Safety manual in conjunction with steam boiler approval

VEGAFLEX 86 with optional process transmitter VEGAMET 381 Ex

Guided radar

as limiting device for low and high water

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Contents

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1 Application area

Guided radar as limiting device for low water (NW) and/or high water (HW) for liquids in vessels subject to requirements according to EN 12952-11 and EN 12953-9.

The measuring system meets the requirements of

- Electrical safety according to IEC/EN 61010-1: 2010
- Functional safety according to IEC 61508 or 61511
- Explosion protection (depending on the version)
- Electromagnetic compatibility according to EN 61326-3-2: 2008
- Use as limiting device according to EN 12952-11/EN 12953-9 for VEGAFLEX 86 (certified by TÜV NORD CERT)
- Continuous self-monitoring
- Continuous measurement
- Measurement virtually independent of product properties
- Measurement event with very agitated surface and foam possible
- Simple setup

2 General information and related documentation

Note:
The instruments may be set up and put into operation only by "qualified personnel".

Maintenance and conversion work must only be carried out by persons appropriately instructed by VEGA.

The type label specifies the technical properties of the instrument. An instrument without an instrument-specific type label may not be put into operation!

Document-ID	Designation
44231	Operating instructions TDR sensor for continuous level and interface measurement of liquids VEGAFLEX 86 - Two-wire 4 … 20 mA/HART Coax probe With SIL qualification
44234	Operating instructions TDR sensor for continuous level and interface measurement of liquids VEGAFLEX 86 - Two-wire 4 … 20 mA/HART Rod and cable probe With SIL qualification
42960	Safety manual VEGAFLEX 80 series Two-wire 4 … 20 mA/HART With SIL qualification

3 System components

The following illustration shows the instruments of the measuring system as an example.

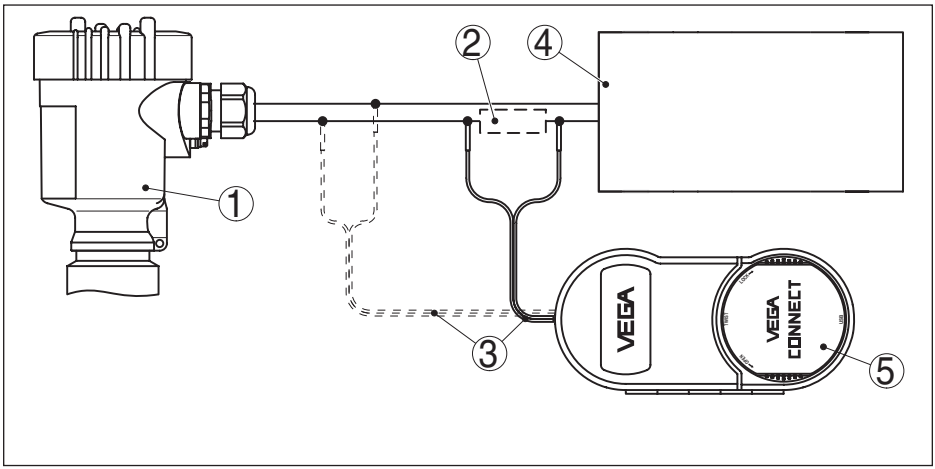

Fig. 1: Connecting the PC via HART to the signal cable

1 Sensor
2 HART resistance 250 Ω (optional depending on evaluation)
3 Connection cable with 2 mm pins and terminals
4 Processing system/PLC/Voltage supply
5 Interface adapter, for example VEGACONNECT 4

Note:
On power supply units with integrated HART resistance (internal resistance approx. 250 Ω) no additional external resistance is required. Standard Ex separators usually have sufficiently high current limitation resistance.

4 Installation and setup

To measure the max. or min. level in a steam generator, at least two probes in redundancy are required (architecture 1oo2, "one out of two"). To increase reliability, it is recommended to install three probes in architecture 2oo3 ("two out of three"). The level transmitter VEGAFLEX 86 can be installed directly in the vessel or in a connected reference vessel (bypass).

The level sensor must be arranged, installed and protected so that its function is not influenced by:

- Foam and turbulence in the boiler water
- Dirt accumulation
- Mechanical influence during operation (e.g. vibration)
- Position changes with respect to the protective tube or other electrodes, which could lead to short-circuiting

Architecture 1oo2
In normal operation

- If the monitored limit value (NW/HW) is reached, all sensors deliver a corresponding output signal within the deviation range (Document-ID: 44231 resp. 44234, chapter 12).

In the event of a fault

- With a dangerous detected failure of a sensor
  - Detection through continuous signal comparison of the sensors in the saftey PLC through wiring of the closing contacts

– Determination through recurring test

Single fault safety is no longer ensured. Immediate action is required!

Architecture 2oo3
In normal operation

- If the monitored limit value (NW/HW) is reached, all sensors deliver a corresponding output signal within the deviation range (Document-ID: 44231 resp. 44234, chapter 12).

In the event of a fault

- With a dangerous detected failure of a sensor
  – Detection by signal comparison (1-2, 2-3, 3-1) in the safety PLC or
  – Determination through recurring test

Single fault safety is still ensured (1oo2). Repair defective sensor or exchange it!

Errors ocurring during setup or measurement are immediately displayed in clear text. In addition, a unique error code is output. You can find a description of the error code in the operating instructions. If there are several system or process errors, the one with the highest priority is always displayed! Further diagnostic messages can be displayed in the submenu.

The values of the upper and lower dead zone (see operating instructions Document-ID: 44231) must be taken into account.

Installation, mounting and wiring
The mounting and wiring of the instrument is described in the operating instructions.

Reliable operation of the instrument requires a correct installation.

Installation position
The permissible installation positions of the instrument are also described in the operating instructions (Document-ID: 44231).

System components
If switching contacts are required, a suitable power supply unit can be used.

When using the controllers, make sure that in case of mains failure/recurrence, a state defined as safe cannot be quit (lock).

VEGAMET 381 must be installed in a suitable IP54 housing.

5 Deviation VEGAFLEX 86

In case of quick pressure changes, additional errors can be caused because the measured reference distance is averaged with the time constant of the level measurement. A state of non-equilibrium, for example through heating, can cause density and pressure gradients in the medium as well as condensation on the probe, which can lead to slightly different levels being measured at different locations of the vessel. These application-related influences can increase the specified measurement deviation.

The propagation speed of the radar impulses in gas or vapour above the medium is reduced by high pressure. This effect depends on the properties of the superimposed gas or vapour and is especially large at low temperatures. Systematically, a level that is too low is displayed.

The following table shows the resulting deviation for some typical gases or vapours. The specified values refer to the distance. Positive values mean that the measured distance is too high, negative values mean that the measured distance is too small (Document-ID: 44231, chapter 12 "Influence of superimposed gas and pressure on the accuracy of the technical data").

These running time changes must be taken into account in the project planning. In the case of small deviations, they can be taken into account by an increased safety tolerance; in the case of larger

deviations and constant gas/vapour concentrations, they can be compensated for by a fixed correction factor in the parameter adjustment or the control system or automatically compensated for by using a coaxial probe with automatic running time correction (feature " *Version/Material*": 4 / 5). The achievable accuracies for probes with automatic compensation are described in the associated operating instructions.

Gas phase	Temperature	Pressure				
		10 bar (145 psig)	50 bar (725 psig)	100 bar (1450 psig)	200 bar (2900 psig)	400 bar (5800 psig)
Air	20 °C/68 °F	0.22 %	1.2 %	2.4 %	4.9 %	9.5 %
	200 °C/392 °F	0.13 %	0.74 %	1.5 %	3.0 %	6.0 %
	400 °C/752 °F	0.08 %	0.52 %	1.1 %	2.1 %	4.2 %
Hydrogen	20 °C/68 °F	0.10 %	0.61 %	1.2 %	2.5 %	4.9 %
	200 °C/392 °F	0.05 %	0.37 %	0.76 %	1.6 %	3.1 %
	400 °C/752 °F	0.03 %	0.25 %	0.53 %	1.1 %	2.2 %
Steam (saturated steam)	100 °C/212 °F	--	--	--	--	--
	180 °C/356 °F	2.1 %	--	--	--	--
	264 °C/507 °F	1.44 %	9.2 %	--	--	--
	366 °C/691 °F	1.01 %	5.7 %	13.2 %	76.0 %	--

6 Instrument behaviour in normal operation and in the event of a fault

6.1 Instrument behaviour during a self-test

After connecting the instrument to voltage supply or after a voltage recurrence, the instrument carries out a self-check for approx. 30 s:

- Internal check of the electronics
- Indication of the instrument type, hardware and software version, measurement loop name on the display or PC
- Indication of the status message "F105 Determine measured value" on the display or PC
- The output signal jumps to the set fault current

6.2 Instrument behaviour on request

As soon as a plausible measured value is found, the corresponding current is output to the signal cable. The value corresponds to the actual level as well as the settings already carried out, e.g. factory setting.

Min. current output: 3.8 mA

Max. current output: 20.5 mA

6.3 Instrument behaviour in the event of a fault

Current output - Behaviour in case of fault: ≤ 3.6 mA

In Document-ID: 44231, Chapter 10.3, the pictographs "Status messages" are categorized and simplified by pictographs, and the error codes and text messages in the status message "Failure" are listed in tabular form, including the causes and ways to rectify the faults.

7 Maintenance

If the instrument is used properly, no special maintenance is required in normal operation. When used in safety-instrumented systems (SIS), the safety function must be triggered on the instrument in regular time intervals by means of a proof test. Possible undetected, dangerous failures can thus be identified. It is the responsibility of the operator to select the type of test. The time intervals correspond to the implemented PFD_{AVG}. During the function test, the safety function must be considered unreliable. It must be noted that the function test influences downstream connected devices. If one of the tests proves negative, the entire measuring system must be switched out of service and the process held in a safe state by means of other measures. You can find detailed information on the proof test in the Safety Manual (SIL).

Warning!

- The VEGAFLEX 86 is hot during operation!
- Serious burns on hands and arms are possible!
- When loosening the probe, steam or hot water can escape!
- Serious scalding of the entire body is possible!
- Carry out installation and maintenance work only when the sensor is cold!
- Dismount VEGAFLEX 86 only at 0 bar boiler pressure!

8 Checking functionality

The function and safety of the limiter must be checked periodically. The test must be carried out in a way that verifies the proper functioning of the limiting device in interaction with all components. The measurement and trigger functions must be checked by lowering or raising the water level.

Note:

Possible test sequences for VEGAFLEX 86 are described in Safety Manual 42960 in chapter 7 "Proof test".

9 Repair

The repair of the instruments must only be carried out by VEGA Grieshaber KG. If the repair is carried out by a third party, the safety-relevant functions can no longer be guaranteed.

The following components can be exchanged by the customer, provided the responsible staff has been properly instructed by VEGA Grieshaber KG.

10 Certificate

TÜV NORD

ZERTIFIKAT
CERTIFICATE

Hiermit wird bescheinigt, dass das unten beschriebene Produkt der Firma
This certifies that the product mentioned below from company

VEGA Grieshaber KG
Am Hohenstein 113
77761 Schiltach
Deutschland

die Anforderungen der folgenden Prüfunterlage(n) erfüllt.
fulfills the requirements of the following test regulations.

Geprüft nach: *Tested in accordance with:*	**EN 12952-11:2007** **EN 12953-9:2007**
Beschreibung des Produktes: **(Details s. Anlage 1)** *Description of product:* *(Details see Annex 1)*	**Guided radar sensor**
Typenbezeichnung: *Type Designation:*	**VEGAFLEX 86 (Version FX86.xxxxxxAxxxxx)**
Bemerkung: *Remark:*	**VEGAFLEX 86 (Guided Level Radar) optional with output control unit** **VEGAMET 381 as limit equipment for high water level (HW) and low water level (NW) and for NW/HW and control in 2-wire version.**

Dieses Zertifikat bescheinigt das Ergebnis der Prüfung an dem vorgestellten Prüfgegenstand. Eine allgemein gültige Aussage über die Qualität der Produkte aus der laufenden Fertigung kann hieraus nicht abgeleitet werden.
This certifies the result of the examination of the product sample submitted by the manufacturer. A general statement concerning the quality of the products from the series manufacture cannot be derived there from.

Registrier-Nr. / *Registered No.* 44 799 13735106
Prüfbericht Nr. / *Test Report No.* 3527 2906
Aktenzeichen / *File reference* 8003020590 / 35272906

Gültigkeit / Validity
von / *from* 2020-07-30
bis / *until* 2025-07-29

Zertifizierungsstelle der
TÜV NORD CERT GmbH

Essen, 2020-07-30

TÜV NORD CERT GmbH Langemarckstraße 20 45141 Essen www.tuev-nord-cert.de technology@tuev-nord.de

Bitte beachten Sie auch die umseitigen Hinweise
Please also pay attention to the information stated overleaf

Hinweise zum TÜV NORD- Zertifikat	Hints to the TÜV NORD - Certificate
Dieses TÜV NORD - Zertifikat gilt nur für die umseitig bezeichnete Firma und das angegebene Produkt. Es kann nur von der Zertifizierungsstelle auf Dritte übertragen werden.	This TÜV NORD - certificate only applies to the firm stated overleaf and the specified product. It may only be transferred to third parties by the certification body.
Notwendige Bedienungs- und Montageanweisungen müssen jedem Produkt beigefügt werden.	Each product must be accompanied by the instructions which are necessary for its operation and installation.
Jedes Produkt muss deutlich einen Hinweis auf den Hersteller oder Importeur und eine Typenbezeichnung tragen, damit die Identität des geprüften Baumusters mit den serienmäßig in den Verkehr gebrachten Produkten festgestellt werden kann.	Each product must bear a distinct indication of the manufacturer or importer and a type designation so that the identity of the tested sample maybe determined with the product launched on the market as a standard.
Der Inhaber des TÜV NORD - Zertifikates ist verpflichtet, die Fertigung der Produkte laufend auf Übereinstimmung mit den Prüfbestimmungen zu überwachen und insbesondere die in den Prüfbestimmungen festgelegten oder von der Zertifizierungsstelle geforderten Kontrollprüfungen ordnungsgemäß durchzuführen.	The bearer of the TÜV NORD - Certificate undertakes to regularly supervise the manufacturing of products for compliance with the test specifications and in particular properly carry out the checks which are stated in the specifications or required by the test laboratory.
Bei Änderungen am geprüften Produkt ist die Zertifizierungsstelle umgehend zu verständigen.	In case of modifications of the tested product the certification body must be informed immediately.
Bei Änderungen und bei befristeten Zertifikaten ist das Zertifikat nach Ablauf der Gültigkeit urschriftlich an die Zertifizierungsstelle zurückzugeben. Die Zertifizierungsstelle entscheidet, ob das Zertifikat ergänzt werden kann oder ob eine erneute Zertifizierung erforderlich ist.	In case of modifications and expiration of validity the original certificate must be returned to the certification body immediately. The certification body decides if the certificate can be supplemented or whether a new certification is required.
Für das TÜV NORD - Zertifikat gelten außer den vorgenannten Bedingungen auch alle übrigen Bestimmungen des allgemeinen Vertrages. Es hat solange Gültigkeit, wie die Regeln der Technik gelten, die der Prüfung zu Grunde gelegt worden sind, sofern es nicht auf Grund der Bedingungen des allgemeinen Vertrages früher zurückgezogen wird.	In addition to the conditions stated above, all other provisions of the General Agreement are applicable to the TÜV NORD - Certificate. It will be valid as long as the rules of technology on which the test was based are valid, unless revoked previously pursuant to the provisions of the General Agreement.
Dieses TÜV NORD - Zertifikat verliert seine Gültigkeit und muss unverzüglich der Zertifizierungsstelle zurückgegeben werden, falls es ungültig wird oder für ungültig erklärt wird.	This TÜV NORD - Certificate will become invalid and shall be returned to the certification body immediately in the event that it shall expire without delay when it has expired or revoked.

ANLAGE
ANNEX

zum Zertifikat Registrier-Nr. / *to Certificate Registration No.* 44 799 13735106

Produktbeschreibung: *Product description:*	Measuring equipment consisting of: - Level sensor in the form of rod-, rope- or coax probes with integrated transmitter (electronic insert) and electrical output signal that functions according to the time of flight method. High-frequency pulses are injected to a probe and led along the probe. The pulses are reflected by the product surface, received by the electronic evaluation unit and converted into level information. - Process transmitter for registration and processing of analog measuring signals
Teilprüfungen: *Partial tests:*	EN 12952-11:2007, Clause 4 and 5 and Annex D EN 12953-9:2007, Clause 4 and 5 and Annex D
Typbezeichnung: *Type designation:*	VEGAFLEX 86 (Guided Level Radar) with output control unit VEGAMET 381 as limit equipment for high water level (HW) and low water level (NW) and for NW/HW and control in 2-wire version
HW- und SW-Versionen: *HW and SW versions:*	See technical report no.: 35272906
Besondere Bedingungen zur sicheren Verwendung: *Special conditions for safe use:*	- All information and safety instructions in the original instruction manual and safety manual in its current version must be rigorously followed. - The control unit VEGAMET 381 has to be mounted in a housing tested, that meets the requirements of degree of protection IP54. - It has to be considered that after a voltage break the device needs up 60 s for start-up and internal tests before it starts to determine a measured value. - The measuring equipment can be used as part of a limit equipment for more than 24 hours without control, if the requirements of EN 12952-7:2002, clause 7.3.9 are observed. With that the 72 h operation and operation without surveillance is also covered (see also prEN 12952-7:2010, clause 7.1, Note 2).
Technische Daten: *Technical data:*	Output signals: Analog outputs 4…20 mA and/or relay outputs. The VEGAMET 381 complies to the absence of reaction, i.e. the independence of equipment with safety function due to the galvanic isolation of the output signals. Therefore this combination of two VEGAFLEX 86 with two VEGAMET 381 is allowed for use as limit equipment for HW and NW and for NW/HW and control in 2-wire.

Zertifizierungsstelle der
TÜV NORD CERT GmbH

Essen, 2020-07-30

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ANLAGE
ANNEX

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zum Zertifikat Registrier-Nr. / *to Certificate Registration No.* 44 799 13735106

Liste der Fertigungsstätten:
List of manufacturing facilities:

1. **VEGA Grieshaber KG**
   Am Hohenstein 113
   77761 Schiltach
   Deutschland

2. **VEGA Americas, Inc.**
   4241 Allendorf Drive
   Cincinnati, OH 45209
   USA

(Diese Liste beinhaltet 2 Fertigungsstätten.)
(This list includes two manufacturing facilities.)

Zertifizierungsstelle der
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Essen, 2020-07-30

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