



Type approval certificate

Number **T8910** revision 5
Project number 2491609
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Issued by NMI Certin B.V.

In accordance with The "Metrologiewet" (Stb. 2006, 137) and the "Regeling nationaal autonoom geregeld meetinstrumenten"

Manufacturer Endress+Hauser SE+Co. KG
Hauptstrasse 1
79689 Maulburg
Germany

Measuring instrument An **automatic level gauge**
Manufacturer's mark or name : Endress+Hauser SE+Co. KG
Type designation : NMR81 and NMR84

Further properties are described in the annexes:
– Description T8910 revision 5;
– Documentation folder T8910-3.

Remarks – This revision replaces the previous revisions;
– The documentation folder replaces the previous documentation folder.

Issuing Authority **The Designated Body, NMI Certin B.V.**
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Description

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1 General information about the level gauge

Properties of the level gauge, whether mentioned or not, shall not conflict with the legislation.

1.1 Essential parts

See document number 8910/0-02 for assembly drawing of the level gauge housing.

1.1.1 Electronic parts

The level gauge is composed of the following parts:

Part	Documentation	Remarks
Display/Keyboard	8910/0-03, 0-04, 0-05, 5-01, 5-02, 5-03	-
Frontplane	8910/0-06, 0-07	-
IOM-Analog AEXd	8910/0-08, 0-09, 0-10, 2-02	-
IOM-Analog AEXi	8910/0-11, 0-12, 0-13, 2-03	-
IOM-Digital	8910/0-14, 0-15, 0-16	-
IOM-Modbus	8910/0-17, 0-18, 0-19	-
IOM-V1/WMM550	8910/0-20, 0-21, 0-22, 5-04, 5-05, 5-06	-
Main Board (CPU)	8910/0-23, 0-24, 0-23	-
Power supply HV AC	8910/0-26, 0-27, 0-28	HV = High voltage
Power supply LV AC	8910/5-07, 5-08, 5-09	LV = Low voltage
Power supply LV DC	8910/5-10, 5-11, 5-12	LV = Low voltage
Ex-Limiter	8910/0-29, 0-30, 0-31	-
SMR-C APP	8910/0-32, 0-33, 0-32	-
SMR-C MWM	8910/0-35, 0-36, 0-37	-
SMR-E APP	8910/0-38, 0-39, 0-40	-
SMR-E MWM	8910/0-41, 0-42, 0-43	-

1.1.2 Antenna's

Part	Documentation	Remarks
NMR81 sensor	8910/0-44, 2-01	Type NMR81 with drop (or so called lens) antennas suitable for free space applications.
- NMR81 DN50	8910/0-45	
- NMR81 DN80	8910/0-46	
- NMR81 DN100	8910/0-47	
NMR84 sensor	8910/0-48	Type NMR84 with planar antennas suitable for stilling well applications. Optionally for the DN150 a horn antenna can be attached.
- NMR84 DN100	8910/0-49	
- NMR84 DN150 Optional horn antenna's DN200, DN250 or DN300	8910/0-50	



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Remark: The sizes mentioned in the table are regarding antenna size.
The process connection is independent of the size of the antenna.

1.1.3 Remote indications (optional)

The following remote indications can be used optionally:

- NRF81, as described in the Test Certificate TC8909;
- Tankvision, as described in the Test Certificate TC7445;
- Tankvision Professional, as described in the Test Certificate TC8732.

1.2 Essential characteristics

1.2.1 Maximum measuring range

Type	Maximum range	Remarks
NMR81	30 metre	-
NMR84 size DN100	20 metre	-
NMR84 size DN150 Optional horn antenna's DN200, DN250 or DN300	35 metre	For the maximum range of 35 m, it is sufficient to calibrate up to 30 m.

1.2.2 Gauge reference compensation

It should be noted that certain applications are possible if and only if a correctly functioning system is implemented for temperature compensation for expansion of the tank shell or stilling well. The actual maximum measuring height is determined per application. Prior to that the manufacturer shall prove, by calculation and by measurements, that the intended application can be considered legal. See paragraph 1.2.7 regarding vapour influence of the liquid product.

1.2.3 Temperature range ambient

- -25 °C / +55 °C

1.2.4 Electromagnetic environment class

- E2

1.2.5 Power supply

The level gauge can be powered by one of these options:

- AC high voltage (HV), in the range of 100 ... 240V AC (-15% / +10%) @ 50/60Hz.
- AC low voltage (LV), with 65 V AC (-20% / +15%) @ 50/60Hz.
- DC low voltage (LV), in the range of 24 ... 55 V DC (-20% / +15%) @ 50/60Hz.

1.2.6 Indication

- Scale interval of the indication, in m or mm, shall not be greater than 1 mm.
- Indication of status messages, error messages and alarm messages.
- Indication of the device locking status.

1.2.7 Liquid product range

Application of the level gauge is allowed on the following products:

- Liquids, stored under atmospheric conditions, with the restriction that no heavy foam is present; and



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- Liquids of which the vapour influence does not affect the legal aspects of the accuracy. The maximum error caused by the vapour influence may be calculated using the following formulas as stated in the next section.

Additional information to determine the vapour influence

The maximum error caused by the vapour influence may be calculated using the following formulas.

If the dielectric constant of the product is known the formula is:

$$\delta \ell = \left[\frac{p_{m,gas}^{(t)}}{p_0} \varepsilon_m^{1/2} + \frac{p_0 - p_{m,gas}^{(t)}}{p_0} \varepsilon_{air}^{1/2} - \varepsilon_{air}^{(20)1/2} \right] \times 1000 \quad [\text{mm/m}]$$

If the breaking index is known the formula is:

$$\delta \ell = \left(\frac{p_{m,gas}^{(t)}}{p_0} n_{m,gas}^{(t)} + \frac{p_0 - p_{m,gas}^{(t)}}{p_0} n_{air}^{(t)} - n_{air}^{(20)} \right) \times 1000 \quad [\text{mm/m}]$$

In the above given formulas the meaning of the variables is as follows:

$\delta \ell$	=	length error, in mm/m
$p_{m,gas}^{(t)}$	=	vapour pressure at the given vapour temperature, in torr
p_0	=	pressure in the tank, in torr
$\varepsilon_m^{1/2}$	=	dielectric constant of the vapour at the given vapour temperature
$\varepsilon_{air}^{1/2}$	=	dielectric constant of the air at the given vapour temperature
$\varepsilon_{air}^{(20)1/2}$	=	dielectric constant of the air at 20 °C (reference value)
$n_{m,gas}^{(t)}$	=	breaking index of the vapour at the given vapour temperature
$n_{air}^{(t)}$	=	breaking index of the air at the given vapour temperature
$n_{air}^{(20)}$	=	breaking index of the air at 20 °C (reference value)
t	=	vapour temperature, in °C
1 torr	=	133,3224 Pa
1 bar	=	750,0617 torr

If the product is not stored at the reference temperature (20 °C), the dielectric constant of product and air may be determined using the following formula:

$$\varepsilon_{air}^{(t,p)} = \left(\varepsilon_{air}^{(20,1Atm)} - 1 \right) \cdot \frac{p}{760[1 + 0.00341(t - 20)]} + 1$$

In an analogous way the breaking index may be determined using the following formula:

$$n_{air}^{(t)} = \frac{(n_{air}^{(20)} - 1) \cdot p}{760(1 + 0.00341(t - 20))} + 1$$

In the above given formulas the meaning of the variables is as following:



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Additional information to determine the vapour influence

- $\epsilon^{(t,p)}_{\text{air}}$ = dielectric constant of the air at given temperature and pressure
- $\epsilon^{(20, 1 \text{ Atm})}_{\text{air}}$ = dielectric constant of the air at 20 °C and 1 Atm (reference value)
- $n^{(t)}_{\text{air}}$ = breaking index of the air at given temperature
- $n^{(20)}_{\text{air}}$ = breaking index of the air at 20 °C (reference value)
- P = actual pressure, in torr
- t = actual temperature, in °C
- 1 torr = 133,3224 Pa
- 1 bar = 750,0617 torr

- 1.2.8 Software specification (refer to WELMEC 7.2):
- Software type P;
 - Risk Class C;
 - Extension T, while extensions L, S and D are not applicable.

Software version	Checksum	Remarks
01.02.00	0x51D2	-
01.02.01	0xD919	-
01.03.03	0x72A3	-
01.03.04	0xA032	-
01.04.01	0xcd58	-

Software version and belonging checksum can be viewed by the display as stated in paragraph 1.5.1.

- 1.2.9 Data communication
- The level gauge is capable of indicating several quantities. Use for Weights and Measures related purposes is allowed for the following quantities:
- Level.
- The following input(s) can be used for legally relevant data:
- 4...20 mA analog input;
 - HART superimposed;
 - Digital input.
- The following output(s) can be used for legally relevant data:
- Display;
 - 4...20 mA analog output;
 - HART superimposed;
 - Digital output;
 - 2-wire serial communication.



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The following transmission protocols can be used for legally relevant data:

- Modbus protocol;
- V1 protocol;
- WM550 protocol.

1.3 Essential shapes

1.3.1 Markings

The main nameplate is bearing at least, good legible, the following information:

- Type approval certificate number T8910;
- Name or trade mark of the manufacturer;
- Serial number and year of manufacture;
- Identification of the measuring tank the level gauged is mounted upon;
- The reference height (in mm);
- The text "Het nulpunt van de vloeistofhoogtemeter ligt mm beneden het referentiepunt." (meaning: "The zero-point of the liquid level gauge is mm below the reference point.");
- The text "Vloeistof" for the nature and characteristics of the liquid product to be measured.

This measuring instrument was previously placed on the market under the name "Endress+Hauser GmbH + Co. KG".

1.4 Conditional parts

1.4.1 Housing

The material of the housing of the level gauge is aluminium or stainless steel.

1.5 Conditional characteristics

1.5.1 Programming

When the Weights & Measures switch is set to "W&M sealed" W&M parameters cannot be changed.

Below an overview is given of the parameters that are important from a legal point of view, with the correct setting:

Parameter	Value	Remarks
Setup		
Units preset	mm or m	Used to select one of a preset unit settings.
Tube diameter	verification	Enter the diameter of stilling well.
Empty	verification	Distance from reference point to zero position (tank bottom or datum plate).
Tank reference height	verification	Defines the distance from the dipping reference point to the zero position (tank bottom or datum plate).



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Parameter	Value	Remarks
Set level	verification	If the level measured by the device does not match the actual level obtained by a manual dip, enter the correct level into this parameter.
Setup->Advanced Setup->Display		
Value 1 display	tank level	Select the measured value that is shown on the local display.
Setup->Advanced Setup->System units		
Distance unit	mm or m	Select the unit for distance. This selection does not affect the measurement and calculation accuracy of the device.
Diagnostics->Device info		
Firmware version	See § 1.2.8	Shows the device firmware version installed.
Firmware CRC	See § 1.2.8	Shows the checksum of the firmware version.
W&M config CRC	information	Shows the checksum of all W&M parameter. This value can differ from the calibration report. For more information chapter 3.
Expert->Sensor->Sensor prop		
Sensor module type	calibration	These parameters shall be according to calibration of the level gauge.
Antenna zero distance	calibration	
Cable zero distance	calibration	
Microfactor	calibration for NMR81 specific	
Phase calibration offset	calibration for NMR84 specific	
Phase calibration slope	calibration for NMR84 specific	

1.5.2 Error messages

On the indication or indications a message is presented if the measured value is not legal and/or a technical problem occurs.



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2 Seals

The following seals are applied:

- The Weights and Measures key switch. A seal or sealing sticker has to be placed over the switch after system is configured and sealed and switch is closed;
- The data plate is fixed to the level gauge and secured against removal by seal or it will be destroyed when removed;
- The housing is sealed against opening.

For an example of the sealing see document number 8910/5-13.

3 Conditions for conformity assessment

- The level gauge shall be constructed in conformity with the description and documentation folder that belong to this Type approval certificate;
- The seals shall be applied as described in chapter 2.
- The calibration of the level gauge can be done in a test lab. The result of this investigation is a calibration report, which states the results and the settings of all parameters of the level gauge (as a result of this investigation, some parameters may have to be changed in respect of the original factory settings to adapt to the local conditions during commissioning). For the measurement accuracy the following parameter mentioned in paragraph 1.5.1 shall be verified according to the calibration report:
 - Sensor module type;
 - Antenna zero distance;
 - Cable zero distance;
 - Microfactor for NMR81 specific;
 - Phase calibration offset for NMR84 specific;
 - Phase calibration slope for NMR84 specific.
- For NMR84 size DN150 (optional with horn antenna's DN200, DN250 or DN300) a calibration up to 30 metre is sufficient for use of a maximum measuring range of 35 metre.

4 Reports

An overview of performed tests is given in the reports:

- NMI-16200591-01;
- NMI-16200591-02;
- NMI-1902618-01;
- NMI-2491609-01;
- NMI-2491609-02.

A report can be a test report, an evaluation report, a type evaluation report and/or a pattern evaluation report.



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