lighter feed rails are installed, or if much faster or slower feeder speeds are required, it will be necessary to change either the natural frequency of the vibrating system, or the driving frequency. If you are using a compact controller without frequency control (using 50 Hz mains power) it is mandatory to tune the system mechanically by adding or removing springs.
In conjunction with frequency controllers (such as ESR 2000) it is usually possible to dispense with mechanical tuning by adjusting the driving frequency on the controller.
The fundamentals and procedures of mechanical tuning and of frequency-based tuning are described below.

5.1.1. Mechanical tuning procedure for use with compact controller

If the feed rail assembly or the desired feed rate of a linear feeder deviate significantly from the values stated under Technical Data, or if no frequency control unit is provided, the vibration system is tuned mechanically.
As a first step it is important to determine the current tuning region of the vibration system: either the **natural frequency is less than 100Hz (50 Hz)** or **the natural frequency is higher than 100Hz (50 Hz).** To do this, you must determine the feeder speed (using amplitude stickers) and then remove a counterweight while leaving all other settings/parameters unchanged. Now you must measure the feeder speed again. The result and the procedure to follow are shown in the table below:

Mechanical tuning of the feeder speed

Change after removal of a small counterweight	Location of natural frequency	Feeder speed to be faster	Feeder speed to be slower
Feeder speed slows down	**>** 50 / 100 Hz 'super-critical'	1. Refit the counterweight 2. **Remove** springs	1. Refit the counterweight 2. **Install** springs
Feeder speed increases	**<** 50 / 100 Hz 'sub-critical'	1. Refit the counterweight 2. **Install** springs	1. Refit the counterweight 2. **Remove** springs

Notice
'Super-critical' means that the *resonance frequency* of the vibrating system is *higher* than the frequency of the current
driving the system.
'Sub-critical' means that the *resonance frequency* of the vibrating system is *lower* than the frequency of the current
driving the system.

Notice

The feeder speeds that can be obtained by tuning the system in the 'super-critical' region are lower than the speeds possible in the sub-critical region. In addition, the speed differences between loaded and unloaded feeder are bigger in this case. 'Sub-critical' tuning should be favoured in most cases.

Notice

As a first step, make a rough adjustment of the feeder speed (by tuning the natural frequency). Then tune the feeding behaviour of the system. As the last step, fine-tune the feeder speed (natural frequency).

5.1.2. Tuning procedure for use with frequency-controlled control system

Tuning by adjusting the driving frequencyis also based on the fundamental principle of the resonance curve described in Section 5.

Following procedure is recommended (for systems without vibration amplitude sensor) in most applications:

1. Shipping braces 'X' must be removed and all components of the rail assembly must be properly mounted.
2. Set the A value to approx. 60 % as a preliminary guideline. (Current limiter to P90% max.205V)
3. Set the frequency to 140Hz (70 Hz) and power up.
4. Slowly approach 100Hz (50 Hz) while you continue to monitor/observe the speed all the time.
5. If the magnets hit the armatures you must lower the A value. If very little vibration occurs, increase the A value and repeat the slow, progressive approach.
6. Find the resonance frequency (biggest vibration amplitude) and note it down.

If the driving frequency deviates by more than + 6 Hz/-3Hz from the vibration frequency stated in the operating instructions manual, i.e. 100 Hz (50 Hz), you must install or remove springs.

7. The driving frequency for operation is now set above the determined resonance frequency.
8. Next, the required vibration amplitude (speed) is set via the A value.
   The A value setpoint should be between 70% and 80 %.

Notice

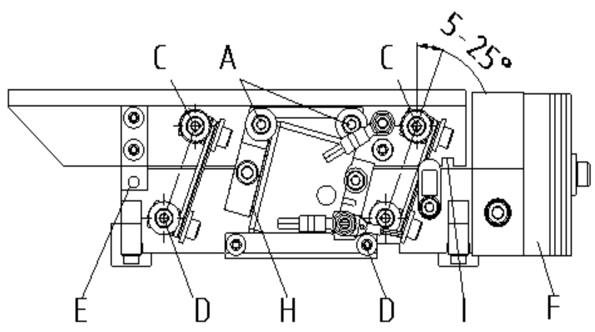
For the tuning procedure of a **vibrating system with amplitude sensor** refer to the operating instructions for the respective controller.

Notice

Be sure never to operate a 100 Hz linear feeder on 50 Hz. The increased current input to the linear feeder may destroy the magnet.

5.1.3. Changing the spring set on linear feeders

Changing the spring set on SLL 175 type linear feeders

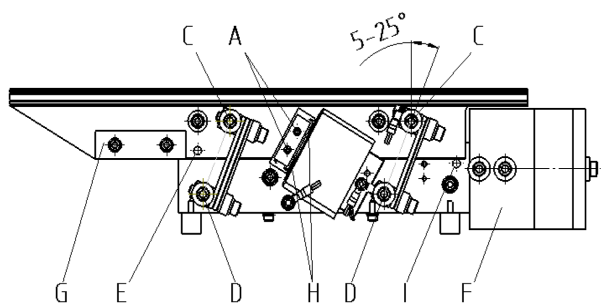


Remove the 4 upper lateral spring fastening screws ‘C’ (M4 DIN 912). Now you can lift out the complete vibratory unit, with feed rail attached. Remove the desired spring pack by loosening the lower lateral spring fastening screws ‘D’ (M4 DIN 912).

In the case of the run-in side spring pack, remove the protective earth conductor from the bottom spring seat before taking out the spring pack.
Screw the removed spring pack into the assembly device for a size 175 spring set and clamp the assembly device into a vise. When adding and removing leaf springs, note that spacers must be inserted between the springs.
If you do not have an assembly device for leaf spring packs, proceed as follows:
Clamp the removed spring pack horizontally in a parallel vise with smooth jaws and perform the requisite adjustments. When tightening each leaf pack, check for parallel alignment. Mutual alignment of the two spring seats is provided by the assembly device. The spring fastening screws must be tightened to a torque of 3.5 Nm.
Refit the complete spring pack.

In order to restore the prior alignment of the linear feeder, adjust the alignment hole relative to the vibratory unit at the upper counter mass end (‘E’) with the aid of a pin (4 mm diameter, minimum length 45 mm).
On the run-in side, adjust the vibratory unit by inserting another pin (4 mm diameter, minimum length 45 mm) into the alignment hole (‘I’) near the counterweight.
Following adjustment of the desired spring angle, you can re-tighten the lateral spring fastening screws to a torque of 3.5 Nm.
Remember to remove the locating pins before re-starting the unit!

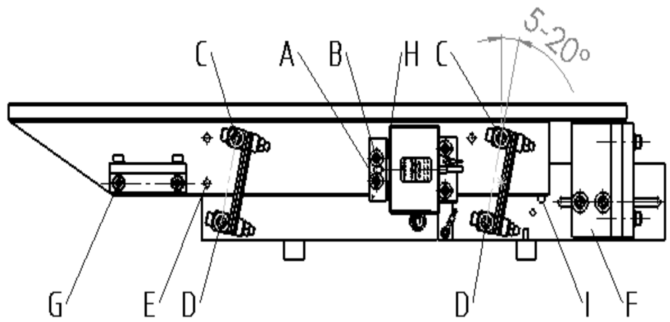
Changing the spring set on SLL 400 type linear feeders



Remove the 4 respectively 6 upper lateral spring fastening screws ‘C’ (M4 DIN 912). Now you can lift out the complete vibratory unit, with feed rail attached. Remove the desired spring pack by loosening the lower lateral spring fastening screws ‘D’ (M6 DIN 912).
In the case of the run-in side spring pack, remove the protective earth conductor from the bottom spring seat before taking out the spring pack.

Screw the removed spring pack into the assembly device for a size 400 spring set and clamp the assembly device into a vise. When adding and removing leaf springs, note that spacers must be inserted between the springs.
If you do not have an assembly device for leaf spring packs, proceed as follows:
Clamp the removed spring pack horizontally in a parallel vise with smooth jaws and perform the requisite adjustments. When tightening each leaf pack, check for parallel alignment.
Mutual alignment of the two spring seats is provided by the assembly device. The spring fastening screws must be tightened to a torque of 12.5 Nm.
Refit the complete spring pack.
In order to restore the prior alignment of the linear feeder, adjust the alignment hole relative to the vibratory unit at the upper counter mass end (‘E’) with the aid of a pin (6 mm diameter, minimum length 70 mm).
On the run-in side, adjust the vibratory unit by inserting another pin (6 mm diameter, minimum length 70 mm) into the alignment hole (‘I’) near the counterweight.
Following adjustment of the desired spring angle, you can re-tighten the lateral spring fastening screws to a torque of 12.5 Nm.
Remember to remove the locating pins before re-starting the unit!

Changing the spring set on SLL 800 and SLL 804 type linear feeders



Remove the bottom armature fastening screw 'A' (M6 DIN 912). Remove the 4 respectively 6 upper lateral spring fastening screws ‘C’ (M8 DIN 912). Now you can lift out the complete vibratory unit, with feed rail attached. Remove the desired spring pack by loosening the lower lateral spring fastening screws ‘D’ (M8 DIN 912).

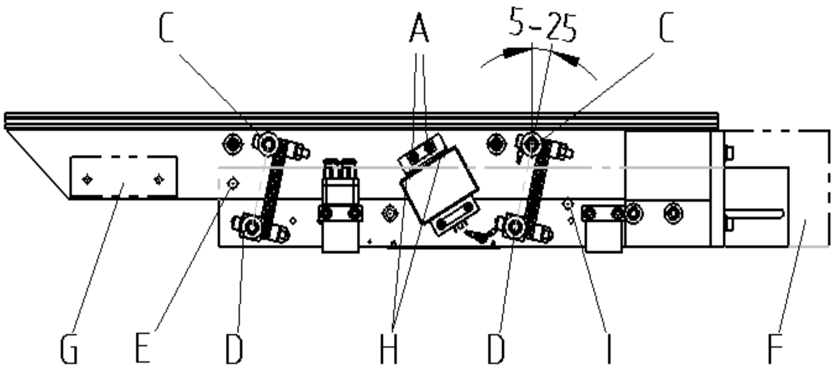
In the case of the run-in side spring pack, remove the protective earth conductor from the bottom spring seat before taking out the spring pack.
Screw the removed spring pack into the assembly device for a size 800 spring set and clamp the assembly device into a vise. When adding and removing leaf springs, note that spacers must be inserted between the springs.
If you do not have an assembly device for leaf spring packs, proceed as follows:
Clamp the removed spring pack horizontally in a parallel vise with smooth jaws and perform the requisite adjustments. When tightening each leaf pack, check for parallel alignment.

Mutual alignment of the two spring seats is provided by the assembly device. The spring fastening screws must be tightened to a torque of 30 Nm.

Refit the complete spring pack.
In order to restore the prior alignment of the linear feeder, adjust the alignment hole relative to the vibratory unit at the upper counter mass end (‘E’) with the aid of a pin (8 mm diameter, minimum length 100 mm).
On the run-in side, adjust the vibratory unit by inserting another pin (8 mm diameter, minimum length 100 mm) into the alignment hole (‘I’) near the counterweight.

Following adjustment of the desired spring angle, you can re-tighten the lateral spring fastening screws to a torque of 30 Nm.
Remember to remove the locating pins before re-starting the unit!

Changing the spring set on SLF 1000 type linear feeders



Remove the 4 upper lateral spring fastening screws ‘C’ (M12 DIN 912). Now you can lift out the complete vibratory unit, with feed rail attached. Remove the desired spring pack by loosening the lower lateral spring fastening screws ‘D’ (M12 DIN 912).
In the case of the run-in side spring pack, remove the protective earth conductor from the bottom spring seat before taking out the spring pack.
Screw the removed spring pack into the assembly device for a size 1000 spring set and clamp the assembly device into a vise. When adding and removing leaf springs, note that spacers must be inserted between the springs.
If you do not have an assembly device for leaf spring packs, proceed as follows:
Clamp the removed spring pack horizontally in a parallel vise with smooth jaws and perform the requisite adjustments. When tightening each leaf pack, check for parallel alignment.
Mutual alignment of the two spring seats is provided by the assembly device. The spring fastening screws must be tightened to a torque of 80 Nm.
Refit the complete spring pack.

In order to restore the prior alignment of the linear feeder, adjust the alignment hole relative to the vibratory unit at the upper counter mass end (‘E’) with the aid of a pin (12 mm diameter, minimum length 210 mm).
On the run-in side, adjust the vibratory unit by inserting another pin (12 mm diameter, minimum length 210 mm) into the alignment hole (‘I’) near the counterweight.

Following adjustment of the desired spring angle, you can re-tighten the lateral spring fastening screws to a torque of 80 Nm.
Remember to remove the locating pins before re-starting the unit!

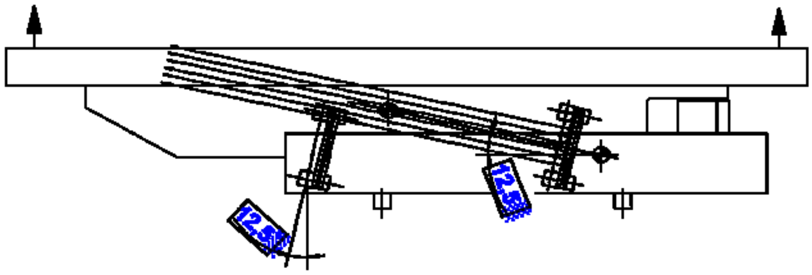
Notice
If the linear feeder mounting plate is designed so that crossbars are situated local to the feet, it is possible to dismount the spring packs one by one from below without removing the feeder mass (moving mass).

Notice
After any work on the spring packs be sure to check the magnet air gap and re-adjust it as necessary.

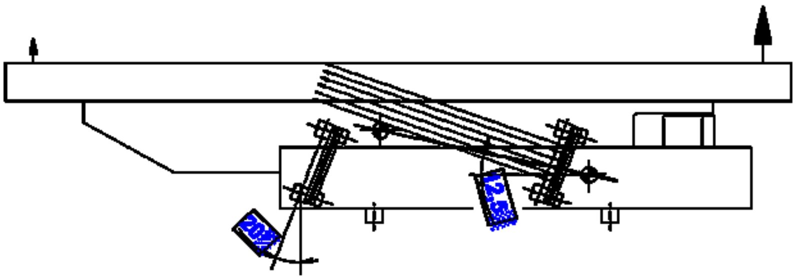
5.1.4. Adjusting the desired feeding behaviour / synchronism of the linear feed rail

For a linear feed rail to operate smoothly and in synchronism, the spring angle must be set to be identical to the centre-of-gravity angle. The centre-of-gravity angle is determined by the locations of the centres of gravity of the vibrating mass and of the counter mass.

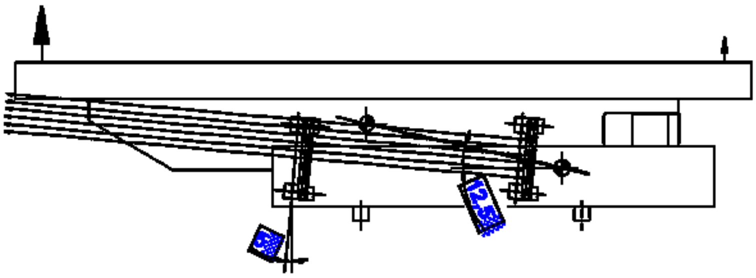
Example based on a centre-of-gravity angle of 12.5 deg.



Spring angle equal to centre-of-gravity angle
The spring force is directed to attack exactly at the vibratory unit's centre of gravity. **Result:** the height amplitude is equal on the run-in and run-out sides.



Spring angle larger than centre-of-gravity angle
The spring force is directed to attack ahead of the vibratory unit's centre of gravity. **Result:** the height amplitude on the run-in side is greater than on the run-out side.



Spring angle smaller than centre-of-gravity angle
The spring force is directed to attack behind the vibratory unit's centre of gravity. **Result:** the height amplitude on the run-in side is smaller than on the run-out side.

If the two angles are not identical, the feed rail will not run smoothly. If the angles deviate very much, the feed rail may even get deflected (vibrate) sideways.

You can adjust the centres of gravity or spring angles, respectively, by the following means:

- Add to, or displace, the counterweight (‘F’)
- Select the rail height and track position so as to improve the location of the centre of gravity.
- Minimize the rail weight as much as possible to keep the vibratory unit's centre of gravity as low as possible.
- Add additional counterweight in the vibratory unit's run-out area (‘G’).
- Adjust the spring angle to match the centre-of-gravity angle.

For type SLL 400 and SLF 1.000 linear feeders you can adjust the spring angle between 5° and 25°, for type SLL800 and SLL 804 linear feeders adjustment is possible between 5° and 20°. If the centre-of-gravity angle lies outside this range, the rail cannot run smoothly and in synchronism. It is necessary in that case to adapt the centres of gravity of the reaction mass and vibrating mass through the measures listed above.

Spring angle adjustment

Fix the vibratory unit relative to the counter mass (see Section 5.1.2. ‘Changing the spring configuration on linear feeders’). You can then loosen the four lateral spring fastening screws (‘C’ + ‘D) so that you can swing the spring pack to the desired spring angle. Now re-tighten the spring fastening screws to the specified tightening torque (see Section 1, ‘Technical Data’) and remove the alignment screws, spacer plate or bolts, respectively.

Adjusting the magnet air gap

The factory setting of the air gap between armature and magnet is indicated in the ‘Technical data’ (Section 1).

Adjustment of this air gap can be performed from the outside without dismounting any components. Slacken the two exterior armature fastening screws very slightly ('A' or 'A' + 'B') (M5 DIN 912 for linear feeder type SLL 400; M6 DIN 912 for linear feeder types SLL 800 and SLL 804, M6 DIN 912 for linear feeder type SLF 1.000, on right and left side). Insert one wire each in the two holes in the vibratory unit's supporting member ‘H'. Use wire with ∅ 1 mm, length 80 mm for SLL 400 (when inserting the wire make sure that it doesn't enter the grooves of the armature); use wire with ∅ 3 mm, length 80 mm for SLL 800 and SLL 804; use wire with ∅ 2.5 mm, length 250 mm for SLF 1.000). Adjust the air gap (see Section 1, ‘Technical Data’) by pressing down the two armature fastening screws against the direction of travel, then tightening them to the specified torque (on SLF 1.000 linear feeders this must be done for both magnets). Pull out the round metal bars. If no round metal bars are on hand, you can adjust the air gap to its specified value from below (possibly after removing the entire linear feeder from its substructure or machine table) using a feeler gauge or shims.

☞ **Notice**
If the rotary knob on the controller is set to 100% and the air gap correctly set, the magnet must not hit the armature upon power-on. If it does, proceed as described under section 5.2. (removal of springs)

Objective of the tuning procedure:
When the desired feeding speed is obtained at a controller setting of 80%, it must increase when a weighting plate is removed.

☞ **Notice**
Make sure that the number of springs per spring pack will not deviate by more than 2 – 3 springs.

6. Feed rail design rules

As the use of aluminium profiles makes the vibratory unit strong enough, the feed rails should be of very lightweight design. Only the rail projections beyond the vibratory unit (max. 100 mm at the entry and max. 200 mm at the exit) must be designed to resist torsional stresses involved. In order to obtain additional resistance to lateral torsion, a one-piece support plate of 10-12 mm thick aluminium should be bolted onto the linear feeder profiles. By changing the profiles of the linear feeder you can obtain the narrow 'S' version or the wide 'B' version.

The higher the feeding speed the higher the clearance should be made between top of product and bottom of feed rail cover. This clearance should be set to the largest acceptable value. When mounting the feed rail observe the following:

- Mount it closely above the top of the vibratory unit.
- Locale as precisely as possible on the aluminium profile center.
- Use stable rigid screws (M5 as a minimum).
- In order to obtain a higher feeding speed the linear feeder can be installed with a slight inclination in feeding direction /about 3 to 5 degrees).
- Never use any loose or hinged covers not firmly bolted in place.

The feed rail may be made up of several short sections to be joined and screwed in place on the vibratory unit. At the entry, flat chamfers assist product transfer from one feed rail section to another.

The split design of several sections is recommended especially for hardened or case-hardened rails (made for low distortion).

Lightweighting of feed rails can be realized by using aluminium strips or profiles. The required wear resistance can then be obtained by segments of hardened spring steel strip bolted in or on.

7. Maintenance

Linear feeders basically require no maintenance. They should be cleaned when soiled or after coming into contact with liquids.

- First pull and tag out the mains plug to prevent accidental activation.
- Clean the inside of the linear feeder (dismount components as necessary), and in particular the air gap between coil and armature.
- After remounting the components and plugging in the mains plug the linear feeder is again ready for operation.

8. Spare parts and customer service

For an overview of genuine spare parts available please refer to the separate spare parts list.
In order to make sure that your order is processed swiftly and correctly please specify the device type (see rating plate), the quantity required, the spare part designation and the spare part number.

For a list of Service Center addresses refer to the back cover page of this manual.

9. What if... (Advice on troubleshooting)

Attention
Only professional electricians are allowed to open the control unit or connector. Pull the mains plug before opening!

If the rail feeding speed or height amplitude is not uniform but rather higher at the exit than at the entry, this indicates that the spring angle is incorrectly set relative to the centre-of-gravity angle (see Section 5.1.3). In this case proceed as follows:

- Increase the spring angle on all spring packs.
- Displace counterweight ‘F’ against part travel direction.
- Fit additional weighting plates to the counterweight.
- Install additional weight 'G' in the vibratory unit's supporting member.

If the rail feeding speed or height amplitude is not uniform but rather higher at the entry than at the exit, this indicates that the spring angle is incorrectly set relative to the centre-of-gravity angle (see Section 5.1.3). In this case proceed as follows:

- Decrease the spring angle on all spring packs.
- Displace counterweight ‘F’ in part travel direction.
- Remove additional weighting plates from the counterweight.
- Remove additional weight 'G' from the vibratory unit's supporting member.

If the rail speed is uniform but the running behaviour is instable and the product jumps too much between rail contact surface and top cover, this indicates that the centre-of-gravity angle and the set spring angle of the overall system and thus the height amplitude is too large. In this case proceed as follows:

- Change the centre-of-gravity angle (more 'flat') by shifting the counterweight 'F' against the feeding direction, attaching additional weighting plates to the counterweight, installing the additional weight into the vibratory unit supporting member and making the feed rail lighter, if necessary.
- Adjust the spring angle to match the new centre-of-gravity angle.

If despite uniform height amplitude the running behaviour is unstable, especially with product having a large contact area or oil-contaminated parts, this indicates that the centre-of-gravity angle and the set spring angle of the entire system is too small. The height amplitude is too small. This prevents the throwing motion and in case of oily product the adhesive force is higher than the throwing force, i.e. the product cannot take off. In this case proceed as follows:

- Change the centre-of-gravity angle (more 'steep') by shifting the counterweight 'F' in feeding direction, removing weighting plates from the counterweight and removing the additional weight from the vibratory unit supporting member.
- Adjust the spring angle to match the new centre-of-gravity angle.

If it is impossible to set-up the feed rail properly by following the above procedures and if lateral oscillation occurs or 'dead spots' are found in certain areas, then the stiffness of the rail is insufficient. The abutment joints move relative to one another or non-symmetric rail sections lead to non-uniform running behaviour. In this case proceed as follows:

- Fit additional reinforcing ribs and screw abutment joints together.
- Counter-balance non-symmetric sections by weights or replace by material lighter in weight.

Fault	Potential cause	Remedy
Linear feeder does not start on power up	Power switch off Mains connector of control unit not plugged-in Connecting cabled between linear feeder and control unit not plugged-in Defective fuse in control unit	Close power switch Plug in the mains connector Plug 5-pin connector into control unit Replace fuse
Only slight feeder vibration 	Rotary knob on controller set at 0 % Shipping locks or braces not removed Wrong vibration frequency **Attention** **If you operate the type SLL 400 linear feeder without having inserted the jumper in the 5-pin connector, there is a risk of damage to the controller and magnet!**	Set controller to 80 % Remove shipping locks or braces. Check that coding in plug connector of the linear feeder is correct (see rating plate and 'Technical Data' (Section 1))
The linear feeder no longer meets the required feed rate after prolonged operation.	Fixing screws of linear rail have come loose. Screws of one or more spring packs have come loose. Misadjusted coil-to-armature gap Vibratory unit displaced towards the counter mass	Re-tighten the screws Tighten screws (for tightening torques see 'Technical Data' in Section 1). Readjust the air gap (for gap size see 'Technical Data' in Section 1). Re-adjust the vibratory unit (see Section 5).
Linear feeder makes loud noises	Foreign matter in air gap	Stop linear feeder and remove foreign matter. Then check the coil-to-armature gap.
Linear feeder cannot be tuned to a permanently constant feeding speed.	The spring constant of the vibrating system has changed. The linear feeder operates close to the resonance point.	Re-tune the linear feeder. Remove springs. See Section 5: Tuning

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