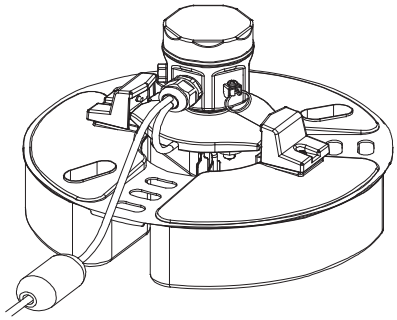
Functional Safety Manual
Oil Leak Detector
NAR300 System



Application

This system is designed to be installed in a pit, dike, plant, or sump pit near a pump yard, where it can provide the ultimate in leak detection function for petrochemicals or vegetable oils.

The oil leak detector NAR300 system utilizes two separate detection functions, conductive and vibronic, to monitor conditions. Highly accurate alarm recognition is attained through a 2-stage logic process which ensures safe tank yard operation, with minimal equipment configuration.

Flame Proof System:
Alarm output transmitted to host controller via connected transmitter NRR261 (outdoor installation) and e.g. level transmitter with switching input

Intrinsically Safe System:
Direct alarm output to host controller when connected in combination with transmitter NRR262 (indoor installation).

Features and Benefits

- Twin detection functions:
  - Conductive sensor detects presence of conductive liquids
  - Vibration sensor determines presence of oil or water
- Easy installation in both empty pits and those containing water
- No moving parts, low maintenance, long life
- Safe operation assured via advanced diagnostics the event of power failures, freezing pit-water, etc.
- Applications requiring water-insoluble oil detection are independent of relative dielectric constant
- Improved performance regardless of pit conditions
- Intrinsically safe design
- EMC-compliant

NAR300 system meets the requirements as follows.

- Functional safety as per IEC 61508
- Explosion protection
- Electro magnetic compatibility as per EN 61326
- Electrical safety as per IEC/EN 61010-1
- Hydro carbon leak detector as per FM7745

Endress+Hauser
People for Process Automation

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SIL Declaration of Conformity

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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 SD01357G/08 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, 25 March 2015
Endress+Hauser Yamanashi Co.,Ltd.

(General Manager)

Important Document Information

Notes on Safety Conventions and Symbols

Symbols for Safety Conventions

Symbol	Meaning
 A0011189-EN	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
 A0011190-EN	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
 A0011191-EN	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
 A0011192-EN	**NOTICE!** This symbol contains information on procedures and other facts which do not result in personal injury.

Symbols for Certain Types of Information

Symbol	Meaning
 A0011182	**Allowed** Indicates procedures, processes or actions that are allowed.
 A0011183	**Recommendation** Indicates procedures, processes or actions that are recommended.
 A0011184	**Forbidden** Indicates procedures, processes or actions that are forbidden.
 A0011193	**Tip** Indicates additional information.

Introduction

NOTICE

General information on functional safety (SIL)is available at: www.endress.com/SIL (German or English) and in Competence Brochure CPZ002Z "Functional Safety in the Process Industry - Risk Reduction with Safety Instrumented Systems".

Structure of Measuring System

System Diagram

The detecting system of devices shows in the following diagram (example).

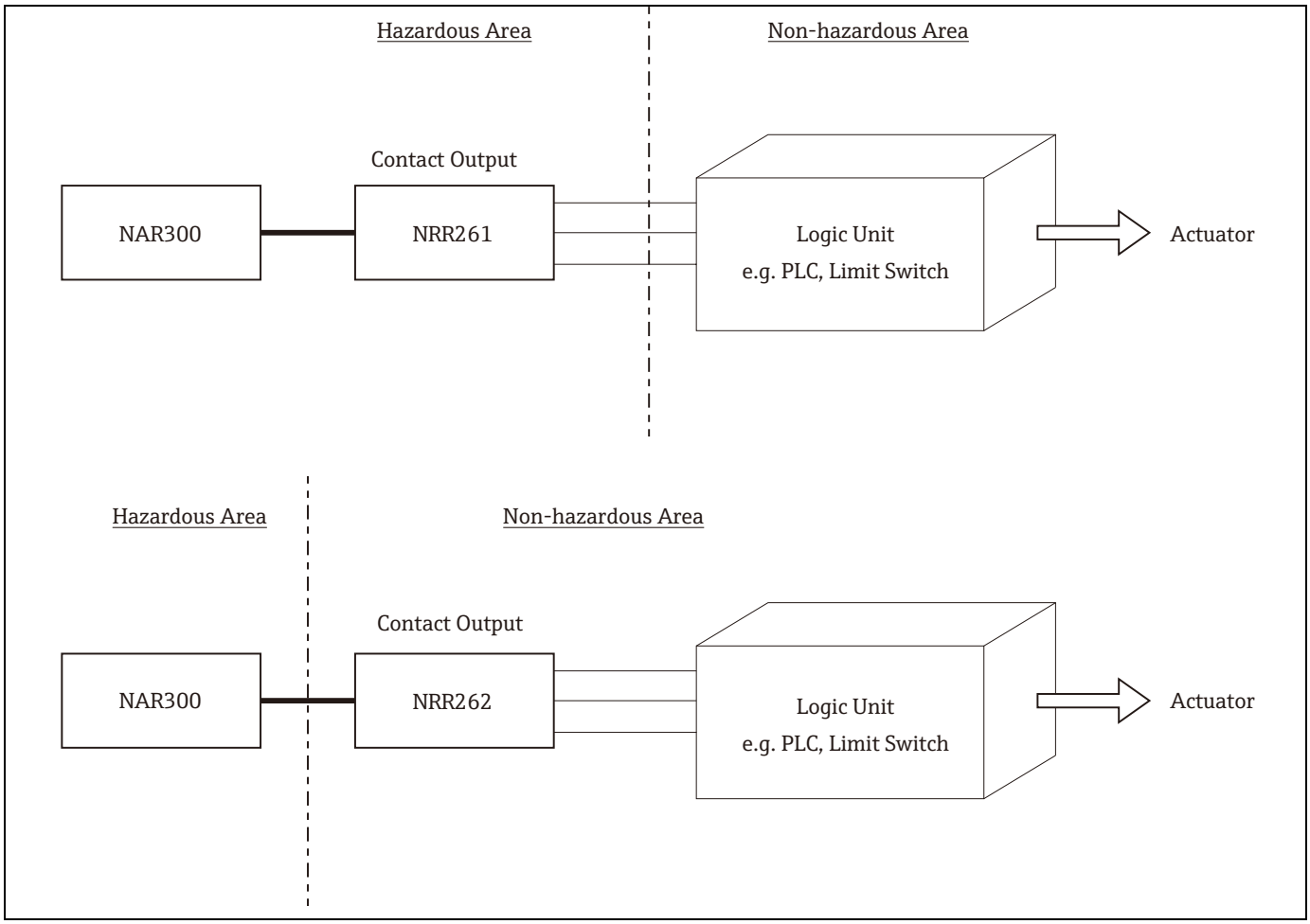


Figure 1: System Diagram

NAR300 system is equipped with selectable safety-related output as follows.
The alarm relay contact output is set to the alarm side for detecting oil leaks or device failure.
The oil detector outputs a contact relay output via a transmitter and this contact relay output is sent to a logic unit (PLC or limit signal transmitter). Then the contact relay output is monitored by the logic unit.

⚠ CAUTION

The contact outputs of NRR261 and NRR262 are 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.	State
Closed	Open	Normal (no oil leak and no device failure)
Open	Closed	Alarm (oil leak or device failure)
Closed	Closed	Relay failed or
Open	Open	Relay failure or

Principle of Alarm Operation

The oil leak detection signal generated at float sensor NAR300 is converted to 8mA (alarm OFF) or 16mA (alarm ON) by a current output circuit in the transmitter or sensor I/F Ex box. It is also connected to the current detection circuit through an IS safety barrier.
In the current detection circuit, the existence/absence of oil leak alarm signal determined by current value and, sent through a delay circuit, turning the alarm output relay ON or OFF. The alarm delay circuit is configurable from 1-30 seconds (an additional 6 seconds is added as the default delay value). Fail-safe function is also available for the relay output (refer to the following table).

Alarm Output Operating

Alarm Output Operating Table

Terminals / Condition	NRR262 N.C. to COM NRR261N.C. to COM Terminal:11,13	NRR262 N.O. to COM NRR261N.O. to COM Terminal:13,15
Oil Leak Alarm	Contact Close	Contact Open
Power OFF	Contact Close	Contact Open
Liquid Freezing	Contact Close	Contact Open
Non-alarm	Contact Open	Contact Close

The 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 delay time is set an alarm output is detected. If the alarm stops within the delay time setting, an alarm is not output, 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 in addition to trimmer delay time.

CAUTION

When 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: $T_{delay\text{-}total} + T_{NAR} + T_{NRR} + T_{ACT} < 30sec.$

Delay Time of NAR300: T_{NAR} (Default 6sec.)

Delay Time of NRR261/262: T_{NRR} (Max. 20sec.)

Delay Time of Actuator: T_{ACT}

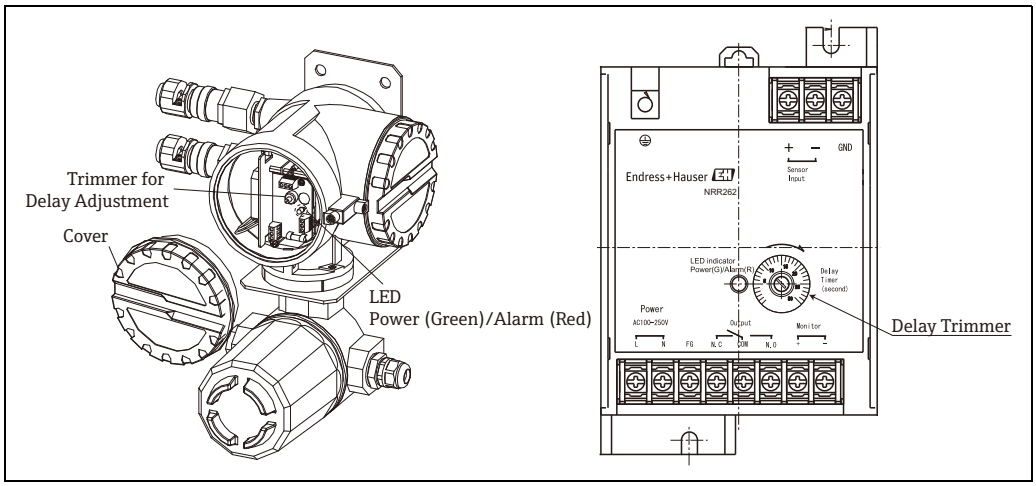


Figure 2: Transmitter NRR261 (Left)/Transmitter NRR262 (Right)

Alarm Indicator of NRR262

The status and dual color LED show in the following table.

Status	Color
Power On and No Alarm	Green
Alarm	Red

Operation Principal

Protective System

The oil leak detector NAR300 measures conductivity of liquid (refer to the Technical Information of NAR300 for details of principal).

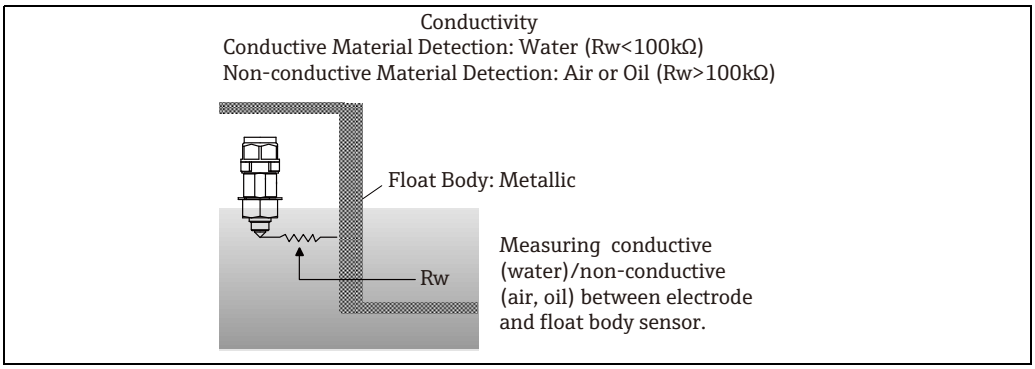
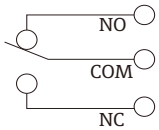
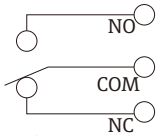


Figure 3: Measuring Conductivity

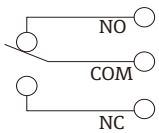
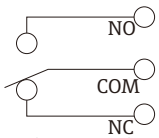
Relay Contact Status for Standard

Allowable ambient temperature of float sensor is 60°C or less.

Relay Contact Status	 (Relay ON)	 (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 for High Temperature Specifications

Allowable ambient temperature of float sensor is 100°C or less.

Relay Contact Status	 (Relay ON)	 (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)

⚠ CAUTION

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.

- 250VAC, 1A, 100VA/100VDC, 1A, 25W

Permitted Device Type

Details of device types depending on functional safety and valid software versions are as follows. All subsequent types, unless otherwise specified, can also be used for safety instrumented systems. A modification process according to IEC61508 is applied for device change.

Descriptions of Items

- Feature: a specific letter or digit in the product specification code.
- Designation: description of a functional category that includes one or more variants
- Version: permissible variants represented by a digit or letter

Oil Leak Detector NAR300-		
Feature	**Designation**	**Version**
010	Approval	All
020	Type (see note)	1,5,6,9
030	Output	2
040	Float Guide	All
050	Cable Entry	All

Converter NRR261-		
Feature	**Designation**	**Version**
010	Approval	All
020	Power Supply	All
030	Cable Entry	All

Converter NRR262-		
Feature	**Designation**	**Version**
010	Approval	All
0 0	Power Supply	All

NOTICE

Type	**Float Sensor/Transmitter**
1	Float* with vibration sensor only (without transmitter circuit) for NRR261-2/A/B/C
5	Float* with vibration sensor + transmitter (standard version) for NRR261-3/D/E/F or NRR262
6	Float* without vibration sensor + transmitter (high temperature version) for NRR261-3/D/E/F or NRR262
9	Special formed float* and/or structure

Float * shows float + conductive sensor.

- Valid software version: 1.50 or later
- Valid hardware version: delivery date [April] 2015.

Safety Requirements

Safety Function

Alarm Relay Contact Output as Safety-related Signal
In case of oil detection, circuit failure or a black out, the relay contact output status changes from Normally Open (N.O.) to Normally Closed (N.C.)
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:

- The occurrence of a fault, relay closed.
- The relay status as shown in Structure of Measuring System (refer to CAUTION).

Restrictions for Use in Safety-related Applications

NAR300 system must be properly used for the specific application under the properties of medium and ambient conditions.
Follow the Operating Instructions (BA00402G or BA00403G) regarding critical process situations and installation.

Functional Safety Indicators

Alarm Relay Contact Output

Characteristic as per IEC61508	Oil Leak Detector NAR300 System with NAR261 or 262
Safety Function	Oil leak detection failure regarding device
SIL	2
HFT	0
Device Type	Type B
Mode of Operation	Low demand mode
λs	1179.4 FIT
λd	1431.9 FIT
λdu	126.7 FIT
SFF	95.1%
PFH [1/h]	1.3×10^{-7}
PFD_{avg} for T_i = 0.5year/1year	$3.1 \times 10^{-3}/6.3 \times 10^{-3}$
MTBF	45years
Recommended time interval for proof-testing Ti	6 months
System reaction time	6 to 30 seconds

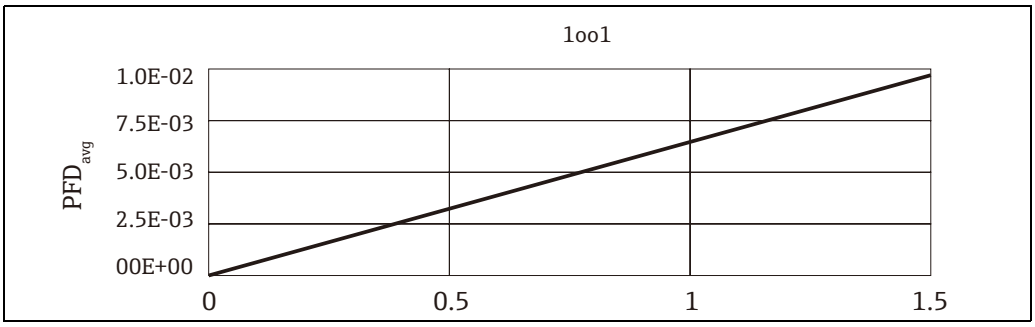


Figure 4: Proof Test Interval (Year)

Dangerous Undetected Failures
The following conditions are considered as a dangerous and undetected failure.

- When detecting oil, NAR300 does not issue an alarm.
- NAR300 can not detect oil leakage (e.g. due to a foreign object adhered to the conductive sensor.).

Useful Lifetime of Electrical Components
The established failure rates of electrical components apply within the useful lifetime as per IEC 61508-2, section 7.4.9.5 note 3.

Installation, Commissioning, Operation, Adjustment, and Maintenance

Details of all items are described in Operating Instructions (BA00402G or BA00403G).

⚠ CAUTION

- When the floating sensor is floating in the water, confirm the sensor position.
- Alternative monitoring measurement must be done to assure the process safety during configuration, proof-testing and maintenance work on the device.
- Overall periodic inspections (maintenance) must be conducted semi-annually.

Proof-Test

Outline

Check the operation and safety functions at appropriate intervals.
Time interval must be determined (refer to the diagram of proof-test interval).
Proof-testing of the device can be performed as follows;

- Cleaning the conductive sensor.
- Check the detection sensitivity.
- Confirm the alarm condition of each situation (use check tool).

Process for Proof-test

Float Sensor and Relay Output Checking Procedure

1. Cleaning sensor using a soft damp cloth (see CAUTION).
2. Check the detection sensitivity.
3. Check the alarm condition of each situation.

⚠ CAUTION

- To avoid an electrostatic discharge, chemical fiber cloth should not be used.
- The proof-test is deemed to have failed if the relay does not change the state.

Refer to the Appendix for details of proof test protocol.
When performing a proof test, record the test results according to Appendix respectively. The recorded data and test results must be stored in a safe place.

⚠ WARNING

- Ex d and Ex ia compartments are separated in NRR261. In a hazardous area, do not open the covers (terminal compartment and electric compartment) of the Ex d compartment while power is supplied to NRR261(including proof-tests).
- When opening the Ex d compartment cover, turn off the power in advance.
- When performing a proof-test, with Ex d compartment cover(s) open, the proof-test must be performed in a non-hazardous area.

Repairs

Outline

Repairs of devices must always be performed by Endress+Hauser.
Safety functions cannot be guaranteed if repairs are not performed by Endress+Hauser.

Exceptions:
The following components can be replaced by the authorized person who has been trained in Endress+Hauser.

- Fuse on the terminal board
- O-rings on electronics compartment cover and terminal compartment cover

The replaced components must be sent to Endress+Hauser if a fault analysis is requested.
When components have been replaced, a proof-test must be performed according to the test sequence.

In the event of failure of a SIL-labeled Endress+Hauser device, which has been operating in a protection function, the "Declaration of Contamination" with the corresponding note "Used as SIL device in protection system" must be enclosed when the device is returned.

NOTICE

Refer to the section "Return" in the Operating Instructions (BA00402G or BA00403G).

Documents

Supplementary Documents

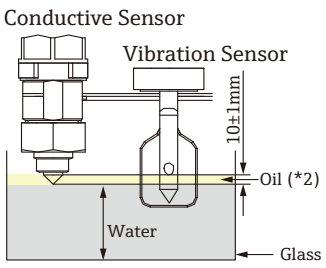
Documents	Descriptions	Comments
Technical Information TI00045G/08 (Standard Spec.) TI00457G/08 (Hight Temperature Spec.)	Function and System Design ▪ Operating Principle ▪ Operating Conditions ▪ Installation ▪ Dimensions ▪ Electrical Connection ▪ Order Information ▪ Specifications ▪ Process Conditions ▪ Accessories ▪ Mechanical Construction ▪ Accessory ▪ Advanced Maintenance ▪ Certificates and Approvals ▪ Documentation	Technical Information is available on our web site (www.endress.com).
Operating Instructions BA00402G/08 (Standard Spec.) BA00403G/08 (High Temperature Spec.)	Safety Instructions ▪ Identification ▪ Delivery Example of Each Order Code ▪ Operating Conditions ▪ Installation ▪ Electrical Connection ▪ Adjustment ▪ Maintenance ▪ Accessories ▪ Troubleshooting ▪ Process Condition ▪ Technical Data	Operating Instruction is supplied with the device. The document is also available on our web site (www.endress.com).
Safety Instructions [NAR300] XA01098G-A/08 (A) XA01104G-A/08 (Ex1087-1177) (F) XA00587G-A/08 (T) [NRR261] XA01103G-A/08 (A) XA01105G-A/08 (Ex1088-1192) (F) XA00588G-A/08 (T) [NRR262] XA01106G-A/08 (A) XA01107G-A/08 (Ex1089-1205) (F) XA00589G-A/08 (T) (A) for ATEX and IECEx, (F) for FM (T) for TIIS	Safety installation and operating instructions for devices which are suitable for use in potentially explosion atmospheres.	The documentation is supplied with the device. FM version has double document number. "XA...." is Endress+Hauser's document control number. "Ex...." is resisted critical document number to FM approvals. Both numbers on the document are indicated.

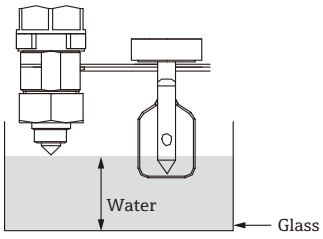
Appendix

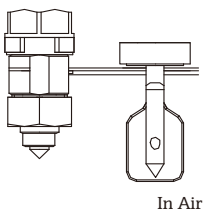
Proof Test Protocol 1

Standard Specifications

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
Relay Status: N.C.		
NAR300 Current Output: 16 ± 1mA		
Alarm: ON		
NAR300 + NRR262: NRR262 LED: Red		

3.

Check Items: Condition	Yes	No
Relay Status: N.O.		
NAR300 Current Output: 12 ± 1mA		
Alarm: OFF		
NAR300 + NRR262: NRR262 LED: Green		

3.

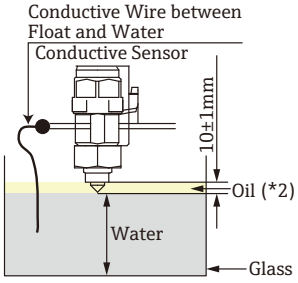
Check Items: Condition	Yes	No
Relay Status: N.O.		
NAR300 Current Output: 12 ± 1mA		
Alarm: OFF		
NAR300 + NRR262: NRR262 LED: Green		

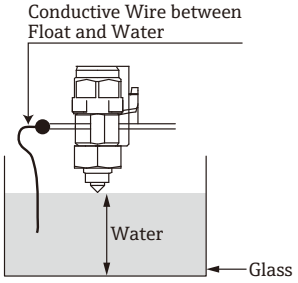
Figure 5: Proof Test Protocol 1

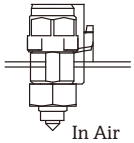
Proof Test Protocol 2

Hight Temperature Specifications

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
Relay Status: N.C.		
NAR300 Current Output: 16 ± 1mA		
Alarm: ON		
NAR300 + NRR262: NRR262 LED: Red		

3.

Check Items: Condition	Yes	No
Relay Status: N.O.		
NAR300 Current Output: 12 ± 1mA		
Alarm: OFF		
NAR300 + NRR262: NRR262 LED: Green		

3.

Check Items: Condition	Yes	No
Relay Status: N.C.		
NAR300 Current Output: 16 ± 1mA		
Alarm: ON		
NAR300 + NRR262: NRR262 LED: Red		

Figure 6: Proof Test Protocol 2

Definitions and Abbreviations

Float	▪ A float to allow the conductive sensor and the vibration sensor floating on the surface of the liquid. ▪ Float + conductive sensor
Float Sensor	Standard specifications Float + conductive sensor + vibronic sensor High temperature specifications Float + conductive sensor
Chemical Fiber Cloth	A cloth made by 100% chemical fiber or mixed chemical fibers and natural fiber.
Ex d	Flameproof enclosure
Ex ia	Intrinsically safe, protection level "ia"
Black Out	Shutdown of power supply
SFF	Safe Failure Fraction
PFH (1/h)	Probability of dangerous Failure per Hour
PFD	Probability of Failure on Demand

Certificate

TÜV NORD

ZERTIFIKAT
CERTIFICATE

Hiermit wird bescheinigt, dass die Firma / *This is to certify, that the company*

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

die Anforderungen der folgenden Normen erfüllt.
meets the requirements of the following standards.

Geprüft nach *Tested in accordance with*	**IEC 61508:2010 (Parts 1-7)**
Beschreibung des Produktes *(Details s. Anlage 1)* Description of product *(Details see Annex 1)*	**Oil Leak Detector system**
Typbezeichnung *Type designation*	**NAR300 with Transmitter NRR261 or NRR262**
Bemerkung *Remark*	**keine** *none*

Registrier-Nr. / *Registered No.* 44 799 13145303
Prüfbericht Nr. / *Test Report No.* 3514 4202
Aktenzeichen / *File reference* 8000436452

Gültigkeit / Validity
von / *from* 2015-03-20
bis / *until* 2020-03-19

Zertifizierungsstelle der TÜV NORD CERT GmbH
Certification body of TÜV NORD CERT GmbH

Essen, 2015-03-20

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

www.addresses.endress.com

Endress+Hauser

People for Process Automation