Vibrating Level Switch
Transistor (NPN/PNP)
With SIL qualification
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1 About this document

1.1 Function
This operating instructions manual provides all the information you need for mounting, connection and setup as well as important instructions for maintenance, fault rectification, the exchange of parts and the safety of the user. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

1.2 Target group
This operating instructions manual is directed to trained personnel. The contents of this manual must be made available to the qualified personnel and implemented.

1.3 Symbols used

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

- **Caution**: If this warning is ignored, faults or malfunctions can result.

- **Warning**: If this warning is ignored, injury to persons and/or serious damage to the instrument can result.

- **Danger**: If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.

- **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.

- **Sequence of actions**
  Numbers set in front indicate successive steps in a procedure.

- **Battery disposal**
  This symbol indicates special information about the disposal of batteries and accumulators.
2 For your safety

2.1 Authorised personnel
All operations described in this documentation must be carried out only by trained specialist personnel authorised by the plant operator. During work on and with the device the required personal protective equipment must always be worn.

2.2 Appropriate use
The OPTISWITCH 5300 C is a sensor for point level detection. You can find detailed information about the area of application in chapter “Product description”.
Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.
For safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.

2.3 Warning about incorrect use
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. Thus damage to property, to persons or environmental contamination can be caused. Also the protective characteristics of the instrument can be influenced.

2.4 General safety instructions
This is a state-of-the-art instrument complying with all prevailing regulations and directives. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for the trouble-free operation of the instrument. When measuring aggressive or corrosive media that can cause a dangerous situation if the instrument malfunctions, the operator has to implement suitable measures to make sure the instrument is functioning properly.
During the entire duration of use, the user is obliged to determine the compliance of the necessary occupational safety measures with the current valid rules and regulations and also take note of new regulations.
The safety instructions in this operating instructions manual, the national installation standards as well as the valid safety regulations and accident prevention rules must be observed by the user.
For safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.
For your safety

reasons, only the accessory specified by the manufacturer must be used.

To avoid any danger, the safety approval markings and safety tips on the device must also be observed and their meaning read in this operating instructions manual.

2.5 Safety label on the instrument
The safety approval markings and safety tips on the device must be observed.

2.6 EU conformity
The device fulfils the legal requirements of the applicable EU directives. By affixing the CE marking, we confirm the conformity of the instrument with these directives.

2.7 Installation and operation in the USA and Canada
This information is only valid for USA and Canada. Hence the following text is only available in the English language.
Installations in the US shall comply with the relevant requirements of the National Electrical Code (ANSI/NFPA 70).
Installations in Canada shall comply with the relevant requirements of the Canadian Electrical Code.

2.8 Safety instructions 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.
3 Product description

3.1 Configuration

Scope of delivery
The scope of delivery encompasses:

- OPTISWITCH 5300 C point level switch
- Documentation
  - This operating instructions manual
  - Safety Manual "Functional safety (SIL)"
  - Supplementary instructions manual "Plug connector for level sensors" (optional)
  - Ex-specific "Safety instructions" (with Ex versions)
  - If necessary, further certificates

Constituent parts
The OPTISWITCH 5300 C consists of the components:

- Housing lid
- Housing with electronics
- Process fitting with tuning fork

![Fig. 1: OPTISWITCH 5300 C - compact version with plastic housing](image)

1 Housing lid
2 Housing with electronics
3 Temperature adapter
4 Process fitting
Fig. 2: OPTISWITCH 5300 C with plastic housing and tube extension

1 Housing lid
2 Housing with electronics
3 Temperature adapter
4 Process fitting
5 Tube extension

Type label

The type label contains the most important data for identification and use of the instrument:

- Article number
- Serial number
- Technical data
- Article numbers, documentation

In addition to the type label outside on the instrument, you find the serial number also inside the instrument.
3.2 Principle of operation

OPTISWITCH 5300 C is a point level sensor with tuning fork for point level detection.

It is designed for industrial use in all areas of process technology and can be used in liquids. It is particularly suitable for applications with high temperatures up to 450 °C (842 °F) and high process pressure up to 160 bar (2320 psig).

Typical applications are overfill and dry run protection. The small tuning fork allows use in all kinds of tanks and vessels. Thanks to its simple and rugged measuring system, OPTISWITCH 5300 C is virtually unaffected by the chemical and physical properties of the liquid.

It functions even under difficult conditions such as turbulence, foam generation, buildup, external vibration or changing products.

The OPTISWITCH 5300 C is not suitable for use in pipelines.

Function monitoring

The electronics module of OPTISWITCH 5300 C continuously monitors the following criteria via frequency evaluation:

- Strong corrosion or damage on the tuning fork
- Loss of vibration
- Break in the vibration drive circuit

If a malfunction is detected or in case of power failure, the electronics takes on a defined switching condition, i.e. the output is open (safe state).

Functional principle

The tuning fork vibrates at its mechanical resonance frequency of approx. 1400 Hz. When the tuning fork is submerged in the product, the frequency changes. This change is detected by the integrated electronics module and converted into a switching command.

Voltage supply

OPTISWITCH 5300 C 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 pump etc.).

The data for power supply are specified in chapter "Technical data".

3.3 Adjustment

With the factory setting, products with a density ≥ 0.7 g/cm³ (0.025 lbs/in³) can be detected. The instrument can be adapted to products with lower density.

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

- Signal lamp for indication of the operating status (green)
- Control lamp for indication of the switching status (yellow)
- Control lamp for fault indication (red)
- DIL switch for sensitivity adjustment
- Mode switch for selecting the switching behaviour (min./max.)
### 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 based on ISO 4180.

The packaging of standard instruments consists of environment-friendly, recyclable carton material. The sensing element is additionally protected with a cardboard cover. For special versions, PE foam or PE foil is also used. Please dispose of the packaging material through specialised recycling companies.

**Transport**
Transport must be carried out in due consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

**Transport inspection**
The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

**Storage**
Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.

Unless otherwise indicated, the packages must be stored only under the following conditions:
- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration

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

**Lifting and carrying**
With instrument weights of more than 18 kg (39.68 lbs) suitable and approved equipment must be used for lifting and carrying.

### 3.5 Accessories

**Flanges**
Screwed flanges are available in different versions according to the following standards: DIN 2501, EN 1092-1, BS 10, ASME B 16.5, JIS B 2210-1984, GOST 12821-80.

You can find additional information in the supplementary instructions manual "Flanges according to DIN-EN-ASME-JIS".

**Electronics module**
The electronics module SW E60 is a replacement part for level switches OPTISWITCH 5300 C.

You can find information in the operating instructions manual of the electronics module.

**Plug connector**
For connecting the sensors with a separator to voltage supply or signal processing, the sensors are also available with plug connectors.
The following plug connectors are available:

- M12 x 1
- ISO 4400
- Harting HAN 7D
- Harting HAN 8D
- Amphenol-Tuchel
4 Mounting

4.1 General instructions

Suitability for the process conditions

Make sure that all parts of the instrument coming in direct contact with the process, especially the sensor element, process seal and process fitting, are suitable for the existing process conditions, such as process pressure, process temperature as well as the chemical properties of the medium.

You can find the specifications in chapter "Technical data" and on the nameplate.

Suitability for the ambient conditions

The instrument is suitable for standard and extended ambient conditions acc. to DIN/EN/IEC/ANSI/ISA/UL/CSA 61010-1.

Switching point

In general, OPTISWITCH 5300 C can be installed in any position. The instrument only has to be mounted in such a way that the tuning fork is at the height of the desired switching point.

The tuning fork has lateral markings (notches) that indicate the switching point with vertical mounting. The switching point applies to water in conjunction with the basic setting of the density switch \( \geq 0.7 \text{ g/cm}^3 \) \( (0.025 \text{ lbs/in}^3) \). When mounting OPTISWITCH 5300 C, make sure that this marking is at the height of the requested switching point. Keep in mind that the switching point of the instrument will shift if the medium has a density other than water - water is 1 g/cm\(^3\) (0.036 lbs/in\(^3\)). For products \( \leq 0.7 \text{ g/cm}^3 \) (0.025 lbs/in\(^3\)) and \( \geq 0.47 \text{ g/cm}^3 \) (0.017 lbs/in\(^3\)) the density switch must be set to \( \geq 0.47 \text{ g/cm}^3 \).

Keep in mind that foams with a density \( \geq 0.45 \text{ g/cm}^3 \) (0.016 lbs/in\(^3\)) are detected by the sensor. This can lead to erroneous switchings, particularly when the sensor is used for dry run protection.

![Diagram](image-url)

*Fig. 3: Vertical mounting*

1. Switching point approx. 13 mm (0.51 in)
2. Switching point with lower density
3. Switching point with higher density
4. Switching point approx. 33 mm (1.3 in)
Fig. 4: Horizontal mounting
1  Switching point
2  Marking on top with threaded versions, marking aligned to flange holes with flange versions

Fig. 5: Horizontal installation (recommended mounting position, particularly for adhesive products)
1  Switching point
2  Marking with screwed version, facing up

In the case of flange versions, the fork is aligned as follows.

Fig. 6: Fork position with flange versions
1  Marking with flange version, facing up

Moisture

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

You can give your instrument 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 outdoor mounting as well as installation in areas where high humidity is expected (e.g. through cleaning processes) or on cooled or heated vessels.

To maintain the housing protection, make sure that the housing lid is closed during operation and locked, if necessary.

Make sure that the degree of contamination specified in chapter "Technical data" meets the existing ambient conditions.
Fig. 7: Measures against moisture ingress

Fig. 8: Housing position (self-emptying acc. to 3A)
1 Stainless steel housing (electropolished)
2 Aluminium die-cast housing

Transport

Caution:
Do not hold OPTISWITCH 5300 C on the tuning fork. Particularly with flange or tube versions, the tuning fork can be damaged just by the weight of the instrument. Transport coated instruments very carefully and avoid touching the tuning fork.

Remove the packaging or the protective cover just before mounting.

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 can damage internal parts of the housing.

Use the hexagon above the thread for screwing in.

Cable entries - NPT thread

Metric threads
In the case of instrument housings with metric thread, the cable glands are screwed in at the factory. They are sealed with plastic plugs as transport protection.

You have to remove these plugs before electrical connection.

NPT thread
In the case of instrument housings with self-sealing NPT threads, it is not possible to have the cable entries screwed in at the factory. The
free openings for the cable glands are therefore covered with red dust protection caps as transport protection.

Prior to setup you have to replace these protective caps with approved cable glands or close the openings with suitable blind plugs.

### 4.2 Mounting instructions

The thread and the seal on the threaded version of OPTISWITCH 5300 C correspond to DIN 3852 part 2, screwed plug Form A.

Use screw-in openings or screw-in sleeves according to DIN 3852 part 2.

Make sure that with instruments with 1" NPT thread, the screw-in opening on the vessel has an inside diameter of at least 29.5 mm (1.16 in).

To mount the sensor, proceed as follows:

1. Screw the OPTISWITCH 5300 C into the mounting boss up to the stop. You can determine the later position already before welding.
2. Mark the position of the OPTISWITCH 5300 C on the mounting boss.
3. Mark the respective position of the mounting boss on the vessel. In case of lateral mounting, make sure the mark on the spanner flat of OPTISWITCH 5300 C points upwards.
4. Remove the OPTISWITCH 5300 C from the mounting boss before welding.
5. Weld the mounting boss according to your marking.

#### Adhesive products

In case of horizontal mounting in adhesive and viscous products, the surfaces of the tuning fork should be vertical in order to reduce buildup on the tuning fork. On the screwed version you will find a marking on the hexagon. With this, you can check the position of the tuning fork when screwing it in.

In the case of flange versions, the fork is aligned with the flange holes.

When used in adhesive and viscous products, the tuning fork should protrude into the vessel to avoid buildup. For that reason, sockets for flanges and mounting bosses should be avoided when mounting horizontally.

#### 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.

The max. permissible pressure is specified in chapter "Technical data" or on the type label of the sensor.

**Note:**

Seal for instruments with process fitting thread

The thread and the seal form on the mounting boss correspond to DIN 3852, part 2, screwed plug Form A.

We recommend using a temperature and medium-resistant seal for dismounting the instrument for maintenance and revision purposes.
Mounting in the vessel insulation

Instruments for high temperatures have a temperature adapter between process fitting and electronics housing. This is used for thermal decoupling of the electronics from high process temperatures.

**Information:**
The temperature adapter may be embedded in the vessel insulation only up to max. 50 mm (1.97 in). Only then is a reliable temperature decoupling guaranteed.

**Fig. 9: Mounting the instrument on insulated vessels.**

1 Temperature isolation - max. 50 mm (1.97 in)
2 Ambient temperature on the housing

Inflowing medium

If OPTISWITCH 5300 C is mounted in the filling stream, unwanted false measurement signals can be generated. For this reason, mount OPTISWITCH 5300 C at a position in the vessel where no disturbances, e.g. from filling openings, agitators, etc., can occur.

This applies particularly to instrument types with long extension tube.
To make sure the tuning fork of OPTISWITCH 5300 C generates as little resistance as possible to product flow, mount the sensor so that the surfaces are parallel to the product movement.

Due to the effects of agitators, equipment vibration or similar, the level switch can be subjected to strong lateral forces. For this reason, do not use an overly long extension tube (optional) for OPTISWITCH 5300 C, instead check if it is possible to mount a short level switch OPTISWITCH 5300 C on the side of the vessel in horizontal position.

Extreme vibration caused by the process or the equipment, e.g. agitators or turbulence in the vessel, can cause a long extension tube of OPTISWITCH 5300 C to vibrate in resonance. This leads to increased stress on the upper weld joint. Should a longer tube version be necessary, you can provide a suitable support directly above the tuning fork to secure the extension tube.

This measure applies mainly to applications in Ex areas of category 1G or WHG as well as to ship classifications. Make sure that the tube is not subject to bending stress due to this measure.
Gas-tight leadthrough

The second seal of the gas-tight leadthrough (option) prevents an uncontrolled leakage of the medium. The service life of the gas-tight leadthrough depends on the chemical resistance of the materials. See "Technical data".

Caution:

If it is determined (e.g. via an error message from OPTISWITCH 5300 C) that medium has already penetrated into the vibrating element, the instrument must be exchanged immediately.
5 Connecting to power supply

5.1 Preparing the connection

Always keep in mind the following safety instructions:

Warning:
Connect only in the complete absence of line voltage.

- The electrical connection must only be carried out by trained personnel authorised by the plant operator.
- Always switch off power supply, before connecting or disconnecting the instrument.

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

Only use metal housings (aluminium, stainless steel). The plastic housing is not permitted.

Connect the voltage supply according to the following diagrams. Take note of the general installation regulations. As a rule, connect OPTISWITCH 5300 C to vessel ground (PA), or in case of plastic vessels, to the next ground potential. On the side of the instrument 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 specified in chapter "Technical data".

Use two-wire, screened cable. Connect the cable screen on both ends to ground potential. In the sensor, the screen must be connected directly to the internal ground terminal. The ground terminal on the outside of the housing must be connected to the potential equalisation (low impedance).

Make sure that the cable used has the required temperature resistance and fire safety for max. occurring ambient temperature.

Use cable with round cross section for instruments with housing and cable gland. To ensure the seal effect of the cable gland (IP protection rating), find out which cable outer diameter the cable gland is suitable for.

- 5 ... 9 mm (0.20 ... 0.35 in)
- 6 ... 12 mm (0.24 ... 0.47 in)
- 10 ... 14 mm (0.40 ... 0.55 in)

Use a cable gland fitting the cable diameter.

In hazardous areas, use only approved cable connections for OPTISWITCH 5300 C.

Cover all housing openings conforming to standard according to EN 60079-1.
5.2 Connection procedure

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

Proceed as follows:

1. Unscrew the housing lid
2. Loosen compression nut of the cable gland and remove blind plug
3. Remove approx. 10 cm (4 in) of the cable mantle, strip approx. 1 cm (0.4 in) of insulation from the ends of the individual wires
4. Insert the cable into the sensor through the cable entry
5. Open the terminals with a screwdriver
6. Insert the wire ends into the open terminals according to the wiring plan
7. Tighten the terminals with a screwdriver
8. Check the hold of the wires in the terminals by lightly pulling on them
9. Tighten the compression nut of the cable entry gland. The seal ring must completely encircle the cable
10. Screw the housing lid back on

The electrical connection is finished.

5.3 Wiring plan, single chamber housing

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

Housing overview

![Housing overview diagram]

Fig. 12: Material versions, single chamber housing

1. Aluminium
2. Stainless steel, precision casting
3. Stainless steel, electropolished (not with Ex d)
4. Filter element for air pressure compensation
5 Connecting to power supply

Electronics and terminal compartment

Fig. 13: Electronics and terminal compartment, single chamber housing
1 Control lamp - fault indication (red)
2 Control lamp - Switching status (yellow)
3 Control lamp - Operating status (green)
4 Mode switch for selecting the switching behaviour (min./max.)
5 DIL switch for sensitivity adjustment
6 Ground terminal
7 Connection terminals

Wiring plan

Connect the OPTISWITCH 5300 C according to the idle current principle, i.e. the switching circuit is open when there is a level signal, line break or fault (safe state).

For control of relays, contactors, magnet valves, warning lights and horns.

Fig. 14: Connection is used for control, e.g. of a relay
1 Load

For control of SPLC inputs (safety-oriented PLC).
Fig. 15: Connection for control of an SPLC

1 Switching signal 1
2 Switching signal 2
3 SSPS
6 Setup

6.1 General information

The figures in brackets refer to the following illustrations.

In the basic setting, products with a density ≥ 0.7 g/cm³ (0.025 lbs/in³) can be detected. For products with lower density, you have to set the switch to ≥ 0.47 g/cm³ (0.017 lbs/in³).

Optionally the instrument can be supplied instead of ≥ 0.47 g/cm also with a min. density range of ≥ 0.42 g/cm³ (0.015 lbs/in³).

On the electronics module you will find the following display and adjustment elements:
- Signal lamps (1, 2, 3)
- DIL switch for mode setting - min./max. (4)
- DIL switch for adjustment of the density range (5)

Note:
Always immerse the tuning fork of OPTISWITCH 5300 C in a liquid to test its function. Do not test the function of OPTISWITCH 5300 C with your hand. This can damage the sensor.
6.2 Adjustment elements

Fig. 16: Oscillator - Transistor output

1. Signal lamp - red (LED)
2. Signal lamp - yellow (LED)
3. Signal lamp - green (LED)
4. DIL switch for mode adjustment
5. DIL switch for adjustment of the density range

Control lamp (1) - fault indication (red)
The instrument monitors the vibrating frequency, electronics temperature and internal instrument functions.
- Red LED lights = fault
- Output open

Signal lamp (2) - Switching condition (yellow)
The signal lamp for indication of the switching condition of the output. With the mode setting (4), the switching condition and hence the function of the signal lamp can be changed.
- Yellow LED lights = output closed

Signal lamp (3) - Operating condition (green)
- Green LED lights = operating voltage on

Mode setting (4)
With the mode switch (max./min.) you can change the switching status. You can set the required mode according to the "Function table"
Setup

OPTISWITCH 5300 C • Transistor (NPN/PNP)

Adjustment of the density range (5)

With this DIL switch (5) you can set the switching point to liquids having a density between 0.47 and 0.7 g/cm³ (0.017 and 0.025 lbs/in³). With the basic setting, liquids with a density of ≥ 0.7 g/cm³ (0.025 lbs/in³) can be detected. In liquids with lower density, you must set the switch to ≥ 0.47 g/cm³ (0.017 lbs/in³). The specifications for the position of the switching point relate to water - density value 1 g/cm³ (0.036 lbs/in³). In products with a different density, the switching point will shift in the direction of the housing or tuning fork end depending on the density and type of installation.

Optionally the instrument can be also supplied with a min. density range of ≥ 0.42 g/cm³ (0.015 lbs/in³). In this case, the max. permissible process pressure is limited to 25 bar (363 psig).

Note:
Keep in mind that foams with a density ≥ 0.45 g/cm³ (0.016 lbs/in³) are detected by the sensor. This can lead to erroneous switchings, particularly when the sensor is used for dry run protection.

Note:
In case of intense boiling or bubbling processes as well as extreme outgassing, the density of the gas/product mixture at the product surface can be so low that it can’t be detected by the sensor. This can cause erroneous switchings.

6.3 Function table

The following table provides an overview of the switching conditions depending on the set mode and the level.

<table>
<thead>
<tr>
<th>Level</th>
<th>Switching status</th>
<th>Signal lamp - green Voltage supply</th>
<th>Signal lamp - yellow Switching status</th>
<th>Signal lamp - red Fault message</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode max. Overflow protection</td>
<td>closed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode max. Overflow protection</td>
<td>open</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode min. Dry run protection</td>
<td>closed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode min. Dry run protection</td>
<td>open</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6 Setup

<table>
<thead>
<tr>
<th>Level</th>
<th>Switching status</th>
<th>Signal lamp - green Voltage supply</th>
<th>Signal lamp - yellow Switching status</th>
<th>Signal lamp - red Fault message</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure of the supply voltage</td>
<td>any</td>
<td>open</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode max./min.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fault</td>
<td>any</td>
<td>open</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

6.4 Proof test

To find out possible undetected, dangerous failures, a proof test must be carried out in adequate time intervals to check the safety function. It is the user’s responsibility to choose the type of testing.

You will find further instructions in the Safety Manual.

The following options are available for carrying out the proof test:

1. Short interruption of the supply line to the sensor
   Average coverage (detected errors)
2. Dismounting of the sensor and immersion in the original medium
   High coverage (detected errors)
3. Filling of the vessel up to the switching point
   High coverage (detected errors)

1 Short interruption of the supply line to the sensor

This test is valid if you cannot change the vessel filling or cannot dismount the sensor.

Test without filling or dismounting the sensor

1. Separate the instrument briefly (> 2 s) from voltage supply.
   After switching on again, the instrument must take on the same switching status.
   If this is not the case, then there is a fault in the measuring system.
   Make sure the connected downstream devices are activated during the function test.
2. Set the mode switch (min./max.)
   Check if the switching status changes (signal lamp - switching status). By doing so, you can check the function of the measuring system.
   If this is not the case, then there is a fault in the measuring system.
   Make sure the connected downstream devices are activated during the function test.
   You can find the coverage of the test in the Safety Manual.
2 Dismounting of the sensor and immersion in the original medium

You can dismount the sensor for test purposes and check its function by immersing the vibrating element in the original medium.

**Procedure**

1. Separate the instrument briefly (> 2 s) from voltage supply.

   After switching on again, the instrument must take on the same switching status.

   If this is not the case, then there is a fault in the measuring system.

   Make sure the connected downstream devices are activated during the function test.

2. Set the mode switch (min./max.)

   Check if the switching status changes (signal lamp - switching status). By doing so, you can check the function of the measuring system.

   If this is not the case, then there is a fault in the measuring system.

   Make sure the connected downstream devices are activated during the function test.

3. Dismount the instrument and immerse the vibrating element up to the switching point in the original medium.

   Check if the switching status changes (signal lamp - switching status). By doing so, you can check the function of the measuring system.

   If this is not the case, then there is a fault in the measuring system.

   Make sure the connected downstream devices are activated during the function test.

You can find the coverage of the test in the Safety Manual.

3 Filling the vessel up to the switching point

If this does not cause any problems, you can fill the vessel up to the switching point and monitor the correct sensor reaction.

**Procedure**

1. Separate the instrument briefly (> 2 s) from voltage supply.

   After switching on again, the instrument must take on the same switching status.

   If this is not the case, then there is a fault in the measuring system.

   Make sure the connected downstream devices are activated during the function test.

2. Set the mode switch (min./max.)

   Check if the switching status changes (signal lamp - switching status). By doing so, you can check the function of the measuring system.

   If this is not the case, then there is a fault in the measuring system.
Make sure the connected downstream devices are activated during the function test.

3. Fill the vessel up to the switching point.
   Check if the switching status changes (signal lamp - switching status). By doing so, you can check the function of the measuring system.
   If this is not the case, then there is a fault in the measuring system.
   Make sure the connected downstream devices are activated during the function test.
You can find the coverage of the test in the Safety Manual.
7 Maintenance and fault rectification

7.1 Maintenance
If the device is used properly, no special maintenance is required in normal operation.

7.2 Rectify faults
The operator of the system is responsible for taking suitable measures to rectify faults.

OPTISWITCH 5300 C offers maximum reliability. Nevertheless, faults can occur during operation. These may be caused by the following, e.g.:
- Sensor
- Process
- Voltage supply
- Signal processing

The first measure to take is to check the output signal. In many cases, the causes can be determined this way and the faults quickly rectified.

**Error** | **Cause** | **Rectification**
---|---|---
OPTISWITCH 5300 C signals "covered" without being submerged (overflow protection) | Operating voltage too low | Check operating voltage
OPTISWITCH 5300 C signals "uncovered" when being submerged (dry run protection) | Electronics defective | Press the mode switch. If the instrument then changes the mode, the vibrating element may be covered with buildup or mechanically damaged. Should the switching function in the correct mode still be faulty, return the instrument for repair.
 | Mount the instrument at a location in the vessel where no dead zones or air bubbles can form.
 | Check the vibrating element and the sensor for buildup and remove the buildup if there is any.
 | Set the correct mode with the mode switch (overflow protection, dry run protection). Wiring should be carried out according to the closed-circuit principle.
7 Maintenance and fault rectification

<table>
<thead>
<tr>
<th>Error</th>
<th>Cause</th>
<th>Rectification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red control lamp lights up</td>
<td>Error on the vibrating element</td>
<td>Check if the vibrating element is damaged or extremely corroded.</td>
</tr>
<tr>
<td>Interference on the electronics module</td>
<td></td>
<td>Exchanging the electronics module</td>
</tr>
<tr>
<td>instrument defective</td>
<td></td>
<td>Exchange the instrument or send it in for repair</td>
</tr>
</tbody>
</table>

**Reaction after fault rectification**

Depending on the reason for the fault and the measures taken, the steps described in chapter "Set up" may have to be carried out again.

### 7.3 Exchanging the electronics

If the electronics module is defective, it can be replaced by the user. In general, all electronics modules of the respective type series can be interchanged. The type name is stated on the electronics module.

If you want to use an electronics module with a different signal output, you have to carry out the complete setup. You can find the required operating instructions manual on our homepage.

With SIL qualified instrument, only a respective electronics module with SIL qualification must be used.

In Ex applications, only instruments and electronics modules with appropriate Ex approval may be used.

You can find all the information you need to carry out an electronics exchange in the handbook of the new electronics module.

### 7.4 How to proceed if a repair is necessary

If it is necessary to repair the instrument, please contact the responsible Krohne agency.
8 Dismount

8.1 Dismounting steps

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 present.

8.2 Disposal

The instrument consists of materials which can be recycled by specialised recycling companies. We use recyclable materials and have designed the electronics to be easily separable.

WEEE directive 2002/96/EG
This instrument is not subject to the WEEE directive 2002/96/EG and the respective national laws. Pass the instrument directly on to a specialised recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.

Correct disposal avoids negative effects on humans and the environment and ensures recycling of useful raw materials.

Materials: see chapter "Technical data"

If you have no way to dispose of the old instrument properly, please contact us concerning return and disposal.
## 9 Supplement

### 9.1 Technical data

#### Note for approved instruments

The technical data in the respective safety instructions are valid for approved instruments (e.g. with Ex approval). These data can differ from the data listed herein - for example regarding the process conditions or the voltage supply.

### General data

Material 316L corresponds to 1.4404 or 1.4435

#### Materials, wetted parts

- Process fitting - thread (up to 100 bar)  
  - Inconel 718
- Process fitting - thread (up to 160 bar)  
  - Inconel 718
- Process fitting - flange  
  - 316L
- Process seal  
  - On site
- Tuning fork  
  - Inconel 718, Alloy C22 (2.4602)
- Extension tube: ø 21.3 mm (0.839 in)  
  - up to 100 bar (optional)  
    - 316L
- Extension tube: ø 21.3 mm (0.839 in)  
  - up to 160 bar (optional)  
    - Alloy C22 (2.4602)

#### Materials, non-wetted parts

- Aluminium die-cast housing  
  - Aluminium die-casting AISi10Mg, powder-coated (Basis: Polyester)
- Stainless steel housing (precision casting)  
  - 316L
- Stainless steel housing (electropolished)  
  - 316L
- Seal between housing and housing lid  
  - Silicone SI 850 R
- Optical fibre in housing cover  
  - PMMA (Makrolon)
- Ground terminal  
  - 316L
- Cable gland  
  - PA, stainless steel, brass
- Sealing, cable gland  
  - NBR
- Blind plug, cable gland  
  - PA
- Temperature adapter (ø 33.7 mm)  
  - 316L

#### Second Line of Defense resp. gas-tight leadthrough (optional)

- The Second Line of Defense (SLOD) is a second level of the process separation in the form of a gas-tight feedthrough in the lower part of the housing, preventing product from penetrating into the housing.
- Supporting material  
  - 316L
- Material  
  - Ceramic Al₂O₃ (99.5 %)
- Contacts  
  - Kovar (gold-plated)
Helium leak rate: $< 10^{-6}$ mbar l/s
Pressure resistance: PN 160

Sensor length - Compact version
- Alloy C22 (2.4602): 74 mm (2.91 in)
- Inconel 718: 74 mm (2.91 in)

Sensor length (L) - Tube version
- 316L, Alloy C22 (2.4602): 260 ... 3000 mm (10.24 ... 118.1 in)
- Inconel 718: 260 ... 3000 mm (10.24 ... 118.1 in)

Sensor length - accuracy: ± 2 mm (± 0.079 in)

Weight
- Instrument weight (depending on process fitting): approx. 0.8 ... 4 kg (0.18 ... 8.82 lbs)
- Tube extension: approx. 1100 g/m (11.8 oz/ft)

Surface quality: $R_a$ approx. 3 µm (1.18 $\times$ 4 in)

Process fittings
- Pipe thread, cylindrical (DIN 3852, part 2, Form A): G1
- Pipe thread, conical (ASME B1.20.1): 1 NPT, core diameter of the internal thread > 28.5 mm (1.12 in)
- Flanges: DIN EN from DN 50, ASME from 1½"

Max. torque - process fitting
- Thread G1, 1 NPT: 285 Nm (210 lbf ft)

Torque for NPT cable glands and Conduit tubes
- Plastic housing: max. 10 Nm (7.376 lbf ft)
- Aluminium/Stainless steel housing: max. 50 Nm (36.88 lbf ft)

Output variable

<table>
<thead>
<tr>
<th>Output</th>
<th>Transistor output, permanently short-circuit proof</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load current</td>
<td>$&lt; 400$ mA</td>
</tr>
<tr>
<td>Voltage loss</td>
<td>$&lt; 2$ V</td>
</tr>
<tr>
<td>Switching voltage</td>
<td>$&lt; 55$ V DC</td>
</tr>
<tr>
<td>Blocking current</td>
<td>$&lt; 10$ µA</td>
</tr>
</tbody>
</table>

Modes (switchable)
- Max.: Max. detection or overflow/overfill protection
- Min.: Min. detection or dry run protection

Accuracy (according to DIN EN 60770-1)

Reference conditions and influencing variables (according to DIN EN 61298-1)
- Ambient temperature: $+18$ ... $+30$ °C ($+64$ ... $+86$ °F)
- Relative humidity: 45 ... 75 %
- Air pressure: 860 ... 1060 mbar/86 ... 106 kPa (12.5 ... 15.4 psig)
- Product temperature: $+18$ ... $+30$ °C ($+64$ ... $+86$ °F)
- Product density: $1 \text{ g/cm}^3 (0.036 \text{ lbs/in}^3)$ (water)
- Product viscosity: $1 \text{ mPa s}$
- Superimposed pressure: $0 \text{ kPa}$
- Sensor installation: Vertically from top
- Density selection switch: $\geq 0.7 \text{ g/cm}^3$

**Measuring accuracy**

Deviation: $\pm 1 \text{ mm (0.04 in)}$

**Influence of the product density on the switching point**

![Diagram showing influence of product density on switching point](image)

**Fig. 39: Influence of the product density on the switching point**

1. Shifting of the switching point in mm (in)
2. Product density in g/cm$^3$ (lb/in$^3$)
3. Switch position $\geq 0.47 \text{ g/cm}^3 (0.017 \text{ lb/in}^3)$
4. Switch position $\geq 0.7 \text{ g/cm}^3 (0.025 \text{ lb/in}^3)$
5. Switching point at reference conditions (notch)
6. Tuning fork
Influence of the process pressure to the switching point

Fig. 40: Influence of the process pressure to the switching point

1. Shifting of the switching point in mm (in)
2. Process pressure in bar (psig)
3. Switching point at reference conditions (notch)
4. Tuning fork

Repeatability
Repeatability 0.1 mm (0.004 in)
Hysteresis
Hysteresis approx. 2 mm (0.08 in) with vertical installation
Switching delay
Switching delay
- Standard
  - approx. 1 s (on/off)
- Optional - can be ordered factory-made
  - 1 ... 60 s (on/off)
Measuring frequency
Measuring frequency approx. 1400 Hz

Ambient conditions

<table>
<thead>
<tr>
<th>Ambient conditions</th>
<th>Limit level of liquids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature on the housing</td>
<td>-40 ... +70 °C (-40 ... +158 °F)</td>
</tr>
<tr>
<td>Storage and transport temperature</td>
<td>-40 ... +80 °C (-40 ... +176 °F)</td>
</tr>
</tbody>
</table>

Process conditions

<table>
<thead>
<tr>
<th>Process conditions</th>
<th>Limit level of liquids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured variable</td>
<td>Limit level of liquids</td>
</tr>
<tr>
<td>Process pressure</td>
<td>Limit level of liquids</td>
</tr>
</tbody>
</table>
  - Instrument version up to 100 bar (1450 psig)         | -1 ... 100 bar/-100 ... 10000 kPa (-14.5 ... 1450 psig) |
  - The process pressure is dependent on the process fitting, e.g. flange (see the following diagrams) |
  - Instrument version up to 160 bar (2320 psig)         | -1 ... 160 bar/-100 ... 16000 kPa (-14.5 ... 2320 psig) |
  - The process pressure is dependent on the process fitting, e.g. flange (see the following diagrams) |
Fig. 41: Process temperature - Process pressure - Version up to 100 bar (1450 psig)
1. Process pressure in bar (psig)
2. Process temperature in °C (°F)

Fig. 42: Process temperature - Process pressure - Version up to 160 bar (2321 psig)
1. Process pressure in bar (psig)
2. Process temperature in °C (°F)

Process temperature (thread or flange temperature)
- OPTISWITCH 5300 C of 316L/Alloy C22 (2.4602)/Inconel 718 (2.4668)

Fig. 43: Ambient temperature - Process temperature
1. Ambient temperature in °C (°F)
2. Process temperature in °C (°F)

Viscosity - dynamic 0.1 ... 1000 mPa s (requirement: with density 1)
Flow velocity max. 6 m/s (with a viscosity of 1000 mPa s)
Density
- Standard sensitivity 0.7 ... 2.5 g/cm³ (0.025 ... 0.09 lbs/in³)
- High sensitivity
  0.47 ... 2.5 g/cm³ (0.017 ... 0.09 lbs/in³)
  Optionally also ≥ 0.42 g/cm³ (0.015 lbs/in³)
Vibration resistance
- Instrument housing
  1 g at 5 ... 200 Hz according to EN 60068-2-6 (vibration with resonance)
- Sensor
  1 g with 5 ... 200 Hz according EN 60068-2-6 (vibration at resonance) with sensor length up to 50 cm (19.69 in)
  With a sensor length > 50 cm (19.69 in) you have to fix the extension tube with a suitable support. See mounting instructions.

Electromechanical data - version IP 66/IP 67 and IP 66/IP 68; 0.2 bar

Cable entry/plug
- Single chamber housing
  - 1 x cable entry M20 x 1.5 (use seal according to the cable diameter), 1 x blind plug M20 x 1.5 or:
  - 1 x closing cap ½ NPT, 1 x blind plug ½ NPT or:
  - 1 x plug (depending on the version), 1 x blind stopper M20 x 1.5

Spring-loaded terminals
  for wire cross-section up to 1.5 mm² (AWG 16)

Adjustment elements

Mode switch
- Max.
  Max. detection or overflow/overfill protection
- Min.
  Min. detection or dry run protection

Sensitivity switch
- ≥ 0.47 g/cm³
  0.47 ... 2.5 g/cm³ (0.017 ... 0.09 lbs/in³)
- ≥ 0.7 g/cm³
  0.7 ... 2.5 g/cm³ (0.025 ... 0.09 lbs/in³)

Voltage supply

Operating voltage
  9.6 ... 55 V DC
Max. power consumption
  2 W (without load)

Electrical protective measures

Protection rating
- Aluminium and stainless steel (standard)
  IP 66/IP 68 (0.2 bar) NEMA Type 6P

Overvoltage category
  das speisende Netzteil kann an Netze der Überspannungskategorie III angeschlossen werden

Protection class
  II

1) Max. permissible process pressure: 25 bar (363 psig)
2) Depending on the version M12 x 1, according to ISO 4400, Harting, 7/8” FF.
3) A suitable cable is required for maintaining the protection rating.
Approvals
Depending on the version, instruments with approvals can have different technical data. For these instruments, please note the corresponding approval documents. They are included in the scope of delivery.

9.2 Dimensions

Housing in protection IP 66/IP 67 and IP 66/IP 68; 0.2 bar

Fig. 44: Housing versions in protection IP 66/IP 67 and IP 66/IP 68; 0.2 bar
1 Stainless steel single chamber (electropolished)
2 Stainless steel single chamber (precision casting)
3 Aluminium - single chamber
OPTISWITCH 5300 C, compact version

Fig. 45: OPTISWITCH 5300 C, compact version

1 Sealing surface
Fig. 46: OPTISWITCH 5300 C, tube version

L  Sensor length - see Technical data - General data
1  Sealing surface
9.3 Trademark
All the brands as well as trade and company names used are property of their lawful proprietor/originator.
KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature assemblies
- Pressure transmitters
- Analysis products
- Products and systems for the oil and gas industry

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