EXNER PROCESS EQUIPMENT

EXSPECT 250 / 260

NIR – Sensor
Technical Information

Imprint

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NIR sensor

Measuring procedure

The NIR sensor EXspect 250/260 is a 180° see-through sensor measuring absorption or opacity in fluids in the near infrared range (880nm wavelength).

Absorption

In liquid media, a collimated light beam is damped by absorption and scattering. This damping can be measured in the event of a defined optical path length (transmission path) and, thus, conclusions can be drawn regarding the rayed medium, because the absorption of a fluid is directly proportional to its concentration, which is described by the Lambert-Beer law. The underlying measuring unit of absorption is AU (absorption units). One AU corresponds to a light loss of 90%, 2 AU correspond to 99%, 3 AU correspond to 99.9% and so on.

Opacity

Opacity is an optical impression describing the property of intransparent media regarding the damping of light. Opacity is not an unambiguously defined or physical quantity, but a subjective impression. In order to improve the comparability, opacity measurements were calibrated using so-called reference standards (e.g. formazine). Nevertheless, the displayed measured values of the opacity measurements strongly depend on the measuring

principle, the wavelength, the measuring angle, and the optical path length.

EXspect 250

The NIR sensor EXspect 250 is a sensor for monitoring the optical density or opacity of fluids in order to monitor continuous process results or to securely indicate changes. In this, the measuring range is between 0...6 AU/OD, 3250 EBC or 0…13,000FAU.

EXspect 260

Just like the EXspect 250, the NIR sensor EXspect 260 is designed for monitoring the optical density of fluids, but this sensor is used in manual or automatic quick-change fittings of the SAW family. By using quick-change fittings, the sensor can be flushed or removed with the process running, efficiently preventing corrupt results caused by coatings on the measuring windows and allowing for secure long-term monitoring of processes.

Measuring range

The measuring range of the EXspect 250/260 sensors is as follows referred to the different measuring units:

0…6 AU/OD	absorption units, this corresponds to an optical density of 6 OD
0…3.250 EBC	European Brewery Convention
0…13.000 FAU	formazine absorption unit
0…13.000 TEF	opacity units formazine
0…26.650 mg/l	milligrams per litre of dry substance

1.2 Functions

Measuring principle

(MPr) Defines the basic measuring principle of the sensor. The selection options are absorption measurement and opacity measurement.

Measuring unit

(Unit) Defines the displayed unit of the measured value. For the absorption measurement, it is possible to select between AU (**a**bsorption **u**nit) and a customer-defined, free measuring unit CDU (**C**ustomer **D**efined **U**nit).
If you selected the opacity measurement option as measuring

principle, you can select between the following measuring units:

EBC **E**uropean **B**rewery **C**onvention

FAU **F**ormazine **A**bsorption **U**nit

TEF **T**rübungs**e**inheiten **F**ormazin (opacity units formazine)

MGL **M**illi**g**rams per **L**itre

and a customer-defined, free measuring unit CDU (**C**ustomer **D**efined **U**nit).

In this, the following is applicable: 1 FAU = 1 TEF = 0.25 EBC = 2.05mg/L.

Decimal point (CdUd) Defines the decimal point (decimal place) in the display

User unit (CdU) Defines the display scope of the user unit

Display switchover Defines which measured value is to be displayed:

(turB) Opacity / absorption

(tEMP) Temperature

(Alt) Opacity / absorption and temperature alternating

Regardless of the display switchover, the analogue output always delivers a signal depending on the opacity / absorption.

Start of measuring range (Mrb) Defines the 4mA point for the output current. The range can be selected freely between 0 …19999 (0.000…19.999). The measuring range is set in the measuring unit currently used in each case.

End of measuring range (MrE) Defines the 20mA point for the output current. The range can be selected freely between 0 …19999 (0.000…19.999). The measuring range is set in the measuring unit currently used in each case.

Damping (dAN) Damps the measured value in the range of 0.0…200.0 seconds both for the output current and for the display.

Zero point range (r-o-) Defines a range in display digits around the zero point where the measured value is set to 0.

Switching-on point (don) Defines the switching-on point of the switching output. The range can be selected freely between 0 …19999 (0.000…19.999).

Switching-off point (*doff*) Defines the switching-off point of the switching output. The range can be selected freely between 0 …19999 (0.000…19.999).

Switching function (*dtYP*) Defines the switching function of the switching output. The options to select from are normally closed (NC) and normally open (NO).

Switching delay (*ddLY*) Defines a switching delay of the switching output. The range can be selected freely between 0.0...200.0 seconds.

Lower output limit (RoLL) Defines the minimum output current. The range can be selected freely between 0 … 22.5mA.

Upper output limit (RoHL) Defines the maximum output current. The range can be selected freely between 0 … 22.5mA.

Leakage current (*Mout*) If the transmitter detects an internal error, an error code is shown on the display and the leakage current defined at this point is generated. The leakage current can be selected freely between 0 … 22.5mA.

Keylock (*AuLo*) Upon corresponding operating time, the keyboard is locked in order to prevent unauthorised operation. The setting range can be selected freely between 0…100 minutes; if 0 is entered, the keylock is disabled.

Reset (*rSt*) By setting the reset function in the user menu to the option "YES", all parameters of the user menu are reset to the factory settings. The calibration values are maintained.

ESC (ESC) When ultimately using the ESC function in the user menu, all changed parameters of the previous parameterisation will be stored. The calibration values are maintained.

1.3 Calibration

The EXspect 250/260 sensor was subjected to a calibration procedure in the factory, whereby it is possible to reset the

product to this configuration, even after accidental misuse. This factory calibration is performed both with absorption standards and with formazine solution. Therefore, the sensor is prepared and can directly be used both for absorption and opacity measurements.

Since the opacity is not an unambiguously defined quantity, but a subjective impression, opacimeters are calibrated with reference standards. The displayed measured values outside of the reference standards strongly depend on the measuring system, the wavelength, and the measuring angle, however. In order to improve the comparability of different measuring systems, user-specific calibration may make sense. This can be performed in the calibration menu without finally deleting the factory calibration. Reasonable calibration procedures are described in chapter 6 Calibration.

Number of calibration points

(CdEF) Defines the number of calibration points for the user-specific calibration. You can select between at least 2 and 6 points at the most.

Calibration points target values

(CJ1...6) The target values of the respective calibration points are set here.

Calibration points actual values

(CAL1...6) The actual values of the respective calibration points are set here.

Save

(SAJE) The user-specific calibration is saved and accepted as soon as the "SAVE" function is set to "YES".

Reset

The reset function in the calibration menu can be used in order to discard the user-specific calibration and the sensor is reset to the factory calibration. However, the parameterisation in the user menu is maintained.

1.4 Process integration

Sensor

The EXSPECT 250 sensor is installed into pipelines or tanks by means of his hygienic modular ½" process connections directly using a welding sleeve (e.g. BP15) or inserted into existing process connections using the corresponding process adapters. The EXspect 260 rod-shaped sensor is installed into a quick-change fitting (SAW) that in turn is connected to the process lines or to the tank.

Transmitter

The transmitter is supplied with 24VDC, is equipped with a freely parameterisable switching output, and a 4…20mA output for measured value output.

Process integration

Pressure

Temperature

The EXspect sensor can be used at pressures of up to 10bar and at maximum process temperatures of up to 90°C.

(140ºC maximum for 2h (SIP cycle)

!!!

Please observe the pressure and temperature diagrams in chapter 9.5!

Installation position

As a matter of principle, the sensors can be operated in any position. However, please observe the good legibility of the indicator and good accessibility and operability.

Measuring window

The measuring windows must be oriented in such a way that no air bubbles or particles may be caught between them.

The measuring windows must be kept clean. This can be achieved by an appropriate CIP / SIP cleaning process or you can alternatively use the EXspect sensor in combination with an SAW quick-change fitting.

2 Parameterisation

2.1 User menu

ATTENTION!

Incorrect settings in the parameters may result in the output of incorrect measured values and switching points. This may result in accidental process influence.

☑ Please make sure that only authorised and trained personnel perform changes to the parameterisation.

The sensor is parameterised using the function keys on the display.

The user menu can be opened by pressing the Enter button. The individual parameters can be accessed by pressing the arrow buttons.

If you want to configure a parameter, you must press the Enter button again, use the arrow button to select the desired setting, and confirm your selection finally using the Enter button.

At the end of the parameters you can return to the display by pressing ESC (Escape) and the Enter button.

User menu

The **bold** and **underlined values** are the **standard user parameters**. The "rST" function resets all user parameters to the factory settings.

Para-meter	Denomination	Value range	Description
ESc	Start/end of menu	not applicable	Menu input and output
MPr	Measuring principle	tur opacity AbS absorption	
unIt	Selection of the measuring unit	MPR = AbS	MPR = tur
		AU (Au) cdu (CDU)	Ebc (EBC) FAu (FAU) tEF (TEF) MGL (mg/l)

Para-meter	Denomination	Value range	Description
			cdu (CDU)
cdud	Decimal place of the user unit	0….0.000	Defines the decimal places of the user unit (cdu)
cdu	User unit	0….19999	Defines the value range of the user unit (cdu)
dsp	Display switchover	turB, temp, ALT	Definition of which measured value is to be displayed: turB: opacity/absorption temp: temperature Alt: opacity/absorption and temperature alternating Regardless of the display switchover, the analogue output always delivers a signal depending on the opacity.
MRB	Start of measuring range (Measuring begin)	**0** … 19999	Defines the 4mA point.
MRE	End of measuring range (Measuring end)	0 … **19999**	Defines the 20mA point.
dAM	Damping (Damping)	**0.0** … 200.0	Damps the measured value for opacity.
r-o-	Zero point range (Range of Zero)	**0** … 1/3 Mbr.	Defines a range in display digits around the zero point where the measured value is set to 0.
Don	Switching-on point (Digital Output on)	**0** … 19999	Defines the switching-on point.
doff	Switching-off point (Digital Output off)	0 … **19999**	Defines the switching-off point.
dtyp	Switching function (Digital Output type)	no, nC	no = normally open nC = normally closed
ddly	Switching delay (Digital Output delay)	**0.0** … 200.0s	Delays the switching point by up to 200s.
Aoll	Lower output limit (Analogue Output lower limit)	**0** … 22.5mA	Defines the minimum output current.
Aoul	Upper output limit (Analogue Output upper limit)	0 … **22.5**mA	Defines the maximum output current.
Mout	Leakage current (Malfunction Output)	0 … **22.5**mA	If the transmitter detects an internal error, an error code is shown on the display and the defined current signal is output.
Aulo	Keylock	**0** … 100min.	Upon corresponding operating time, the keyboard is locked in order to prevent unauthorised operation. The setting 0 will deactivate the keylock.
rst	Reset	no, Yes	Resetting the user parameters to the default settings; the calibration values are maintained
esc	Start/end of menu	not applicable	Menu input and output (saving the entered parameters)

2.2 Output current

The EXspect sensor is equipped with a 4…20mA output in order to output the absorption measured values. The output current is configured by means of the following parameters:

MRB defines the start of the measuring range and thus the 4mA point.

MRE defines the end of the measuring range and thus the 20mA point.

dAM defines the damping effecting the display and the output current.

Aoll defines the minimum output current that can be output.

Aoul defines the maximum output current that can be output.

Mout defines the leakage current applied to the output current in the event of an internal error.

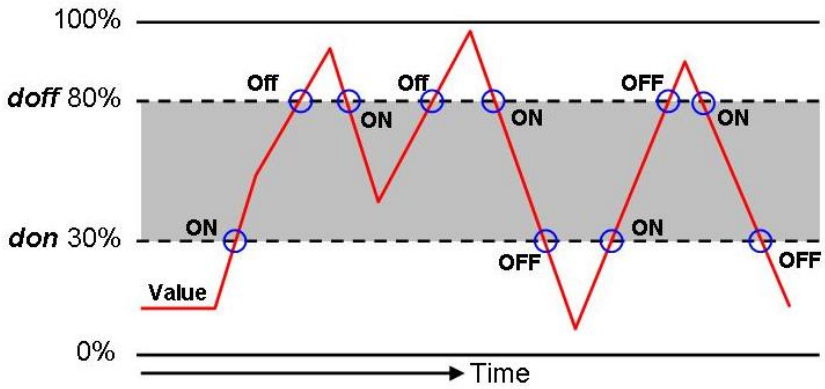
2.3 Switching points

The EXspect sensor is equipped with a PNP switching output configured by four parameters.

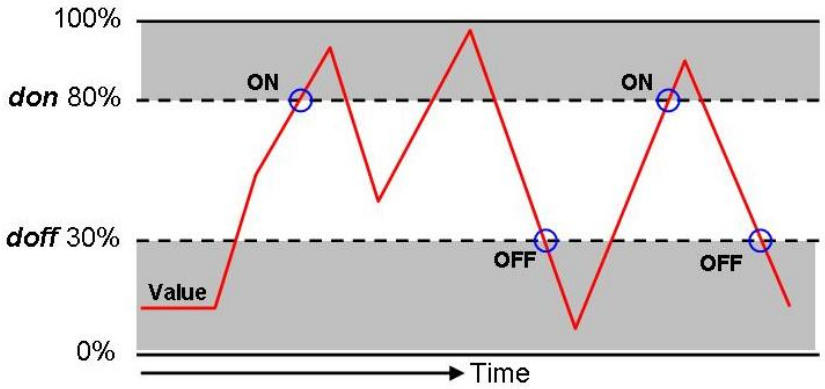
Don defines the switching-on point and doff defines the switching-off point.

Together, both parameters determine the function of the switching output:

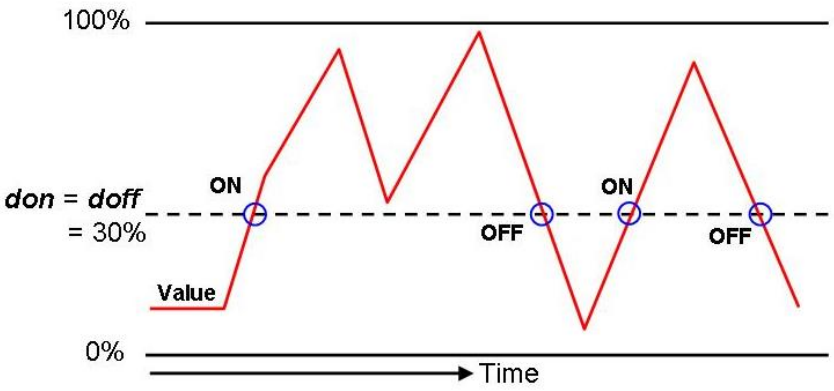
If *don* is lower than *doff*, the output is switched on once the measured value is between the switching points (window function).



If *don* is higher than *doff*, the output is switched on once the measured value exceeds *don*. The product is switched off only when the measured value falls below *doff* (hysteresis function).



If *don* equals *doff*, the output is switched on once the measured value exceeds the switching value *don* + *doff* and is switched off once the measured value falls below the switching value *don* + *doff* again.



Both parameters can be set independently.

dtyp inverts the function of the switching output.

If the value is NO, the switching output will work as normally open (NO) contact; if the value is NC, the switching output will work as normally closed (NC) contact.

ddly delays the reaction of the switching output by up to 200.0s. This value holds true for switching on and switching off.

2.4 Display

The EXspect sensor is equipped with a removable display. The sensor can be parameterised using the display (optionally using the PC).

Even without the display, the sensor works as previously parameterised.

Dsp defines the display value. The display can show the opacity/absorption, the temperature in °C, or both values in an alternating fashion.

2.5 Keylock

You can protect the keyboard against unauthorised access.

Aulo activates the keylock by setting a value of more than "0". The set value corresponds to the time in minutes, as of which the keyboard will be locked after the last entry was made. If another entry is made, the time will start anew. If "0" is entered, the keylock will be deactivated.

The locked keyboard can be unlocked by de-energising the sensor for a short period of time. For this, disconnect the connector for a short period of time and reconnect it afterwards.

2.6 Reset

You can reset all user parameters to factory settings.

rst resets all parameters to the factory settings if you change the setting value to YES and confirm your selection with the Enter button. The aforementioned does not affect a user calibration, because it can only be reset in the calibration menu, see chapter 6.1.

3 Calibration by the user

3.1 Calibration menu

ATTENTION!

Incorrect settings in the parameters may result in the output of incorrect measured values and switching points. This may result in accidental process influence.

☑ Please make sure that only authorised and trained personnel perform changes to the calibration.

The sensor is parameterised using the function keys on the display.

Pressing the arrow **Λ** button for 4-5 seconds will open the calibration menu. If you press the arrow keys repeatedly, you can go to the individual parameters.

If you want to configure a parameter, you must press the Enter button, use the arrow key to select the required setting, and confirm your selection by using the Enter button.

At the end of the parameters you can return to the display by pressing ESc (Escape) and the Enter button. The "RST" function resets the calibration to the factory calibration.

Para-meter	Denomination	Value range	Description
ESc	Start/end of menu	not applicable	Menu input and output
cdef	Number of calibration points	2…6	Defines the number of calibration points.
CJ1 …CJ4	Calibration points: target values	0….19999 and/or 0,000…19,999	Defines the target values of the calibration points (must be entered by the user)
CAL1 …CAL4	Calibration points: actual values	0….19999 and/or 0,000…19,999	Defines the actual values of the calibration points (must be entered by the user) The display alternates with the target values
SAVE	Saving the calibration	no, YES	Saves and/or accepts the user calibration values and overwrites the most recent calibration this way.
rst	Reset	no, Yes	Reset to factory calibration, the user

Para-meter	Denomination	Value range	Description
			parameters are maintained
esc	Start/end of menu	not applicable	Menu input and output (saving the entered parameters)

3.2 Calibration using reference solutions

ATTENTION!

Incorrect settings in the parameters may result in the output of incorrect measured values and switching points. This may result in accidental process influence.

☑ Please make sure that only authorised and trained personnel perform changes to the calibration.

The sensor is parameterised using the function keys on the display. The operating steps can be found in chapter 6.1.

Please proceed as follows to perform a calibration using reference solutions:

1. Please check that the sensor is set to the required measuring principle (absorption / opacity) (see chapter 5.1).
2. Reset the calibration to the factory calibration (rst, see chapter 6.4) and save the reset by selecting SAVE = Yes.
3. Prepare a table in accordance with the following example, shown for 4 different reference solutions here.

Reference solution	known **target value** of the reference solutions	determined **actual value** of the reference solutions
1	e.g. 250 EBC	e.g. 234EBC
2		
3		
4		

In this, the target value describes the known value of the reference solution (e.g. manufacturer's specifications).

4. Please enter the known values of the reference solutions in the column **target values** of the table. The device must show these values upon calibration.

5. Use the sensor to consecutively measure the reference solutions and enter the actual values displayed by the sensor in the table. Avoid erroneous measurements caused by diversion by flushing and thoroughly drying the sensor between the respective measurements.

6. Transfer the values from the table into the sensor as follows (see chapter 6.1):

   - define the number of calibration points cdef

   - enter the known target values of the calibration solutions cj1-cj4

   - enter the determined actual values of the calibration solutions cal1-cal4

7. Confirm your entries by selecting SAVE = Yes (chapter 6.1).

You can check the calibration by re-submerging the sensor into the reference solutions. If the sensor shows the target values, the calibration was successful.

!!! Please make sure that the used reference solutions cover your required measuring range as far as possible.

3.3 Calibration using reference device

ATTENTION!

Incorrect settings in the parameters may result in the output of incorrect measured values and switching points. This may result in accidental process influence.

☑ Please make sure that only authorised and trained personnel perform changes to the calibration.

The sensor is parameterised using the function keys on the display. The operating steps can be found in chapter 6.1.

If you want to adapt the Exspect sensor to a reference device during an ongoing process, please calibrate the sensor as follows using a reference device:

1. Please check that the sensor is set to the required measuring principle (absorption / opacity) (see chapter 5.1)
2. Reset the calibration to the factory calibration (rst, see chapter 6.4) and save the reset by selecting SAVE = Yes.
3. Prepare a table in accordance with the following sample, shown for 4 different reference measurements here.

Reference solution	**Target value** measured value of the reference device	**Actual value** measured value of the sensor
1	e.g. 1250 FAU	e.g. 1225 FAU
2		
3		
4		

In order to adapt the EXspect sensor to a reference device, any samples are used for calibration instead of ready-to-use reference solutions. These samples are measured by means of a reference device. The respective result corresponds to the target value.

The measured values the EXspect sensor displays in the respective samples correspond to the actual values.

4. Please enter the measured values of the samples determined using the reference device in column **target values** of the table. The device must show these values upon calibration.
5. Use the EXspect sensor to consecutively measure the samples and enter the actual values displayed by the sensor in the table. Avoid erroneous measurements caused by diversion by flushing and thoroughly drying the sensor between the respective measurements.
6. Transfer the values from the table into the sensor as follows (see chapter 6.1):

   - define the number of calibration points cdef
   - enter the known target values of the calibration solutions cj1-cj4
   - enter the determined actual values of the calibration solutions cal1-cal4

7. Confirm your entries by selecting SAVE = Yes (chapter 6.1).

You can check the calibration by re-submerging the sensor into the samples. If the sensor shows the target values, the calibration was successful.

!!! Please make sure that the used samples cover your required measuring range as far as possible.

3.4 Resetting to the factory calibration

ATTENTION!

Incorrect settings in the parameters may result in the output of incorrect measured values and switching points. This may result in accidental process influence.

Please make sure that only authorised and trained personnel perform changes to the calibration.

☑

The sensor is parameterised using the function keys on the display. The operating steps can be found in chapter 6.1.

Please proceed as follows if you want to reset the EXspect sensor to the factory calibration and delete possible user calibrations in doing so:

1. Press the arrow **Λ** button for 4-5 seconds. You will get access to the calibration menu.
2. Press the arrow **Λ** button until the display shows rst.
3. Press the Enter button and use the arrow **Λ** button to select the option Yes.
4. Again press the Enter button in order to confirm the resetting process.
5. Press the arrow **V** button in order to open the SAVE function.

   Confirm your selection using SAVE = Yes in order to save the reset to the factory calibration.

4 Technical data

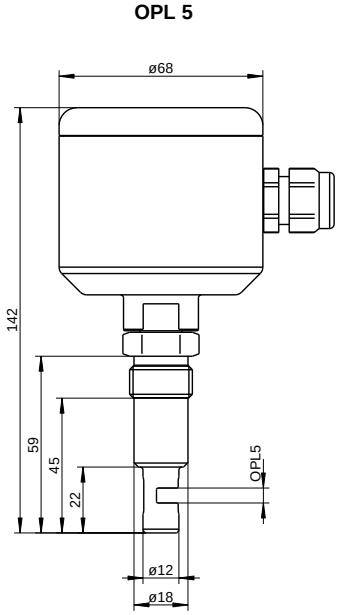
4.1 Standards

EN 61326-1: 10-2006
EN 61326-2-3: 5-2007
DIN/EN 27027 (ISO 7027)

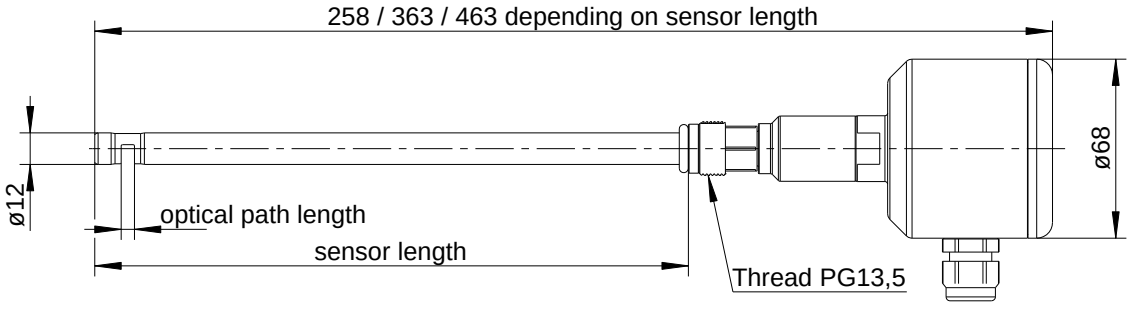
4.2 Specification

Sensor specifications	
Measuring range	0..6 AU (OD) /0...3250 EBC/0…13,000 FAU
Wavelength	880 nm
Light source	LED
Optical path length	5mm
Material	Stainless steel 1.4435 (316L)
Surface quality	Electropolished < Ra 0.37µm
Measuring window	Sapphire
Supply voltage	24VDC
Output current	4…20mA
Switching output	NO or NC parameterisable 150mA max
Degree of protection	IP67/IP69K
Cable connection	M12 connector 5-pin
Cable length	3m or 5m
Process connection	G ½" for process connections (modular@process)

4.3 Dimensions



EXspect 250



EXspect 260

Sensor length 225mm

4.4 Ambient conditions

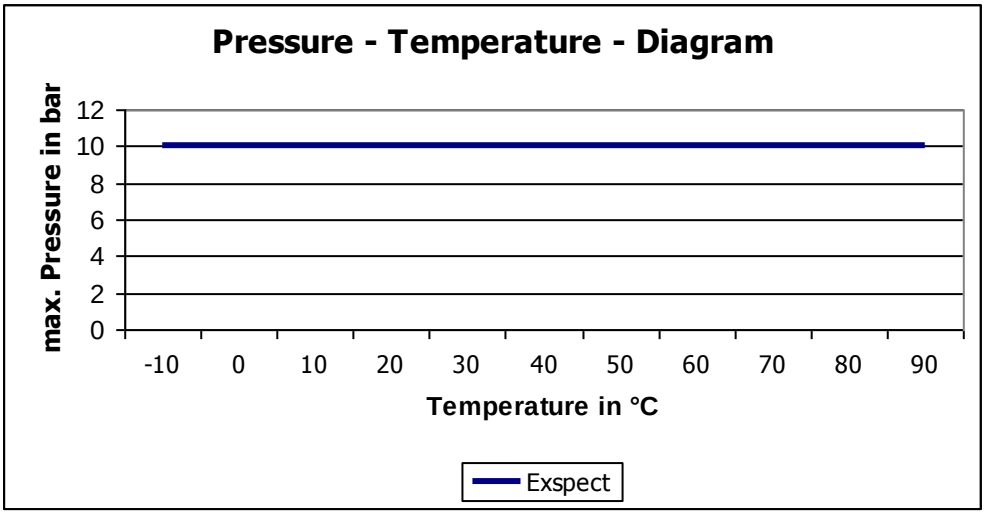
Ambient temperature	**- 10 - 70°C**
Transport and storage temperature	**- 20 - 80°C**

4.5 Process conditions EXSPECT

maximum admissible pressure PS: 10bar

maximum admissible temperature TS: 90°C

maximum admissible sterilisation temperature 141°C max 2h



Pressure – temperature diagram EXspect

4.6 Order structure EXSPECT 250

Sensor EXSPECT 250

Code	Material
4435	Stainless steel, 1.4435 / 316L
XXXX	Special option

Code	Optical Path Length
05	5 mm
XXX	Special option

Code	Process Connection
G12	Thread G1/2" for weld in socket
I25	Ingold DN25 G1 1/4" o-ring position 25mm
XXX	Special option

Code	Elektrischer Anschluss
M12	Plug M12, 5 pins Plug M12, 5 pins
XXX	Special option

Code.	Display
1	With integrated display
0	Without display
X	Special option

EXSPECT 250	-	-	-	-	-	Order code

4.7 Order structure EXSPECT 260

Sensor EXspect 260

Code	Material
4435	Stainless steel 1.4435 (316L)
XXXX	Special option

Code	Sensor length
120	120 mm
225	225 mm
325	325 mm
XXX	Special option

Code	Optical Path Length
05	5 mm
XX	Special option

Code	Processconnection
PG1	Thread PG13.5 Thread PG13.5
XXX	Special option

Code	Electrical connection
M12	Plug M12, 5 pins
XXX	Special option

Code	Display
1	With integrated display
0	Without display
X	Special option

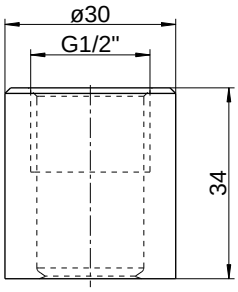
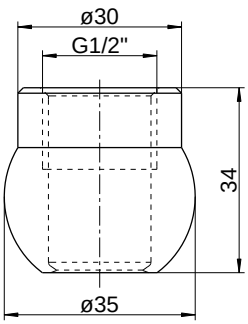
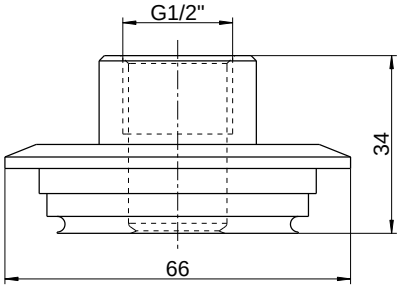
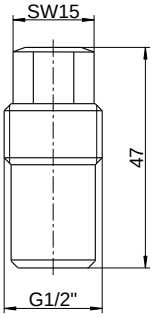
EXSPECT 260 - - - - - Order code

5 Spare parts and accessories

Accessories EXspect 250 / 260	
Description	**Order code**
Connecting cable 2m	2-125-00-001
Connecting cable 5m	2-125-00-002
Connecting cable 10m	2-125-00-003
Control display	2-116-00-003

Accessories for rod-shaped sensor EXspect 260	
Description	**Order code**
Manual retractable holder EXtract8XX-M	auf Anfrage
Automatic retractable holder EXtract8XX	auf Anfrage
Controlunit EXmatic460	auf Anfrage

Certificates EXspect 250 / 260	
Description	**Order code**
Certificate EN10204-2.2 for surface roughness (Ra<0.38µm)	2-121-01-001
Certificate EN10204-3.1 for material	2-121-01-002

Einbauadapter EXspect 250		
Beschreibung	**Zeichnung**	**Bestellnummer**
Einschweißstutzen G ½" zylindrisch		2-087-33-003
Einschweißstutzen G ½" rund		2-083-33-004
Prozessadapter Varivent F DN25-40		2-083-33-001
Einschweißhilfe G1/2" aus Messing		2-086-11-001

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