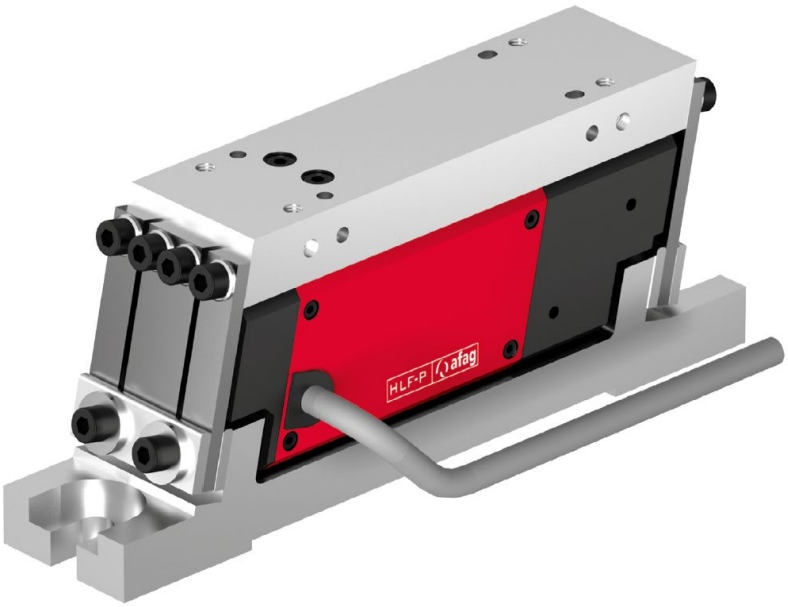
Operating & Installation Instructions

Linear Feeder
HLF07-P / 12-P



Translation of the Original Assembly Instructions EN

- Linear feeder HLF07-P (230 V/50 Hz) ⇨ Order no.: 50260509
- Linear feeder HLF12-P (230 V/50 Hz) ⇨ Order no.: 50259973

Dear Customer

Thank you for choosing our products and placing your trust and confidence in our company!

These operating and installation instructions contain all essential information you need about your product. Our aim is to provide the required information as concisely and clearly as possible. If, however, you still have any questions on the contents or suggestions, please do not hesitate to contact us. We are always grateful for any feedback.

Our team will also be glad to answer any further question you may have regarding the linear feeder or other options.

We wish you every success with our products!

With kind regards

Your Afag team

© Subject to modifications

The linear feeders have been designed by Afag Automation AG according to the state of the art. Due to the constant technical development and improvement of our products, we reserve the right to make technical changes at any time.

Updates of our documentations

Unlike the printed documents, our digital instructions manuals, product data sheets and catalogues are being continuously updated on our website.

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1 General

1.1 Contents and purpose of this manual

These operating and installation instructions contain important information on assembly, commissioning, functioning and maintenance of the linear feeder HLF to ensure safe and efficient handling and operation.

Consistent compliance with these operating instructions will ensure:

- permanent operational reliability of the linear feeders,
- optimal functioning of the linear feeders,
- timely detection and elimination of defects (thereby reducing maintenance and repair costs),
- prolongation of the linear feeder's service life.

The illustrations in this manual shall provide you with a basic understanding of the module and may vary from the actual design of your module.

1.2 Explanation of symbols

The safety notes are marked by a pictogram and a signal word. The safety notes describe the extent of the hazard.

DANGER

Danger!

This safety note indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Warning!

This safety note points out a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Caution!

This safety note points out a potentially dangerous situation which, if not avoided, can result in minor or slight injuries.

NOTICE

This safety note points out a potentially dangerous situation which, if not avoided, can cause substantial damage to property and the environment.

This note contains important additional information as well as useful tips for safe, efficient and trouble-free operation of the linear feeders.

Further warning signs:

Where applicable, the following standardised symbols are used in this manual to point out the various potential health risks.

	Warning - Dangerous electrical voltage.
	Warning - Risk of hand and finger injury due to uncontrolled movements of components.
	Warning - Magnetic field

1.3 Additional symbols

In these assembly instructions the following symbols are used to highlight instructions, results, references, etc..

Symbol	Description
1.	Instructions (steps ...)
⇨	Results of actions
➲	References to sections
■	Enumerations not ordered

1.4 Warranty

The warranty terms for Afag handling components and handling systems are the following:

- 24 months from initial operation and up to a maximum of 27 months from delivery.
- Wear parts are excluded from the warranty (The customer is entitled to a product free of defects. *This does also apply to defective accessories and wear parts. Normal wear and tear are excluded from the warranty.*

The warranty covers the replacement or repair of defective Afag parts. Further claims are excluded.

The warranty shall expire in the following cases:

- Improper use of the module
- Non-observance of the instructions regarding installation, commissioning, operation and maintenance.
- Improper assembly, commissioning, operation and maintenance.
- Repairs and design changes carried out without prior technical instructions of Afag Automation AG
- Removing the serial number from the product
- Non-observance of the EC Machinery Directive, the Accident Prevention Regulations, the Standards of the German Electrotechnology Association (VDE) and these safety and assembly instructions.

1.5 Liability

No changes shall be made to the linear feeders unless described in this manual or approved in writing by Afag.

Afag accepts no liability for unauthorized changes or improper assembly, installation, commissioning, operation, maintenance or repair work.

2 Safety instructions

2.1 General

This chapter provides an overview of all important safety aspects to ensure safe and proper use of the linear feeders and optimal protection of personnel.

Safe handling and trouble-free operation of the linear feeder requires knowledge of the basic safety regulations.

Every person carrying out installation, commissioning, maintenance work or operating the linear feeders must have read and understood the complete user manual, especially the chapter on safety instructions.

Beyond this, there are rules and regulations regarding accident prevention that are applicable to the place of installation which must be observed.

Failure to follow the directions and safety instructions given in this instructions manual may result in serious hazards.

2.2 Intended use

The HLF may only be used for transporting, buffering and arranging parts. Regarding the maximum permissible dimensions and weights of add-on parts, the notes in chapter 3 "Technical data" must be observed.

The following uses of the HLF are considered as improper **use**:

- Use in damp and wet areas.
- Use at temperatures below 10°C or above 45°C.
- Use in areas with highly flammable media.
- Use in areas with explosive media.
- Use in heavily polluted or dusty environments.
- Use in aggressive environment (e.g., salty atmosphere).

The intended use of the module also includes:

- observance of all instructions given in this manual.
- compliance with the inspection and maintenance work and the specifications in the data sheets,
- using only original spare parts.

2.3 Foreseeable misuse

Any use other than or beyond the intended use described above is considered a misuse of the linear feeder.

WARNING

Risk of injury if the HLF is not used for its intended purpose or if it is foreseeable used incorrectly!

The improper use of the HLF poses a potential hazard to the personnel.

- The linear feeders may only be used in a technically perfect condition in accordance with its intended use and the instructions in this manual as well as in compliance with the safety requirements!

2.4 Obligations of the operator and the personnel

2.4.1 Follow these instructions

A basic prerequisite for safe and proper handling of the linear feeders is a good knowledge of the basic safety instructions.

This manual, in particular the safety instructions contained therein, must be observed by all persons working with the linear feeder.

2.4.2 Obligations of the operating company

In addition to the safety instructions given in this manual, the operating company must comply with the safety accident prevention and environmental protection regulations valid for the field of application of the linear feeder.

The operating company is required to use only personnel who :

- have the necessary professional qualifications and experience,
- are familiar with the basic rules regarding occupational safety and accident prevention,
- have been instructed in the correct handling of the linear feeder,
- have read and understood these operating instructions.

The operating company is also required to:

- monitor on an ongoing basis that the personnel work safely considering any potential hazard involved and the assembly instructions are observed,
- ensure that the assembly instructions are always kept at hand at the installation in which the linear feeder is mounted,
- observe and communicate universally applicable laws and regulations regarding accident prevention and environmental protection,
- provide the necessary personal protective equipment (e.g., protective gloves) and instruct the personnel to wear it.

2.4.3 Obligations of the personnel

All personnel working with the modules are required to:

- read and observe these assembly instructions, especially the chapter on safety,
- observe the occupational safety and accident prevention regulations,
- observe all safety and warning signs on the controllers,
- refrain from any activity that might compromise safety and health.

In addition, the personnel must wear the personal protective equipment required for carrying out their work. (➲chap. 2.6).

2.5 Personnel requirements

2.5.1 Personnel qualification

The activities described in the assembly instructions require specific requisites at the level of professional qualifications of the personnel.

Personnel not having the required qualification will not be able to asses the risks that may arise from the use of the linear feeder thus exposing himself and others to the risk of serious injury. Therefore, only qualified personnel may be permitted to carry out the described activities on the linear feeders.

These operating instructions are intended for skilled personnel (installers, system integrators, maintenance personnel, technicians), electricians and operating personnel.

The following is a description of the professional skills (qualifications) required for carrying out the different activities:

Qualified personnel:
Qualified personnel with appropriate training who are qualified due to their special know-how and fully familiar with the machine and who have been given instructions on how to carry out the task entrusted to them safely.

Qualified electrician:
Persons who have obtained their electrical qualifications through appropriate professional training and complementary courses that enables them to identify risks and prevent possible hazards resulting from electricity.

Operator (trained personnel):
Authorized persons who due to their specialized professional training, expertise and experience can identify risks and preventing possible hazards arising from the use of the machine.

2.6 Personal protective equipment (PPE)

The personal protective equipment serves to protect the personnel from hazards affecting their safety and health at work.

When working on/with the linear feeder, the personnel must wear the personal protective equipment assigned by the safety officer of the operating company or as required by safety regulations. In addition, the personnel is required to:

- wear the personal protective equipment Intended company (employer),
- check the personal protective equipment for proper condition, and
- immediately notify the person responsible on site of any defects found on the personal protective equipment.

2.7 Changes & Modifications

No changes may be made to the linear feeders which have not been described in these operating instructions or approved in writing Afag Automation AG.

Excluded from this are the rails stated in ➲ chap. 6.4.1 and ➲ chap. 6.2.3, as well as the accessories specified in ➲ chap. 3.3.

Afag Automation AG accepts no liability for unauthorised changes or improper assembly, installation, commissioning, maintenance or repair work.

The linear feeders may not be changed or modified in any way, except with the prior written consent of Afag.

2.8 General hazards / residual risks

Despite the safe design of the HLF and the technical protective measures taken, there still remain residual risks that cannot be avoided, and which present a non-obvious residual risk when operating the rotary modules.

Observe the safety instructions in this chapter and in the other sections of this manual to avoid damage to property and dangerous situations for the personnel.

2.8.1 General hazards at the workplace

The HLF linear feeder has been built according to the state-of-the-art and the applicable health and safety requirements. However, improper use of the linear feeder may cause the following hazards to the personnel:

- danger to life and limb of the operator or third parties,
- on the HLF themselves,
- property damage.

Always keep the operating instructions ready at hand at the workplace! Please, also observe:

- the general and local regulations on accident prevention and environmental protection,
- the safety information sheet for the linear feeder.

WARNING

Danger - Do not use in unsuitable environment !

The HLF are designed for use in **non-** explosive atmospheres.

- Do **not** use the HLF modules in potentially explosive atmospheres!

CAUTION

Risk of injuries due to uncontrolled parts movements!

When operating the HLF uncontrolled movements may occur which can cause personal injury or property damage.

- Only qualified personnel may work with or on the HLF.
- Read this manual carefully before carrying out any work on or with the HLF.

2.8.2 Danger due to electricity

WARNING

Danger! Risk of electric shock!

If work on electrical components is required, ensure that the work is carried out properly, failure to do so will cause serious or fatal injuries.

- Work on the machine's electrical equipment may only be performed by skilled electrician or trained personnel under the supervision of a skilled electrician in accordance with all relevant electrical regulations.

2.8.3 Hazards due to strong alternating magnetic fields

DANGER

Danger due to alternating magnetic fields!

The alternating magnetic fields occurring in the immediate vicinity of the HLF07-P/ HLF12-P can affect the proper functioning of e.g. pacemakers and defibrillators.

Persons with a pacemaker must keep a **safety distance** of **at least 10 cm**.

2.8.4 Mechanical hazards

CAUTION

Danger of injury by moving components!

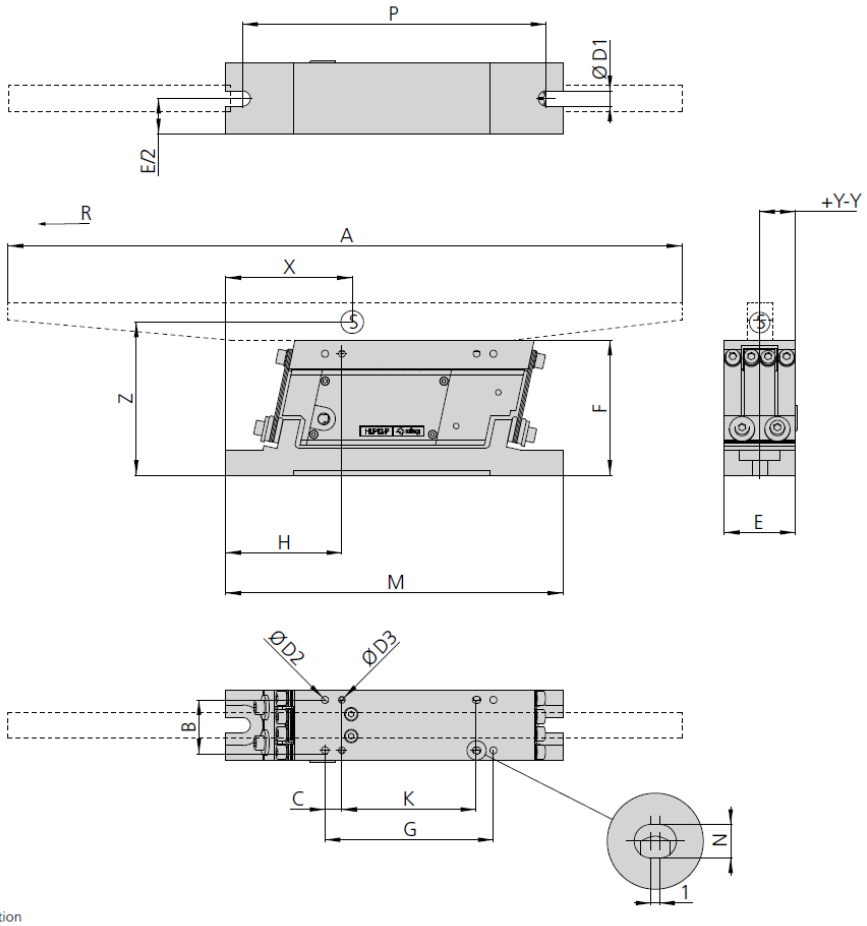
Limbs can be crushed by moving components!

- Work on and with the HLF may only be carried out by qualified personnel.
- Never reach into the system during normal operation!

3 Technical data

3.1 Dimensional drawing HLF-P

Type	HLF07-P	HLF12-P
A	300 mm	400 mm
B	25 mm	30 mm
C	10 mm	10 mm
D1	7 mm	9 mm
D2	4 x M5	4 x M5
D3	2 x 4 H7	2 x 4 H7
E	36 mm	42 mm
F	73 mm	80 mm
G	80 mm	100 mm
H	60 mm	69 mm
K	60 mm	80 mm
M	170 mm	200 mm
N	4 mm	4 mm
P	150 mm	180 mm
X	85 ± 10 mm	105 ± 10 mm
Y	0 ± 9 mm	0 ± 10 mm
Z	77 ± 8,5 mm	84 ± 11 mm



R = Feeding direction
S = Track center of gravity

Fig. 1 Dimensional drawing HLF-P

3.2 Technical data HLF-P

HLF-P	
Operating temperature	10 - 45 ° C

Type	HLF07-P	HLF12-P
Order number	**50260509**	**50259973**
Mechanical vibration frequency	220 - 240 Hz	190 - 210 Hz
Mains connection (mains voltage/mains frequency)	230 V/50 Hz	230 V/50 Hz
Max. power consumption	23 VA	23 VA
Net weight	1.8 kg	2.7 kg
Feed rail weight (ideal)	0.7 ± 0.1 kg	1.2 ± 0.1 kg
Max. feeder speed	7 m/min	7 m/min
Reactive force compensation	•	•
Protection type	IP 51	IP 51

Note: • = existent
Track not included in scope of supply.

3.3 Accessories

3.3.1 Mounting parts

Type	Designation	Note	Order Number
HLF07-P	Trimming weight NM07	Weight: 25 g	50217298
	Trimming weight GM07	Weight: 15 g	50216944
	Side plate O-07	-	50197283
	Side plate S-07	-	50217291
HLF12-P	Trimming weight NM12	Weight: 50 g	50216719
	Trimming weight GM12	Weight: 25 g	50216708
	Side plate O-12	-	50197284
	Side plate S-15	-	50216714

3.3.2 Controller

Type	Power supply	Order Number	Note
PSG1	230V, ±10%, 50/60 Hz	50211833	Soft start/soft stop

For more information on the controller, see ➲ chap. 6.3 and the controller manufacturer's instructions.

4 Transport, packaging and storage

4.1 Safety instructions

CAUTION

Danger of injury due to improper transport equipment!

The improper use of transport equipment such as industrial trucks, overhead cranes, slings can lead to injuries (e.g., crushing!)

- Observe transport and assembly instructions.
- Use the means of transport properly!

NOTICE

Damage to property due to improper lifting!

The linear feeder must not be lifted at the conveyor rail! Using the conveyor rail as a lifting point can damage the linear feeder!

- Lift the linear feeder by the base only!

The linear feeders are packed in the original packaging (cardboard box). Carefully remove the linear feeder from the original packaging.

4.2 Scope of supply

The corresponding documentation is supplied with each linear feeder (e.g., operating and installation instructions, etc.).

Fig. 2 Scope of delivery HLF-P

[Unt]	Designation
1 x	Linear feeder HLF-P
1 x	Operating and installation instructions

4.3 Transport

No liability can be assumed for damages caused by improper installation on the part of the operating company.

The following conditions must be complied with for transport and storage:

- Storage temperature: 0-50 °C
- Relative air humidity: < 90%, non condensing

4.4 Packaging

The linear feeder is transported in the Afag Automation AG transport packaging. If no Afag packaging is used, the linear feeder must be packed in such a way that it is protected against shocks and dust.

NOTICE

Risk to the environment due to incorrect disposal of the packaging material

Environmental damage can be caused by incorrect disposal of the packaging material.

- Dispose of the packaging material in an environmentally sensitive way in accordance with the local environmental regulations.

4.5 Storage

If the linear feeder is stored for an extended period, observe the following:

- Store the linear feeder in the transport packaging.
- Do not store the telescope spindle axes outdoors or expose them to weather conditions.
- The storage space must be dry and dust free.
- Room temperature of the storage space: 0-50 °C.
- Relative air humidity: < 90% non condensing.
- Protect the linear feeder from dirt and dust.

5 Design and description

5.1 Structure of the HLF-P linear feeder

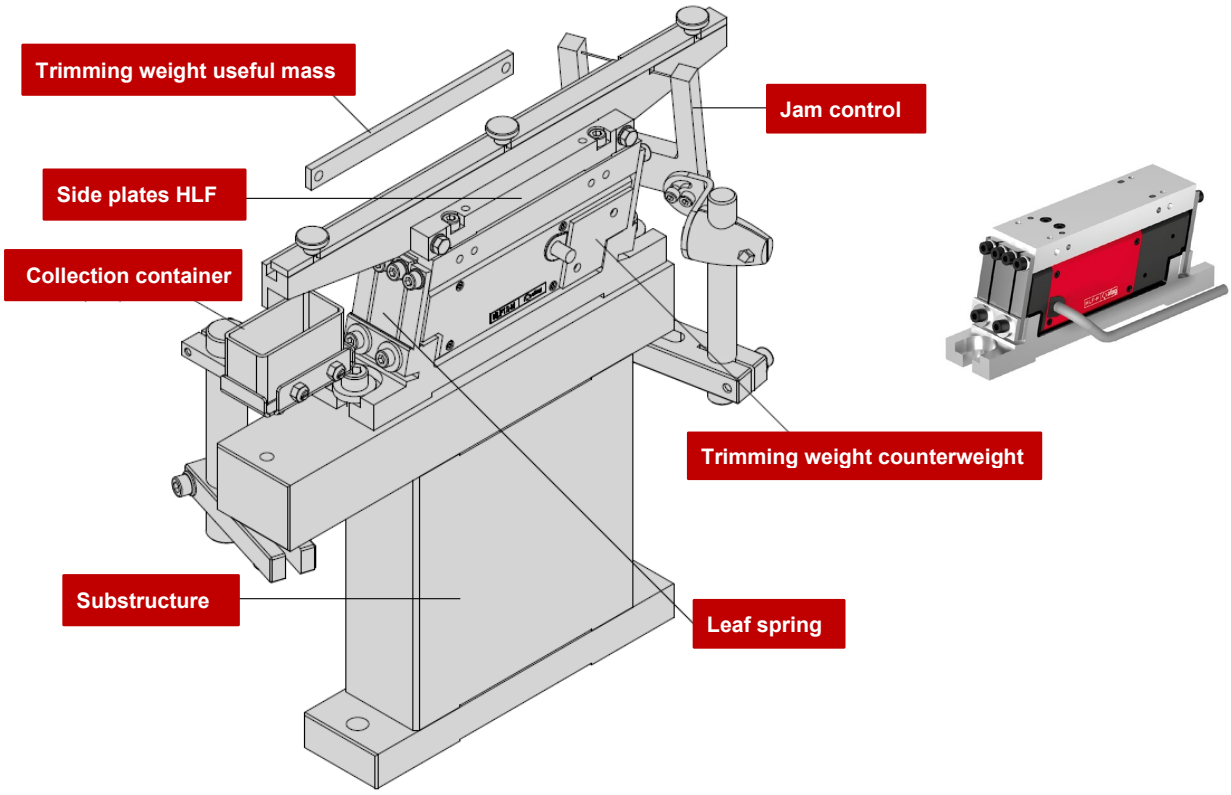


Fig. 3 Design of the HLF-P

5.2 Description of the HLF-P linear feeder

The Afag linear feeders of the HLF-P type are used to transport parts from upstream machines and/or feed parts to downstream machines. Furthermore, the HLF-P feeder is also used for sorting parts, with due consideration of various criteria. Linear feeders HLF-P are fitted in individual feeding units as well as in complex assembly systems.

The HLF-P 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 upper oscillating part is used as a useful mass for fastening the conveyor rail. The oscillating part at the bottom forms the counterweight. A piezo drive unit is installed horizontally between the two oscillating sections.

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

6 Installation, assembly and setting

For safe operation, the module must be integrated into the safety concept of the system in which it is installed.

During normal operation, it must be ensured that the user cannot interfere with the working area of the linear feeder. This can be achieved through suitable protective measures (e.g. enclosure, light grid).

When the system is running in special operating modes, it must be ensured that there is no danger to the operator.

The system operator is responsible for the installation of the linear feeder in a system!

6.1 Safety instructions

WARNING

Danger! Risk of electric shock!

If work on electrical components is required, ensure that the work is carried out properly, failure to do so will cause serious or fatal injuries.

- Work on the machine's electrical equipment may only be performed by skilled electrician or trained personnel under the supervision of a skilled electrician in accordance with all relevant electrical regulations.
- Disconnect the power supply before assembly and disassembly work and when making changes to the installation!

No liability for damages can be assumed for damages caused by improper installation on the part of the operator.

Observe the safety instructions in ➲ chap. 2 "Safety instructions" of this Installation instructions as well as the instructions in ➲ chap. 6.3.

6.2 Assembly

6.2.1 Tightening torques

Tightening torques M_{Sp} in [Nm] for shaft bolts with metric ISO standard threads and head rests according to DIN 912 or DIN 931.

Screw	Tightening torques M_{Sp} in [Nm]		
	Strength class 8.8	Strength class 10.9	Strength class 12.9
M4	2.8	4.1	4.8
M5	5.5	8.1	9.5
M6	9.5	14.0	16.5
(M7)	15.5	23.0	27.0
M8	23.0	34.0	40.0
M10	46.0	68.0	79.0
M12	79.0	117.0	135.0
M14	125.0	185.0	215.0
M16	195.0	280.0	330.0
M18	280.0	390.0	460.0
M20	390.0	560.0	650.0
M22	530.0	750.0	880.0
M24	670.0	960.0	1120.0
M27	1000.0	1400.0	1650.0
M30	1350.0	1900.0	2250.0

6.2.2 Fastening the module

The HLF is firmly bolted to the foundation using the slots (2) made in the base plate. This means that the interfaces at the infeed and outfeed of the conveyor rails are precisely defined and adjustable.

In the horizontal plane, the base should be designed to be vibration-resistant (slab or block construction) to be able to absorb possible residual forces. Self-supporting profile constructions must be reinforced with a base plate to which the linear feeder is attached. Here, a plate made of steel should be used that is at least 20mm thick and has a width of more than 120mm.

The vertical oscillating forces responsible for energy induction in the foundation structure should be virtually eliminated by a careful balance of weights (➲ chap. 6.4.2). The height adjustment must be made by means of appropriate substructures. Suitable AFAG standard components are available for complete station set-ups.

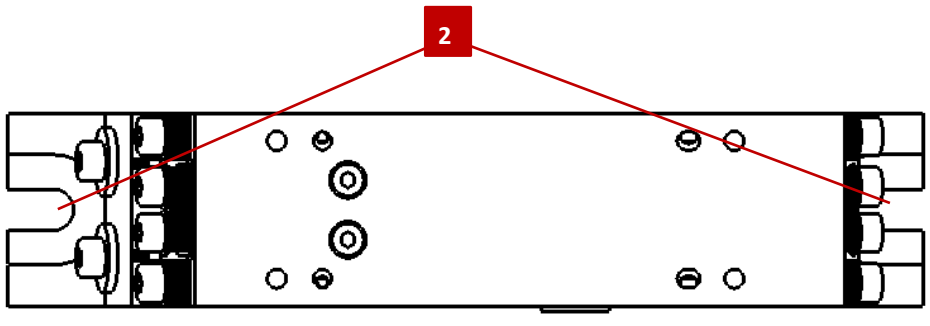


Fig. 4 Attachment slots(2) in the base plate

6.2.3 Assembly of the useful mass

The linear feeder type HLF-P is based on the oscillating force compensation according to the counter oscillation principle. To receives a good vibration force balance, it is necessary that the lines of action of the centres of gravity of the working and counterweight are as close together as possible.

The position of the centre of gravity of the counterweight is determined by the design of the linear feeder. The centre of gravity of the useful mass is determined by the design of the useful mass (e.g., conveyor rail).

To ensure a good balance of oscillating forces with minimum residual oscillation, the overall centre of gravity of the working weight must be located within the area specified in.

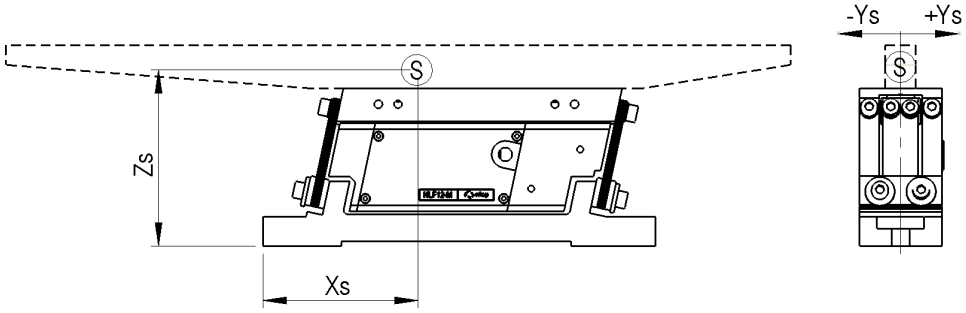


Fig. 5 Centre of gravity range (S: Rail centre of gravity)

Limiting coordinates for the position of centre of gravity of the working weight [mm]

Dimension	HLF07-P	HLF12-P
X_s [mm]	85 ± 10	105 ± 10
Y_s [mm]	0 ± 9	0 ± 10
Z_s [mm]	$77 \pm 8{,}5$	84 ± 11

6.2.4 Assembly of the conveyor rail

The conveyor rail is attached by means of a side plate. The side plate is fixed in an accurate and reproducible position by means of locating pins. Vertical slots are provided in the side plate for conveyor rail attachment, allowing fine adjustment of the interfaces at the rail inlet and rail outlet in the vertical direction.

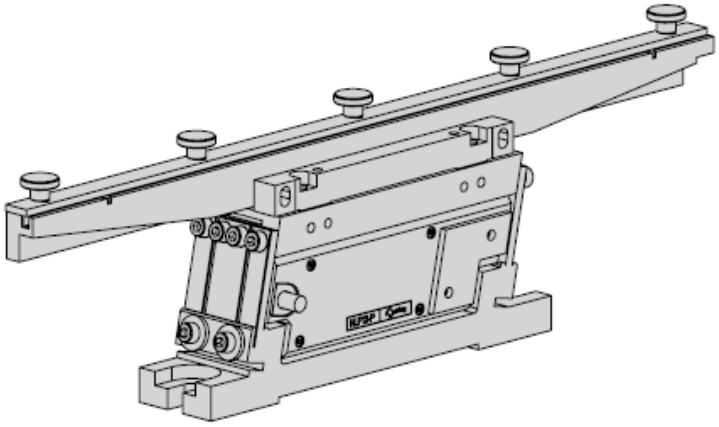


Fig. 6 Mounting with side plate “O”

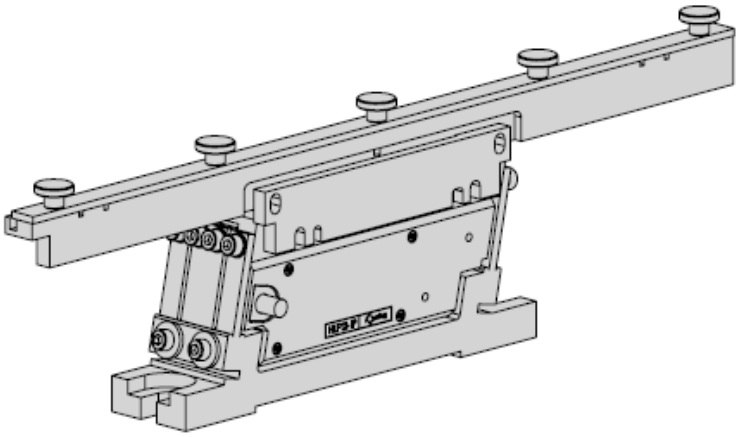


Fig. 7 Mounting with side plate “S”

useful mass must correspond to the values given in ➲ chap. 6.4.2 "Mass balancing".

6.3 Electrical connection

WARNING

Danger! Risk of electric shock!

Improperly performed work can result in serious or fatal injuries.

- Work on the machine's electrical equipment may only be performed by skilled electrician or trained personnel under the supervision of a skilled electrician in accordance with all relevant electrical regulations.

Important notes on the electrical connection

- The mains supply must be provided by the customer via a residual current circuit breaker!
- The feeder may only be operated with the mains supply specified on the type plate!
- The electrical connections must be covered!
- Protective conductor connections must be checked for proper function after installation.
- Emergency-STOP devices must remain effective in all operating modes. Unlocking the Emergency-STOP devices must not cause an uncontrolled restart!

Power connection via controller

The HLF-P is connected to the AC mains 230 V, 50/60 Hz via a control unit type PSG. The linear feeder operates at the operating frequency set on the control unit.

Vibration displacement and thus the transport speeds are infinitely adjustable due to magnet current and thus magnetic force variability.

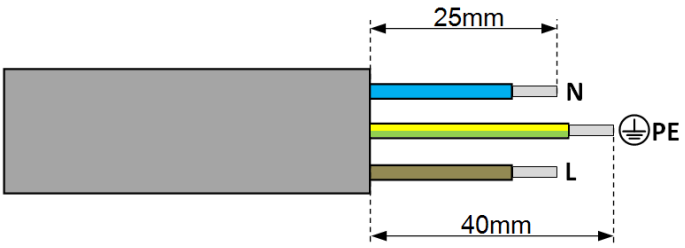


Fig. 8 Cable end additional plug

The linear feeder operates in full-wave mode at twice the mains frequency, i.e., at 50Hz AC with a mechanical vibration frequency of 100Hz.

Vibration displacement and thus the transport speeds are infinitely adjustable due to magnet current and thus magnetic force variability. All IRG types operate with soft-starting and offer different options for mounting, attachment and control.

A detailed description of the control units can be found in the instructions of the control unit manufacturer. Third-party control units can also be used, provided they meet the technical conditions.

6.4 Settings

Before adjusting the linear feeder, the feeder rails must be designed. When adjusting the linear feeder, always adjust the balance of weights first and then the natural frequency.

6.4.1 Design of the conveyor rails

The conveyor rails must be designed to be vibration-resistant so that the conveying impulses generated by the unit are transferred exactly to the conveyor rail and thus to the parts and no superimposed natural vibrations of the conveyor rail negatively influence the conveying process.

Tool steel is the preferred material for conveyor rails (e.g.: 1.2842, 90MnCrv8).

When designing the conveyor rail, observe the technical data (➲ chap. 3.2) as well as the ➲*dimensions of the conveyor rails* given in this chapter and the *values for the useful mass* given in ➲chap. 6.4.2.

Conveyor rail dimensions

The following applies to the dimensional ratio of the conveyor rail cross-section:

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

[mm]	HLF07-P	HLF12-P
Length	300	400
Width	17	17

Fig. 9 Table with the recommended dimensions of the conveyor rails

The dimensions are for one vibrating section and can be applied to each of the two vibrating sections.

6.4.2 Adjust 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.

To ensure this vibration force compensation, the following conditions must be observed in the design of the conveyor rail:

1. This means that the working weight and the counterweight are equal. The working weights specified for respective sizes are listed in the table below and must be observed.

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 mass of the useful mass must be in the area shown below.

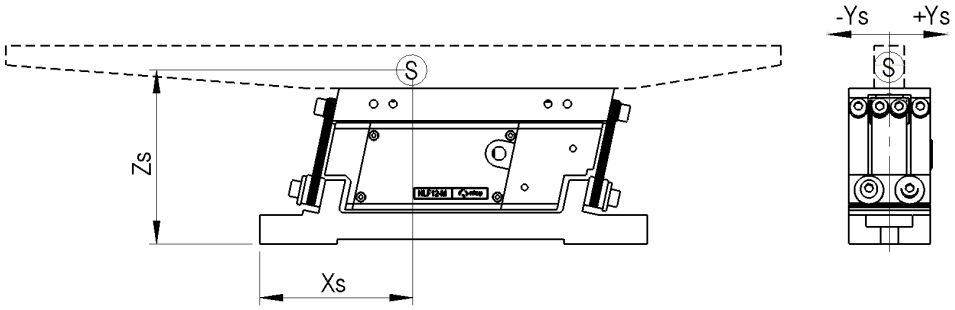


Fig. 10 Area of the centre of gravity - see also. ➲ chap. 6.2.3

The mass balance is precisely tuned when almost no more residual vibrations can be felt in the base.

With a precisely adjusted mass balance, the conveying speed is the same on the working side and the opposite side.

Values for the useful mass

Type	Ideal working mass [kg]	Max. useful mass [kg]
HLF07-P	0.7 ± 0.05	0.9
HLF12-P	1.2 ± 0.05	1.4

6.4.3 Natural frequency fine adjustment

The Afag linear feeder works by making use of resonance. Weights that are not exactly balanced require a spring stiffness modification.

For this purpose, sliding adjustment plates (1) are mounted on the base plate attachment of the spring assemblies. The natural frequency is adjusted by moving these adjustment plates.

Adjustment plates upwards ⇒	Natural frequency increases
Adjustment plates downwards ⇒	Natural frequency decreases

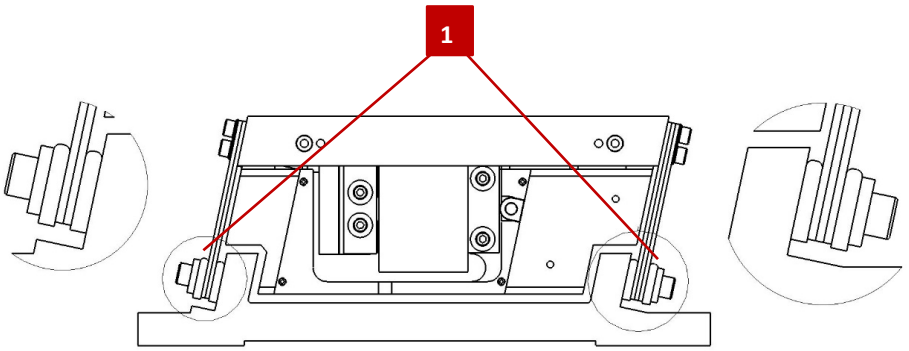


Fig. 11 Spring assembly with adjustment plates

To fine adjustment of the natural frequency, carry out the following test:

1. Place the test part on the conveyor rail and switch on the controller.
2. Reduce the conveying speed of the HLF until the test part only moves slowly on the conveyor rail.
3. Keep the setting of the controller constant and slowly loosen the screws of the setting plates on a spring assembly of the HLF.
4. Check the transport speed of the test part while loosening the screws:
   - If the conveying speed increases briefly and then decreases again when the screws are loosened further, the linear feeder is set correctly.
   - The natural frequency is slightly higher than the excitation frequency.
   - Return the adjustment plates to the position they had before loosening the screws.

   ⇨ The process is completed.

In the following cases, the natural frequency of the linear feeder is not set correctly and must be readjusted by moving the adjustment plates.

When moving the setting plates, make sure that the setting plates are always horizontal and that the top edges are always exactly opposite each other.

Loosen the adjustment plates only at one spring assembly at a time to prevent the oscillating parts from sinking.

- The conveying speed increases when the screws are loosened and does not decrease, or only slightly, when the screws are completely loosened.
  - The linear feeder is still too stiffly adjusted. The natural frequency is still too high.
  - Push the adjustment plates down or - if the weight deviation is too great - remove a leaf spring.
  - Carry out the test for fine adjustment of the natural frequency (see above) again.

  ⇨ The process is completed.

- If the conveying speed decreases immediately when the screws are loosened, the linear feeder is still set too soft.
  - Push the adjustment plates upwards or, if necessary, install an additional leaf spring.
  - Carry out the test for fine adjustment of the natural frequency (see above) again.

  ⇨ The process is completed.

6.4.4 Adjust air gap

The air gap of the magnet system is set to the values given in the following table during series assembly.

Type	Power supply	Air gap value [mm]	Tolerance
HLF07-P	230V/50Hz	1.00	± 0,05
HLF12-P	230V/50Hz	1.00	± 0,05

If the air gap deviates from the specified values (e.g., after a natural frequency adjustment), the air gap must be readjusted.

NOTICE

Danger of property damage due to overheating!

If a larger air gap than specified is set, there is a risk that the magnet will overheat and burn out the coil.

- Always comply with the specified air gap values!

To set the air gap proceed as follows:

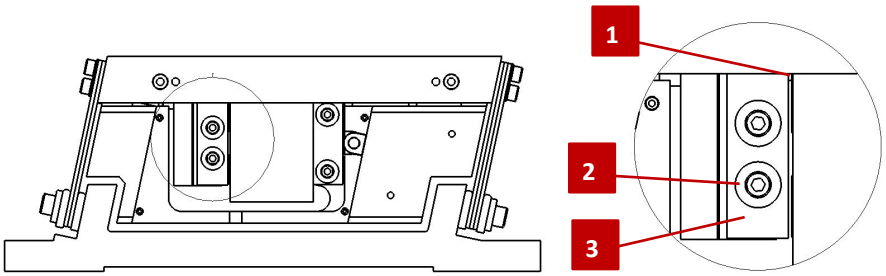


Fig. 12 Anchor fastening

1. Remove the cover.
2. Loosen the lateral fastening screws (2) of the magnetic anchor (3).
3. Readjust the air gap (1) using the distance gauge.
   - The surfaces of the magnetic core and the magnetic armature must be exactly parallel to each other.
4. Tighten the fastening screws (2) alternately in stages.

   ⇨ The process is completed.

7 Operation

After connection, the linear feeders are put into operation for the first time via the system controller.

Commissioning must only be carried out in setup/jog mode. Before commissioning, check whether the rated voltage of the device matches the local mains voltage.

7.1 Safety instructions for commissioning

DANGER

Risk of injury due to electric shock!

Unauthorized removal of the plug cover causes a risk of electric shock!

- Do NOT dismount the plug cover!
- Avoid any action on the module which could endanger safety!

NOTICE

Risk of property damage if different controllers are used!

Operation with another control unit will result in the destruction of the piezo element.

- Only operate the HLF with the Afag Piezo control unit PSG-1!

7.2 Piezo control

The Afag Piezo linear feeder is a spring-mass oscillation system and works by exploiting resonance behaviour.

To achieve a stable operating point with the desired conveying capacity, the control parameters (voltage and operating frequency) must be matched to each other. The same conveying capacity can be achieved by different combinations of the parameter's voltage and operating frequency.

Depending on the application, the optimum setting regarding stability, protection of the piezo and mutual interference (in the case of several units) must be determined for the required conveying capacity.

NOTICE

Risk of material damage due to incorrect operating frequency!

If the piezo linear feeder is operated exactly at the resonance point (operating frequency = natural frequency), this will result in the destruction of the piezo drive unit in the medium term!

- The operating frequency must be **greater** than the natural frequency of the piezo linear feeder!

To set the control parameters, proceed as follows:

1. Set start parameters (start setting):
   - Voltage 80%
   - Operating frequency (➲ chap. 2.8)
2. From the start setting, adjust the operating frequency up and down to search for the resonance point.
   - The resonance point is at the frequency with the highest amplitude of the oscillation system.
3. Set the operating frequency above the resonance point in steps of 0.1 Hz (depending on the required conveying capacity).
   - Tap upwards from the resonance point until the required delivery rate is reached.
   - The further the operating frequency is from the resonance point, the more stable the operating point is against external disturbances.
4. Reduce or increase voltage to fine-tune the conveying capacity.
   - The lower the set voltage, the more the piezo is protected.

   ⇨ The process is complete.

In the case of new units, it may be necessary to readjust the conveying speed according to the above scheme within 48 operating hours after commissioning due to settling processes.

7.2.1 Perform stability test (recommended)

After setting the operating parameters (voltage and frequency), a simple stability test is recommended.

Proceed as follows:

1. Hold the running linear feeder with your hand (external disturbance) and release it again.
   - The HLF-P quickly returns to conveying capacity by itself.

   ⇨ The process is complete.

If the HLF-P does not return to the set conveying capacity, proceed as follows:

2. Readjust the conveying capacity by changing the combination of parameters.
   - Resonance point: 200.8Hz; previous operating point: 70% / 201.5Hz ➔ new operating point 82% / 202.2Hz).
3. Repeat stability test.

   ⇨ The process is complete.

7.2.2 Multiple piezo linear feeders in one feeder

If several piezo linear feeders are operated on the same base plate / on the same substructure, under certain circumstances the linear feeders may influence each other.

This is noticeable, for example, in the form of a fluctuating conveying capacity or in the conveying behaviour of the parts in the rail.

By operating all linear feeders with the same operating frequency, this mutual interference can be eliminated.

The required conveying capacity of the individual HLF-P must still be guaranteed. This can be achieved by changing the voltage.

This will be explained in more detail below with the help of an example.

- Initial situation: Two HLF-P linear feeders on one base plate with the operating points **70% / 202.4Hz (1. HLF-P) and 82% / 203.0Hz (2. HLF-P).**
- ➔ new operating points with the same operating frequencies and adjusted voltages: **75% / 202.7Hz (1. HLF-P) and 79% / 202.7Hz (2. HLF-P).**

8 Fault elimination

8.1 Safety instructions

Observe the safety instructions in ➲ chap. 2 "Safety instructions" of these installation instructions as well as the safety instructions of the controller manufacturer.

8.2 Fault causes and remedy

The following table contains an overview of possible fault causes and how to proceed to eliminate them.

Fault	Possible cause	Remedy:
Linear feeder does not run - no vibrations noticeable	▪ Connection to the mains supply interrupted.	▪ Check connections, drive control unit, control power supply unit.
	▪ Controller is switched off <0>	▪ Switch on the controller <1> or, if a jam control is used, check the jam control signal.
	▪ Controller defective	▪ Electrical check of the unit, use replacement or spare device.
	Piezo damaged or destroyed	Replace piezo drive unit, check settings (➲ chap. 3, ➲ chap. 6.4.2)
	▪ Foreign part jammed in the air gap between working weight and counterweight	▪ Remove foreign part.
Conveyor runs too slowly or no movement visible	▪ Output frequency of the controller set incorrectly.	▪ Set the controller to the required frequency.
	▪ Conveyor rail not sufficiently connected to the drive.	▪ Tighten the fastening screws, check the thread if necessary.
	▪ Piezo damaged or destroyed.	▪ Replace piezo drive unit, check settings (➲ chap. 3, ➲ chap. 6.4.2)
	▪ Spring fracture results in a change of the system natural frequency.	▪ Loosen screws of spring assemblies, check springs, replace broken/defective springs. The cause of spring breakage is usually too much swing amplitude. -> Check the swing amplitude!
	▪ Adjustment of the drive faulty, i.e., natural frequency of the system too far away from excitation frequency	▪ Re-adjust drive (➲ chap. 6.4.3)
	▪ Foreign part jammed in the air gap between working weight and counterweight	▪ Remove foreign part

Fault	Possible cause	Remedy:
Unstable delivery behaviour, delivery speed varies	▪ Output frequency of the controller set incorrectly.	▪ Set the controller to the required frequency.
	▪ Conveyor rail not sufficiently firmly connected to the respective drive.	▪ Tighten the fastening screws, check the thread if necessary.
	Piezo damaged or destroyed	Replace piezo drive unit, check settings (➲ chap. 3, ➲ chap. 6.4.2)
	▪ Spring fracture results in a change of the system natural frequency	▪ Loosen screws of spring assemblies, check springs, replace broken or damaged springs. The cause of spring breakage is usually too much swing amplitude. --> Check swing amplitude.
	▪ Adjustment of the drive faulty, i.e., natural frequency of the system too far away from excitation frequency	▪ Re-adjust drive (➲ chap. 6.4.3).
	▪ Foreign part jammed in the air gap between working weight and counterweight	▪ Remove foreign part.
Feeders transmit vibrations	▪ Conveyor rail not sufficiently fastened to the drive.	▪ Tighten the fastening screws, check the thread if necessary.
	▪ Spring fracture results in a change of the system natural frequency	▪ Loosen screws of spring assemblies, check springs, replace broken or damaged springs. The cause of spring breakage is usually too much swing amplitude. --> Check swing amplitude
	▪ Adjustment of the drive faulty, i.e. natural frequency of the system too far away from excitation frequency	▪ Re-adjust drive (➲ chap. 6.4.3).
Conveyor rail lifts off or hits the ground	▪ Conveyor rail is not sufficiently firmly connected to the drive.	▪ Tighten the fastening screws, check the thread if necessary.
	▪ Spring fracture results in a change of the system natural frequency	▪ Loosen screws of spring assemblies, check springs, replace broken or damaged springs. The cause of spring breakage is usually too much swing amplitude. → Check swing amplitude!
	▪ Adjustment of the drive faulty, i.e. natural frequency of the system too far away from excitation frequency	▪ Re-adjust drive (➲ chap. 6.4.3).
	▪ Foreign part jammed in the air gap between working weight and counterweight	▪ Remove foreign part

9 Maintenance and repair

9.1 General notes

The linear feeder requires minimal maintenance. Depending on the type and manner of use, signs of wear may occur which can be compensated by readjusting the adjustment plates.

9.2 Safety instructions

WARNING

Danger of injury due to improper maintenance!

Improperly carried out maintenance activities can cause considerable damage to property and serious injury.

- Only use trained specialist personnel to carry out the activities.
- Always wear personal protective equipment when carrying out maintenance and repair work!

WARNING

Risk of injuries due to uncontrolled parts movements!

Signals from the controller can trigger unintentional movements of the linear feeder, which can cause injury.

- Before starting any work on the linear feeder, switch off the controller and secure to prevent it from being switched on.
- Observe the operating instructions of the controller used!

Also observe the safety instructions in ➲ chap. 2 „Safety instructions“ in this manual.

9.3 Maintenance activities and maintenance intervals

- The maintenance intervals must be strictly observed. The intervals refer to a normal operating environment.

9.3.1 Overview of the maintenance points

Fig. 13 Maintenance linear feeder HLF-P

No.	Maintenance point	Maintenance work	Interval	System [On/Off]	Remarks
1	Spring	Check, clean if necessary	As required	[Off]	-
			▪ Check leaf springs for: - Wear, oxidation (increased resonance frequency) - Settling behaviour (reduced resonance frequency)		

9.3.2 Check springs for wear and oxidation

Depending on the operating condition and environment, the leaf springs can develop an oxidation layer on the contact surfaces, which can impair the vibration behaviour in the long term.

This can lead to an increase in the resonance frequency.

In this case, lower the adjustment plates to compensate for the increased resonance frequency.

Replace leaf springs in case of high wear (chap. 9.3.4).

9.3.3 Check spring setting behaviour

Longer storage times can lead to settling of the installed leaf springs. Settling behaviour can result in a reduction in spring stiffness and resonance frequency.

Raise the adjustment plates slightly to compensate for the reduction in resonance frequency.

This eliminates the need to readjust the resonance frequency.

9.3.4 Remove leaf springs

It may be necessary to remove the leaf springs to clean them or replace them if they are very worn.

To remove the leaf springs, please proceed as follows:

1. Support the oscillating parts in a vertical direction.
2. Remove the spring assembly (only remove one spring assembly at a time to avoid displacement of the oscillating parts and thus impairment of function).
3. Clean the leaf springs.

Do not oil or grease leaf springs! This would lead to the springs sticking together and negatively influence the oscillation behaviour.

4. Install cleaned or - in case of high wear - replacement spring assembly.

   ⇨ The process is completed.

9.3.5 Further maintenance

Further maintenance is not required, if the ambient conditions listed below are complied with:

- Clean working area.
- No use of splash water.
- No abrasion or process dusts.
- Environmental conditions as specified in the technical data.

9.4 Wear parts, repairs

Afag Automation AG offers a reliable repair service. Defective linear feeder can be sent to AFAG for warranty repair within the warranty period.

After expiry of the warranty period, the customer may replace or repair defective modules or wear parts himself or send them to the Afag repair service.

Please note that Afag does not assume any warranty for modules that have not been replaced or repaired by Afag!

Wear parts

Type	Designation	Order Number
HLF07-P	Leaf spring	50203877
HLF12-P	Leaf spring	50203471
HLF07-P & HLF12-P	Piezo drive unit	50256407

10 Decommissioning and disposal

The linear feeder must be properly dismounted after use and disposed of in an environmentally friendly manner.

10.1 Safety instructions

WARNING

Risk of injury due to improper decommissioning and disposal!

Improperly carried out activities can result in considerable material damage and serious injury.

- Only use trained specialist personnel to carry out the activities.
- Disconnect the media supply before dismounting the module!
- Only remove the linear feeder when the controller is switched off and secured!

10.2 Decommissioning

If the linear feeders are not used for a longer period, they must be properly commissioned and stored as described in ➲ chap. 4.5.

10.3 Disposal

The linear feeders must be disposed of properly at the end of their service life and the raw materials used must be recycled. Observe the legal regulations and company requirements.

The linear feeder must not be disposed of as a complete unit. Dismantle the linear feeder and separate the various components according to type of material and dispose of them properly:

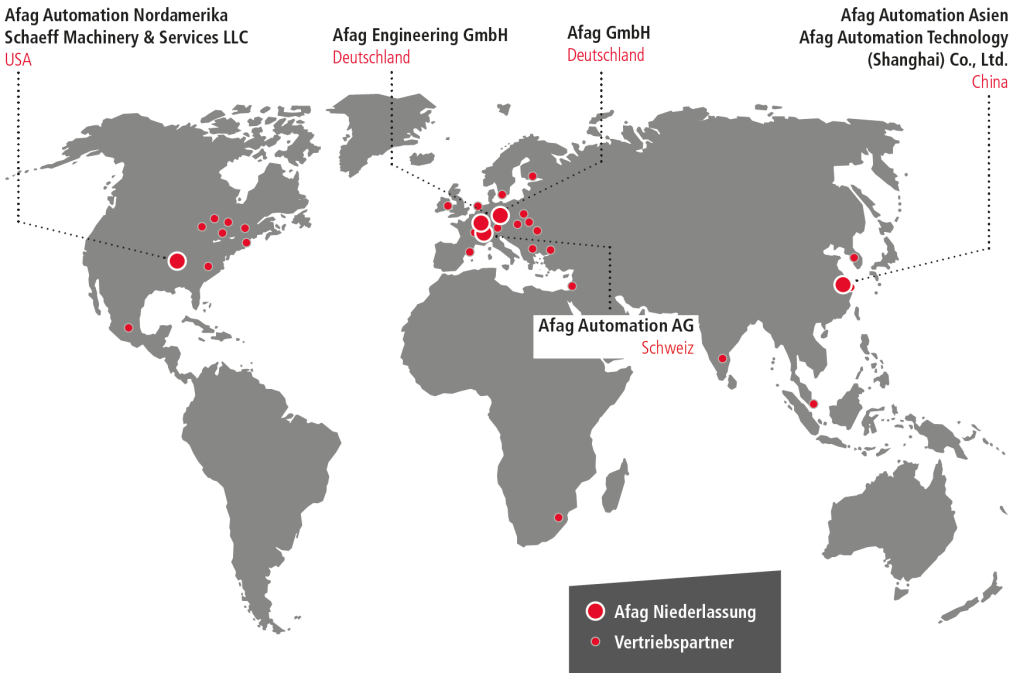
- Scrap the metallic materials.
- Hand over plastic parts for recycling.
- Sort the rest of the components by their material properties and dispose of them accordingly.

NOTICE

Risk to the environment due to incorrect disposal of the linear feeder!

Environmental damage can be caused by improper disposal.

- Electronic parts, electrical scrap, auxiliary and operating materials must be disposed of by approved specialist companies.
- Information on proper disposal can be obtained from the responsible local authorities.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