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Project number : 15200301
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Issued by NMI Certin B.V.

In accordance with 'Metrologiewet'

Manufacturer Endress + Hauser GmbH + Co., KG
Hauptstrasse 1
Maulburg
Germany

Measuring instrument An **automatic level gauge**

Characteristics

Manufacturer's mark or name	:	Endress + Hauser GmbH + Co. KG
Type	:	Micropilot S, designs FMR 530; FMR 531; FMR 532; FMR 533
Mechanical environment class	:	light vibrations
Electromagnetic environment class	:	industrial
Temperature range ambient	:	-25 °C to +55 °C
Humidity	:	condensing

Measuring height

:	Type FMR 530: 25 m
:	Type FMR 531: 10 m
:	Type FMR 532 DN150: 25 m
:	Type FMR 532 DN200: 25 m
:	Type FMR 532 DN250: 25 m
:	Type FMR 532 DN300: 25 m
:	Type FMR 533: 25 m

Further properties and test results are described in the annexes:

- Description T7480 revision 5;
- Documentation folder T7480-3.

Valid until 21 October 2028

Initially issued 21 October 2008

Remarks

- This revision replaces the previous revisions;
- The documentation folder is not changed.

Issuing Authority

The Designated Body, NMI Certin B.V.
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Certification Board

NMI Certin B.V.
Thijssseweg 11
2629 JA Delft
The Netherlands
T +31 88 636 2332
certin@nmi.nl
www.nmi.nl

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1 General information concerning the automatic level gauge

All properties of the level gauge, whether mentioned or not, shall not be in conflict with the legislation.

1.1 Essential parts

See drawings at documentation no. 7480/0-02, 0-03, 0-04.

1.1.1 Electronic parts

Part	Identification	Documentation
Main board	FMR53x_Main	7480/0-06, 0-07, 0-08, 0-09, 0-10, 4-01, 4-02
Application board	FMR53x_Applic	7480/0-11, 0-12, 0-13, 0-14, 0-15, 4-03, 4-04
Ex-i limiter	Ex-i limiter	7480/0-16, 0-17
Radar module	Radar Module uPII2 6_3GHz I7	7480/0-18, 0-19, 4-05, 4-06
HF - board	Radar Module II.2	7480/0-20, 0-21, 0-22
Display	Display	7480/0-05, 4-07, 4-08

1.1.1.1 Software version 2.00 or 2.02 or 3.00.

1.1.2 Antenna's

Type	Description	Documentation
FMR 530	DN150	7480/0-23, 4-09
	DN 200	7480/0-23, 4-09
	DN 250	7480/0-23, 4-09
FMR 531	Teflon 1,5" (Rod)	7480/0-24, 4-10
FMR 532	DN150	7480/0-25, 4-11
	DN 200	7480/0-25, 4-11
	DN 250	7480/0-25, 4-11
	DN 300	7480/0-25, 4-11
FMR 533	DN 450 (Parabolic);	7480/0-26, 4-12

For antenna with anti-condense plate, the so-called drip-off antenna, see documentation no. 7480/1-01.

1.1.3 Remote indications

1.1.3.1 NRF590, as described in the Test Certificate TC7351.

1.1.3.2 Tankvision, as described in the Test Certificate TC7445.

1.1.3.3 Tankvision Professional, as described in the Test Certificate TC8732.

1.2 Essential characteristics

1.2.1 The characteristics as specified on the first page of this Type Approval certificate.

1.2.2 Nominal power supply voltage = 24 Vdc.

1.2.3 Indication

- 1.2.3.1 Indication of the measured level, in m, in units of 0.001 m or 0.0001 m;
- 1.2.3.2 Indication of the way of measuring (innage or ullage);
- 1.2.3.3 Indication of status messages, error messages and alarm messages.

1.2.4 Protection legal parameters against alterations.

1.2.5 Application of the level gauge is allowed on the following products.

- 1.2.5.1 Liquids, stored under atmospheric conditions, with the restriction that no heavy foam is present.
- 1.2.5.2 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.

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

$$\delta l = \left[\frac{P_{m, gas}^{(t)}}{P_0} \varepsilon_m^{1/2} + \frac{P_0 - P_{m, gas}^{(t)}}{P_0} \varepsilon_{air}^{1/2} - \varepsilon_{air}^{(20)^{1/2}} \right] \times 1000 \quad [\text{mm/m}]$$

If the breaking index is known the formula is:

$$\delta l = \left(\frac{P_{m, gas}^{(t)}}{P_0} n_{m, gas}^{(t)} + \frac{P_0 - P_{m, gas}^{(t)}}{P_0} n_{air}^{(t)} - n_{air}^{(20)} \right) \times 1000 \quad [\text{mm/m}]$$

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

δl	=	length error, in mm/m
$P^{(t)}_{m, gas}$	=	vapour pressure at the given vapour temperature, in torr
P_0	=	pressure in the tank, in torr
$\varepsilon^{1/2}_m$	=	dielectric constant of the vapour at the given vapour temperature
$\varepsilon^{1/2}_{air}$	=	dielectric constant of the air at the given vapour temperature
$\varepsilon^{(20)^{1/2}}_{air}$	=	dielectric constant of the air at 20 °C (reference value)
$n^{(t)}_{m, gas}$	=	breaking index of the vapour at the given vapour temperature
$n^{(t)}_{air}$	=	breaking index of the air at the given vapour temperature
$n^{(20)}_{air}$	=	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:

$\varepsilon^{(t,p)}_{air}$	=	dielectric constant of the air at given temperature and pressure
$\varepsilon^{(20, 1\text{ Atm})}_{air}$	=	dielectric constant of the air at 20 °C and 1 Atm. (reference value)
$n^{(t)}_{air}$	=	breaking index of the air at given temperature
$n^{(20)}_{air}$	=	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

In the given application at the **maximum height of the vapour part inside the tank** the maximum error in the level measurement must not be exceeded. At a liquid level lower than or equal to 5 m this maximum error has a value of plus or minus 2,6 mm; for liquid levels higher than 5 m the maximum error is determined using the formula [plus or minus (2,1 mm + 0,1 · L mm)], in which L is the liquid level, rounded up to an integer number of meters.

For 236 products the manufacturer has determined the dielectric constant or the breaking index, at a given pressure and temperature. These values are available in "Anhang; Physikalisch-Chemische Konstanten und Parameter für ausgewählte Substanzen".

1.3 Essential shapes

1.3.1 Kind of measuring tanks

Application of the level gauges FMR 530, FMR 531 and FMR 533 is allowed on vertical cylindrical tanks with a fixed roof and on vertical cylindrical tanks with an inner floating roof. Application of the level gauges FMR532 is allowed on tanks with a stilling well of DN150 (6"), DN200 (8"), DN250 (10") or DN300 (12").

1.3.2 Measuring range

The maximum measuring range of the level gauge, measured from the antenna top is equal to the values as indicated on the first page of this approval document.

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.

1.3.3 Mounting on the measuring tank

The level gauge shall be mounted following one of the following methods.

- Directly on the fixed roof of the measuring tank.
- On a trunk such that the antenna is positioned in the free space of the measuring tank.

- On a stilling well of DN150 (6"), DN200 (8"), DN250 (10") or DN300 (12").

Basically the maximum measuring range, measured from the antenna top, is as indicated before. The actual maximum measuring height however is also determined by the material the tank shell is constructed of. So, the actual measuring height is determined for each individual application. Also refer to paragraph 1.3.2.

The level gauge must be installed in conformity with the manufacturer's demands.

1.3.4 Sealing of the Weights & Measures switch.

The Weights & Measures switch is sealed with a sealing mark.

When the Weights & Measures switch is sealed the legal parameters cannot be altered. See documentation no. 7480/0-01.

1.3.5 Sealing of the name plate.

The name plate is sealed with a legal stamp.

See documentation no. 7480/0-01.

1.3.6 Inscriptions on the name plate

1.3.6.1 Manufacturer's name or logo.

1.3.6.2 The number of this approval: T7480.

1.3.6.3 Year of manufacture.

1.3.6.4 Manufacturing number, i.e. a serial number.

1.3.6.5 The text: Het nulpunt van de vloeistofhoogtemeter ligt mm beneden het referentiepunt.

1.3.6.6 The identification of the measuring tank the level gauged is mounted upon.

1.3.6.7 A description of the symbols on the display, or a reference where this description can be found.

1.4 Conditional characteristics

1.4.1 Error messages.

In the following situation signals the display that the level is not legal.

1.4.1.1 A memory problem or computer problem exists.

1.4.1.2 The HF-module or the quartz crystal are defective or do not function in a correct way.

1.4.1.3 The Weights and Measures switch is not set to "legal".

1.4.1.4 Phase measurement and amplitude measurement are inconsistent.

1.4.1.5 A defective amplifier or antenna, or no return signal exists.

Also refer to chapter "Error-Messages" in the manual.

1.4.2 Legal parameter settings

Parameter	Description	Setting
002	tank shape	correct shape
003	dielectric constant	Refer to remark 1.
004	process conditions	"standard" or "calm surface"

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Parameter	Description	Setting
005	empty calibration	distance from meter flange to minimum tank level
014	delay time	As short as possible; refer to remark 1.
015	safety distance	Refer to remark 1.
016	in safety distance	"alarm w. ackn."
031	auto correction	Refer to remark 1.
032	pipe diameter correction	"off" For a free space application. For a pipe-application refer to remark 1.
040	level or ullage	"lvl m, ft, in"
042	customer unit	"m"
055	offset	Difference between indicated level and actual level.
057	blocking distance	Correct value; refer to remark 1.
060	communication address (when connecting to a central system)	address
093	back to home	"10"
094	format display	"x" or "x.x"
0C5	distance unit	"m"

Remark 1

These parameters are set and motivated by the manufacturer.

Remark 2

The parameters 33 up to and including 38 offer the possibility to the user to correct measuring errors that were not caused by the level gauge. The dip-table may or may not be switched on. All settings are protected by the Weights & Measures switch.



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2 Seals

- 2.1 The Weights & Measures switch is sealed with a sealing stamp.
See documentation no. 7480/0-01.
- 2.2 The name plate is sealed with a legal approval stamp.
See documentation no. 7480/0-01.

3 Conditions for Conformity Assessments

- 3.1 The level gauge shall be constructed in conformity with the description and documentation of this approval document.
- 3.2 The seals shall be attached as described in chapter 2.
- 3.3 Third parties are not allowed to use this document and the companion documentation folder without written permission of the owner of this document.