FY01032G/00/EN/02.25-00
71683770
2025-06-11

Valid as of version
01.50.zz (Device firmware)

Functional Safety Manual
Oil leak detector NAR300 system

Tank gauging

Endress+Hauser
People for Process Automation

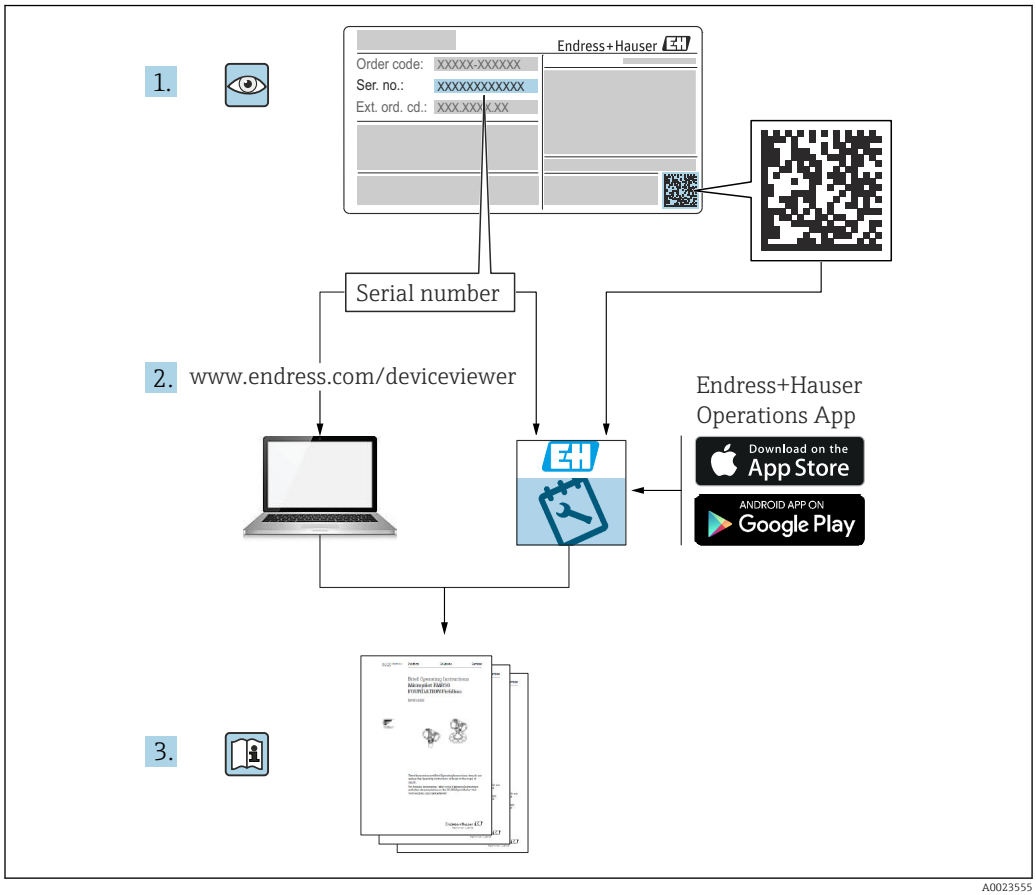

1.
Endress+Hauser
Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX XXX XX XX
Serial number
2. www.endress.com/deviceviewer
Endress+Hauser
Operations App
Download on the App Store
ANDROID APP ON Google Play
3.
A0023555

Table of contents

1 Declaration of Conformity

Endress+Hauser
People for Process Automation

15001

SIL Declaration of Conformity

Functional Safety according to IEC 61508

Endress+Hauser Yamanashi Co., Ltd.
862-1 Mitsukunugi, Sakaigawa-cho, Fuefuki-shi,
Yamanashi Prefecture, 406-0846 Japan

Declares as manufacturer, that the Oil leak detector system

NAR300 with Transmitter NRR261 or NRR262

is suitable for the use in safety-instrumented system according to IEC 61508, if the functional safety manual FY01032G and following characteristics are observed:

Characteristic	Alarm relay contact output
Safety functions	Oil leak detect
SIL [3)]	2
HFT	0
Device type	Type B
Mode of operation	Low demand mode
λs [1)]	1179.4 FIT
λ_D [1)]	1431.9 FIT
λ_{DU} [1)]	126.7 FIT
SFF	95.1%
PFD_{avg} (T_i = 1 year)	6.3×10^{-3}
Recommended proof test interval	6 months
MTBF	43 years

[1)] according to Siemens SN29500
[2)] according to Siemens SN29500, including faults outside the safety function

The device including software and the modification process.

Yamanashi, 11 06 2025
Endress+Hauser Yamanashi Co.,Ltd.

Kotaro Wariishi (General Manager)

A0039943

1.1 Safety-related characteristic values

Characteristics as per IEC 61508	Value
MTBF [1]	43 years
System reaction time as per DIN EN 61508-2	User configurable: → 17

1) According to Siemens SN29500, this value takes into account failure types relevant to the function of the electronic components.

2 About this document

2.1 Document function

This supplementary Safety Manual applies in addition to the Operating Instructions, Technical Information and Safety Instructions. The supplementary device documentation must be observed during installation, commissioning and operation. The requirements specific to the protection function are described in this Safety Manual.

General information on functional safety (SIL) is available at:
- www.endress.com/SIL
- CP01008Z, Brochure "Functional Safety – SIL, Safety Instrumented Systems in the Process Industry"

2.2 Symbols used

2.2.1 Safety symbols

DANGER
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

WARNING
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

CAUTION
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE
This symbol contains information on procedures and other facts which do not result in personal injury.

2.2.2 Symbols for certain types of information and graphics

Tip
Indicates additional information

Reference to documentation

Reference to graphic

Notice or individual step to be observed

1., 2., 3.
Series of steps

Result of a step

1, 2, 3, ...
Item numbers

A, B, C, ...
Views

Hazardous area
Indicates the hazardous area

Safe area (non-hazardous area)
Indicates the non-hazardous area

2.3 Supplementary device documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *W@M Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from nameplate
- *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2D matrix code (QR code) on the nameplate

The following documentation types are available in the Downloads section of the Endress+Hauser website (www.endress.com/downloads):

2.3.1 Further applicable documents

Document	Description
Technical Information (TI)	TI00045G (Standard specification) TI00457G (High temperature specification)
Operating Instruction (BA)	BA00402G (Standard specification) BA00403G (High temperature specification)
Safety Instruction (XA)	IECEX/ ATEX ▪ XA01741G (NAR300) ▪ XA01742G (NNRR261) ▪ XA01743G (NRR262) FM ▪ XA01744G (NAR300) ▪ XA01745G (NNRR261) ▪ XA01746G (NRR262) JPN Ex ▪ XA01839G (NAR300) ▪ XA01840G (NNRR261) ▪ XA01841G (NRR262)

This supplementary Safety Manual applies in addition to the Operating Instructions, Technical Information and Safety Instructions. The associated documentation must be observed during installation, commissioning and operation. The requirements specific to the protection function are described in this Safety Manual.

2.3.2 Technical Information (TI)

Planning aid
The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.

2.3.3 Operating Instructions (BA)

Your reference guide
These Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and

storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.

2.3.4 Safety Instructions (XA)

Depending on the approval, the following Safety Instructions (XA) are supplied with the device. They are an integral part of the Operating Instructions.

The nameplate indicates the Safety Instructions (XA) that are relevant to the device.

3 Design

3.1 Permitted device types

The details pertaining to functional safety in this manual relate to the device versions listed below and are valid as of the specified firmware and hardware versions. Unless otherwise specified, all subsequent versions can also be used for safety functions. A modification process according to IEC 61508 is applied for device changes. Valid device versions for safety-related use:

3.1.1 Ordering features

NAR300

Position 1 (Approval)		
Selected option		**Description**
NAR300	A	ATEX II 1/2G Ex ia IIB T5/T4
	B	IECEx ia IIB T5/T4 Ga/Gb
	C	FM IS Cl.I Div.1 Gr.C,D T5/T4, zone 0,1 AEx ia IIB T5/T4
	2	JPN Ex ia IIB T4
	9	Special version, TSP-no. to be spec.

Position 2 (Type)		
Selected option		**Description**
NAR300	1	Float with vibronic sensor only
	5	Float with vibronic sensor, Ex I/F box
	6	Float, high temperature, Ex I/F box
	9	Special version, T SP-no. to be spec. [1)]

1) This shows special formed float and/or structure (e.g. dual cylindrical float, dumbbell formed float, float without vibronic sensor, etc.).

Position 3 (Output) [1)]		
Selected option		**Description**
NAR300	2	2 wire current

1) The output shows output signal of the transmitter.

Position 4 (Signal cable) [1)]		
Selected option		**Description**
NAR300	A	6 m (19.69 ft)
	B	10 m (32.81 ft)
	C	15 m (19.21 ft)
	D	20 m (65.62 ft)
	E	25 m (82.02 ft)

Position 4 (Signal cable) [1]		
Selected option		Description
	F	30 m (98.43 ft)
	Y	Special version, TSP-no. to be spec.

1) The cable length shows the length between the float sensor and the transmitter.

Position 5 (Cable entry)		
Selected option		Description
NAR300	A	Not used
	B	G1/2
	C	NPT1/2
	F	M20
	Y	Special version, TSP-no. to be spec.

Special specs do not impact explosion proof performance.

NRR261

Position 1 (Approval)		
Selected option		Description
NRR261	A	ATEX II 1/2G Ex d[ia] IIB T4 (NAR300 integrated type)
	B	IECEx d[ia] IIB T4 Ga/Gb (NAR300 integrated type)
	C	FM XP-AIS Cl.I Div.1 Gr.C,D, T4, zone 0,1 AEx d[ia] IIB T4 (NAR300 integrated type)
	D	ATEX II 1/2G Ex d[ia] IIB T4 (NAR300 separate type)
	E	IECEx d[ia] IIB T4 Ga/Gb (NAR300 separate type)
	F	FM XP-AIS Cl.I Div.1 Gr.C,D, T4, zone 0,1 AEx d[ia] IIB T4 (NAR300 separate type)
	4	JPN Ex d[ia] IIB T4 (NAR300 integrated type)
	5	JPN Ex d[ia] IIB T4 (NAR300 separate type)
	9	Special version, TSP-no. to be spec.

Position 2 (Power supply)		
Selected option		Description
NRR261	A	90 to 250 V_{AC} 50/60 Hz
	B	22 to 26 V_{DC}

Position 3 (Cable entry) [1]		
Selected option		Description
NRR261	A	G3/4 x2 (Ex d), G1/2 x1 (Ex ia)
	K	G1/2 x2 (Ex d), G1/2 x1 (Ex ia)
	Q	NPT3/4 x2 (Ex d), NPT1/2 x1 (Ex ia)
	R	NPT1/2 x2 (Ex d), NPT1/2 x1 (Ex ia)
	U	M25 x2 (Ex d), M20 x1 (Ex ia)

Position 3 (Cable entry) [1]		
Selected option		Description
	W	M20 x2 (Ex d), M20 x1 (Ex ia)
	Y	Special version, TSP-no. to be spec.

1) The cable entries, excluding G3/4 and G1/2 (Exd), are attached to the cable glands prior to shipping.

Special specs do not impact explosion proof performance.

NRR262

Position 1 (Approval)		
Selected option		Description
NRR262	A	ATEX [Ex ia] IIB
	B	IEC [Ex ia] IIB
	C	FM AIS AEx [ia] IIB
	4	JPN Ex ia IIB T4
	9	Special version, TSP-no. to be spec.

Position 2 (Power supply)		
Selected option		Description
NRR261	A	90 to 250 V_{AC} 50/60 Hz
	B	22 to 26 V_{DC}

Special specs do not impact explosion proof performance.

3.2 Identification marking

SIL-certified devices are marked with the SIL logo (SIL) on the nameplate.

3.3 Basic conditions for use in safety-related applications

The measuring system must be used correctly for the specific application, taking into account the medium properties and ambient conditions. Carefully follow instructions pertaining to critical process situations and installation conditions, as described in the Operating Instructions. The application-specific limits must be observed. The specifications in the Operating Instructions and the Technical Information must not be exceeded.

3.4 Useful lifetime of electric components

The established failure rates of electrical components apply within the useful lifetime as per components IEC 61508-2:2010 section 7.4.9.5, note 3. In accordance with DIN EN 61508-2:2011 section 7.4.9.5, national footnote N3, appropriate measures taken by the manufacturer and operator can extend the useful lifetime.

4 Commissioning (installation and configuration)

4.1 Requirements for personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- Trained, qualified specialists must have a relevant qualification for this specific function and task.
- Personnel must be authorized by the plant owner/operator.
- Personnel must be familiar with federal/national regulations.
- Before starting work: personnel must read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- Personnel must follow instructions and comply with general policies.

The operating personnel must fulfill the following requirements:

- Personnel are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- Personnel follow the instructions in this manual.

4.2 Installation

The mounting and wiring of the device and the permitted orientations are described in the Operating Instructions pertaining to the device.

4.3 Commissioning

The commissioning of the device is described in the Operating Instructions pertaining to the device.

4.4 Operation

The operation of the device is described in the Operating Instructions pertaining to the device.

4.5 Safety function

4.5.1 Definition of the safety function

Relay contact output status changes under the following conditions.

- Oil leak detection
- Circuit failure
- Black out

The safety-related output signal is fed to a downstream logic unit, e.g. a programmable logic controller or a limit signal transmitter, where it is monitored for the following:

- In the event of an oil leak alarm or breakdown, the relay contact will move to N.C.
- The relay status as shown in Device behavior during operation.

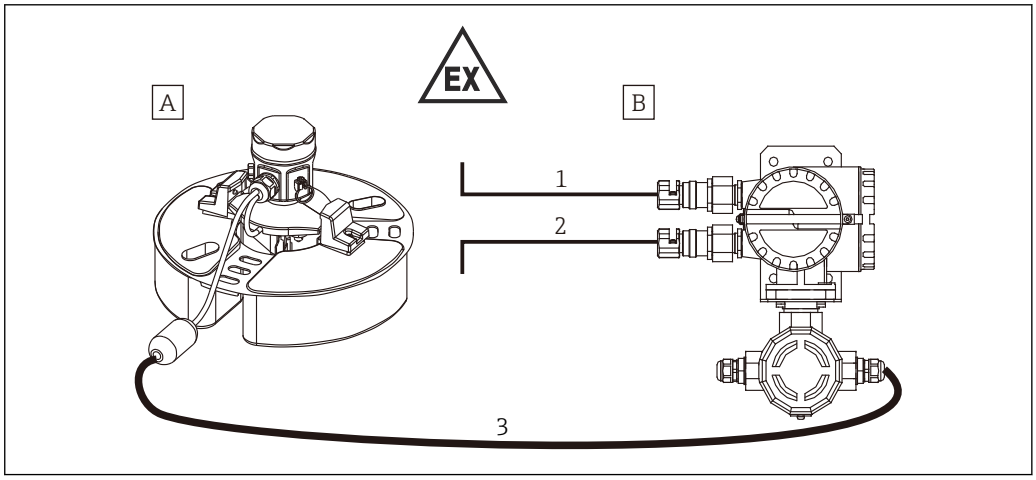
4.5.2 Safety-related signal

NAR300 system is equipped with selectable safety-related relay contact output on the converter. When the conditions above are met, the relay contact output status changes from Normally Open (N.O.) to Normally Closed (N.C.).

4.5.3 Restrictions for use in safety-related applications

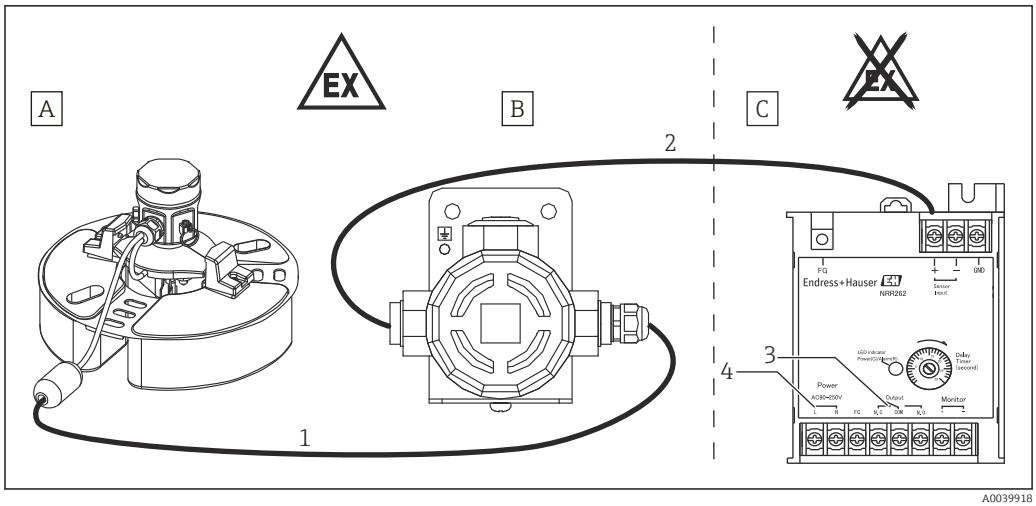
When pit conditions are normal, the NAR300's transmitter output will be 12 mA. When the float sensor detects oil in the pit and specified failure, the transmitter output will be 16 mA. For other failure modes, transmitter output will be less than 10 mA or more than 14 mA.

- The measuring system must be used correctly for the specific application, taking into account the medium properties and ambient conditions. Carefully follow instructions pertaining to critical process situations and installation conditions, as described in the Operating Instructions. The application-specific limits must be observed.
- Information on the safety-related signal
- The specifications from the Operating Instructions must not be exceeded
- Device configuration for the oil leak detection system for SIL are as shown in the figures below. Refer to the Operating Instructions for connection details.



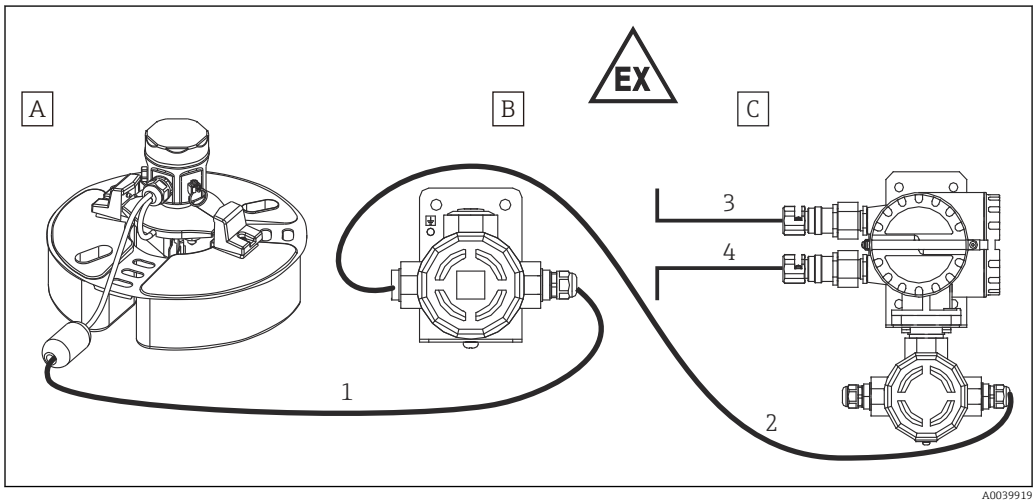
1 System design 1

A Float sensor NAR300-x1xxxx
B Converter NRR261 (integrated type)
1 Alarm output: Alarm/PLC/DCS, etc.
2 Power supply (AC/DC)
3 Ex [ia] dedicated connection cable (6 to 30 m (19.69 to 98.43 ft))



2 *System design 2*

A Float sensor NAR300-x5/6xxxx
B Ex I/F box
C Converter NRR262
1 Ex [ia] dedicated connection cable (6 to 30 m (19.69 to 98.43 ft))
2 Cable for transmitter/converter
3 Alarm output: Alarm/PLC/DCS, etc.
4 Power supply (AC/DC)



3 *System design 3 (TIIS qualification: TC18324 (NAR300) / TC18327 (FTL) / TC18325 (NRR261))*

A Float sensor NAR300-x5/6xxxx
B Ex I/F box
C Converter NRR261 (separate type)
1 Ex [ia] dedicated connection cable (6 to 30 m (19.69 to 98.43 ft))
2 Cable for Ex I/F box/converter
3 Alarm output: Alarm/PLC/DCS, etc.
4 Power supply (AC/DC)

Dangerous undetected failures in this scenario

The following conditions are considered as a dangerous and undetected failures.

- If NAR300 does not issue an alarm when detecting oil.
- If float sensor cannot detect oil leakage (e.g. due to a foreign object adhering to the conductive sensor).

5 Repair and error handling

5.1 Maintenance

Maintenance instructions and instructions regarding recalibration may be found in the Operating Instructions pertaining to the device.

Alternative monitoring measures must be taken to ensure process safety during configuration, proof-testing and maintenance work on the device.

5.2 Repair

Repair means restoring functional integrity by replacing defective components.

Components may be repaired/replaced by the customer's technical staff if **genuine spare parts** from Endress+Hauser are used (they can be ordered by the end user) and the appropriate installation instructions are followed.

A proof test must always be performed after every repair.

Spare parts are grouped into logical kits with the associated replacement instructions.

Document the repair with the following information:
- Serial number of the device
- Date of the repair
- Type of repair
- Person who performed the repair

Installation Instructions are supplied with the original spare part and can also be accessed in the Downloads section of www.endress.com

Return the replaced component to Endress+Hauser for fault analysis.

When returning the defective component, always enclose the "Declaration of Hazardous Material and Decontamination" with the note "Used as SIL device in a safety instrumented system.

For information on device returns, see:
http://www.endress.com/support/return-material

Spare parts have both SIL and TIIS versions. Make sure to select parts for the SIL version as TIIS versions are not certified for use.

5.3 Modification

Modifications are changes to SIL devices that are already delivered or installed.
- Modifications to SIL devices are usually performed in the Endress+Hauser manufacturing center.
- Modifications to SIL devices onsite at the user's plant are possible following approval by the Endress+Hauser manufacturing center.
  In this case, the modifications must be performed and documented by an Endress+Hauser service technician.
- **Modifications to SIL devices by the user are not permitted.**

5.4 Decommissioning

When decommissioning, the requirements according to IEC 61508-1:2010 section 7.17 must be observed.

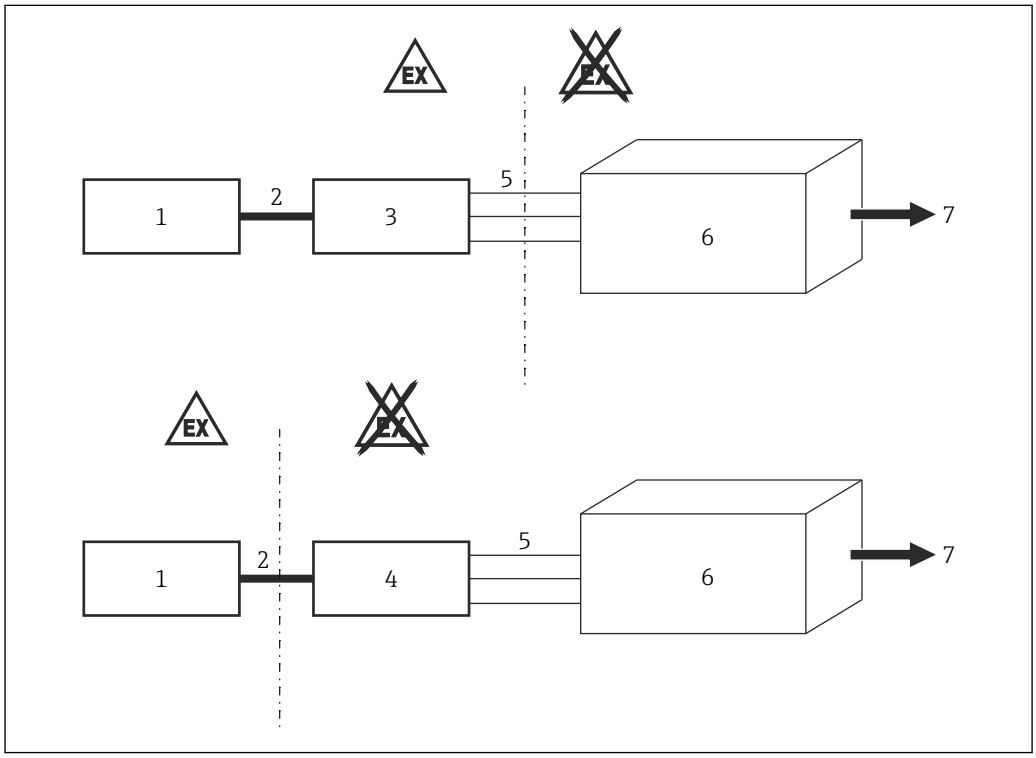
6 Appendix

6.1 Structure of the measuring system

6.1.1 System components

NAR300 system is equipped with selectable safety-related outputs as follows. The contact relay output is monitored by the logic unit.

Measuring system devices are as shown in the diagram below.



4 *System diagram*

1 Oil leak detector NAR300
2 Current output line
3 Converter NRR261
4 Converter NRR262
5 Relay output line
6 Logic unit (e.g. PLC, limit signal transmitter)
7 Actuator

The combination with 1 and 3 shown above has two types of NAR300 system. For details of the combination, → 13

6.1.2 Description of use as a protective system

Device behavior during operation

Device behavior during power-up

Once switched on, the device runs through a diagnostic phase of approx. 30 seconds. Relay contacts are in Alarm mode during this time.

Device behavior in event of alarms and warnings

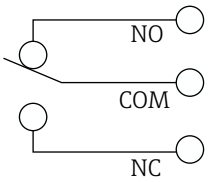
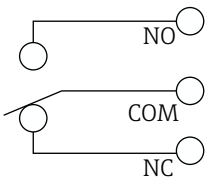
Relay contact states are shown in the following table. Status must be monitored and processed accordingly by a connected logic unit.

The contact outputs of NRR261 and NRR262 include Normally Open (N.O.) and Normally Closed (N.C.). For judgment of NAR300 system status, monitoring both N.O. and N.C. is highly recommended. Combinations of the contact states are shown in the following table.

N.O.	N.C.	Status
Closed	Open	Normal (no oil leak and no device failure)
Open	Closed	Alarm (oil leak or device failure)
Closed	Closed	Relay failed
Open	Open	Relay failed

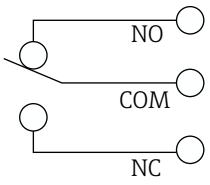
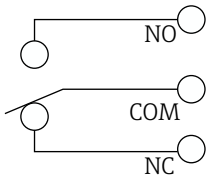
Relay contact status for standard version

Allowable ambient temperature of float sensor is 60 °C (140 °F) or less.

Relay contact status	 5 *Relay ON*	 6 *Relay OFF*
Alarm status	No alarm (No oil leak)	Alarm: ▪ Detecting oil leak ▪ Power OFF (or black out) ▪ Liquid freezing ▪ Detector circuit failure ▪ Short circuit or open wire between converter and transmitter

Relay contact status for high temperature version

Allowable ambient temperature of float sensor is 100 °C (212 °F) or less

Relay contact status	 7 *Relay ON*	 8 *Relay OFF*
Alarm status	No alarm (No oil leak)	Alarm: ▪ Detecting oil leak ▪ Power OFF (or black out) ▪ Liquid freezing ▪ Detector circuit failure ▪ Short circuit or open wire between converter and transmitter ▪ Pit empty (no water)

The contact output of NAR261/262 load is switched via a single floating change-over contact (SPST). The operator must use suitable measures (e.g. current limiter, fuse) to make sure that the relay contact characteristic does not exceed the allowable value.

250 V_{AC}, 1 A, 100 VA/100 V_{DC}, 1 A, 25 W

Delay time

The alarm ON delay time is adjustable via a delay trimmer. After turning off power to transmitter NRR261, remove the electronics compartment cover to reveal the trimmer. On NRR262 it is located on the surface of the case. Delay may be set from 1-20 seconds. When an alarm continues for longer than the set delay time, an alarm output is detected.When the alarm stops within the set delay time output is not detected, thus preventing false alarms.

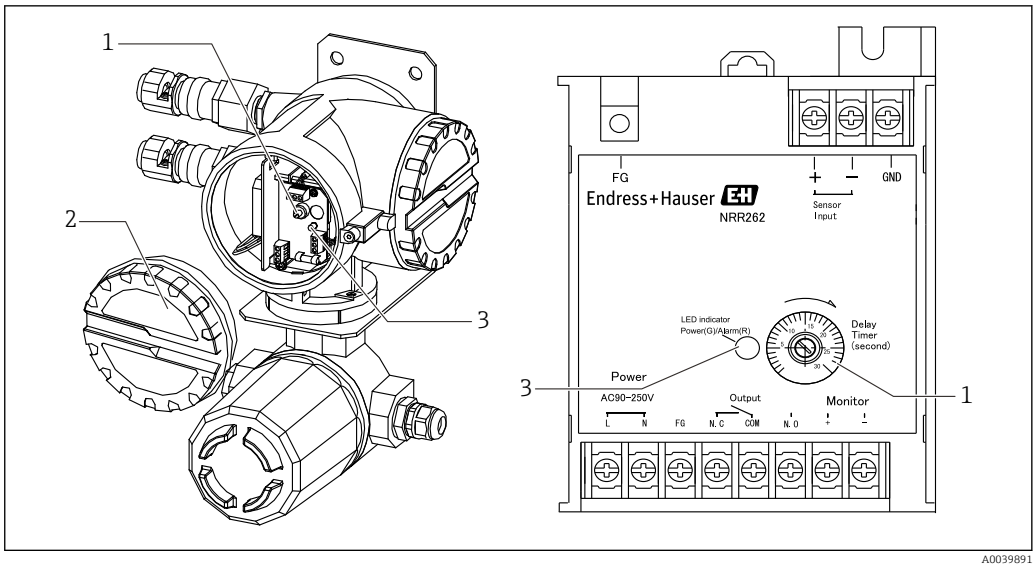
A delay time of approximately 6 seconds is added by default. Response delay time of approximately 6 second is a detection circuit factory preset, and is always present in addition to trimmer delay time.

System reaction time

6 to 30 seconds

When the oil leak detector system is used in U.S.A., delay time must be set to 30 seconds or less (requirement of FM class 7745).

Total delay time: $T_{NAR} + T_{NRR} + T_{ACT} \leq 30$sec	
Delay time of NAR300:	T_{NAR} (Default 6 sec.)
Delay time of NRR261/262:	T_{NRR} (Max. 20 sec.)
Delay time of actuator:	T_{ACT}



9 *Converter NRR261 (Left)/Converter NRR262 (Right)*

1 Extension trimmer
2 Cover
3 LED power (green) / Alarm (red)

The NRR262 alarm indicator displays status as described in the following table.

Alarm indicator of NRR262

Status	Color
Power on and no alarm	Green
Alarm	Red

6.2 Commissioning or proof test report

Check the operation and safety functions at appropriate intervals. The operator must determine the time intervals.

The values and graphics in the additional safety-related characteristics section can be used for this purpose. The test must be carried out in such a way that it verifies the correct operation of the protective system in interaction with all of the components. In a single-channel architecture, the value to be used depends on the diagnostic rate of coverage for the proof-test (PTC = proof test coverage) and the intended lifetime (LT = lifetime), as specified in the following formula:

In a single-channel architecture, the value to be used depends on the diagnostic rate of coverage for the proof-test (PTC = proof test coverage) and the intended lifetime (LT = lifetime), as specified in the following formula:

$$PFD_{avg} = ½ \cdot PTC \cdot \lambda_{du} \cdot T_I + \lambda_{DD} \cdot MTTR + ½ \cdot (1 - PTC) \cdot \lambda_{du} \cdot LT$$

For the proof-tests described as follows, the respective proof test coverages are specified, which may be used for calculation. The proof test coverage rates depend on the specific test sequence. A test sequence for the proof test must be selected from the following table for every safety function used. If both safety functions are used, two test sequences must be performed for the proof test.

Safety function (relay output)		PTC
	Test sequence 1 -for standard version	98%
	Test sequence 2-for high temperature version	98%

Make sure to check that all covers and cable entries are sealed securely.

⚠ CAUTION

To ensure process safety

- During the proof-test, alternative monitoring measures must be taken to ensure process safety. If one of the test criteria from the following test sequences is not fulfilled, the device may no longer be used as part of a protective system. The purpose of proof-testing is to detect random device failures (λ_{du}). The impact of systematic faults on the safety function is not covered by this test and must be assessed separately. Systematic faults can be caused, for example, by process material properties, operating conditions, build-up or corrosion.

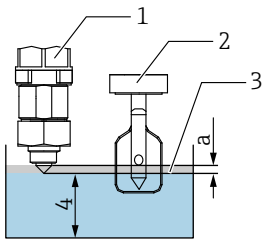
When performing a proof test, copy the following form and record and keep the test results.

6.2.1 Proof test sequence and check sheet 1

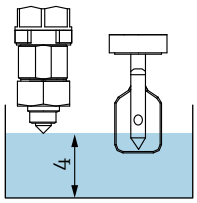
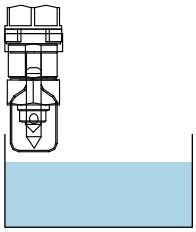
Standard version

System-specific Data		
Company/Place		
System		☐ NAR300 + NRR261 ☐ NAR300 + NRR262
Device Type/Order Code		NAR300-
		NRR26 -
Device Serial Number		NAR300:
		NRR26 :
Inspector		
Name		
Test Date		
Signature		
1.	Cleaning conductive sensor and parts around the conductive sensor.	☐ YES ☐ NO
2.	Detection Sensitivity:	See below
3.	Alarm condition under each situation	See below

2. *and* 3.

Check items: condition		Yes	No
2. 3.  *a* 10 mm (0.39 in) ± 1 mm (0.04 in) *1* Conductive sensor *2* Vibration sensor *3* Oil *4* Water	Relay status: N.C.		
	NAR300 current output: 16 ± 1 mA		
	Alarm ON		
	NAR300 +NRR262: NRR262 LED: Red		

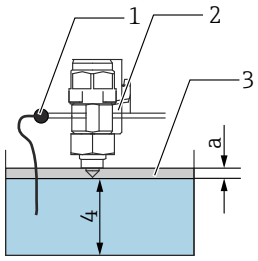
3.

Check items: condition		Yes	No
3.  *4* Water 3. 	Relay status: N.C.		
	NAR300 current output: 12 ± 1 mA		
	Alarm OFF		
	NAR300 +NRR262: NRR262 LED: Green		

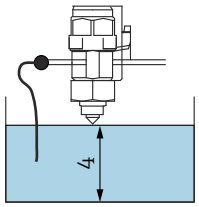
High temperature version

System-specific Data	
Company/Place	
System	☐ NAR300 + NRR261 ☐ NAR300 + NRR262
Device Type/Order Code	NAR300- NRR26 -
Device Serial Number	NAR300: NRR26 :
Inspector	
Name	
Test Date	
Signature	
1. Cleaning conductive sensor and parts around the conductive sensor.	☐ YES ☐ NO
2. Detection Sensitivity:	See below
3. Alarm condition under each situation	See below

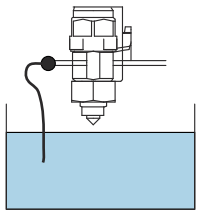
2. *and* 3.

Check items: condition		**Yes**	**No**
2. 3.  *a 10 mm (0.39 in) ± 1 mm (0.04 in)* *1 Conductive wire between float and water* *2 Conductive sensor* *3 Oil* *4 Water*	Relay status: N.C.		
	NAR300 current output: 16 ± 1 mA		
	Alarm ON		
	NAR300 +NRR262: NRR262 LED: Red		

3.

Check items: condition		Yes	No
3.  4 *Water*	Relay status: N.O.		
	NAR300 current output: 12 ± 1 mA		
	Alarm OFF		
	NAR300 +NRR262: NRR262 LED: Green		

3.

Check items: condition		Yes	No
3. 	Relay status: N.C.		
	NAR300 current output: 16 ± 1 mA		
	Alarm ON		
	NAR300 +NRR262: NRR262 LED: Red		

6.3 Version history

Date	Software Versions	Modifications
11.2003	V1.40	Original software
04.2015	V1.50	SIL2 obtained

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