# EU-type examination Certificate

Number **T11948** revision 1
Project number 3692100


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|---|---|
| Issued by | NMi Certin B.V.,<br>designated and notified by the Netherlands to perform tasks with respect to conformity assessment procedures mentioned in article 17 of Directive 2014/32/EU, after having established that the Measuring instrument meets the applicable requirements of Directive 2014/32/EU, to: |
| Manufacturer | Endress+Hauser Flowtc AG<br>Kägenstrasse 7<br>4153 Reinach<br>Switzerland |
| Measuring instrument | A non-interruptible **measuring system** for the measurement of LNG.<br>Manufacturer's mark or name : Endress+Hauser Flowtec AG<br>Type designation : LNG Bunker Metering System<br>Accuracy class : 1.5 or 2.5<br>Destined for the measurement of : Liquefied Natural Gas (LNG)<br><br>Further properties are described in the annex:<br>– Description T11948 revision 1. |
| Valid until | 18 December 2030 |
| Initially issued | 18 December 2020 |
| Remarks | – This revision replaces the previous revision. |

Issuing Authority **NMi Certin B.V., Notified Body number 0122**
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Certification Board

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PRODUCTS RvA C 681

# Description



## 1 General information about the measuring system

Properties of this measuring system, whether mentioned or not, shall not conflict with the legislation.

### 1.1 Essential parts

1.1.1 Measurement sensor
Endress+Hauser Flowtec AG, type Promass F or Promass Q.
See Evaluation certificate number TC7149 for details about the measurement sensor.

1.1.2 Flow transmitter
The following flow transmitter can be used:

- Endress+Hauser Flowtec AG, type Promass 300 or Promass 500.
  See Evaluation Certificate number TC10822 for details.
  The mandatory parameter settings for the Promass 300/500 flow transmitters for the bunkering application are mentioned in Annex 1 of this EU-type examination certificate. Please note that these settings override the settings mentioned in Annex 1 of TC10822 only for bunkering applications.

1.1.3 Flow computer for the measurement of LNG
The following flow computers can be used:

- Newflow Limited, type NÅNOflow
  See Evaluation Certificate TC11943 for details on the hardware. For this application, the NÅNOflow is equipped with a dedicated LNG software:
  - See chapter 1.2.7 for the software versions.
  - See chapter 1.2.8 for information on the dedicated functions of the NÅNO flow computer.

1.1.4 Flow computer for the batch totalisation
The following flow computer can be used:

- Endress+Hauser FLOWTEC AG, type LNG Metering Computer (LNG MC).
  See Evaluation certificate TC11955 for details.

1.1.5 Correction device for the measurement of vapour return
The above mentioned 'Measurement sensor' (chapter 1.1.1), 'Flow transmitter' (chapter 1.1.2) and 'Flow computer for the measurement of LNG' (chapter 1.1.3) can be used as correction device for the vapour return line (measurement of boil-off gas (BOG)).

### 1.2 Essential characteristics

In addition to the characteristics as stated on page 1 of this EU-type examination certificate the following characteristics apply to the measuring system:

1.2.1 Flow rate range ($Q_{min}$ – $Q_{max}$)

- $Q_{min}$: Shall not be smaller than any $Q_{min}$ of the components making up the measuring instrument.
- $Q_{max}$: Shall not be larger than any $Q_{max}$ of the components making up the measuring instrument.
- The ratio $Q_{max}/Q_{min}$ shall be at least 4:1.

1.2.2 Minimum measured quantity (MMQ)
The MMQ value shall have the form $1x10^n$, $2x10^n$ or $5x10^n$, with n being any integer or zero.
The MMQ is the largest of:

- The MMQ stated in the Evaluation Certificate of the measurement sensor.
- nnn times the largest display scale interval (see table below).
- nnn times the printed scale interval (see table below).
- In case the pipe work between measurement sensor and transfer point is not always full of liquid during shutdown periods, the following shall be taken into account regarding the liquid which is not measured or not delivered:
  - If not corrected, the MMQ is nnn times the mass of this liquid.
  - If corrected, the MMQ is nnn times the estimated variance in the corrected mass of this liquid.

Where nnn is determined by:

| **Accuracy class** | 1,5 | 2,5 |
|---|---|---|
| **nnn** | 67 | 100 |

1.2.3 Maximum operating pressure ($P_{max}$):
The maximum operating pressure shall not exceed the maximum pressure of the measurement sensor as stated in Evaluation Certificate number TC7149.

1.2.4 Temperature range liquid: -200 °C … -120 °C.

1.2.5 Temperature range ambient: -25 °C … +55 °C.

1.2.6 Environment classes: M1 / E2

1.2.7 The NÅNO flow computer used a dedicated LNG app for this application, instead of the standard measurement app that is part of TC11943. The following app versions and corresponding checksums are approved:

| **Part** | **Version** | **Checksum** | **Remark** |
|---|---|---|---|
| System | 4v7r8310-R | Metrology Block Checksum 5956577C409BCBF2 | Used with HMI[1] version 1 |
| | 4v7r9214-R | | Used with HMI[1] version 2 |
| ISO6578_2017 | - | FDA59B33E2994E8A42A6817D9A473F26 | Density calculation |
| ISO6976_2016 | - | C2E97F8644997F84DA5B18320EAE9C4D | Calorific value calculation |
| Totaliser | - | 281EE714633B1E8D5D6623BB61936774 | |

The system software version can be checked on the LNG Metering Computer. The version is indicated on the same display as LNG Metering Computer software version.

[1] HMI version of the LNG Metering computer.

The checksums of the ISO6578_2017, ISO6976_2016, and Totaliser part can be verified via the webserver of the NÅNO flow computer. The information is shown via login with username user with password nano. This gives a read only access to the NÅNO flow computer. Via menu items Home – Logs & Info – Constants Log the settings of the NÅNO flow computer are shown. The software checksums are presented in the second block of the file. If needed, the shown information can be printed.

1.2.8 Energy and density calculation of the LNG

- The NÅNO flow computer makes the following calculations:
  - Energy content of the LNG using the composition measured by the Raman analyser. Although not part of the legal metrology information, the energy calculation is compliant with the ISO 6976:2016 standard. The following energy information is available: Gross and Net calorific value (MJ/kg) and Gross and Net Wobbe Index ($MJ/m^3$).
  - Total energy delivered based on the calculated gross calorific value for the LNG and on a fixed calorific value for the vapour return.
  - Density of the LNG using the composition and the actual product temperature. Although not part of the legal metrology information, the density calculation is compliant with the ISO 6578:2017 standard. It is **NOT** allowed to use the density for the conversion from measured mass to measured volume.
  - Calculation of the flow weighted averages of LNG composition, calorific values and LNG density.
  - From version 4v7r9214-R onwards, the methane number is calculated according the following methods: PKI, CARB, ISO 14503 L/C, and ISO 14503 H/C. At the start of the measurement the used method is selected on the LNG Metering Computer. The methane number is for information purposes only.

## 1.3 Essential shapes

1.3.1 Configuration

| Accuracy class | Type of measuring system | Schematic drawing | Remarks |
|---|---|---|---|
| 1,5 | Measuring systems for LNG | Annex 2, page 2. | |
| 2,5 | Measuring systems for cryogenic liquids (temperature below – 153 °C) | | |

- The essential parts stated in paragraph 1.1 can be applied in each desired combination as long as there is no conflict with the concerning Evaluation or Parts Certificates.

1.3.2 Inscriptions

- The following information is clearly visible on the nameplate:
  - CE marking including the supplementary metrological marking (M + last 2 digits of the year in which the instrument has been put into use).
  - Notified Body identification number, following the supplementary metrological marking.
  - EU-type examination certificate number: **T11948**.
  - Manufacturer's name, registered trade name and/or registered trademark.
  - Manufacturer's postal address.
  - Type designation.
  - Year of manufacture and serial number.
  - Accuracy class.

- Minimum and maximum flow rate.
- Maximum pressure.
- Name(s) or nature(s) of the product(s) to be measured.
- Mechanical and electromagnetic environment class.
- Ambient temperature range.
- Liquid temperature range.
- Serial numbers of all essential parts stated in paragraph 1.1 (optional, see clause 2).

Remarks:
The nameplate must be clearly visible without removing the covers.
See Annex 2, page 1 for an example of the nameplate.

- Further inscriptions:
  - The inscription “Minimum Measured Quantity … kg” in the vicinity of the display of the calculating and indicating device and/or on the nameplate.
  - The inscriptions on the essential parts as mentioned in the applicable Evaluation Certificates or Parts Certificates.

## 1.4 Conditional parts

1.4.1 Raman analyser
A Raman analyser is used to determine the composition of the LNG. The composition contains the molar fraction of methane, ethane, propane, n-butane, i-butane, n-pentane, i-pentane and nitrogen. Other components are not measured, as these are only present in trace quantities due to the cryogenic product temperatures.

1.4.2 Temperature sensors
4-Wire Class A PT-100 sensors to measure the liquid temperature. The temperature sensor can be installed in a thermowell. Each sensor has its own temperature transducer or is directly connected to the flow computer.

1.4.3 Flow control valve
An on/off valve or a flow control valve is located upstream and/or downstream of the measurement sensor and is used to control the flow rate through the measurement sensor.

1.4.4 Check valve or non-return valve
A non-return valve can be fitted downstream of the measurement sensor to prevent the reverse flow to be measured with the measuring system.

1.4.5 Liquid return valve (optional for Cryogenic products and LNG)
In order to pre-cool the meter before the delivery, a recirculation line downstream of the meter can be used. The valve for opening and closing this recirculation line shall be safe guarded. During the delivery, this valve must be closed, and an alarm shall be generated if this valve comes to the ‘not closed’ status during the delivery.

1.4.6 Pipeline connections
The pipeline connection shall be such that there are no by-passes over the measuring sensor. Other connections to the pipelines can be used for filling the system or gas-exchange. It should be clear to both parties of the transaction that these valves should be closed. Temporary seals can be used during the transaction that it is ensured that the valves are closed during the delivery.

1.4.7 Printing device
A printer is connected to the flow computer and is used for printing the reports (deliveries), events and alarms. The printer can be of any brand and type under the condition that it is equipped with a paper out detection and that the communication with the printer is safeguarded.

1.4.8 Memory device
The memory device of the LNG Metering Computer is programmed in such way that no overwriting of data batches occurs before settlement of the transaction has taken place.

## 1.5 Conditional characteristics

1.5.1 Elimination of air or gases
During a delivery, no air or gas shall pass through the measuring sensor.

1.5.2 Vapour return / Boil-off Gas (BOG) meter (optional)

- The correction device is optional and can be used for the measurement of the amount of gas through the vapour return line, which is subtracted by the flow computer from the batch delivered. The operator shall indicate at the start if the BOG line is used or not.
- The vapour recovery flow can fluctuate greatly, and so the sensor size selected should be based upon the $Q_{max}$ vapour that is expected in normal operations.
- The delivered corrected amount shall be calculated and presented in mass.
- The calculation of the correction shall be covered by the approval of the flow computer mentioned in paragraph 1.1;
- The accuracy of the correction device shall be such that the residual effect after the correction is smaller than one third of the applicable Maximum Permissible Error (MPE) of the measuring system.

1.5.3 Protection measures and alarms

- Protection measures shall be arranged that the measurement can only start when the essential parts mentioned in paragraph 1.1 are ready for operation.
- Alarms occurring in the essential parts mentioned in paragraph 1.1 shall be transferred to the flow computer. The presence of such an alarm shall be indicated, stored and/or printed by the flow computer. In case of an interruptible measuring system, the flow shall be stopped, and the ongoing delivery shall be ended.

## 1.6 Conditional shapes

- Housing
  The LNG Metering Computer, the NÅNO flow computers, and the Raman analyser can be installed in one or more cabinets.

## 1.7 Non-essential parts

- Pipe work and connections.
- Valves.
- Hose(s).
- Filter/strainer.
- Drain valves.
- Pump.
- Temperature transducers (not for legal metrology).
- Pressure transducers (not for legal metrology).

## 2 Seals

The following items of the measuring system are sealed:

- Nameplate to the frame of the measurement system. Removal of the nameplate without destroying it or without breaking a seal shall not be possible.
- If the serial numbers of the essential parts stated in paragraph 1.1 are not mentioned on the nameplate, the essential parts have to be sealed against removal.
- For sealing of the essential parts, see the applicable Evaluation Certificates or Parts Certificates.
- Valves installed between the measurement sensor and the transfer point that allow diversion of the measured product from the normal path, are sealed against opening. This requirement is not applicable if opening of the valve (during a delivery) leads to an alarm.

## 3 Conditions for conformity assessment

### 3.1 Verification procedure of the system

- Examination for conformity of the measuring system according to this EU-type examination certificate.
- Essential parts covered by an Evaluation Certificate or Parts Certificate shall be constructed and set-up according to the applicable Evaluation/Parts Certificate.
- In case the measurement is non-repeatable and one of the trading parties is absent, a printing device and/or memory device shall be used for the registration of the measurement data.
- Verification of the correct parameter settings of the essential parts.

### 3.2 Verification procedure of the measurement transducer

- See “Conditions for Conformity Assessment” as mentioned in Evaluation Certificate TC7149.

  This part describes the standard procedure (on site calibration or calibration in a test lab) as well as an alternative method based on water calibration only.

  As an additional note on chapter 4.4 (Step 2) of procedure CPC-EH-01, the following is also accepted:
  - As it is difficult to maintain stable and safe operating conditions during the zero-point verification, it is acceptable to divide the zero-point verification in multiple shorter verifications, under the condition that:
    - The total time of zero-point verification is at least equal to 3 minutes.
    - The value of zero-point verification to calculate with is the average of the performed verifications.
    - Between the verifications, the measurement sensor is flushed for at least 3 minutes and until stable operating conditions are reached again.
  - The procedure as described in chapter 4.7 of procedure CPC-EH-01, which describes an alternative method for zeroing in case of extended operating conditions, for example measuring LNG.
- The on value for the low flow cut off of the vapour return meter (BOG) shall be related to the minimum flow rate for gas measurement and not the minimum flow rate of this LNG system. Also, see note (7) of Annex 1.

# Annex 1



**Mandatory parameter setting Promass 300 and 500 flow transmitters in case of bunkering. These setting override the settings mentioned in Evaluation Certificate TC10822.**

General settings for all parameters (where applicable):

| | |
|---|---|
| Mass unit: | t, kg or g |
| Mass flow unit: | Metrical (for example kg/min) |
| Volume unit: | $m^3$; $dm^3$; $cm^3$; L or ml |
| Volume flow unit: | Metrical (for example $m^3/h$) |
| Density unit: | Metrical (for example $kg/m^3$) |
| Temperature unit: | °C or K |
| Pressure unit: | Metrical unit |
| Simulation modes: | Shall be disabled |

| Menu | Sub Menu | Sub sub menu | Parameter | Value |
|---|---|---|---|---|
| - | | | Display Language | English (preferred); local language |
| Operation | | | | |
| | | | Locking Status | CT act.; CT act.-def.par. |
| Setup | | | Medium selection | Liquid<br>Gas for BOG meter |
| | Advanced | Pulse / frequency / Switch output | Operation mode | Frequency |
| | | | Minimum frequency | 0 Hz |
| | | | Maximum frequency | ≤ 10 kHz |
| | | | Value frequency low | 0 |
| | | | Value frequency high | See note (1) |
| | | | Operating mode | Passive |
| | | | Failure mode | Actual value |
| | Curr.output | | 0/4 mA value | See note (2) |
| | | | 20 mA value | |
| | PFS output | | Assign pulse | Mass flow |
| | | | Value per pulse | See note (3) |
| | | | Pulse width | See note (4) |
| | Low flow cut off | | Assign variable | Mass flow |
| | | | On value | See note (5) |
| | | | Off value | See notes (6) and (7) |

## Mandatory parameter setting Promass 300 and 500 flow transmitters in case of LNG bunkering.

**These setting override the settings mentioned in Evaluation Certificate TC10822.**

| Menu | Sub Menu | Sub sub menu | Parameter | Value |
|---|---|---|---|---|
| Setup | Partial pipe det | | Assign variable | Density |
| | | | Low value | See note (8) |
| | | | High value | |
| | Advanced setup | Totaliser n | Operation mode | See note (9) |
| | | | Failure mode | Actual value |
| | Communication | | Baud rate | 19200 or 38400 |
| | | | Data transfer mode | RTU |
| | | | Parity | Even |
| | | | Byte order | 1-0-3-2 |
| | | | Delay tele.reply | 0 ms |
| | | | Failure mode | Last valid value |
| Expert | System | Diagn. handling | Alarm delay | 0 |
| | Process param. | | Flow damping | In accordance with the calibration data |
| | | | Density damping | |
| | | | Temp. Damping | |
| Expert | Sensor | Sensor adjust. | Install direct. | Correct installation direction shall be selected. |
| | | Variable adjust | Mass flow offset | See note (10) |
| | | | Mass flow factor | See note (11) |
| | | Calibration | Cal.Factor | According calibration data |
| | | | Nominal diameter | Correct size |
| | | | C0 … C5 | According calibration data |

**Mandatory parameter setting Promass 300 and 500 flow transmitters in case of LNG bunkering.**

**These setting override the settings mentioned in Evaluation Certificate TC10822.**

# Annex 1



**Notes to the mandatory parameter settings:**

**(1)** The max value of the frequency should have such a value that the frequency does not exceed 10.000 Hz and does not exceed the maximum input frequency of the connected electronic calculator/indicating device. Primary data transmission (mass) is via frequency, checking is via Modbus.
The resulting min value of the frequency should not be below 120 Hz.

**(2)** The settings in the flow computer shall match the settings in the flow transmitter.

**(3)** The settings shall be such that the maximum pulse frequency of 5000 Hz is not exceeded.

**(4)** The value shall be such that the pulses can still be processed by the connected flow computer.

**(5)** Value at which the low flow cut off is enabled (pulse output stopped).

**(6)** Value at which the low flow cut off is disabled (pulsed started). It is given as a percentage in respect of the On value.
Actual value = On value x (1 + Off value / 100).
If the actual flow rate is higher than 20% of the minimum flow rate of the (complete) measuring system, pulses must be generated by the flow transmitter.

**(7)** The on value for the vapour return meter (BOG) shall be set the factory default for gas measurements as the expected mass flow of this meter is much lower than the minimum flow rate of the system (applicable to LNG).

**(8)** Values shall be explained during conformity assessment.
Empty pipe detection may be off for horizontal meter installation. In all other cases (vertical or angled installation) the empty pipe detection must be ON.

**(9)** At least one of the totalisers must be in accordance with the calibration data.

**(10)** If the mass or volume flow offset is not zero, the value shall be explained during the conformity assessment for the impact on the measurement performance. These parameters are not intended for a correction of the zero-flow rate.

**(11)** If the mass/volume flow factor is not 1 the actual value shall be explained during the conformity assessment for the impact on the measurement performance.

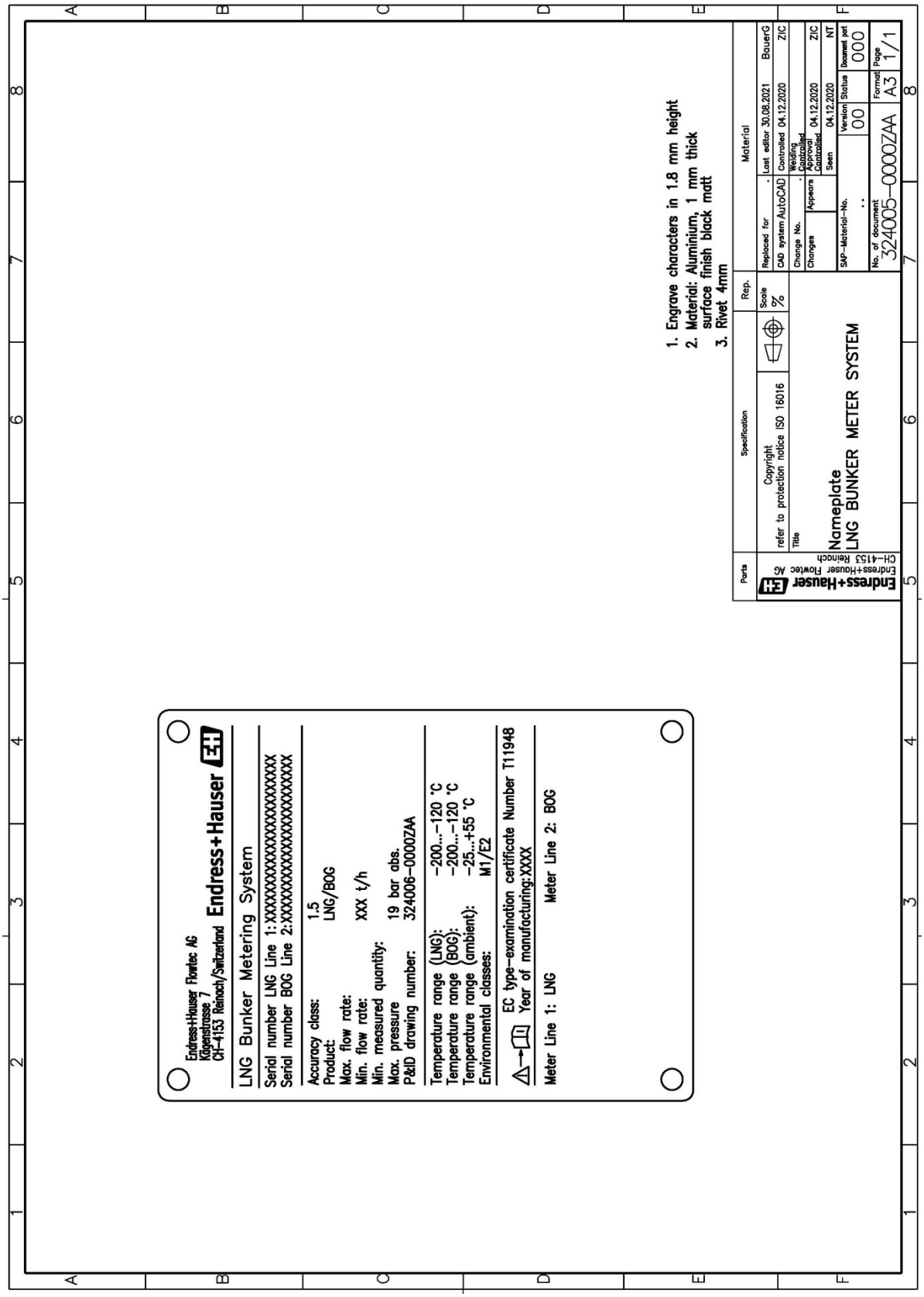
**(12)** If the density offset and density factor are not 0 resp. 1, the actual value shall be explained during the conformity assessment.

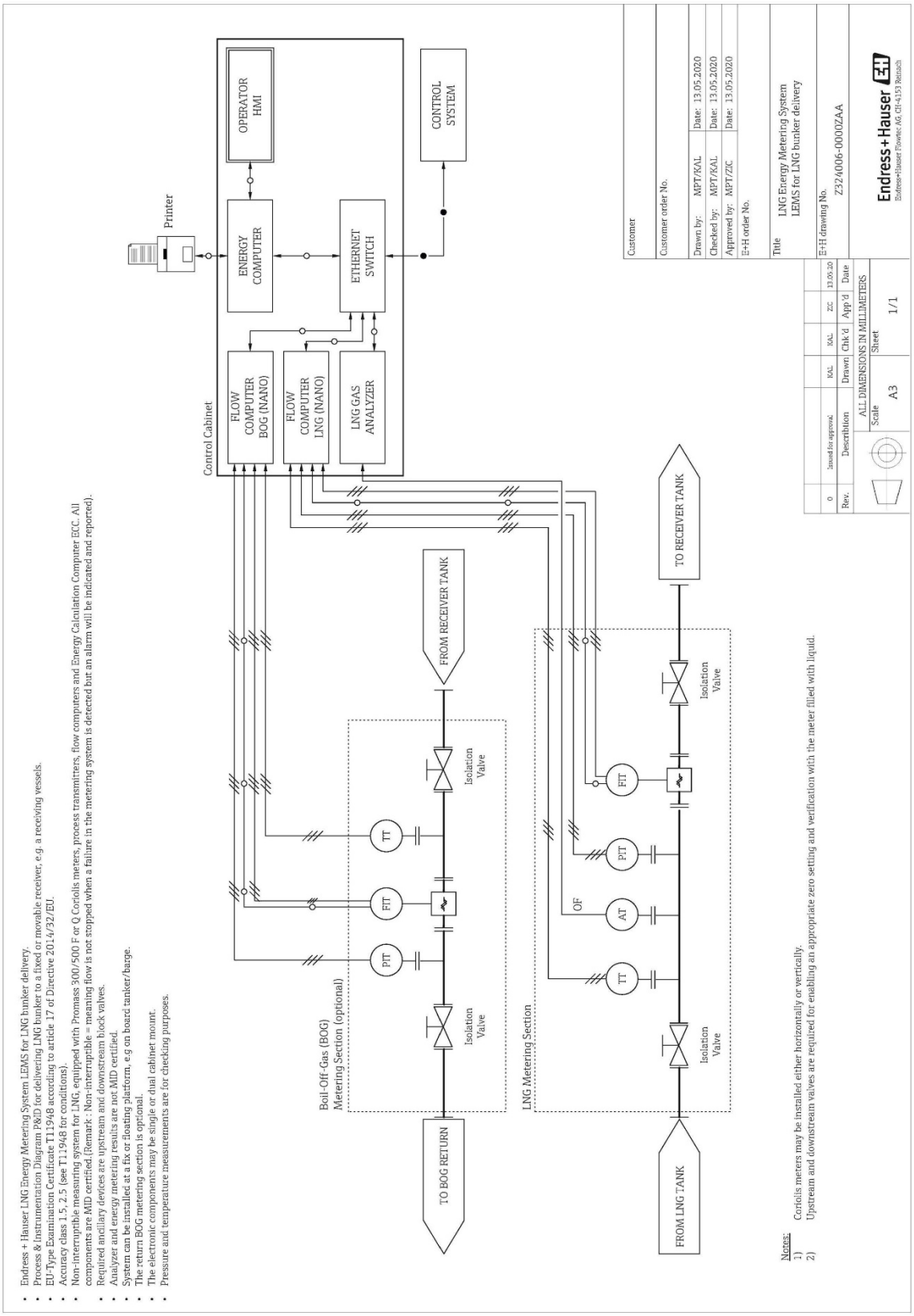
## Mandatory parameter setting Promass 300 and 500 flow transmitters in case of LNG bunkering.

**These setting override the settings mentioned in Evaluation Certificate TC10822.**

# Annex 2

Number **T11948** revision 1
Project number 3692100


Endress + Hauser LNG Energy Metering System LEMS for LNG bunker delivery.
Process & Instrumentation Diagram P&ID for delivering LNG bunker to a fixed or movable receiver, e.g. a receiving vessels.
EU-Type Examination Certificate T11948 according to article 17 of Directive 2014/32/EU.
Accuracy class 1.5, 2.5 (see T11948 for conditions).
Non-interruptible measuring system for LNG, equipped with Promass 300/500 F or Q Coriolis meters, process transmitters, flow computers and Energy Calculation Computer ECC. All components are MID certified.(Remark: Non-interruptible = meaning flow is not stopped when a failure in the metering system is detected but an alarm will be indicated and reported).
Required ancillary devices are upstream and downstream block valves.
Analyzer and energy metering results are not MID certified.
System can be installed at a fix or floating platform, e.g on board tanker/barge.
The return BOG metering section is optional.
The electronic components may be single or dual cabinet mount.
Pressure and temperature measurements are for checking purposes.
Control Cabinet
OPERATOR HMI
ENERGY COMPUTER
ETHERNET SWITCH
CONTROL SYSTEM
Printer
FLOW COMPUTER BOG (NANO)
FLOW COMPUTER LNG (NANO)
LNG GAS ANALYZER
FROM RECEIVER TANK
TO RECEIVER TANK
TO BOG RETURN
FROM LNG TANK
Isolation Valve
Boil-Off-Gas (BOG) Metering Section (optional)
LNG Metering Section
TT
FIT
PIT
AT
OF
Customer
Customer order No.
Drawn by: MPT/KAL Date: 13.05.2020
Checked by: MPT/KAL Date: 13.05.2020
Approved by: MPT/ZIC Date: 13.05.2020
E+H order No.
Title LNG Energy Metering System LEMS for LNG bunker delivery
E+H drawing No. Z324006-0000ZAA
Endress+Hauser
Endress+Hauser Flowtec AG, CH-4153 Reinach
Rev. Description Drawn. Chk'd App'd Date
0 Issued for approval KAL. KAL. ZIC 13.05.20
ALL DIMENSIONS IN MILLIMETERS
Scale A3 Sheet 1/1
Notes:
1) Coriolis meters may be installed either horizontally or vertically.
2) Upstream and downstream valves are required for enabling an appropriate zero setting and verification with the meter filled with liquid.