Operating Instructions

VEGAVIB 63

with relay output

Contents

29277-EN-050812

1 About this document

1.1 Function

This operating instructions manual has all the information you need for quick setup and safe operation of VEGAVIB 63. Please read this manual before you start setup.

1.2 Target group

This operating instructions manual is directed to trained personnel. The contents of this manual should be made available to these personnel and put into practice by them.

1.3 Symbolism used

Information, tip, note
This symbol indicates helpful additional information.

Caution, warning, danger
This symbol informs you of a dangerous situation that could occur. Ignoring this cautionary note can impair the person and/or the instrument.

Ex applications
This symbol indicates special instructions for Ex applications.

● **List**
The dot set in front indicates a list with no implied sequence.

→ **Action**
This arrow indicates a single action.

1 **Sequence**
Numbers set in front indicate successive steps in a procedure.

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2 For your safety

2.1 Authorised personnel

All operations described in this operating instructions manual must be carried out only by trained, specialised personnel authorised by the operator. For safety and warranty reasons, any internal work on the instruments must be carried out only by personnel authorised by the manufacturer.

2.2 Appropriate use

VEGAVIB 63 is a sensor for level detection.

Detailed information on the application range of VEGAVIB 63 is available in chapter Product description.

2.3 Warning about misuse

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overfill or damage to system components through incorrect mounting or adjustment.

2.4 General safety instructions

VEGAVIB 63 is a high-tech instrument requiring the strict observance of standard regulations and guidelines. The user must take note of the safety instructions in this operating instructions manual, the country-specific installation standards (e.g. the VDE regulations in Germany) as well as all prevailing safety regulations and accident prevention rules.

2.5 CE conformity

VEGAVIB 63 is in CE conformity with EMC (89/336/EWG), fulfils the NAMUR recommendation NE 21 and is in CE conformity with LVD (73/23/EWG).

Conformity has been judged acc. to the following standards:

- EMC:
  - Emission EN 61326: 1997 (class B)
  - Susceptibility EN 61326: 1997/A1: 1998
- LVD: EN 61010-1: 2001

2.6 SIL conformity

VEGAVIB 63 fulfills the requirements for functional safety acc. to IEC 61508. You will find further information in chapter "Functional safety".

2.7 Safety information for Ex areas

Please note the Ex-specific safety information for installation and operation in Ex areas. These safety instructions are part of the operating instructions manual and come with the Ex-approved instruments.

2.8 Environmental instructions

Protection of the environment is one of our most important duties. That is why we have introduced an environment management system with the goal of continuously improving company environmental protection. The environment management system is certified acc. to DIN EN ISO 14001.

Please help us fulfil this obligation by observing the environmental instructions in this manual:

- Chapter "*Storage and transport*"
- Chapter "*Disposal*"

3 Product description

3.1 Configuration

Scope of delivery

The scope of delivery encompasses:

- VEGAVIB 63 level sensor
- Documentation
  - this operating instructions manual
  - Ex-specific safety instructions (with Ex versions) and, if necessary, further certificates

Components

VEGAVIB 63 consists of the following components:

- Housing cover
- Housing with electronics
- process fitting with vibrating rod

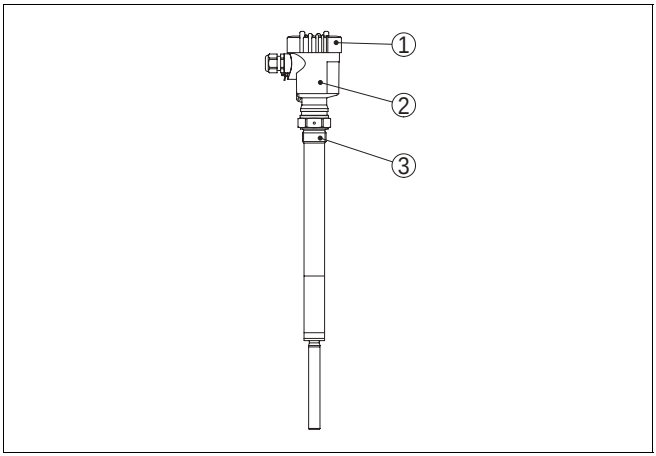


Fig. 1: VEGAVIB 63 - with plastic housing
1 Housing cover
2 Housing with electronics
3 Process fitting

3.2 Principle of operation

Area of application

VEGAVIB 63 is a level sensor with vibrating rod for level detection.

It is designed for industrial use in all areas of process technology and is preferably used for bulk solids.

Typical applications are overfill and dry run protection. Thanks to its simple and robust measuring system, VEGAVIB 63 is virtually unaffected by the chemical and physical properties of the solid.

It functions even when exposed to strong external vibration or changing products.

Solid detection in water
If VEGAVIB 63 was ordered for solid detection in water, the vibrating rod is to the density of water. In air or if covered by water (density: 1 g/cm³/0.036 lbs/in) VEGAVIB 63 signals uncovered. Only if the vibrating element is also covered with solids (e.g. sand, sludge, gravel etc.) will the sensor signal covered.

Fault monitoring
The electronics of VEGAVIB 63 continuously monitors the following criteria:

- Correct vibrating frequency
- Line break to the piezo drive

If one of these faults is detected or in case the power supply fails, the electronics takes on a defined switching condition, i.e. the relay deenergizes (safe condition).

Physical principle

The vibrating rod is piezoelectrically energised and vibrates at its mechanical resonance frequency of approx. 360 Hz. When the vibrating rod is submerged in the product, the vibrating amplitude changes. This change is detected by the integrated oscillator and converted into a switching command.

Power supply

VEGAVIB 63 is a compact instrument, i.e. it can be operated without external evaluation system. The integrated electronics evaluates the level signal and outputs a switching signal. With this switching signal, a connected device can be operated directly (e.g. a warning system, a PLC, a pump etc.).

The exact range of the power supply is stated in the Technical data in the Supplement.

3.3 Adjustment

With the factory setting with a density >0.05 g/cm³ (>0.002 lbs/in³) can be measured. The instrument can be adapted if products with lower density should be measured.

On the electronics module you will find the following indicating and adjustment elements:

- signal lamp for indication of the switching condition (green/red)
- potentiometer for adaptation to the product density
- mode switch for selection of the output current

3.4 Storage and transport

Packaging

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test acc. to DIN 55439.

The packaging of standard instruments consists of environment-friendly, recyclable cardboard. In addition, the sensor is provided with a protective cover of cardboard. For special versions PE foam or PE foil is also used. Dispose of the packaging material via specialised recycling companies.

Storage and transport temperature

- Storage and transport temperature see "Supplement - Technical data - Ambient conditions"
- Relative humidity 20 … 85 %

4 Mounting

4.1 General instructions

Switching point

In general, VEGAVIB 63 can be mounted in any position. The instrument must be mounted in such a way that the tuning fork is at the height of the requested switching point.

Moisture

Use the recommended cable (see chapter "*Connecting to power supply*") and tighten the cable entry.

You can give your VEGAVIB 63 additional protection against moisture penetration by leading the connection cable downward in front of the cable entry. Rain and condensation water can thus drain off. This applies mainly to mounting outdoors, in areas where moisture is expected (e.g. by cleaning processes) or on cooled or heated vessels.

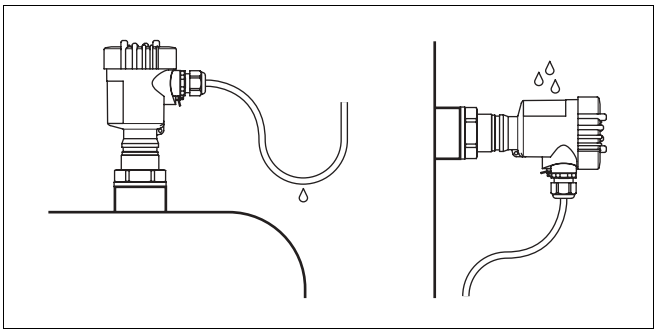


Fig. 2: Measures against moisture penetration

Transport

Do not hold VEGAVIB 63 on the vibrating element. Especially with flange and tube versions, the sensor can be damaged by the weight of the instrument.

Remove the protective cover just before mounting.

Pressure/Vacuum

The process fitting must be sealed if there is gauge or low pressure in the vessel. Before use, check if the seal material is resistant against the measured product and the process temperature.

Handling

The vibrating level switch is a measuring instrument and must be treated accordingly. Bending the vibrating element will destroy the instrument.

Warning:
The housing must not be used to screw the instrument in! Applying tightening force to the housing can damage its internal mechanical components.

To screw in, use the hexagon above the thread.

4.2 Mounting information

Agitators and fluidization

Due to agitators, vibrations or similar, the level switch can be subjected to strong lateral forces. For this reason, do not use an overly long extension tube for VEGAVIB 63, but check if you can mount a short level switch on the side of the vessel in horizontal position.

Extreme vibrations from the system side, e.g. by agitators or turbulence in the vessel, e.g. by fluidization can cause the extension tube of VEGAVIB 63 to vibrate. This will cause increased stress on the upper weld joint. Should a longer tube version be necessary, you can provide a suitable straining or fastening directly above the tuning fork to fasten the extension tube.

This measure applies particularly to applications in Ex areas. Make sure that the tube is not subjected to bending forces through this measure.

Inflowing material

If VEGAVIB 63 is mounted in the filling stream, unwanted switching signals may be generated. Mount VEGAVIB 63 at a location in the vessel where no disturbing influence from e.g. filling openings, agitators, etc. can occur.

This applies particularly to instrument types with long extension tube.

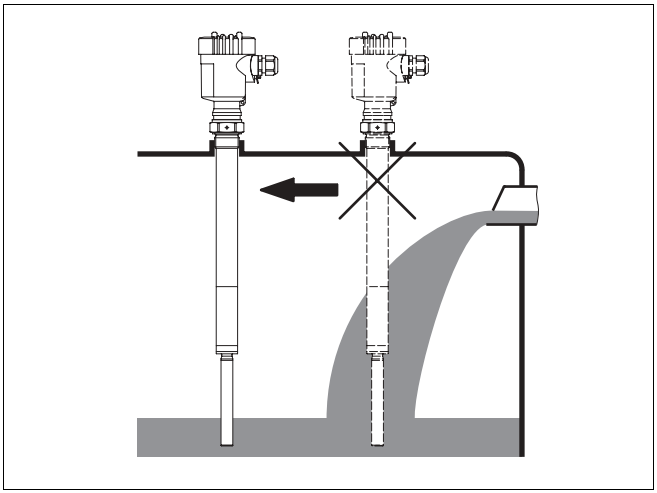


Fig. 3: Inflowing material

Lock fitting

VEGAVIB 63 can be mounted with a lock fitting for height adjustment. Take note of the pressure information of the lock fitting.

Socket

The vibrating element should protrude into the vessel to avoid buildup. For that reason, avoid using mounting bosses for flanges and screwed fittings. This applies particularly to use with adhesive products.

Material cone

Material cones can form in solids silos which can change the switching point. Please keep this in mind when installing the sensor in the vessel. We recommend selecting an installation location where the vibrating rod detects an average value of the material cone.

Depending on the arrangement of the filling and emptying opening in the vessel, the vibrating rod must be mounted respectively.

To compensate measurement errors in cylindrical vessels caused by the material cone, the sensor must be mounted at a distance of d/6 from the vessel wall.

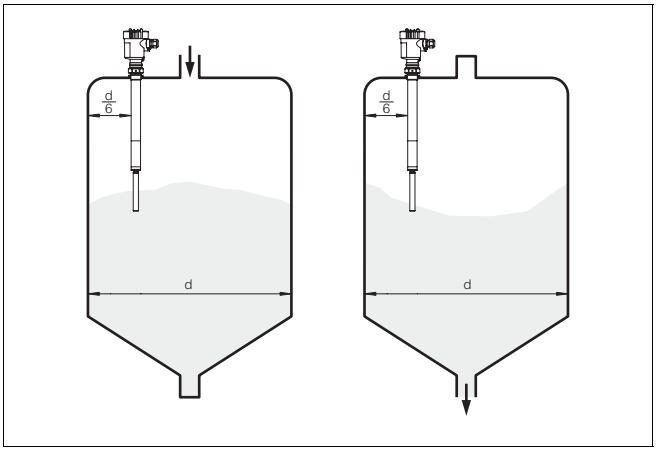


Fig. 4: Filling and emptying centered

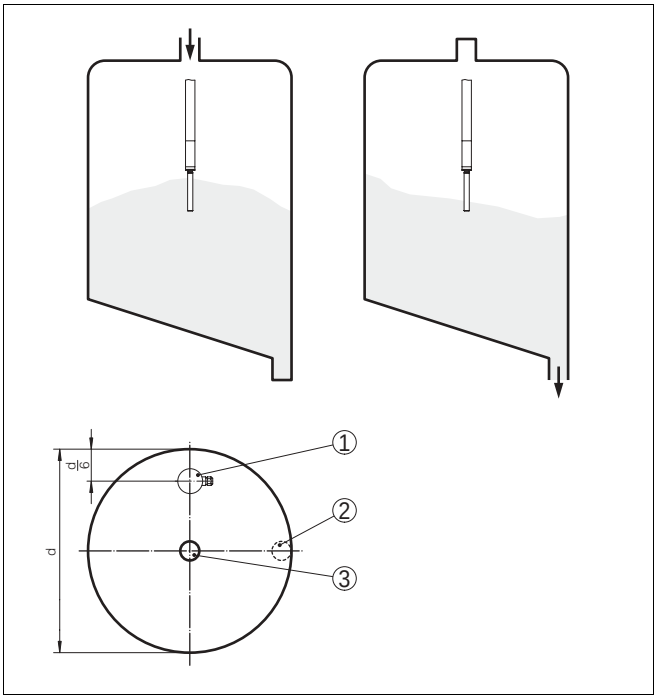


Fig. 5: Filling in the center, emptying laterally
1 VEGAVIB 63
2 Emptying opening
3 Filling opening

Baffle for protection against physical damage

In applications such as grit chambers or settling basins for coarse sediments, the vibrating element must be protected against damage with a suitable baffle.

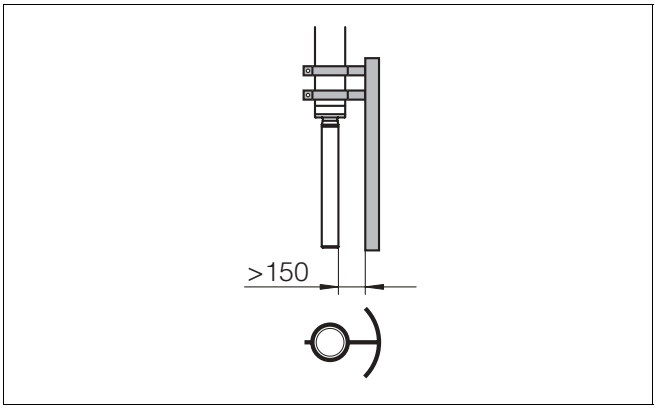


Fig. 6: Baffle for protection against physical damage

5 Connecting to power supply

5.1 Preparing the connection

Note safety instructions

Always observe the following safety instructions:

- Connect only in the complete absence of line voltage

Take note of safety instructions for Ex applications

In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units.

Select power supply

Connect the power supply acc. to the following diagrams. Oscillator VB 60R is designed in protection class 1. To maintain this protection class, it is absolutely necessary that the ground conductor is connected to the internal ground terminal. Take note of the general installation regulations. As a rule, connect VEGAVIB 63 to vessel ground (PA), or in case of plastic vessels, to the next ground potential. On the side of the housing there is a ground terminal between the cable entries. This connection serves to drain off electrostatic charges. In Ex applications, the installation regulations for hazardous areas must be given priority.

The data for power supply are stated in the Technical data in the Supplement.

Selecting the connection cable

VEGAVIB 63 is connected with standard cable with round wire cross section. An outer cable diameter of 5 … 9 mm (0.2 … 0.35 in) ensures the seal effect of the cable entry.

If cable with a different diameter or wire cross section is used, exchange the seal or use an appropriate cable connection.

In hazardous areas, only use approved cable connections for VEGAVIB 63.

Select connection cable for Ex applications

Take note of the corresponding installation regulations for Ex applications.

5.2 Connection procedure

With Ex instruments, the housing cover may only be opened if there is no explosive atmosphere.

Proceed as follows:

1 Unscrew the housing cover

2 Loosen compression nut of the cable entry

3 Remove approx. 10 cm (4 in) of the cable mantle, strip approx. 1 cm (0.4 in) insulation from the ends of the individual wires

4 Insert the cable into the sensor through the cable entry

5 Lift the opening levers of the terminals with a screwdriver (see following illustration)

6 Insert the wire ends into the open terminals according to the wiring plan

7 Press down the opening levers of the terminals, you will hear the terminal spring closing

8 Check the hold of the wires in the terminals by lightly pulling on them

9 Tighten the compression nut of the cable entry, the seal ring must completely encircle the cable

10 Screw the housing cover back on

The electrical connection is finished.

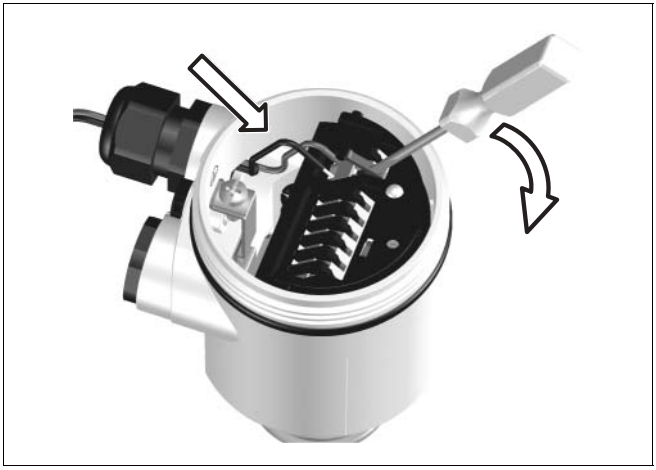


Fig. 7: Connection steps 5 and 6

5.3 Wiring plans, single chamber housing

The following illustrations apply to the non-Ex as well as to the EEx d version.

Housing overview

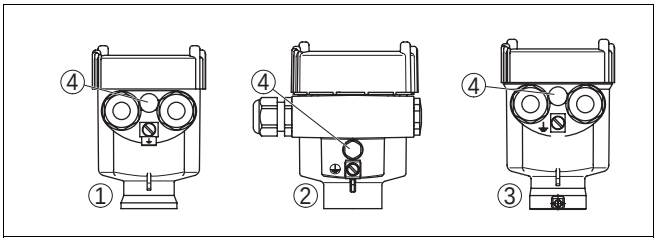


Fig. 8: Material versions, single chamber housing
1 Plastic (not with EEx d)
2 Aluminium
3 Stainless steel (not with EEx d)
4 Filter element for pressure compensation (not with EEx d)

Electronics and connection compartment

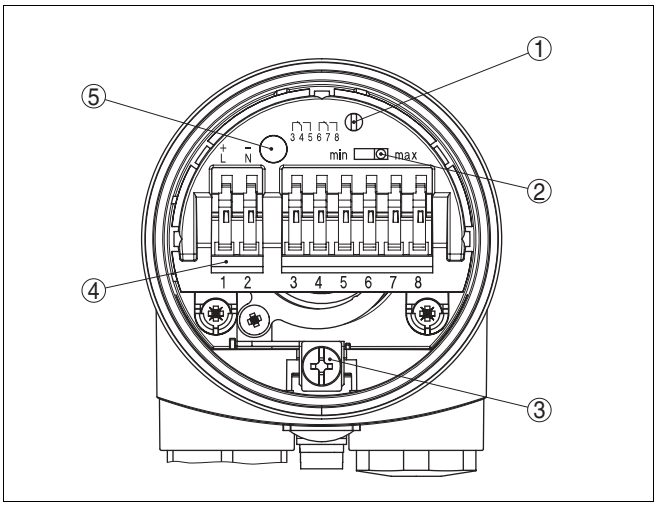


Fig. 9: Electronics and connection compartment
1 Potentiometer for switching point adaptation (covered)
2 DIL switch for mode adjustment
3 Ground terminal
4 Terminals
5 Control lamp

Wiring plan

We recommend connecting VEGAVIB 63 in such a way that the switching circuit is open when there is a level signal, line break or failure (safe condition).

The relays are always shown in non-operative condition.

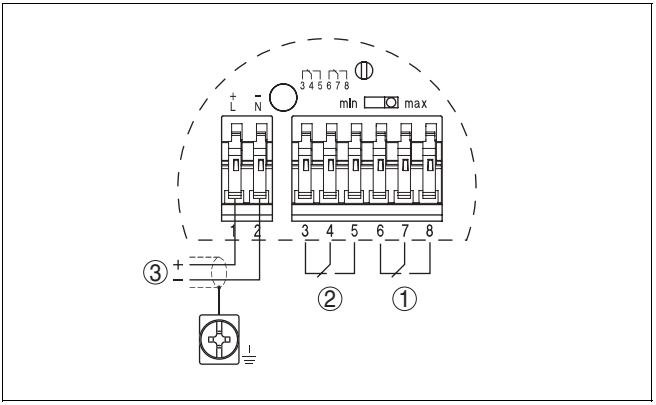


Fig. 10: Wiring plan
1 Relay output
2 Relay output
3 Supply voltage

6 Set up

6.1 General

The numbers in brackets refer to the following illustrations.

Function/Configuration

On the electronics module you will find the following indicating and adjustment elements:

- Potentiometer for switching point adaptation (1)
- DIL switch for mode adjustment - min/max (2)
- Signal lamp (5)

Note:
As a rule, always set the mode with the mode switch (2) before starting to set up VEGAVIB 63. The switching output will change if you set the mode switch (2) afterwards. This could possibly trigger other connected instruments or devices.

6.2 Adjustment elements

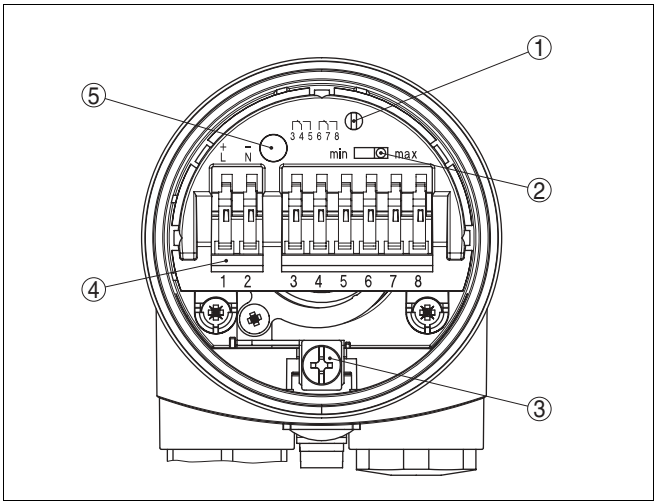


Fig. 11: Electronics module VB 60R - Relay output
1 Potentiometer for switching point adaptation
2 DIL switch for mode adjustment
3 Ground terminal
4 Terminals
5 Control lamp

Switching point adaptation (1)

You can adapt the switching point to the solid with the potentiometer. The switching point is preset and covered by a label. It must only be modified in special cases.

By default, the potentiometer of VEGAVIB 63 is set to mid position (0.05 … 1 g/cm³ or 0.002 … 0.036 lbs/in³). In very light solids, turn the potentiometer to complete left position (0.02 … 0.1 g/cm³ or 0.0007 … 0.0036 lbs/in³). By doing this, VEGAVIB 63 will be more sensitive and light solids can be detected more reliably.

For very heavy solids, turn the potentiometer to the complete right position (>0.3 g/cm³ or >0.011 lbs/in³). Hence VEGAVIB 63 is less sensitive.

For instruments detecting solids in water, these values are not applicable. The potentiometer is preset and must not be changed.

Mode adjustment (2)

With the mode adjustment (min./max.) you can change the switching condition of the relay. You can set the required mode acc. to the "Function chart" (max. - max. detection or overfill protection, min. - min. detection or dry run protection).

We recommend connecting acc. to the quiescent current principle (replay contact deenergizes when reaching the switching point), because the relay takes on the same (safe) condition if a failure is detected.

Signal lamp (5)

Signal lamp for indication of the switching condition.

- green = relay energized
- red = relay deenergized
- red (flashing) = failure

6.3 Function chart

The following chart provides an overview of the switching conditions depending on the adjusted mode and level.

	Level	Switching status	Control lamp
max. mode Overfill protection		 Relay energized	 green

	Level	Switching status	Control lamp
max. mode Overfill protection		 3 4 5 (6) (7) (8) Relay deenergized	 red
min. mode Dry run protection		 3 4 5 (6) (7) (8) Relay energized	 green
min. mode Dry run protection		 3 4 5 (6) (7) (8) Relay deenergized	 red
Failure of the supply voltage (min./max. mode)	any	 3 4 5 (6) (7) (8) Relay deenergized	○
Failure	any	 3 4 5 (6) (7) (8) Relay deenergized	 flashes red

7 Maintenance and fault rectification

7.1 Maintenance

When used as directed in normal operation, VEGAVIB 63 is completely maintenance-free.

7.2 Fault rectification

Checking the switching signal Causes of malfunction

VEGAVIB 63 offers maximum reliability. Nevertheless faults can occur during operation. These may be caused by the following, e.g.:

- Sensor
- Process
- Power supply
- Signal processing.

Fault rectification

The first measure is checking the output signal. In many cases the reasons can be determined and faults rectified.

24 hour service hotline

Should the following measures not be successful, please call in urgent cases the VEGA service hotline under the phone number **+49 1805 858550**.

The hotline is available to you 7 days a week round-the-clock. Since we offer this service world-wide, the support is only available in the English language. The service is free of charge, only the standard telephone costs will be charged.

? VEGAVIB 63 signals "covered" when the vibrating element is not submerged (overfill protection)

? VEGAVIB 63 signals "uncovered" when the vibrating element is submerged (dry run protection)

- Supply voltage too low

→ Check the power supply

- Electronics defective

→ Push the mode switch (min./max.). If the instrument then changes the mode, the instrument may be mechanically damaged. Should the switching function in the correct mode still be faulty, return the instrument for repair.

→ Push the mode switch. If the instrument then does not change the mode, the oscillator may be defective. Exchange the oscillator.

→ Check if there is buildup on the vibrating element, and if so, remove it.

- Unfavourable installation location

→ Mount the instrument at a location where no dead zones or mounds can form in the vessel.

→ Check if the vibrating element is covered by buildup on the socket.

- Wrong mode selected

→ Set the correct mode on the mode switch (max: overfill protection; min: dry run protection). Wiring should be carried out acc. to the quiescent current principle.

? Signal lamp flashes red

- Electronics has detected a failure

→ Exchange instrument or return it for repair

7.3 Exchanging the electronics

In general, all oscillators of series VB60 can be interchanged. If you want to use an oscillator with a different signal output, you can download the corresponding operating instructions manual from our homepage under Downloads.

With EExd instruments, the housing cover must only be opened if there is no explosive atmosphere.

Proceed as follows:

1 Switch off power supply

2 Unscrew the housing cover

3 Lift the opening levers of the terminals with a screwdriver

4 Pull the connection cables out of the terminals

5 Loosen the two screws with a Phillips screwdriver (size 1)

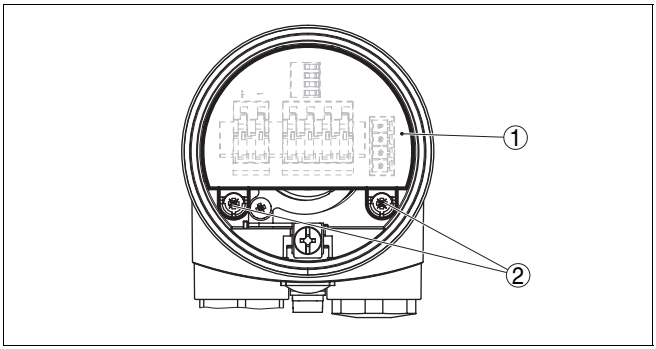


Fig. 12: Loosen the screws
1 Electronics module
2 Screws (2 pcs.)

6 Remove the old oscillator

7 Compare the new oscillator with the old one. The type label of the oscillator must correspond to that of the old oscillator. This applies particularly to instruments used in hazardous areas.

8 Compare the settings of the two oscillators. Set the adjustment elements of the new oscillator to the settings of the old oscillator.

Information:
Make sure that the housing is not rotated during the electronics exchange. Otherwise the plug may be in a different position later.

9 Insert the oscillator carefully. Make sure that the plug is in the correct position.

10 Screw in and tighten the two screws with a Phillips screwdriver.

11 Insert the wire ends into the open terminals according to the wiring plan

12 Close the opening levers of the terminals, you will hear the terminal spring closing

13 Check the hold of the wires in the terminals by lightly pulling on them

14 Check the tightness of the cable entry. The seal ring must completely encircle the cable.

15 Screw the housing cover back on

The electronics exchange is finished.

7.4 Instrument repair

If it is necessary to repair VEGAVIB 63 please proceed as follows:

You can download a return form (23 KB) from our homepage www.vega.com under: "*Services – Downloads – Forms and Certificates – Repair form*".

By doing this you help us carry out the repair quickly and without having to call back for needed information.

- Print and fill out one form per instrument
- Clean the instrument and pack it damage-proof
- Attach the completed form and possibly also a safety data sheet to the instrument.
- Send the instrument to the respective address of your agency. In Germany to the VEGA headquarters in Schiltach.

8 Dismounting

8.1 Dismounting procedure

Warning:
Before dismounting, be aware of dangerous process conditions such as e.g. pressure in the vessel, high temperatures, corrosive or toxic products etc.

Take note of chapters "*Mounting*" and "*Connecting to power supply*" and carry out the listed steps in reverse order.

With Ex instruments, the housing cover may only be opened if there is no explosive atmosphere.

8.2 Disposal

VEGAVIB 63 consists of materials which can be recycled by specialised recycling companies. We have purposely designed the electronic modules to be easily separable. Mark the instrument as scrap and dispose of it according to national government regulations (e.g. in Germany acc. to electronic scrap ordinance).

Materials: see "*Technical data*"

If you cannot dispose of the instrument properly, please contact us about disposal methods or return.

9 Functional safety

9.1 General

Validity

This safety manual applies to measuring systems consisting of VEGAVIB 63 vibrating level switches and integrated oscillator VB60R. The instrument corresponds to a subsystem of type B.

The sensor software must correspond at least to version 1.03 or higher.

Area of application

The measuring system can be used for level detection of powders and granules which meet the specific requirements of the safety technology, e.g.:

- Mode "max" for overfill protection
- Mode "min" for dry run protection

The measuring system is qualified in both modes to meet the following requirement degree acc. to IEC 61508-2:

- **SIL2** with architecture 1oo1D (single channel)
- **SIL3** with architecture 1oo2D (double-channel/redundant)

With a special factory setting, the measuring system is also suitable for detection of solids in water (see operating instructions manual).

Safety function

The safety function of this measuring system is the detection and signalling of the condition of the vibration element. The safe condition depends on the mode:

- In mode "max": condition "covered"
- In mode "min": condition "uncovered"

Relevant standards

- IEC 61508-1, -2, -4
  - Functional safety of electrical/electronic/programmable electronic systems

Safety requirements

The failure limit values for a safety function, depending on the SIL class (of IEC 61508-1, 7.6.2)

Safety integrity level	Low demand mode	High demand mode
SIL	**PFD_{avg}**	**PFH**
4	$>=10^{-5}$ up to $<10^{-4}$	$>=10^{-9}$ up to $<10^{-8}$
3	**$>=10^{-4}$ up to $<10^{-3}$**	**$>=10^{-8}$ up to $<10^{-7}$**
2	**$>=10^{-3}$ up to $<10^{-2}$**	**$>=10^{-7}$ up to $<10^{-6}$**
1	$>=10^{-2}$ up to $<10^{-1}$	$>=10^{-6}$ up to $<10^{-5}$

Safety integrity of the hardware for safety-relating subsystems of type B (IEC 61508-2, 7.4.3)

Safe failure fraction	**Hardware fault tolerance**		
SFF	**HFT = 0**	**HFT = 1**	**HFT = 2**
<60 %	not permitted	SIL1	SIL2
60 % up to <90 %	SIL1	SIL2	SIL3
90 % up to <99 %	**SIL2**	**SIL3**	(SIL4)
>=99 %	SIL3	(SIL4)	(SIL4)

9.2 Planning

General instructions and restrictions

- The measuring system must be used acc. to the application
- The application-specific limits must be maintained and the specifications must not be exceeded.
- Acc. to the specifications in the operating instructions manual, the current load of the output circuits must be within the limits.
- It must be used only in products to which the materials of the vibrating system are sufficiently chemically resistant.

Note the following items for use as dry run protection system:

- Avoid buildup on the vibrating system (possibly smaller proof test intervals)

Assumptions

For the implementation of FMEDA (Failure Mode, Effects and Diagnostics Analysis) the following assumptions form the basis:

- Failure rates are constant, wear of the mechanical parts is not taken into account
- Failure rates of external power supplies are not included
- Multiple errors are not taken into account
- The average ambient temperature during the operating time is +40°C (104°F)
- The environmental conditions correspond to an average industrial environment
- The lifetime of the components is around 8 to 12 years (IEC 61508-2, 7.4.7.4, remark 3)
- The processing unit evaluates the output circuit of the measuring system acc. to the quiescent current principle.

- The communication via the IIC bus interface is only used for default scaling and for service purposes.
- The repair time (exchange of the meas. system) after a fail-safe error is eight hours (MTTR = 8 h)
- In the mode with the lowest demand rate, the reaction time of a connected control and processing unit to dangerous detectable errors is max. 1 hour.

Low demand mode

If the demand rate is only once a year, then the measuring system can be used as safety-relevant subsystem in "low demand mode" (IEC 61508-4, 3.5.12).

If the ratio of the internal diagnostics test rate of the measuring system to the demand rate exceeds the value 100, the measuring system can be treated in the way it is executing a safety function in the mode with low demand rate (IEC 61508-2, 7.4.3.2.5).

Corresponding characteristics is the value PFD_{avg} (average Probability of dangerous Failure on Demand). It is dependent on the test interval T_{Proof} between the function tests of the protective function.

Numbers see paragraph "Safety-technical characteristics".

High demand mode

If the "low demand mode" does not apply, the measuring system must be used as safety-relevant subsystem in "high demand" (IEC 61508-4, 3.5.12).

The fault tolerance time of the complete system must be higher than the sum of the reaction times or the diagnostics test periods of all components in the safety chain.

Corresponding characteristics is the value PFH (failure rate).

Numbers see paragraph "Safety-technical characteristics".

Safe condition and fault description

The safe condition of the measuring system is the switched off status (quiescent current principle):

- VB60R (relay output) – Relay deenergized

A fail-safe failure (safe failure) exists if the measuring system changes to the defined safe condition without demand of the process.

If the internal diagnosis system recognises a failure, the safe condition is taken up.

A dangerous undetected failure exists if the measuring system does not go to the defined safe condition when required by the process.

Configuration of the processing unit

The processing unit must evaluate the output circuit of the measuring system by taking the quiescent current principle into account.

The processing unit must correspond to the SIL level of the measuring chain.

9.3 Setup

Mounting and installation

The prevailing plant conditions influence the safety of the measuring system. Therefore note the mounting and installation instructions of the appropriate operating instructions manual. Mainly important is the correct setting of the mode (min./max.).

In heavy or very light-weight solids the switching point of the measuring system must be adapted acc. to the operating instructions manual depending on the density limits.

9.4 Reaction during operation and in case of failure

- The adjustment elements must not be modified during operation.
- In case of modifications during operation, you have to take note of the safety functions.
- Occurring fault signals are described in the appropriate operating instructions manual.
- In case of detected failures or fault signals, the entire measuring system must be switched out of service and the process held in a safe condition by means of other measures.
- An electronics exchange is easily possible and described in the operating instructions manual.
- If due to the detected failure, the electronics or the complete sensor is interchanged, the manufacturer must be informed (incl. a fault description).

9.5 Recurring function test

The recurring function test serves to reveal potential dangerous errors that are otherwise not discernible. The function of the measuring system must be checked at adequate intervals.

The operator is responsible for choosing the type of test and the intervals in the stated time frame. The time frame depends on the PFD_{avg} value acc. to the chart and diagram in section "Safety-related characteristics".

In high demand rate, no recurring function test is arranged in IEC 61508. A proof of the functional efficiency is seen in the more frequent demand of the measuring system. In double channel architectures it is useful to proof the redundancy by recurring function tests in appropriate intervals.

The test must be carried out in a way that verifies the flawless operation of the safety functions in conjunction with all system components.

This is ensured by a controlled reaching of the response height during filling. If filling up to the response height is not possible, then a response of the measuring system must be triggered by a suitable simulation of the level or the physical effect.

The methods and procedures used during the tests must be stated and their suitability must be specified. The tests must be documented.

If the function test proves negative, the entire measuring system must be switched out of service and the process held in a safe condition by means of other measures.

In the double channel architecture 1oo2D this applies separately to both channels.

9.6 Safety-related characteristics

The failure rates of the electronics and the vibrating system are determined by an FMEDA acc. to IEC 61508. These calculations are based on component failure rates acc. to SN 29500. All numerical values refer to an average ambient temperature during the operating time of +40°C (104°F). The calculations are also based on the specifications stated in chapter "Planning".

Overfill protection

Mode switch is set to "max"

λ_{sd}	0 FIT	safe detected failure (1 FIT = failure/10^9h)
λ_{su}	586 FIT	safe undetected failure
λ_{dd}	124 FIT	dangerous detected failure
λ_{du}	27 FIT	dangerous undetected failure
SFF	>96 %	Safe Failure Fraction
DC_S	0 %	Diagnosis coverage $DC_S = \lambda_{sd}/(\lambda_{sd} + \lambda_{su})$
DC_D	82 %	Diagnosis coverage $DC_D = \lambda_{dd}/(\lambda_{dd} + \lambda_{du})$

Dry run protection

Mode switch is set to "min"

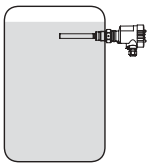
λ_{sd}	0 FIT	safe detected failure
λ_{su}	565 FIT	safe undetected failure
λ_{dd}	135 FIT	dangerous detected failure
λ_{du}	37 FIT	dangerous undetected failure
SFF	>95 %	Safe Failure Fraction
DC_S	0 %	Diagnosis coverage $DC_S = \lambda_{sd}/(\lambda_{sd} + \lambda_{su})$
DC_D	78 %	Diagnosis coverage $DC_D = \lambda_{dd}/(\lambda_{dd} + \lambda_{du})$

General data

$T_{Diagnosis}$ Diagnosis test period	100 sec
MTBF = MTTF + MTTR	1.33×10^6 h
max. useful life of the measuring system for the safety function	approx. 10 years

Single channel architecture

Architecture 1oo1D – Overfill protection



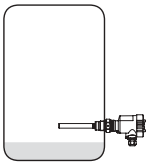
SIL2 (Safety Integrity Level)

HFT = 0 (Hardware Fault Tolerance)

Mode switch is set to "max"

PFD_{avg} T_{Proof} = 1 year T_{Proof} = 5 years T_{Proof} = 10 years	 $< 0.012 \times 10^{-2}$ $< 0.059 \times 10^{-2}$ $< 0.118 \times 10^{-2}$
PFH [1/h]	$< 2.7 \times 10^{-8}$/h

Architecture 1oo1D – Dry run protection



SIL2 (Safety Integrity Level)

HFT = 0 (Hardware Fault Tolerance)

Mode switch is set to "min"

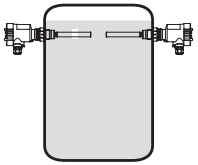
PFD_{avg} T_{Proof} = 1 year T_{Proof} = 5 years T_{Proof} = 10 years	 $< 0.016 \times 10^{-2}$ $< 0.082 \times 10^{-2}$ $< 0.164 \times 10^{-2}$
PFH [1/h]	$< 3.7 \times 10^{-8}$/h

Double channel architecture

Here you see an example how the measuring system in double channel architecture can be used in an application with demand rate SIL3. A Common Cause Factor of beta = 10 % (worst case) is taken into account.

If the instruments are used in another (multiple channel) architecture, the values must be calculated for the selected application by means of the above failure rates.

Architecture 1oo2D – Overfill protection



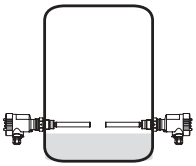
SIL3 (Safety Integrity Level)

HFT = 1 (Hardware Fault Tolerance)

Mode switch is set to "max"

PFD_{avg} T_{Proof} = 1 year T_{Proof} = 5 years T_{Proof} = 10 years	 $< 0.012 \times 10^{-3}$ $< 0.059 \times 10^{-3}$ $< 0.120 \times 10^{-3}$
PFH [1/h]	$< 1.5 \times 10^{-8}$/h

Architecture 1oo2D – Dry run protection



SIL3 (Safety Integrity Level)

HFT = 1 (Hardware Fault Tolerance)

Mode switch is set to "min"

PFD_{avg} T_{Proof} = 1 year T_{Proof} = 5 years T_{Proof} = 10 years	 $< 0.016 \times 10^{-3}$ $< 0.081 \times 10^{-3}$ $< 0.160 \times 10^{-3}$
PFH [1/h]	$< 1.7 \times 10^{-8}$/h

Time-dependent process of PFD_{avg}

The time-dependent process of PFD_{avg} reacts in the time period up to 10 years virtually linear to the operating time. The above values only apply to the T_{Proof} interval, after which a recurring function test must be carried out.

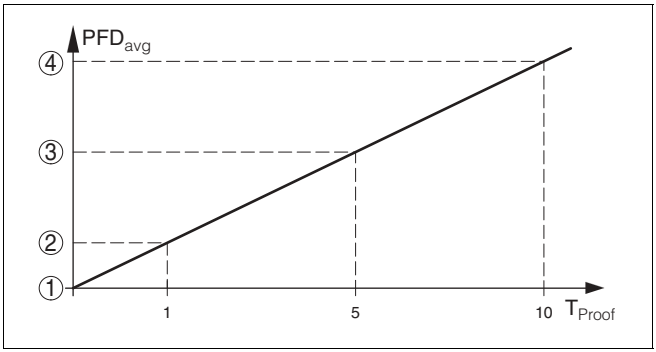


Fig. 13: Time-dependent process of PFD_{avg}[1)]
1 PFD_{avg} = 0
2 PFD_{avg} after 1 year
3 PFD_{avg} after 5 years
4 PFD_{avg} after 10 years

1) Numbers see in the above charts.

10 Supplement

10.1 Technical data

General data

Material 316L corresponds to 1.4404 or 1.4435

Materials, wetted parts	
– Process fitting – Thread	316L
– Process fitting - Flange	316L
– Process seal	Klingersil C-4400
– Vibrating rod	316L/1.4462 (318S13)
– Extension tube ø 29 mm (ø 1.14 in)	316L
Materials, non-wetted parts	
– Housing	plastic PBT (Polyester), Alu-die casting powder-coated, stainless steel 316L
– Seal ring between housing and housing cover	NBR (stainless steel housing), silicone (Alu/plastic housing)
– Ground terminal	316L
Weights	
– with plastic housing	1150 g (40 oz)
– with Aluminium housing	1600 g (56 oz)
– with stainless steel housing	1950 g (69 oz)
– Extension tube	approx. 1450 g/m (15.6 oz/ft)
Sensor length	0.3 … 6 m (1 … 20 ft)

Output variable

Output	relay output (DPDT), 2 floating spdts
Turn-on voltage	
– min.	10 mV
– max.	253 V AC, 253 V DC
Switching current	
– min.	10 µA
– max.	3 A AC, 1 A DC

Breaking capacitance	
– min.	50 mW
– max.	750 VA AC, 54 W DC If inductive loads and higher currents are applied, the gold plating on the relay contact surface can be permanently damaged. The contact is then no longer suitable for switching of low-level signal circuits.
Contact material (relay contacts)	AgNi or AgSnO and Au plated
Modes (adjustable)	min/max
Integration time	
– when immersed	approx. 0.5 s
– when laid bare	approx. 1 s

Ambient conditions

Ambient temperature on the housing	-40 … +80°C (-40 … +176°F)
Storage and transport temperature	-40 … +80°C (-40 … +176°F)

Process conditions

Parameter	level of solids
Process pressure	-1 … 16 bar (-100 … 1600 kPa; -14.5 … 232 psi)

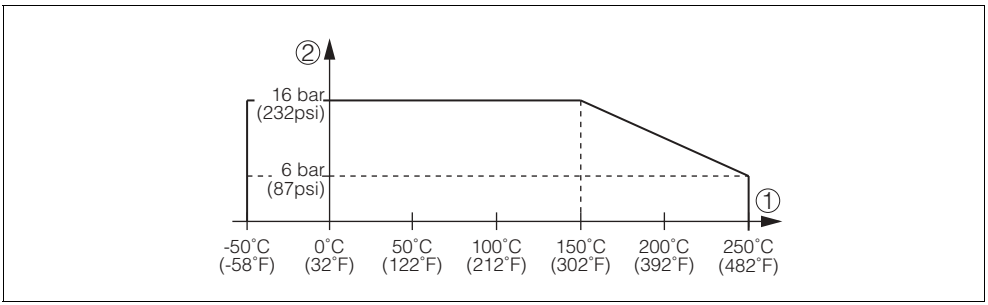


Fig. 14: Process pressure – Product temperature
1 Product temperature
2 Process pressure

VEGAVIB 63 of 316L	-50 … +150°C (-58 … +302°F)
Process temperature (thread or flange temperature) with temperature adapter (option)	-50 … +250°C (-58 … +482°F)

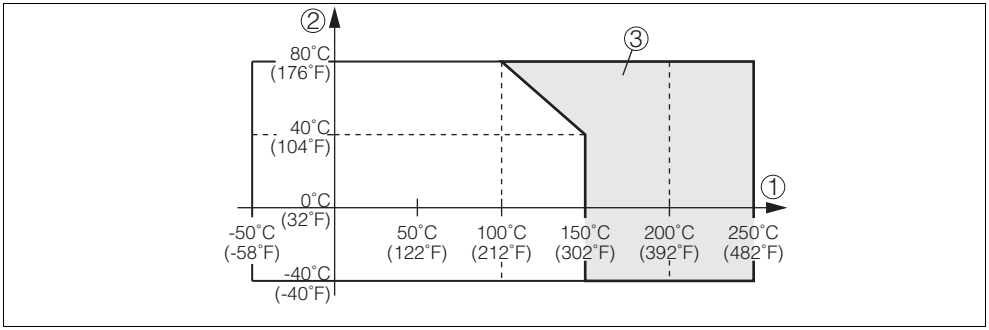


Fig. 15: Ambient temperature – Product temperature
1 Product temperature
2 Ambient temperature
3 Temperature range with temperature adapter

Density	>0.02 g/cm³ (>0.0007 lbs/in³)

Electromechanical data

Cable entry/plug (dependent on the version)	
– Single chamber housing	• 1x cable entry M20x1.5 (cable-ø5 … 9 mm), 1x blind stopper M20x1.5, attached 1x cable entry M20x1.5 or: • 1x cable entry ½ NPT, 1x blind stopper ½ NPT, 1x cable entry ½ NPT or: • 1x plug M12x1, 1x blind stopper M20x1.5
Spring-loaded terminals	for wire cross section up to 1.5 mm² (0.0023 in²)

Adjustment elements

Mode switch	
– min	min. detection or dry run protection
– max	max. detection or overfill protection

Supply voltage

Supply voltage	20 … 253 V AC, 50/60 Hz, 20 … 72 V DC (at U >60 V DC the ambient temperature must be max. 50°C/122°F)
Power consumption	1 … 8 VA (AC), approx. 1.3 W (DC)

Electrical protective measures

Protection	IP 66/IP 67
Overvoltage category	III
Protection class	I

Approvals[2)]

ATEX II 1/2G, 2G EEx d IIC T6

ATEX II 1/2 D IP66 T

[2)] Deviating data with Ex applications: see separate safety instructions.

10.2 Dimensions

VEGAVIB 63 [3)]

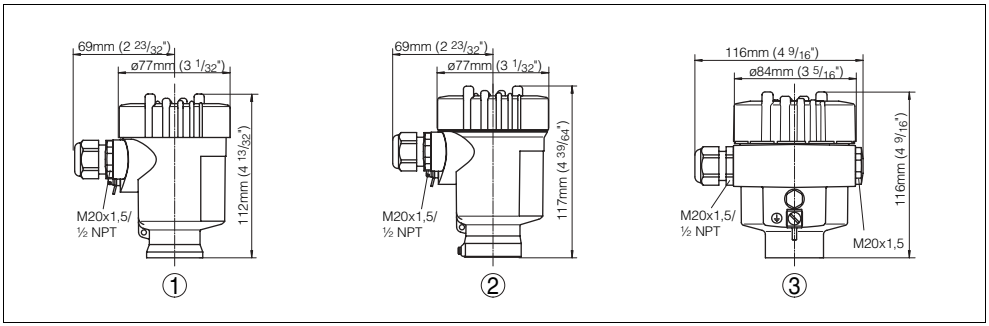


Fig. 16: Housing versions
1 Plastic housing
2 Stainless steel housing
3 Aluminium housing

[3)] All dimensions in mm (inch)

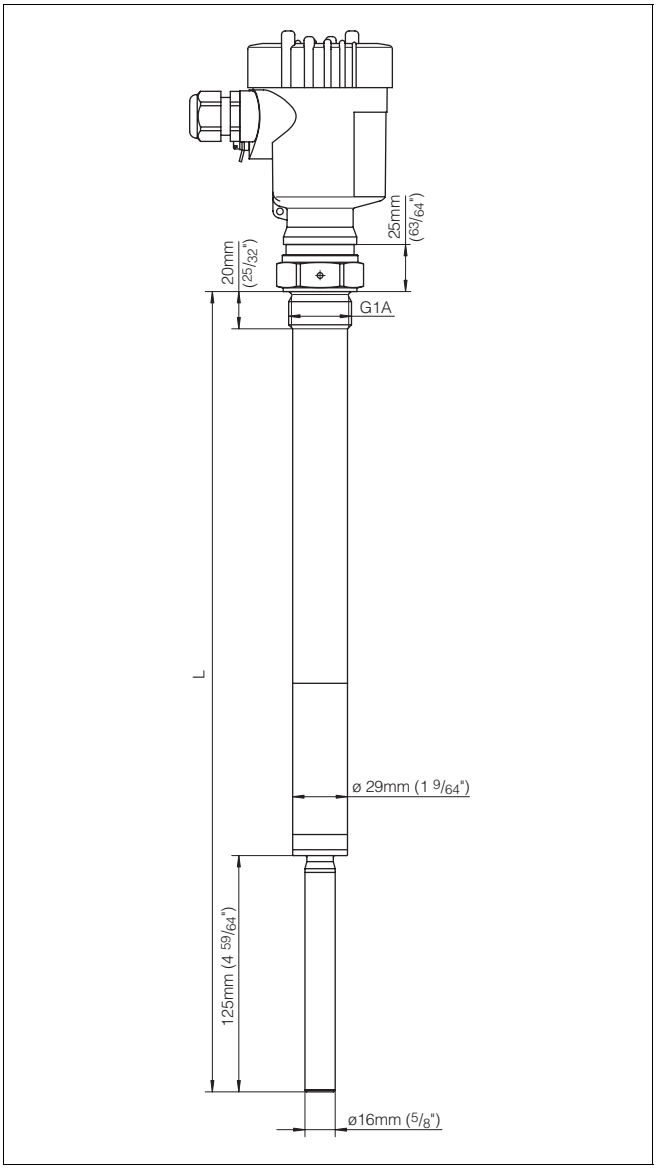


Fig. 17: VEGAVIB 63 - Threaded version G1A

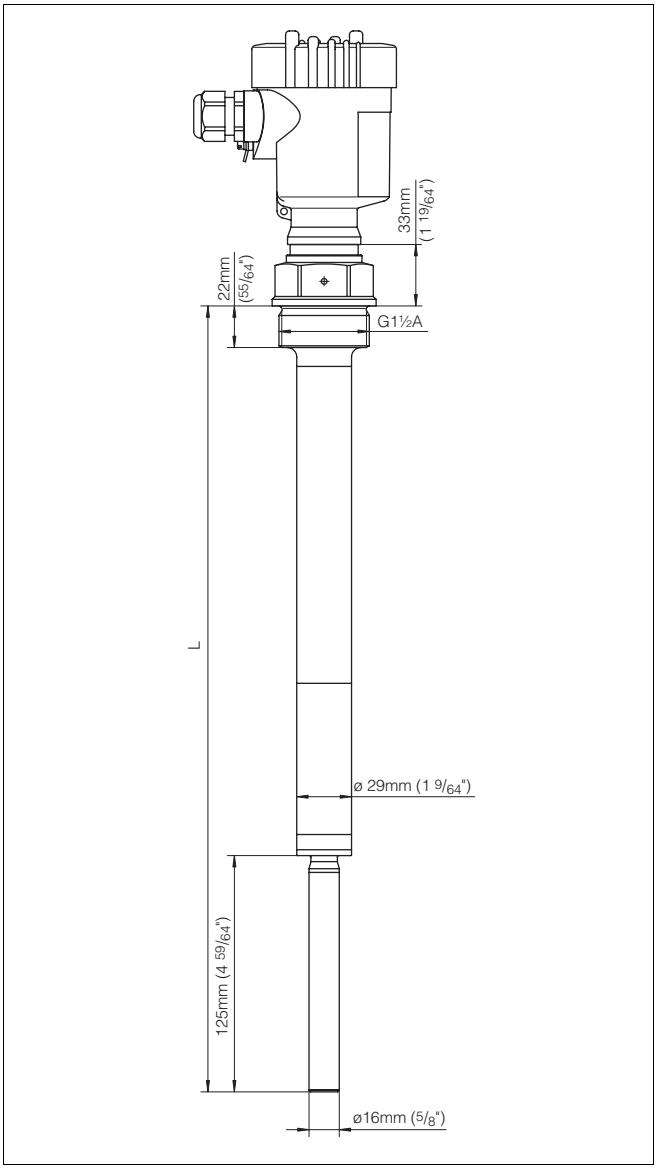


Fig. 18: VEGAVIB 63 - Threaded version G1½A

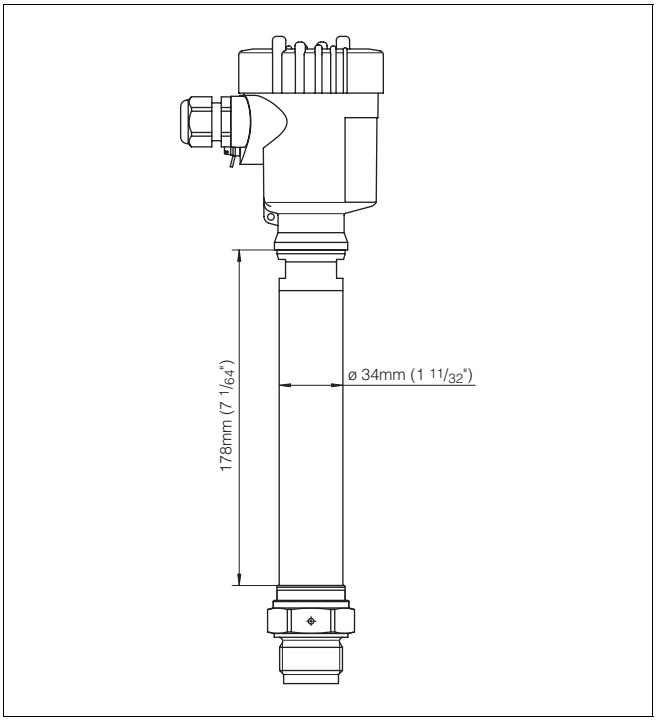


Fig. 19: Temperature adapter

10.3 Certificates

SIL declaration of conformity

SIL declaration of conformity
Functional safety according to IEC 61508 / IEC 61511

VEGA Grieshaber KG, Am Hohenstein 113, D-77761 Schiltach

declares as manufacturer, that the vibrating level switches of the product family

VEGAVIB 61, 62, 63, 65, 66, 67 with oscillator VB60R

according to IEC 61508 are suitable for safety-related applications
e.g. overfill protection or dry run protection.
The corresponding instructions of the safety manual must be considered. 1)

Safety-related characteristics:

SIL	Safety Integrity Level	**SIL 2**	2)
HFT	Hardware Fault Tolerance	**HFT=0** (the measuring system corresponds to the type B)	

	Mode switch	overfill protection MAX	dry run protection MIN	
λ_{sd}	safe detected failure	0 FIT	0 FIT	3)
λ_{su}	safe undetected failure	586 FIT	565 FIT	
λ_{dd}	dangerous detected failure	124 FIT	135 FIT	
λ_{du}	dangerous undetected failure	27 FIT	37 FIT	
SFF	Safe Failure Fraction	> 96%		
PFD_{avg}	T_{Proof} = 1 year	0.012×10^{-2}	0.016×10^{-2}	4)
average Probability of dangerous Failure on Demand	T_{Proof} = 5 years	0.059×10^{-2}	0.082×10^{-2}	
	T_{Proof} = 10 years	0.118×10^{-2}	0.164×10^{-2}	
PFH	Probability of a dangerous Failure per Hour	2.7×10^{-8} / h	3.7×10^{-8} / h	5)
Diagnostic Coverage	$DC_S = \lambda_{sd} / (\lambda_{sd}+\lambda_{su})$	0%	0%	
	$DC_D = \lambda_{dd} / (\lambda_{dd}+\lambda_{du})$	82%	78%	
Diagnostic test duration	$T_{Diagnose}$	100 sec		6)
MTBF = MTTF + MTTR		1.33×10^{8} h		
max. useful life of the measuring system for the safety function		ca. 10 years		

1) Safety Manual see operating instructions
2) Safety related characteristics for **SIL3** (two- channel architectures) see Safety Manual
3) The failure rates were determined by a FMEDA (Failure Modes, Effects and Diagnostics Analysis) (FIT = failure in time /10^9 h)
4) PFD_{avg} is valid only for the T_{Proof} interval according to which a recurring function test must be carried out
5) PFH is to a large extent independent from T_{Proof} and it is constant over the time. According to the standard, a recurring function test is not necessary
6) The failure tolerance time of the overall system must be higher than the sum of the diagnostic test times of all components of the safety measuring chain

The assessment of the measures for error prevention and error control were a component of the safety proof according to the requirements of the IEC 61508.

Schiltach, 26.10.2004
VEGA Grieshaber KG

i.V. Frühauf
Head of Certification department

i.A. Blessing
Commissioner for functional safety

Fig. 20: SIL declaration of conformity

CE declaration of conformity

CE

Konformitätserklärung

Declaration of conformity
Déclaration de conformité

VEGA Grieshaber KG
Am Hohenstein 113
77761 Schiltach

erklärt in alleiniger Verantwortung, daß das Produkt / declare under our sole responsibility that our product / déclare sous sa seule responsabilité que le produit

VEGAVIB 6x
mit Relaisausgang / with relay output / avec sortie relais (VB60REX)
mit Transistorausgang / with transistor output / avec sortie transistor (VB60TEX)
mit Zweileiterausgang / with two-wire output / avec sortie bifilaire (VB60ZEX)

auf das sich diese Erklärung bezieht, mit den folgenden Normen übereinstimmt / to which this declaration relates is in conformity with the following standards / auquel se réfère cette déclaration est conforme aux normes

Emission / Emission / Emission → EN 61326 : 1997 (Klasse B)
Immission / Susceptibility / Immission → EN 61326 : 1997 / A1 : 1998
EN 61010 – 1 : 2001

gemäß den Bestimmungen der Richtlinien / following the provision of Directives / conformément aux dispositions des Directives

73/23 EWG
89/336 EWG

Schiltach, 14.04.2004 ppa. J. Fehrenbach

Josef Fehrenbach
Entwicklungsleitung

Fig. 21: CE declaration of conformity

10.4 Industrial property rights

VEGA product lines are global protected by intellectual property rights.
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Only in U.S.A.: Further information see patent label at the sensor housing.

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