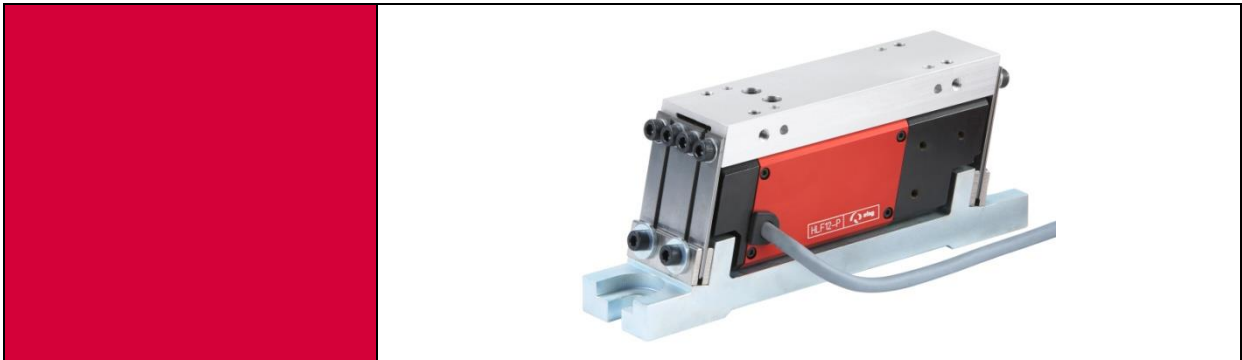


Linear feeder HLF07-P / 12-P



Translation of original instruction manual

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This operation instruction applies to:

Type			Order number
Linear feeder	HLF07-P	230 V / 50 Hz	50162932
Linear feeder	HLF12-P	230 V / 50 Hz	50162933

Version of Documentation: BA_HLF07-12P_R01.3_E
Release: 1.3
Date: 2014-11-06

Following US patents are registered or announced:

- Linear vibratory conveyor (U.S. Patent No.7,784,604)
- Linear vibratory conveyor (U.S. Patent No.8,051,974)

Following Canadian patents are registered or announced:

- Linear vibratory conveyor Hybrid (CA-Patent No.2,636,171)
- Linear vibratory conveyor (CA-Patent No. 2,636,968)

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1 Declaration of incorporation for the incomplete machine

Declaration of incorporation in compliance with the European Machinery Directive 2006/42/EC, Annex II B

The manufacturer: Afag GmbH, Wernher-von-Braun-Strasse 1, D-92224 Amberg

www.afag.com – Phone: +49 (0)9621 650 27-0

herewith declares, that the incomplete machine: **Linear feeder HLF**

Designation: **HLF07-P / HLF12-P**

complies with the basic safety and health requirements of the Machinery Directive **2006/42/EC Annex I**.

The incomplete machine also complies with the following:

Relevant EC Directives:

Machinery Directive 2006/42/EC

Low Voltage Directive 2014/35/EU

EMC Directive 2014/30/EU

Applied harmonised standards:

EN ISO 12100-2010

The technical documentation for this incomplete machine was prepared in accordance with Annex VII, Part B. Upon request, the manufacturer undertakes to transmit these technical documents electronically to national authorities, if requested.

Authorised representative for the compilation of the instruction manual:

Claus Piechatzek

Development / Product Management ZTK

Afag GmbH

The start-up of the incomplete machine is prohibited until installed in a complete machine that complies with the regulations of the EC Machinery Directive and until the EC Declaration of Conformity according to Annex II A is available.

City - Date: Company: Afag GmbH

Amberg, 06.11.2014 Last name / first name

Mr. Klaus Bott



Managing Director

Afag GmbH

2 Safety instructions



2.1 Explanation of symbols and notes


Symbols: Assembly and commissioning must be carried out by qualified personnel only and according to these operating instructions.

Please observe the meaning of the following symbols and notes. They are grouped into risk levels and classified according to ISO 3864-2.

 DANGER	
	<p>Indicates an immediate threatening danger.</p> <p>Non-compliance with this information can result in death or serious personal injuries (invalidity).</p>

 WARNING	
	<p>Indicates a possible dangerous situation.</p> <p>Non-compliance with this information can result in death or serious personal injuries (invalidity).</p>

 CAUTION	
	<p>Indicates a possibly dangerous situation.</p> <p>Non-compliance with this information can result in damage to property or light to medium personal injuries.</p>

NOTE	
	<p>Indicates general notes, useful operator tips and operating recommendations which don't affect safety and health of the personnel.</p>

2.2 Basic safety information

Familiarity with these basic safety rules and regulations constitutes the fundamental prerequisite for safe handling and trouble-free operation of Afag HLF-P linear feeders.

These operating instructions contain the most significant regulations for safe HLF-P operation. These operating instructions - and in particular the safety regulations - must be observed by anyone working on and with the HLF-P. The applicable on-site accident prevention rules and regulations must also be observed. These operating instructions must always be kept handy where the HLF-P is operated.

Operation of the hopper is only to be carried out by technically qualified personnel.

Qualified personnel are deemed to be persons who, by reason of their training, experience and instructions as well as their knowledge of the prevailing standards, regulations, accident prevention regulations and operational conditions, have been authorized by the people responsible for the safety of the system to perform the required activities, and who are capable of recognizing possible hazards and avoiding them (definition of qualified personnel as per IEC 364).

Any malfunctions that may have an adverse effect on the safety of any persons, the HLF-P or other material assets must be eliminated without delay.

The following instructions are not only intended to ensure the personal safety of the operators but also the operation of the products described and the devices connected to them:


2.2.1 Electrical hook up

NOTE





- **Disconnect the power supply prior to assembling or dismantling as well as when changing fuses or carrying out installation modifications.**
- **Observe all current accident prevention and safety regulations applicable to particular cases of operation.**
- **Check whether the rated voltage of the hopper coincides with the local power supply prior to putting into operation.**
- **All E-Stops must remain effective for all modes of operation. Unlocking the E-Stops must not, under any circumstances, cause uncontrolled restarting of the hopper.**
- **The electrical connections must be safeguarded!**
- **Ground wires must be checked for proper function subsequent to assembly!**
- **Hook-up is only to be carried out by authorized personnel.**

2.2.2 Specific danger points

NOTE	
	<p>Afag HLF-P linear feeders are state-of-the-art equipment designed in compliance with the EU Machinery Directive and accepted safety regulations. Nevertheless, however, risks may arise from using this equipment that may endanger life and limb of user or third parties and cause interference with the HLF-P or other material assets.</p>

2.3 Intended use

The HLF-P is intended exclusively for the transporting and buffering of components and can also be used for component sorting. For maximum permissible dimensions and weights of add-on components, observe details in chapter 3.3 Table 1: Technical data, chapter 4 Assembly instructions and chapter 5 Operating instructions. Appropriate use also includes observation of all Notes in these operating instructions.

 WARNING	
	<p>The KLF may <u>not</u> be used:</p> <ul style="list-style-type: none"> a) in damply and wet area b) in temperature lower than 10°C or higher than 45°C c) in areas where readily flammable media are present d) in areas where readily explosive media are present e) in heavy polluted or dust- laden area f) in aggressive area (e.g. saliferous atmosphere)

None modification or reconstruction are allowed. The Tracks (in the chapter 5.1 Feeder track design and in the chapter 4.3 Mounting of the useful mass) as well as the accessories (chapter 7) are excluded from this arrangement.

NOTE	
	<p>Any use other than that described above is deemed to be improper and will cause the warranty to terminate.</p>

Also refer here to our general terms and conditions of sale.

3 Description of the device

3.1 General

Afag Type HLF-P Linear Feeders are used to remove parts from upstream machines and/or feed parts to downstream machines. Afag Linear Feeders are also used for sorting parts, with due consideration of various criteria. Linear feeders are fitted in individual feeding units as well as in complex assembly systems.

The different types of Linear Feeders vary in size and application (see Table 1: Technical data)

NOTE



The HLF-P may only be operated with the Afag Piezo controller PSG-1. The PSG1 is adapted to the specific operating parameters of the Piezo element. Operation with another controller will result in destruction of the Piezo element.

3.2 Functional description

HLF-P devices consist of two oscillating parts arranged on top of each other which oscillate asynchronously. Slotted leaf springs connect these to a common base plate at which the opposing oscillating forces virtually cancel each other out. The oscillating part on top is used as a structure (working weight) for attaching the feeder track. The lower oscillating part is the counterweight.

A Piezo drive unit is mounted horizontally between the two oscillating parts. The favourable characteristics of the HLF-P linear conveyors are based on the high operating frequency which enables smaller amplitudes of oscillation and thus a smoother conveyance with utmost precision. A further advantage of this device is the mass balance between useful mass and opposing mass which eliminates free reactive forces directly at the unit.

3.3 Technical data

Figure 1: Dimensions HLF-P

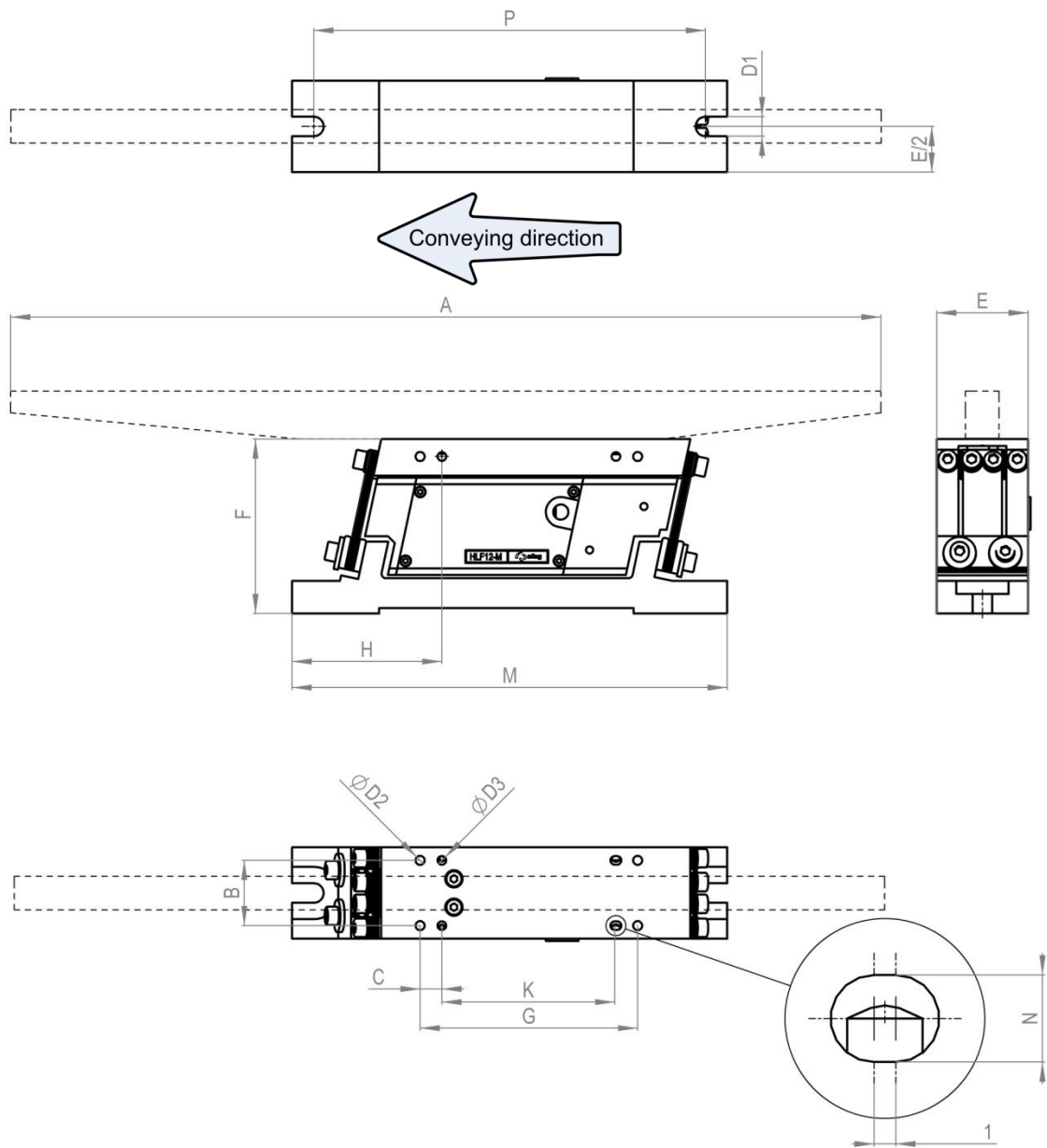


Table 1: Technical data

Description		Units	HLF07-P	HLF12-P
Dimension	A	[mm]	400	500
	B	[mm]	25	30
	C	[mm]	10	10
	D1	[mm]	7	9
	D2	[mm]	4 x M5	4 x M5
	D3	[mm]	2 x 4H7	2 x 4H7
	E	[mm]	36	42
	F	[mm]	73	80
	G	[mm]	80	100
	H	[mm]	50	59
	K	[mm]	60	80
	M	[mm]	170	200
	N	[mm]	2 x 4H7	2 x 4H7
P	[mm]	150	180	
Ideal track weight		[kg]	0,7 ± 0,05	1,2 ± 0,05
Max. track weight		[kg]	1,0	1,4
Weight of basic device		[kg]	1,8	3,0
Mech. osc. frequency		[Hz]	220-240	190-210
Power supply		[V/Hz]	230 V, ±10%, 50 / 60 Hz	
Max. power consumption		[VA]	7,5	7,5
Degree of protection		-	IP 54	
Control device (not in scope of delivery)		-	PSG1	
Temperature range for operation		[C°]	+10 to +45	
Noise emission: Continuous noise pressure level (without transported material)		[dB]	<70	
Measuring height/measuring distance		[m]	1,6/1	
Measurement direction with respect to the noise source		[°]	90	
Measurement method		-	A-evaluation	



Various sizes are available (see Table 1: Technical data) depending on the area of application and available space. The main criterion is the working weight (track length) and the space available for installation.

The Afag Piezo linear conveyors are designed for connection to 230 V, ±10%, 50 / 60Hz. The Afag Piezo controllers PSG-1 are available for controlling the linear conveyors (see chapter 7.2 Control device).

4 Assembly instructions

4.1 Transport

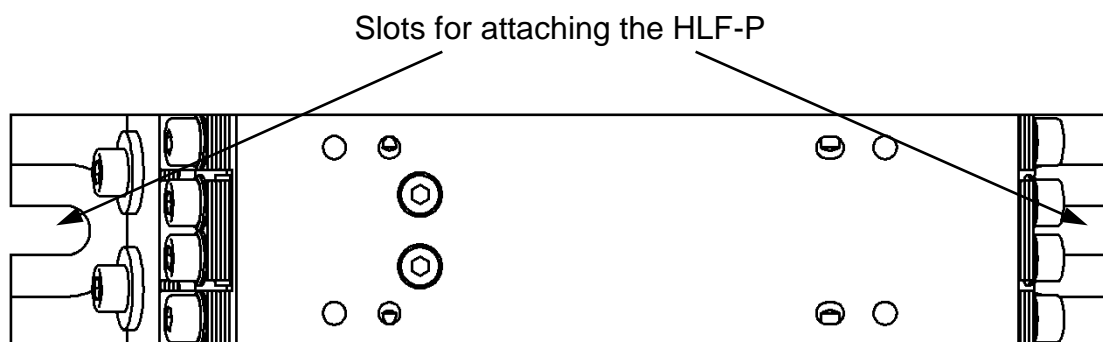
 WARNING	
	<p>Improper use of transport means (industrial trucks, cranes, technical aids, sling gear etc.) may lead to bruises and other injuries.</p> <p>Required behaviour:</p> <ul style="list-style-type: none"> - Observe and follow the transport and maintenance instructions - Proper use of transport means

 CAUTION	
	<p>During transport, the linear feeder must only be held by the base. The linear track is no lifting point.</p>

4.2 Installing the unit

The HLF-P is firmly screwed to the foundation structure by means of slots provided in the base plate (see Figure 2). This precisely defines the interfaces where the feeder track enters and exits as well as allowing adjustment. The substructure should be non-oscillating in a horizontal plane in order to be able to take up any residual forces. Self-supporting profile constructions have to be reinforced with a base plate to which the Linear Feeder is attached. A steel plate of at least 20mm thickness and a width of over 120mm should be used for this purpose. The vertical oscillating forces responsible for energy induction in the foundation structure should be virtually completely eliminated by a careful balance of weights (see chapter 5.2 Balance of weights). Height adjustments can be achieved by means of appropriate substructures. Standard Afag components are available for setting up complete units.

Figure 2: Attachment slots in the base plate



4.3 Mounting of the useful mass

4.3.1 General

The HLF-P Linear Feeder is based on a balance of the oscillating forces by the principle of opposing oscillation (push-pull). In order to ensure an effective balance of oscillating forces, it is necessary to keep the lines of action of the centres of gravity of the working weight and counterweight as close together as possible. The position of the centre of gravity of the counterweight is determined by the Linear Feeder design. The centre of gravity of the working weight is determined by the construction design specified for the working weight (e.g. feeder track). In order to ensure a good balance of oscillating forces with minimum residual oscillation, the overall centre of gravity of the working weight has to be located within the area specified in Table 2: Limiting coordinates for the position of the centre of gravity of the working weight.

Figure 3: Centre of gravity range

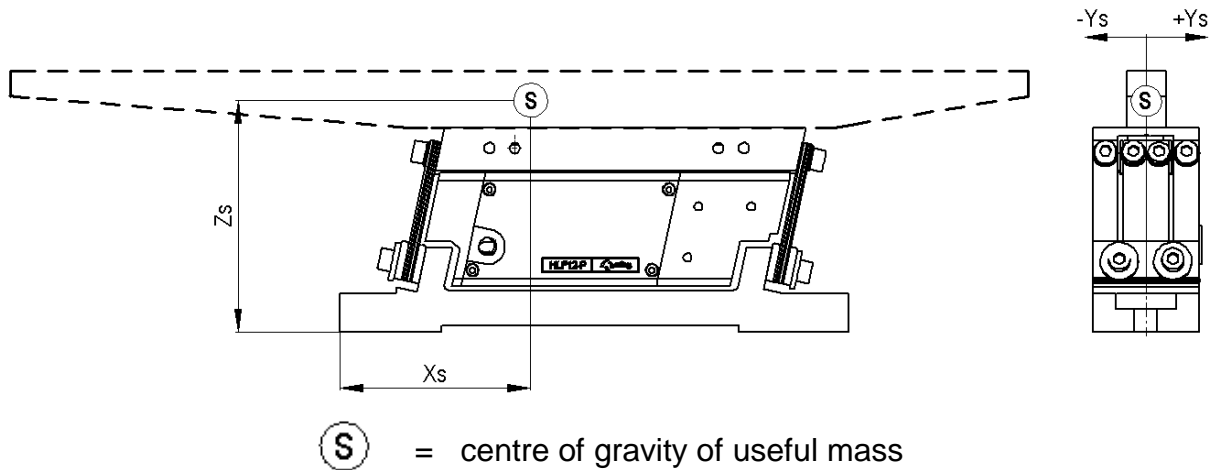


Table 2: Limiting coordinates for the position of the centre of gravity of the working weight

		HLF07-P	HLF12-P
Dimension [mm]	X_S	85 ± 10	105 ± 10
Dimension [mm]	Y_S	0 ± 9	0 ± 10
Dimension [mm]	Z_S	$77 \pm 8,5$	84 ± 11

4.3.2 Mounting a linear track

The feeder track is attached by means of a side plate (see Figure 4). The side plate is fixed precisely and reproducibly using fitting pins. Vertical slits in the side plate are provided for feeder track attachment, allowing fine adjustment of the track entry and exit interfaces in a vertical direction.

Figure 4: Attachment using a side plate O

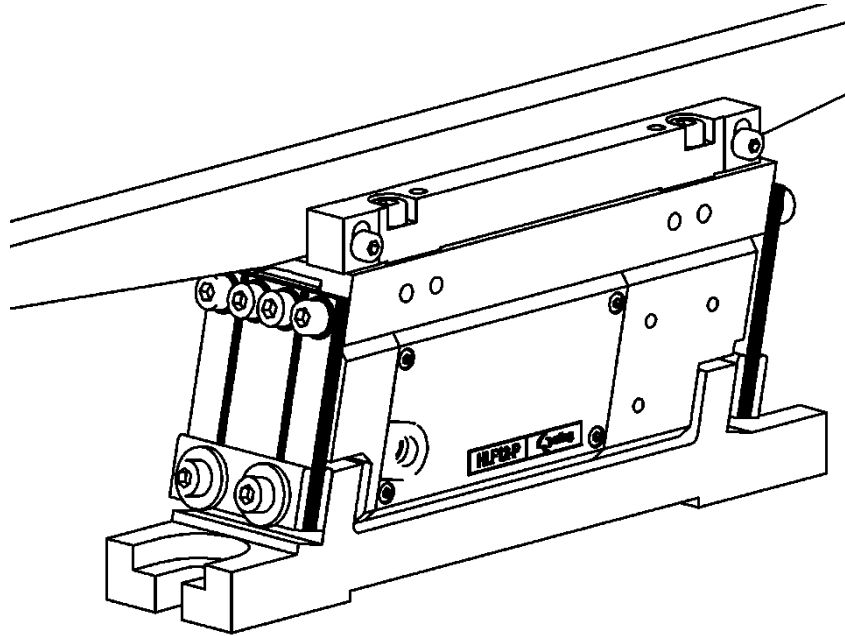
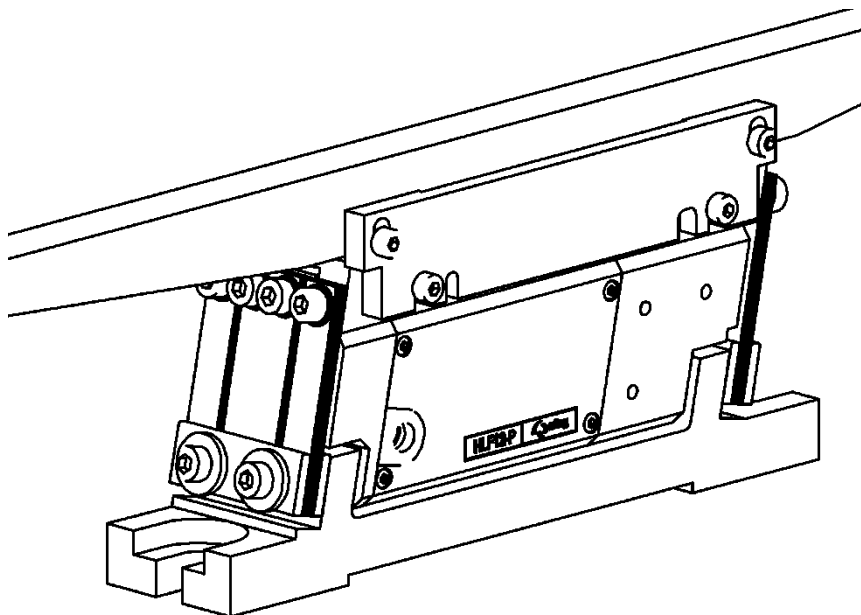


Figure 5: Attachment using a side plate S



HINWEIS



The useful mass has to correspond to the values specified in chapter 5.2 Balance of weights.

5 Operating instructions

The first step in adjusting the linear feeders is always to balance the masses and then to adjust the natural frequency.

5.1 Feeder track design

The linear tracks must be unyielding so that the transport pulses generated by the unit are fully transferred to the work pieces and no superimposed natural vibration can adversely affect the transport process. This requirement has priority over mass reduction measures. The preferred material for linear tracks is tool steel (e.g. 1.2842, 90MnCrV8). Linear track design should adhere to the useful masses specified in chapter 3 Table 1: Technical data and Table 4: Obligatory values for the working weight

The following size ratio should be aimed for with regard to the feeder track cross-section:

$$\frac{Height}{Width} = \frac{2,5}{1}$$

The recommended dimensions are listed in Table 3: *Linear track dimensions*. The dimensions are for one vibrating section and can be applied to each of the two vibrating sections.

Table 3: *Linear track dimensions*

	HLF07-P	HLF12-P
Height [mm]	400	500
Width [mm]	17	17

5.2 Balance of weights

The oscillating forces in the base plate of the Afag Linear Feeder are compensated almost completely due to the principle of opposing oscillations (push-pull). This balance of oscillating forces is however only achieved if:

1. The working weight and the counterweight are balanced as closely as possible. This means that the working weight and the counterweight are equal. The working weights specified for respective sizes are listed in Table 4: below. The working weight is the total weight of all components attached to the mounting plate including the side plate. The balance of weight is verified by simply weighing the working weight.
2. The centre of gravity of the working weight is located in the range represented in Figure 3.

Both conditions have to be taken into consideration at the construction stage of the feeder track. An optimal balance of weight is achieved when almost no residual vibrations can be detected in the substructure.

Table 4: *Obligatory values for the working weight*

Type	Ideal useful mass [kg]	Max. useful mass [kg]
HLF07-P	0,7 ± 0,05	0,9
HLF12-P	1,2 ± 0,05	1,4

NOTE



Useful and counter masses should correspond to the values specified in Table 4: .

NOTE



- 1. Masses are fully balanced if hardly any vibrations are noticeable in the floor.**
- 2. When masses are fully balanced, the transport speeds at useful and counter sides are identical.**



5.3 Piezo control


The Afag Piezo linear conveyor is a spring and mass vibration system and works by taking advantage of the resonance behaviour. Please proceed as follows in order to achieve a stable operating point with the desired conveying capacity when adjusting the control parameters (voltage and operating frequency):

1. Start settings: Voltage 80% and operating frequency according to Table 1: Technical data
2. Find the resonance point by increasing or decreasing the operating frequency from the start setting. The resonance point is at the frequency with the highest amplitude of the vibration system.
3. Set the operating frequency above the resonance point in 0.1 Hz increments depending on the conveying capacity required, i.e. increase the operating frequency from the resonance point until the required conveying capacity is reached. The greater the distance between operating frequency and resonance point, the more insensitive is the operating point to external disturbances.
4. Fine-adjustment of the conveying capacity is possible by changing the voltage. Set the voltage as low as possible in order to save the Piezo.

The same conveying capacity can be reached by different combinations of the operating parameters “voltage” and “operating frequency”. The optimum setting as re-

guards stability, care of the Piezo and mutual influence (with several devices) for the required conveying capacity must be determined depending on the application.

 CAUTION	
	The operating frequency must be higher than the natural frequency of the Piezo linear conveyor. If the operating frequency is the same as the natural frequency, i.e. if the Piezo linear conveyor is operated at the resonance point, the Piezo drive unit will be destroyed in the medium term.

NOTE	
	Readjustment of the conveying speed according to the above diagram can become necessary for new devices 48 hours after start-up.

We recommend to carry out a simple stability test after having set the operating parameters (voltage and frequency): If the running linear conveyor is manually stopped for a short time (external fault), the HLF-P must return automatically to the previously set conveying capacity (amplitude) after it was released again. If this is not the case, the required conveying capacity should be set by selecting other operating parameters (e.g. resonance point: 200.8Hz; previous operating point: 70% / 201.5Hz → new operating point 82% / 202.2Hz); afterwards the stability test should be repeated.

5.4 Several Piezo linear conveyors in one feeder:

If several Piezo linear conveyors are operated on the same base plate / subbase the linear conveyors may interfere with each other. This can be noticed from an unstable conveying capacity or the conveying behaviour of parts in the rail. The interference can be eliminated by operating all linear conveyors at the same operating frequency. The required conveying capacity of the individual HLF-Ps must be guaranteed. This can be achieved by changing the voltage. Please see the following example for more details: Original situation: two HLF-Ps on one base plate with the operating point 70% / 202.4Hz (1st HLF-P) and 82% / 203.0Hz (2nd HLF-P) → new operating points with the same operating frequencies and adapted voltages: 75% / 202.7Hz (1st HLF-P) and 79% / 202.7Hz (2nd HLF-P).

6 Maintenance

A Linear Feeder Type HLF-M is generally maintenance free. After a long time of operation, cold fusion at the contact surfaces of the linear feeder leaf springs can occur. This may have negative influence on oscillation. In this case, replacing leaf springs is necessary. During this procedure, the oscillating parts have to be supported vertically. Only one spring assembly may be removed at a time, since the oscillating parts will be displaced otherwise, and proper function is not guaranteed any more.

 CAUTION	
	The leaf springs must not be oiled or greased as this would make the springs sticky and in turn adversely affect the vibration response.

6.1 Troubleshooting

Conveyor does not run, there is no vibration detectable	
Cause of fault	Fault repair
Connection to the power supply interrupted	Check the connection between drive control unit and control mains adapter
Control unit is switched off <0>	Switch on the control unit <1> or check the jam control signal if a jam control is used
Control unit is defective	Electrical check of the device, use an exchange or a replacement unit
The Piezo is damaged, or destroyed	Replace the Piezo drive unit. Check settings, see Table 1: Technical data and Table 4: Obligatory values for the working weight
Foreign part jammed in the air gap between useful and counter mass.	Remove foreign part
Conveyor runs too slowly, there is no movement recognisable	
Cause of fault	Fault repair
Output frequency of the control unit is set improperly	Set the frequency in the control unit according to the required frequency.
The conveyor rail is not sufficiently fastened to the corresponding drive	Tighten fastening screws, check thread, if necessary
The Piezo is damaged, or destroyed	Replace the Piezo drive unit. Check settings, see Table 1: Technical data and Table 4: Obligatory values for the working weight

Change of the system's natural frequency due to a broken spring	Undo screws of the spring assemblies, check springs, replace broken or damaged springs. CAUTION! Cause for a broken spring is often too high oscillation amplitude. --> Check oscillation amplitude!
The drive is improperly adjusted, i.e. the system's natural frequency does not match the exciting frequency	Adjust the drive by changing the spring stiffness, the position of the adjustment plates or by setting the oscillation frequency with the controller. Tighten the screws of the spring assemblies. CAUTION! Adjust the conveyors according to the operating manual!
Foreign part jammed in the air gap between useful and counter mass.	Remove foreign part
The conveying behaviour is instable, the conveyor speed varies	
Cause of fault	Fault repair
Output frequency of the control unit is set improperly	Set the frequency in the control unit according to the required frequency.
The conveyor rail is not sufficiently fastened to the corresponding drive	Tighten fastening screws, check thread, if necessary
The Piezo is damaged, or destroyed	Replace the Piezo drive unit. Check settings, see Table 1: Technical data and Table 4: Obligatory values for the working weight
Change of the system's natural frequency due to a broken spring	Undo screws of the spring assemblies, check springs, replace broken or damaged springs. CAUTION! Cause for a broken spring is often too high oscillation amplitude. --> Check oscillation amplitude!
The drive is improperly adjusted, i.e. the system's natural frequency does not match the exciting frequency	Adjust the drive by changing the spring stiffness, the position of the adjustment plates or by setting the oscillation frequency with the controller. Tighten the screws of the spring assemblies. CAUTION! Adjust the conveyors according to the operating manual!
Foreign part jammed in the air gap between useful and counter mass.	Remove foreign part
The conveyor transmit vibrations	
Cause of fault	Fault repair
The conveyor rail is not sufficiently fastened to the corresponding drive	Tighten fastening screws, check thread, if necessary
Change of the system's natural frequency due to a broken spring	Undo screws of the spring assemblies, check springs, replace broken or damaged springs. CAUTION! Cause for a broken spring is often too high oscillation amplitude. --> Check oscillation amplitude!
The drive is improperly adjusted, i.e. the system's natural frequency does not match the exciting frequency	Adjust the drive by changing the spring stiffness, the position of the adjustment plates or by setting the oscillation frequency with the controller. Tighten the screws of the spring assemblies. CAUTION! Adjust the conveyors according to the operating manual!

Conveyor rail lifts off or hits	
Cause of fault	Fault repair
The conveyor rail is not sufficiently fastened to the corresponding drive	Tighten fastening screws, check thread, if necessary
Foreign part jammed in the air gap between useful and counter mass.	Remove foreign part
Change of the system's natural frequency due to a broken spring	Undo screws of the spring assemblies, check springs, replace broken or damaged springs. CAUTION! Cause for a broken spring is often too high oscillation amplitude. --> Check oscillation amplitude!
The drive is improperly adjusted, i.e. the system's natural frequency does not match the exciting frequency	Adjust the drive by changing the spring stiffness, the position of the adjustment plates or by setting the oscillation frequency with the controller. Tighten the screws of the spring assemblies. CAUTION! Adjust the conveyors according to the operating manual!

6.2 Wear parts and spare parts

Table 5: *Wear parts*

Type	Designation	Order number
HLF07-P	Leaf spring	50203877
HLF12-P	Leaf spring	50203471
Both	Piezo-drive unit	50256407

7 Accessories

7.1 Mounting parts

Table 6: Order data

Type	Designation	Remark	Order number
HLF07-P	Trimming weight useful mass	Mass: 25 g	50217298
	Trimming weight counter mass	Mass: 15 g	50216944
	Side plate O-07		50197283
	Side plate S-07		50217291
HLF12-P	Trimming weight useful mass	Mass: 50 g	50216719
	Trimming weight counter mass	Mass: 25 g	50216708
	Side plate O-12		50197284
	Side plate S-15		50216714

7.2 Control device

The HLF-P is connected with the controller, type PSG, to the A.C. network 230 V, 50 / 60 Hz. The linear conveyor is operated with the operating frequency set at the controller. Due to the change of the voltage applied and the operating frequency, the amplitude of oscillation and thus the conveyor speed is infinitely variable. The PSG-1 operates with softstart. A detailed description of the controller can be found in the operating instructions of the controller.

Table 7: Controllers for HLF-P - Linear feeder

Type	Power supply	Order number	Comments
PSG1	230V, $\pm 10\%$, 50/60 Hz	50211833	Soft start / stop

7.3 Ordering address

Germany:

Afag GmbH
Wernher-von-Braun-Straße 1
D – 92224 Amberg
Tel.: ++49 (0) 96 21 / 65 0 27-0
Fax: ++49 (0) 96 21 / 65 0 27-490

Sales

sales@afag.com

www.afag.com

Switzerland:

Afag Automation AG
Zuführtechnik
Fiechtenstrasse32
CH – 4950 Huttwil
Tel.: ++41 (0) 62 / 959 86 86
Fax: ++41 (0) 62 / 959 87 87

8 Disposal

HLF-P feeders that are no longer in use should not be disposed of as complete units but dismantled into separate materials and recycled. Non-recyclable components must be disposed of correctly.