Vibrating refill hopper
NVB07/0.5 | NVB12/1.0 | NVB25/3.0

Original Operating Manual

This operating manual is valid for:

Type			Order number
Vibrating refill hopper	NVB07/0.5	230 V / 50 Hz	50398072
		115 V / 60 Hz	50439559
Vibrating refill hopper	NVB12/1.0	230 V / 50 Hz	50398076
		115 V / 60 Hz	50439561
Vibrating refill hopper	NVB25/3.0	230 V / 50 Hz	50398089
		115 V / 60 Hz	50439562

Version of this documentation: BA_NVB07-25_R01.0_DE

Release: 01.0

Date: 2016-02-17

US patents have been registered or are pending for the following items:

- Vibration conveyor Hybrid (U.S. Patent Ho.7,784,604)
- Vibration conveyor Piezostack (U.S. Patent Ho.8,051,974)

CA patents have been registered or are pending for the following items:

- Linear vibration conveyor Hybrid (CA Patent Ho.2,636,171)
- Linear vibration conveyor Piezostack (CA-Patent Ho. 2,636,968)

Contents:

1 Declaration of Incorporation for a Partly Completed Machine

Declaration of incorporation according to the EC directive Machinery 2006/42/EC, Appendix II B

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

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

hereby declares that the incomplete machine: **Vibrating refill hopper NVB**

Designation: **NVB07/0.5 | NVB12/1.0 | NVB25/3.0**

Meets the basic safety and health requirements of the machinery directive **2006/42/EC, Appendix I**.

The incomplete machine further corresponds to the

relevant EC directives:

Machinery directive 2006/42/EC

Low-voltage directive 2014/35/EU

EMC directive 2014/30/EU

Applied harmonized standards:

EN ISO 12100-2010

The technical documentation for this incomplete machine was drawn up according to Appendix VII, part B. The manufacturer commits to electronically submitting these technical documents to individual state offices upon request.

Authorized person for assembly of the operating manual:

Claus Piechatzek
Product manager ZT
Afag GmbH

Start-up of the incomplete machine shall be forbidden until the incomplete machine has been installed in a machine which corresponds to the provisions of the EC directive machinery, and the EC declaration of conformity purs. to Appendix II A is present.

Place, Date

Amberg, 17/02/2016

Company: Afag GmbH

First name Surname

Mr Klaus Bott

Managing Director

Afag GmbH

2 Safety instructions

2.1 Explanation of symbols and signs

Symbols: Installation and commissioning only by qualified personnel in accordance with the operating manual.

Please observe the meaning of the following symbol and note explanations. They are structured in hazard levels and classified according to ISO 3864-2.

DANGER	
	**Designates a directly threatening danger.** **If the information is not observed, death or most severe injury (invalidity) will be the consequence.**

WARNING	
	**Designates a possible dangerous situation.** **If the information is not observed, death or most severe injury (invalidity) will be the consequence.**

CAUTION	
	**Designates a potentially dangerous situation.** **If the information is not observed, property damage or light to moderate injury will be the consequence.**

NOTE	
	**Draws attention to general notes, useful tips for the operator and working recommendations, but which have no influence on the health and safety of the personnel.**

2.2 Basic safety notes

This operating manual serves as basis for the safe use and operation of the NVB vibrating refill hopper. This operating manual, and specifically the safety notes, must be observed by all persons who work on or with the NVB. Furthermore, the rules and regulations on accident prevention applicable at the place of installation must also be observed. The operating manual must be kept at the site of use of the NVB at all times.

The device must only be operated by technically qualified staff. Qualified staff means staff who, due to their training, experience and instruction, as well as knowledge of relevant standards, provisions, accident prevention provisions and operating situations, have been authorized by the person responsible for safety of the plant to perform the respective required work and who are able to recognize and avoid possible dangers in this (definition for specialists purs. to IEC 364).

Faults that may impair the safety of persons, the NVB or other assets must be removed without delay.

The following notes serve for the personal safety of the operating staff, as well as the safety of the described products and connected devices:

2.2.1 Electrical connection

NOTE	
	▪ **Disconnect the voltage supply before assembly or disassembly work and when changing attachments.** ▪ **Observe the accident prevention and safety provisions applicable in the specific use case.** ▪ **Before commissioning, check if the nominal voltage of the device matches the local mains voltage.** ▪ **EMERGENCY OFF facilities must remain active in all operating modes. Unlocking the EMERGENCY OFF facilities must not lead to uncontrolled reactivation.** ▪ **The electrical connections must be covered!** ▪ **Protective ground connections must be checked for proper function after assembly!**

2.2.2 Danger points

NOTE	
	**The Afag vibrating refill hoppers have been built according to the EC machinery directive, the state of the art and the recognized safety-technical rules. Nevertheless, use may result in dangers to the life and limb of the operator or third parties and/or in impairments to the NVB or other assets.**

2.3 Intended use

The NVB must only ever be used for supplying and providing components. Regarding the maximum permitted dimensions and weights of attached items, the notes in chapter 3.3 Table 1: Technical data, chapter 4 Installation instructions and chapter 5 Operating Manual must be observed. Intended use also includes observation of all notes from the operating manual.

WARNING	
	**The NVB must <u>not</u> be used:** a) In humid and wet areas. b) At temperatures under 10 °C or over 50 °C c) In areas with easily flammable media d) In areas with explosive media e) In strongly contaminated or dusty environments f) In aggressive environments (e.g. salt-containing atmosphere)

No changes or conversions on the basic NVB device are permitted without the manufacturer's approval . The accessories listed in chapter 7 are excepted from this.

NOTE	
	**Any use or constructional change beyond this is deemed improper and will cause the warranty claim to expire.**

In this regard, also refer to our general terms & conditions of business.

3 Description of the device

3.1 General

The NVB vibratingrefill hopper is used for the storage of bulk materials. The conveyor movement is performed by vibration. This involves components being conveyed in the direction of movement by micro-throws.

NOTE	
	**The NVBs are operated in combination with an Afag control unit. Optimum conveyor movement is only assured by this combination.**

3.2 Function description

The NVB vibrating refill hopper is a device that converts electromagnetic vibrations into movement to supply and transport packaged goods. The NVB vibrating refill hoppers primarily comprise a vibration channel and an Afag linear conveyor from the HLF-M series.

These HLFs comprise two super-imposed vibration components that vibrate alternately in opposing directions, i.e. towards each other. Slotted leaf springs connect them to a shared base plate on which these opposing vibrational forces virtually cancel each other out. The uppermost vibration component is used as a payload to secure the conveyor rail. The lower vibration component acts as the counterweight. A magnet system is installed horizontally between these two vibration components (armature - magnet core). The beneficial properties of the HLF-M linear conveyor are founded upon the compensation of masses achieved between payload and counterweight. This action virtually eliminates the free vibrational forces exerted directly on the device.

3.3 Technical data

Figure 1: *NVB dimension sheet*

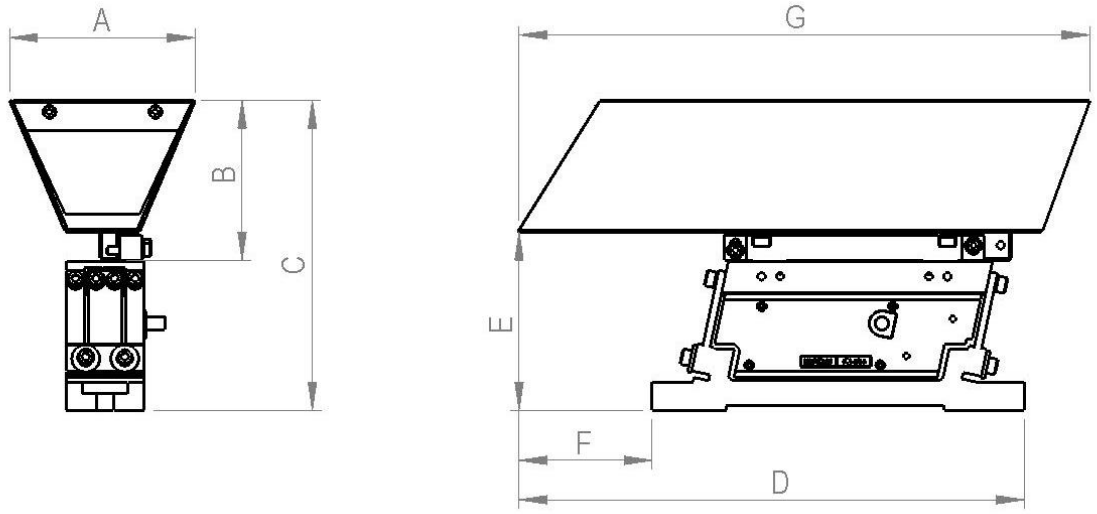


Table 1: *Technical data*

Description		Unit	NVB07/0.5	NVB12/1.0	NVB25/3.0
Dimensions	A	[mm]	90	100	151
	B	[mm]	70	86	95
	C	[mm]	145	167	205
	D	[mm]	223	272	384
	E	[mm]	85	96	125
	F	[mm]	53	72	124
	G	[mm]	224	307	430
Fill volume		[l]	0.5	1.0	3.0
Max. fill weight		[kg]	1.7	3.2	9
Operating voltage		[VAC]	230 / 115	230 / 115	230 / 115
Surface roughness R_a		[microns]	< 0.8	< 0.8	< 0.8
Surface roughness R_a		[microns]	< 4.5	< 4.5	< 4.5
Mains frequency		[Hz]	50 / 60	50 / 60	50 / 60
Operating frequency (electrical)		[Hz]	50 / 60	50 / 60	50 / 60
Mechanical vibrations		rpm	6000 / 7200	6000 / 7200	6000 / 7200
Protection type			IP54	IP54	IP54

The Afag linear conveyors can be supplied with 230V/50Hz and 115V/60Hz versions. Various Afag control units are available to control the linear conveyor (see chapter 7.3 Control unit).

4 Installation instructions

4.1 Transport

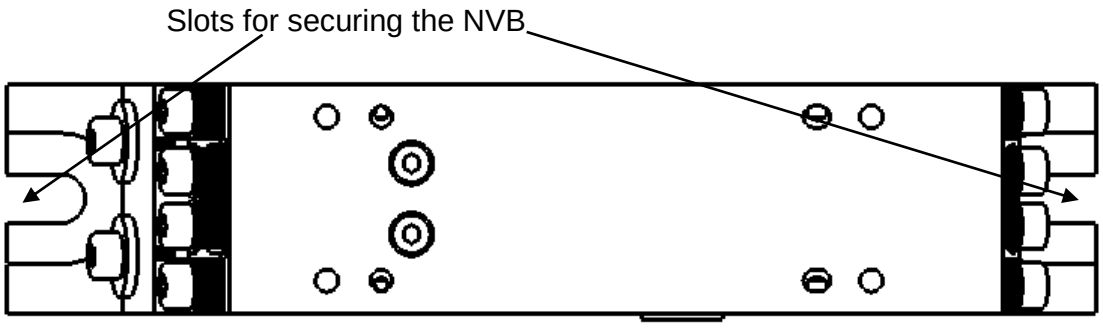
⚠ WARNING	
	**Improper use of transports (industrial trucks, hall crane, auxiliary equipment, attachments, etc.) may cause crushing and other injuries. Required behaviour:** ▪ **Observing transport and installation instructions and complying with them** ▪ **Properly using means of transport**

⚠ CAUTION	
	**The vibrating refill hopper must only be raised by the base during transport.** **The conveyor rail is not a lifting point.**

4.2 Installation of the device

The NVB is bolted firmly to its foundations through slots in the base plate (see Figure 2). This means that interfaces in the inlet and outlet points on the conveyor rail are precisely defined and are adjustable. In a horizontal plane, the substrate should be vibrationally rigid (plate or block construction) to absorb any residual forces in this plane. Free-supporting profile constructions must be reinforced with a base plate secured to the linear conveyor. For this purpose, a steel plate should be used that is at least 20 mm thick, and more than 120 mm wide. The fundamental perpendicular vibration forces for foundation excitation can be eliminated almost completely through careful mass compensation (see chapter 5.1 Mass compensation). Adjustment to the height should involve the use of appropriate supporting structures. For complete station structures, suitable afag standard components are available.

Figure 2: *Retaining slots in the base plate*



4.3 Power supply

WARNING	
	▪ **Work at the electrical supply must only be performed by trained, approved specialists!** ▪ **The mains infeed must be provided on-site via an FI protection switch!** ▪ **The spiral conveyor must only be operated with the mains supply indicated on the rating plate!**

The IRG1-S control unit is available to activate the linear conveyor.

The installation must only be performed by a specialist.

5 Operating Manual

When setting up the vibrating refill hopper, always first adjust the mass compensation and then the natural frequency.

5.1 Mass compensation

Due to the opposing vibration principle employed on the Afag vibrating refill hopper, the vibration forces in the base plate are almost completely balanced out. However, this compensation of vibration forces is then only assured if:

1. Payload and counterweight can be matched to one another as accurately as possible. That means that payload and counterweight must be the same size as one another. In the following Table 2: binding values for the payload the payload dimensions to be maintained are listed for each size of unit. The payload constitutes the total weight of all components attached to the retaining plate, including side panel. The mass compensation is checked by a simple weighing process of the payload.

2. The mass centre of gravity of the payload lies in the area shown in **Fehler! Verweisquelle konnte nicht gefunden werden.**.

Both conditions have already been taken into account in the construction of the conveyor rail. Mass compensation is precisely coordinated once almost no vibrations can be sensed in the substrate.

Table 2: *binding values for the payload*

Type	Ideal payload [kg]	Max. payload [kg]
NVB07/0.5	0.7 ± 0.05	0.9
NVB12/1.0	1.2 ± 0.05	1.5
NVB25/3.0	2.5 ± 0.1	3.0

NOTE

Payload and counterweight should correspond to the values indicated in Table 2: binding values for the payload.

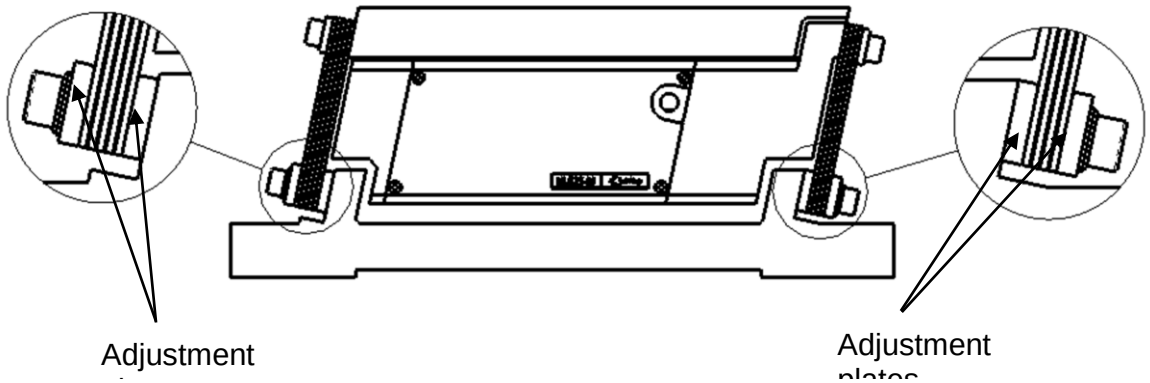
NOTE

1. **Mass compensation is precisely coordinated once almost no vibrations can be sensed in the substrate.**
2. **Once the mass compensation is precisely coordinated, the conveyor speeds on payload and counterweight sides are identical.**

5.2 Precision adjustment of natural frequency

The Afag vibrating refill hopper is a spring-mass vibration system and it operates by making full use of resonance characteristics. Imprecisely matched masses require a change in spring strength. For this, movable adjustment panels are fitted to the base plate mounting of the spring packs (see Figure 3). The natural frequency can be adjusted by moving these adjustment plates.

Figure 3: *Spring pack with adjustment plates (illustration without vibration channel)*



The vibrating refill hopper must always be tuned 'sub-critically', i.e. the excitation frequency must be approx. 5% less than the natural frequency. For a 100Hz hopper, this means a natural frequency of approx. 103Hz, and a natural frequency of approx. 124 Hz for a 120Hz hopper.

Proceed as follows with the fine-tuning:

Place a test component in the vibration channel and switch the control unit on. Using the rotary knob, reduce the conveyor speed of the vibrating refill hopper until the part on the conveyor rail is only moving slowly. The setting of the control device should be kept at a constant level and then release the screws on the adjustment plates slowly on a spring pack on the linear conveyor (see Figure 3). While unfastening the screws, check the conveyor speed of the test component. If the conveyor speed initially picks up slightly, then reduces as the screws continue to be loosened, the linear conveyor is set up correctly and the natural frequency is slightly higher than the excitation frequency. The adjustment plates must be set in the position that they were in before the screws were unfastened.

If the conveyor speed increases when the screws are loosened, and if it does not decrease when the screws are completely loosened, or only decreases slightly, the linear conveyor is set up too rigidly, i.e. the natural frequency is still too high. In this case, the adjustment plates must be pushed down or, if the weight difference is too great, a leaf spring can be removed. Then the test needs to be repeated.

If the conveyor speed decreases as soon as the screws are unfastened, the linear conveyor is on too soft a setting. In this case, the adjustment plates must be pushed upwards or additional leaf springs may need to be installed. Then the test needs to be repeated.

When moving the adjustment plates, ensure that they are always horizontal and are always positioned precisely above one another.

Adjustment plates upwards ⇒ Natural frequency increases

Adjustment plates downwards ⇒ Natural frequency decreases

⚠ CAUTION	
	**The linear conveyor must always be set 'sub-critically' (i.e. the natural frequency must always be about 5% above the excitation frequency), otherwise the magnet may get too hot and burn out, or the conveyor speed may reduce as soon as components reach the conveyor rail.**

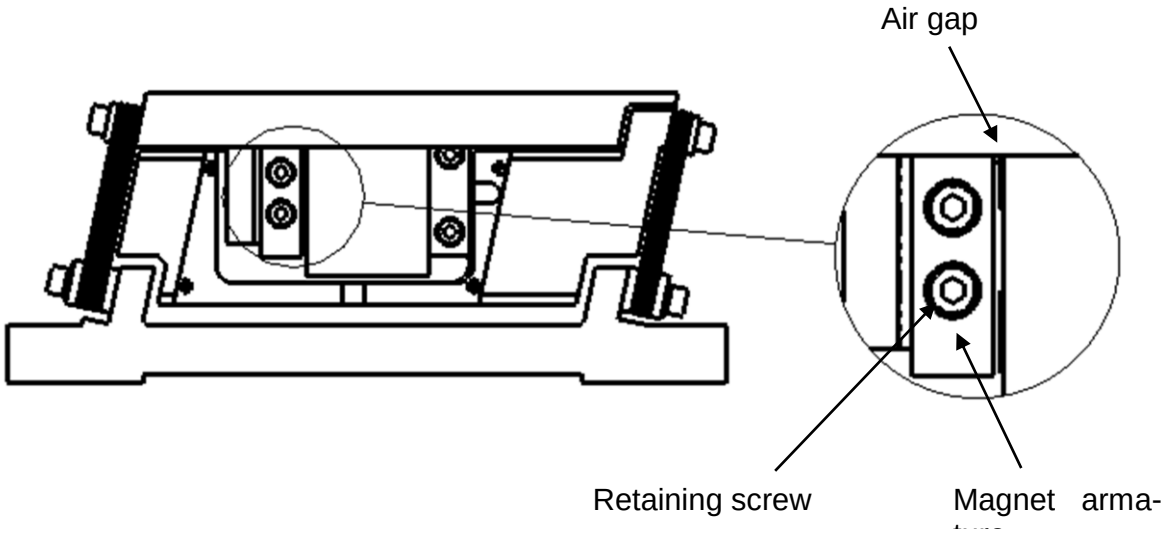
When fine-tuning the frequency, only unfasten the adjustment plates on one spring pack to prevent the vibration components from sinking.

NOTE	
	**Ensure that the adjustment plates are arranged horizontally. The upper edges must always be positioned above one another.**

5.3 Adjustment of the air gap

The air gap in the magnet system is adjusted during volume production to the values stipulated in Table 3. If this air gap deviates from the values stipulated in Table 3 after an adjustment to the natural frequency, it must be adjusted again. To do this, remove the cover, unscrew the side retaining screws on the armature and reset the air gap using the spacer gauge (see Table 7).

Figure 4: *Armature mounting*



The values stipulated in Table 3 only apply to the corresponding power supply. During adjustment work, always ensure that the surface area of the magnet core and the armature are arranged precisely parallel to one another. To achieve the required level of precision, the screws must be tightened progressively and alternately.

Table 3: *Adjustment values for the air gap between armature and magnet core.*

Type	Power supply	Air gap value [mm]	Tolerance
HLF07	230V/50Hz	1.0	± 0.05
	115V/60Hz	1.0	± 0.05
HLF12	230V/50Hz	1.0	± 0.05
	115V/60Hz	1.0	± 0.05
HLF25	230V/50Hz	1.1	± 0.05
	115V/60Hz	1.1	± 0.05

⚠ CAUTION

If a larger air gap than specified is set, this runs the risk of the magnet overheating and the coil burning out. Therefore, always comply with the stipulated air gaps.

6 Maintenance instructions

A type NVB vibrating refill hopper is essentially a zero-maintenance unit. Under certain operating conditions however, the leaf springs used can develop an oxidation layer (i.e. rust) on the contact surfaces with the spacer discs (shims) which can adversely affect the vibration characteristics in the due fullness of time. In such cases, it may be necessary to remove and clean the leaf springs, and/or to replace them completely. For this, the two vibration parts must be braced in a perpendicular direction. Only ever remove one spring pack otherwise the vibration components may get dislodged. This then prevents perfect functionality from being assured.

⚠ CAUTION	
	**The leaf springs must not be oiled or greased because this would cause the springs to stick together, and this in turn would have an adverse effect on vibration characteristics.**

6.1 Troubleshooting and remedial action

Conveyor is not running and no vibration can be detected.	
Troubleshooting	**Remedial action**
Mains voltage too low or unstable, e.g. only 180 V.	Check mains voltage, possibly readjust the conveyor while taking account of available mains voltage.
Connection to mains power has been interrupted.	Check of connections between drive control unit and control power unit.
Control unit is switched off <0>	Switch on control unit <1> and/or when using a blockage control, check the blockage control signal.
Control unit is defective	Electrical check of device, use replacement or back-up device.
The magnet is damaged and the magnetic coil has burned through.	Electrical inspection of magnet, replacement of damaged magnet. Check settings. 50 Hz setting, full shaft (excitation frequency = 100 Hz)
The air gap between magnet and armature is too small (limit stops) or too big.	Adjust air gap in acc. with stipulations in operating manual.
A foreign body is jammed in the air gap between magnet and armature.	Remove the foreign body.
Conveyor runs too slowly and/or no movement can be detected.	
Troubleshooting	**Remedial action**
Mains voltage too low or unstable, e.g. only 180 V.	Check mains voltage, possibly readjust the conveyor while taking account of available mains voltage.

Output frequency of control unit is set incorrectly.	On control units with a switch in the control unit, adjust in accordance with the required frequency. 50 Hz setting, full shaft (excitation frequency = 100 Hz)
The conveyor rail is not connected firmly enough to the relevant drive unit.	Tighten down the retaining screws, checking threads if possible.
The magnet is damaged and the magnetic coil has burned through.	Electrical inspection of magnet, replacement of damaged magnet. Check settings. 50 Hz setting, full shaft (excitation frequency = 100 Hz)
The air gap between magnet and armature is too small (limit stops) or too big.	Adjust air gap in acc. with stipulations in operating manual.
Spring breakage has resulted in a change in the natural frequency of the system.	Unfasten screws on spring packs, check springs, then replace broken or damaged springs. ATTENTION! Spring breakage is usually caused by an excessively high vibrational amplitude. -> Check air gap
Fine-tuning of drive unit is incorrect, i.e. the natural frequency of the system is too far removed from the excitation frequency.	Fine-tuning the drive by altering the spring strength. Variation in position of adjustment plates. Tighten down screws in the spring packs. ATTENTION! Fine-tuning of conveyor in acc. with operating manual!
A foreign body is jammed in the air gap between magnet and armature.	Remove the foreign body.
The conveyor characteristics are unstable, and the conveyor speed is variable.	
Troubleshooting	**Remedial action**
Mains voltage too low or unstable, e.g. only 180 V.	Check mains voltage, possibly readjust the conveyor while taking account of available mains voltage.
Output frequency of control unit is set incorrectly.	On control units with a switch in the control unit, adjust in accordance with the required frequency. 50 Hz setting, full shaft (excitation frequency = 100 Hz)
The conveyor rail is not connected firmly enough to the relevant drive unit.	Tighten down the retaining screws, checking threads if possible.
The magnet is damaged and the magnetic coil has burned through.	Electrical inspection of magnet, replacement of damaged magnet. Check settings. 50 Hz setting, full shaft (excitation frequency = 100 Hz)
Spring breakage has resulted in a change in the natural frequency of the system.	Unfasten screws on spring packs, check springs, then replace broken or damaged springs. ATTENTION! Spring breakage is usually caused by an excessively high vibrational amplitude. -> Check air gap
Fine-tuning of drive unit is incorrect, i.e. the natural frequency of the system is too far removed from the excitation frequency.	Fine-tuning the drive by altering the spring strength. Variation in position of adjustment plates. Tighten down screws in the spring packs. ATTENTION! Fine-tuning of conveyor in acc. with operating manual!
A foreign body is jammed in the air gap between magnet and armature.	Remove the foreign body.

The conveyors transmit vibrations.	
Troubleshooting	**Remedial action**
The vibration channel is not connected firmly enough to the relevant drive unit.	Tighten down the retaining screws, checking threads if possible.
Spring breakage has resulted in a change in the natural frequency of the system.	Unfasten screws on spring packs, check springs, then replace broken or damaged springs. ATTENTION! Spring breakage is usually caused by an excessively high vibrational amplitude. -> Check air gap
Fine-tuning of drive unit is incorrect, i.e. the natural frequency of the system is too far removed from the excitation frequency.	Fine-tuning the drive by altering the spring strength. Variation in position of adjustment plates. Tighten down screws in the spring packs. ATTENTION! Fine-tuning of conveyor in acc. with operating manual!
Conveyor rail lifts up and/or makes physical contact.	
Troubleshooting	**Remedial action**
The vibration channel is not connected firmly enough to the relevant drive unit.	Tighten down the retaining screws, checking threads if possible.
The air gap between magnet and armature is too small (limit stops) or too big.	Adjust air gap in acc. with stipulations in operating manual.
A foreign body is jammed in the air gap between magnet and armature.	Remove the foreign body.
Spring breakage has resulted in a change in the natural frequency of the system.	Unfasten screws on spring packs, check springs, then replace broken or damaged springs. ATTENTION! Spring breakage is usually caused by an excessively high vibrational amplitude. -> Check air gap
Fine-tuning of drive unit is incorrect, i.e. the natural frequency of the system is too far removed from the excitation frequency.	Fine-tuning the drive by altering the spring strength. Variation in position of adjustment plates. Tighten down screws in the spring packs. ATTENTION! Fine-tuning of conveyor in acc. with operating manual!

6.2 Wearing parts and spare parts

Table 4: *Wearing parts*

Type	Designation	Order number
NVB07/0.5	Leaf spring	50203877
NVB12/1.0	Leaf spring	50203471
NVB25/3.0	Leaf spring	50254134

Table 5: *Spare parts*

Type	Designation	Mains connection	Order number
NVB07/0.5	Vibration magnet	230V/50Hz	15054450
		115V/60Hz	15002283
NVB12/1.0	Vibration magnet	230V/50Hz	50277472
		115V/60Hz	50277904
NVB25/3.0	Vibration magnet	230V/50Hz	50270048
		115V/60Hz	50280087

7 Accessories

7.1 Attachments

Table 6: *Order details*

Type	Designation	Remarks	Order number
NVB07/0.5	Trim weight NM07	Weight: 25g	50217298
	Trim weight GM07	Weight: 15g	50216944
	Side plate O-07	-	50197283
NVB12/1.0	Trim weight NM12	Weight: 50g	50216719
	Trim weight GM12	Weight: 25g	50216708
	Side plate O-12	-	50197284
NVB25/3.0	Trim weight NM25	Weight: 100g	50217316
	Trim weight GM25	Weight: 50g	50217312
	Side plate O-25	-	50197285

7.2 Adjustment aids

Table 7: *Spacer gauges*

Designation	Drive type	Order number
Spacer gauge	HLF07-M	50185560
	HLF12-M	50185560
	HLF25-M	50273499

7.3 Control unit

The NVB is connected via a Type IRG control unit to the AC power supply 230/50 Hz. It is also possible to configure it for other mains voltages and frequencies, e.g. 115V/60 Hz. The linear conveyor works in full-shaft mode at double the mains frequency, i.e. at 50 Hz AC, with a mechanical vibration frequency of 100 Hz. By changing the magnet currents and therefore also the magnet forces, vibrations and through that the conveyor speeds can be adjusted across an infinitely variable range. All IRG types operate with a soft-start function and offer different forms of set-up and attachment as well as various activation options. The full-length AFAG catalogue contains a detailed description of these control units. Third-party control units can also be used, provided that they meet the technical requirements.

Table 8: *Control units for NVB vibrating refill hopper*

Type	Power supply	Order number	Remarks
IRG1-S	230V/50Hz	50360105	Activation without timer function External stipulation of nominal value
	115V/60Hz	50360106	

7.4 Order 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

Feeding technology

Fiechtenstrasse 32

CH – 4950 Huttwil

Tel.: ++41 (0) 62 / 959 86 86

Fax: ++41 (0) 62 / 959 87 87

8 Disposal

Devices that are no longer in use should not be disposed of as a complete unit, but should be dismantled into individual parts and recycled according to the type of materials. Non-recyclable components must be disposed of appropriately.