Australian Government
Department of Industry, Innovation and Science

National Measurement Institute

36 Bradfield Road, West Lindfield NSW 2070

# Certificate of Approval

# NMI 10/2/21

Issued by the Chief Metrologist under Regulation 60
of the
*National Measurement Regulations 1999*

This is to certify that an approval for use for trade has been granted in respect of the instruments herein described.

Endress+Hauser Model Promass 300 Bulk LPG Mass Flowmetering System

Submitted by Endress & Hauser Australia Pty Limited
Level 1, 16 Giffnock Avenue
Macquarie Park, NSW 2113
Australia

**NOTE:** This Certificate relates to the suitability of the pattern of the instrument for use for trade only in respect of its metrological characteristics. This Certificate does not constitute or imply any guarantee of compliance by the manufacturer or any other person with any requirements regarding safety.

This approval has been granted with reference to document NMI R 81, *Dynamic Measuring Devices and Systems for Cryogenic Liquids*, dated August 2009, and with reference to document NMI R 117-1, *Measuring for Liquids Other Than Water*, dated June 2011.

This approval becomes subject to review on 1/08/23, and then every 5 years thereafter.

DOCUMENT HISTORY

| Rev | Reason/Details | Date |
|---|---|---|
| 0 | Pattern & variant 1 to 2 provisionally approved – interim certificate issued | 22/06/18 |
| 1 | Pattern & Variant 1 to 2 approved – interim certificate issued | 27/07/18 |

Document History (cont…)

| Rev | Reason/Details | Date |
|---|---|---|
| 2 | Pattern amended (level indicating device) – Variant 3 provisionally approved – interim certificate issued | 10/09/18 |
| 3 | Pattern and variant 1 and 2 approved – certificate issued | 04/07/19 |

## CONDITIONS OF APPROVAL

### General

Instruments purporting to comply with this approval shall be marked with pattern approval number 'NMI 10/2/21' and only by persons authorised by the submittor.

Instruments purporting to comply with this approval and currently marked 'NMI P10/2/21' may be re-marked 'NMI 10/2/21' but only by persons authorised by the submittor.

It is the submittor's responsibility to ensure that all instruments marked with this approval number are constructed as described in the documentation lodged with the National Measurement Institute (NMI) and with the relevant Certificate of Approval and Technical Schedule. Failure to comply with this Condition may attract penalties under Section 19B of the National Measurement Act and may result in cancellation or withdrawal of the approval, in accordance with document NMI P 106.

### Special Conditions of Approval: (Provisional Approval Variant 3)

**VARIANT 3 VALID FOR VERIFICATION PURPOSES UNTIL 1 OCTOBER 2020**

This approval is limited to five (5) sites only, the locations of which may be obtained from the National Measurement Institute. The submittor shall advise NMI in writing of the proposed location or serial number of each instrument prior to it being initially verified.

Instruments purporting to comply with Variant 3 of this approval shall be marked with approval number 'NMI P10/2/21' and only by persons authorised by the submittor. (Note: The 'P' in the approval number may be a temporary marking.)

The approval will remain provisional pending completion of satisfactory testing and evaluation.

The submittor shall provide the NMI Pattern Approval Laboratory with copies of test results from the initial verification.

In the event of unsatisfactory performance the approval may be cancelled (or altered).

The submittor shall implement such modifications as required by NMI. In the event that such modifications (if any are required by NMI) are not made to the satisfaction of NMI, this approval may be withdrawn.

Signed by a person authorised by the Chief Metrologist to exercise their powers under Regulation 60 of the *National Measurement Regulations 1999*.

**Darryl Hines**
Manager
Policy and Regulatory Services

TECHNICAL SCHEDULE No 10/2/21

## 1. Description of Pattern **provisionally approved on 22/06/18**
**approved on 27/07/18**

An Endress+Hauser model Promass 300 Bulk LPG Mass flowmetering system (Figure1) using any model of the Endress+Hauser Promass F or Promass Q series of Coriolis flow sensors (Figure 2) listed in Table 1 – Accuracy Class and Table 2 below for the bulk metering of LPG and other liquefied gasses.

The Promass 300 flowmetering system is also approved for bulk metering of cryogenic products liquified natural gas (LNG) and liquid nitrogen (LIN).

### 1.1 Field of Operation

The field of operation of the measuring system is determined by the following characteristics:

- Minimum measured quantity, $V_{min}$ or $M_{min}$ (*) — see table 2
- Maximum flow rate, $Q_{max}$ — see table 2
- Minimum flow rate, $Q_{min}$ — see table 2
- Maximum pressure of the liquid, $P_{max}$ — see table 1
- Density range — 400 to 1400 kg/m³
- Ambient temperature range — -40 to 55°C
- Liquid temperature range — see table 1
- Accuracy class — see table 1
- Power supply range — 19.2 to 28.8 V DC
  100 to 264 V AC

For Cryogenic products

- Density range — 400 to 1400 kg/m³
- LNG temperature range — see table 1
- LNG maximum pressure — see table 1
- LIN temperature range — see table 1
- LIN maximum pressure — see table 1

(*) For minimum measured quantities ($V_{min}$ or $M_{min}$) less than or equal to 200 kg, the resolution of the calculator/indicator is set to display the delivered volume in 0.1 L increments.

Table 1 – Accuracy Class

| | Maximum pressure (MPa) | Liquefied gasses under pressure Accuracy Class 1.0 | Cryogenic liquids, LNG Accuracy class 1.5; 2.5 |
|---|---|---|---|
| Product temperature range ($^0$C) | | -10 / 90 | -200 / -10 |
| Promass F sensors | 10 | **M V** | **M** |
| Promass Q sensors | 10 | **M D V** | **M** |

Indicates approved measurements: M for Mass, D for Density, V for Volume.

Table 2
Minimum ($Q_{min}$) and Maximum flowrates ($Q_{max}$) and Minimum Measured Quantity (MMQ)

| **Promass F sensors** | **DN8** | **DN 15** | **DN25** | **DN40** | **DN50** | **DN80** |
|---|---|---|---|---|---|---|
| $Q_{max}$ (kg/min) | 30 | 100 | 300 | 700 | 1000 | 3000 |
| $Q_{min}$ (kg/min) | 1.5 | 5 | 15 | 37.5 | 58.3 | 150 |
| MMQ (kg) | 2 | 5 | 20 | 20 | 20 | 200 |

| | **DN100** | **DN150** | | | | |
|---|---|---|---|---|---|---|
| $Q_{max}$ (t/h) | 270 | 720 | | | | |
| $Q_{min}$ (t/h) | 14 | 32 | | | | |
| MMQ (kg) | 200 | 500 | | | | |

| **Promass Q sensors** | **DN25** | **DN50** | **DN80** | **DN100** | | |
|---|---|---|---|---|---|---|
| $Q_{max}$ (t/h) | 20 | 80 | 200 | 400 | | |
| $Q_{min}$ (t/h) | 0.45 | 2 | 6 | 14 | | |
| MMQ (kg) | 10 | 20 | 100 | 200 | | |

## 1.2 Components of Measuring System

### (i) Supply Tank

To ensure air does not enter the pipework, the supply tank incorporates an Endress+Hauser model Vibronic point level detection Liquiphant FTL50 level indicating device (Figure 3) or equivalent (**) for detecting low liquid level. The device must be positioned in the tank in a manner that the level of liquid detected will not be affected if the supply tank is positioned on an incline.

(**) 'Equivalent' is defined to mean other proprietary equipment of the same or better specifications requiring no changes to the software specified in this approval for satisfactory operation of the system.

### (ii) Pump

A positive displacement, centrifugal or submersible turbine type pump may be used to provide flow through one or more flowmeters. The pump is fitted in a positive suction head (flooded suction) installation, i.e. below the liquid level in the supply tank.

For all combination of usage, the pump(s) shall be of sufficient capacity to ensure that each flowmeter can operate within its approved flow rate range.

### (iii) Gas Elimination Device

A gas elimination device need not be fitted as the flow metering system is designed to keep the pipework full of liquid at all times, and on the occasion that small amounts of vapour may form in the pipework, the mass of this vapour will be insignificant compared to the mass of liquid.

### (iv) Measurement Transducer

The measurement transducer of the pattern comprises an Endress+Hauser Promass F or Promass Q series of flow sensors interfaced to an Endress+Hauser model Promass 300 microprocessor-based transmitter designed to provide pulse output signal proportional to the mass throughput. The transmitter is connected to an AC or DC power supply. The transmitter may be fitted with a liquid crystal display however this display is not approved for trade use.

The Promass 300 transmitter is mounted on top of the measurement sensor and may be optionally equipped with a remote display.

The Promass flow sensor may be used for measuring mass, volume and density. The minimum and maximum volumetric flow rate is derived from the mass flow rates divided by the density of the liquid. The $V_{min}$ is equal to the $M_{min}$ divided by the density.

The volume and density outputs for the Promass Q series flow sensors can be applied for trade measurement purposes.

The volume and density outputs for the Promass F or Promass X series flow sensors can be applied for trade measurement purposes if at least one of the following two conditions is met:

1. A special density calibration, prior to installation in the field, has been performed.

2. A standard density calibration followed by a density calibration in the field on the liquid to be measured, has been performed.

The Promass 300 transmitter may have the following output options:

- single or double pulse, 90 degree or 180 degree phase shifted pulse-output for the transmission of volume or mass information;
- 4-20 mA output for the transmission of density (can also be used for input/output via HART protocol;
- status input or output; or
- MODbus 485 serial protocol.

The Promass flow sensor may be used for bi-directional measurements when delivering quantities greater than $V_{min}$ or $M_{min}$.

For verification purposes, provision is made for inserting a thermometer and connecting a pressure gauge to measure the temperature and pressure of the liquid at the flowmeter.

### (v) Differential flow control valve

A Brodie BV03-03C differential flow control valve or any compatible (#) solenoid-operated flow control valve is installed downstream of the meter to maintain liquid phase. The vapour side of the differential flow control valve is connected to the vapour space of the supply tank via the vapour return line.

The flow control valve is located downstream of the measurement transducer and may be interfaced to the instrument for controlling the delivery process and to stop measurements in the event of errors detected by the checking facility.

### (vi) Controller/Indicator

An ISOIL model VEGA II or model VEGA T calculator/indicator (Figure 4) or other compatible (#) NMI-approved calculator/indicator interfaced to the Promass 300 flow transmitter and configured to provide a signal output proportional to mass flow/volume throughput at observed temperature, or volume throughput referenced to 15ºC. The models VEGA II and VEGA T are described in the documentation of approval NMI 10/2/18.

(#) 'Compatible' is defined to mean that no additions/changes to hardware/software are required for satisfactory operation of the complete system.

### (vii) Transfer Device

A transfer device, which defines the start and stop of the quantity measured, is installed downstream of the flow sensor. The transfer device is in the form of a positive shut-off component such as a manually or automatically-operated shut-off valve.

The transfer device may also be designed to control the flow rate within the specified flow rate range of the flowmeter.

## 1.3 Volume Conversion for Temperature

The system has the possibility to calculate the density and volume under reference conditions as specified in API Manual of Petroleum Measurement Standards, Chapter 11, Physical Properties Data, Section 1 and 2(2007) (also known as ASTM D1250-07). The following conversion methods are possible:

- API table 53/54A, 53/54B, 53/54C, 53/54D and 53/54E (15 °C reference temperature)

Note: the liquid temperature and, if needed, pressure have to be measured with external sensors. It is not allowed to use the temperature probe of the connected measurement sensor.

## 1.4 Verification Provision

Provision is made for the application of a verification mark.

## 1.5 Sealing Provision

Provision is made for sealing the cover of the transmitter (Figure 5) which contains the calibration functions of the instrument.

### 1.6 Markings and Notices

Each measuring system shall bear the following information, placed together either on the indicating device or on a data plate:

| | |
|---|---|
| Manufacturer's identification mark or trade mark | ….. |
| Meter model | ….. |
| Serial number of the instrument | ….. |
| Pattern approval mark | NMI 10/2/21 |
| Year of manufacture | ….. |
| Maximum flow rate, $Q_{max}$ | ….. kg/min |
| Minimum flow rate, $Q_{min}$ | ….. kg/min |
| Maximum pressure of the liquid, $P_{max}$ | ….. kPa |
| Type of the liquid for which the system is verified | ..... (##) |
| Environmental class | class C or I |

(##) This may be located separately, e.g. on a metal tag sealed to the instrument.

The minimum measured quantity ($V_{min}$ or $M_{min}$) is clearly visible on the indicating device, e.g. 'Minimum Delivery 200 kg', or alternatively the controller/indicator is programmed for deliveries equal to or greater than the stated minimum delivery.

## 2. Description of Variant 1 **provisionally approved on 22/06/18 approved on 27/07/18**

An Endress+Hauser model Promass 500 Bulk LPG Mass flowmetering system (Figure 6). The system is similar to the pattern but with the flow sensor interfaced to a Promass 500 transmitter.

The Promass 500 transmitter is similar to the Promass 300 transmitter of the pattern but is mounted remotely from the measurement sensor with two possibilities.

a) An analog version where the amplifier board is mounted inside the transmitter. The cable between the sensor and transmitter carries analogue signals.

b) A digital version where the amplifier board is mounted on top of the measurement sensor. The cable between the transmitter and amplifier board carries digital communication signals.

## 3. Description of Variant 2 **provisionally approved on 22/06/18 approved on 27/07/18**

With the system approved for the measurement of anhydrous ammonia with the following characteristics:

- Density range 579 to 638 kg/m³
- Liquid temperature range -10 to 40°C

The system is approved for vehicle-mounted installations as an interruptible measuring system**.**

## 3.1 Components of Measuring System

### (i) Supply Tank

The supply tank is located above the pump. It is fitted with a Rochester Remote Ready Dial, R3D level indicator (Figure 7) or equivalent (**) that provides continuous level measurement and a low-level switch point. The device must be positioned in the tank in a manner that the level of liquid detected will not be affected if the supply tank is positioned on an incline

(**) 'Equivalent' is defined to mean other proprietary equipment of the same or better specifications requiring no changes to the software specified in this approval for satisfactory operation of the system.

### (ii) Pump

A sliding vane type pump is mounted lower than the minimum height of the liquid in the supply tank. The supply pipe from the tank has a continuous fall to the pump.

### (iii) Measurement Transducer

Promass F flowmeter interfaced with either a Promass 300 or 500 transmitter. The meter is protected from the measurement of vapour:

a) The provision of a low liquid-level switching device mounted in the supply tank, which stops the delivery when the liquid level reaches the defined low level set point. Thus, preventing vapour or air entering the pump or metering system.

b) By configuring partial and empty pipe detection on the flow meter to detect vapour or air entering the meter. If vapour or air are detected in the meter the delivery is immediately stopped.

### (iv) Differential flow control valve

A Brodie BV03-03C differential flow control valve is installed downstream of the meter to maintain the anhydrous ammonia in liquid phase. The vapour side of the differential flow control valve is connected to the vapour space of the supply tank via the vapour return line.

The system is fitted with a Brodie BV03-03C carbon steel 300# flanged differential flow control valve or any compatible (#) solenoid-operated flow control valve configured for anhydrous ammonia service with signal pilot from vapour separator. The flow control valve is located downstream of the measurement transducer and may be interfaced to the instrument for controlling the delivery process and to stop measurements in the event of errors detected by the checking facility.

### (v) Calculator/Indicator

For the measurement of anhydrous ammonia the system is fitted with an ISOIL model VEGA T calculator/indicator as mentioned in approval NMI 10/2/18 or other compatible (#) NMI-approved calculator/indicator. The model VEGA T has a graphics display and numerical/function soft/hard keys housed in an aluminium enclosure, and totalises accumulated mass in metering conditions and at base conditions. It pre-sets or starts/stops the mass (at metering or base conditions) to be delivered.

(#) 'Compatible' is defined to mean that no additions/changes to the hardware/software specified in this approval are required for satisfactory operation of the system.

### (vi) Transfer device

The transfer point that defines the start and stop of measurement is either a valve or a nozzle fitted to a pipe/hose connected to the outlet of the differential flow control valve with no intermediate connections that may divert the delivery. However, two delivery outlets may be installed provided an isolation valve is fitted before each delivery outlet and that one or more notices are fitted near each isolation valve/delivery outlet indicating that only one outlet is to be in use at any one time.

The metering system is considered an interruptible system where an operator monitors the entire delivery process and responds to any alarms given by the metering system.

## 4. Description of Variant 3 provisionally approved on 10/09/18

With the measurement transducers of the pattern using Endress+Hauser model Promass F and Promass X sensors (Figure 8) given in table 3 and 4 below.

Table 3 – Accuracy Class

| | Maximum pressure (MPa) | Liquefied gasses under pressure Accuracy Class 1.0 | Cryogenic liquids, LNG Accuracy class 1.5; 2.5 |
|---|---|---|---|
| Product temperature range ($^0$C) | | -10 / 90 | -200 / -10 |
| Promass F sensors | 10 | **M V** | **M** |
| Promass X sensors | 10 | **–** | **M** |

Indicates approved measurements: M for Mass, D for Density, V for Volume.

Table 4
Minimum ($Q_{min}$) and Maximum flowrates ($Q_{max}$) and Minimum Measured Quantity (MMQ)

| **Promass F sensors** | **DN250** |
|---|---|
| Qmax (t/h) | 2200 |
| Qmin (t/h) | 90 |
| MMQ sensor (kg) | 1000 |

| **Promass X sensors** | **DN350** |
|---|---|
| Qmax (t/h) | 3500 |
| Qmin (t/g) | 137 |
| MMQ sensor (kg) | 1000 |

# TEST PROCEDURE

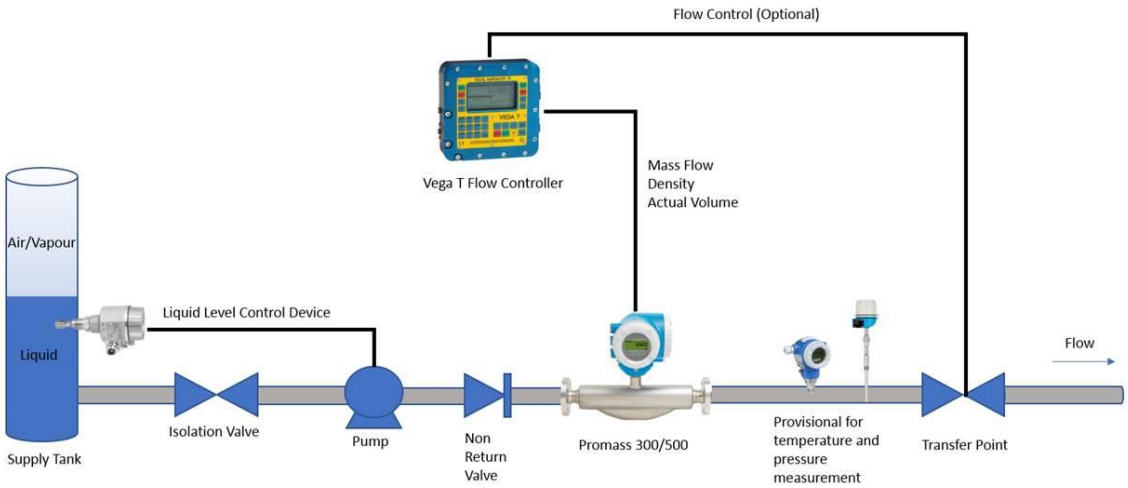
Instruments shall be tested in accordance with any relevant tests specified in the National Instrument Test Procedures. Tests should be conducted in conjunction with any tests specified in the approval documentation for any controller/indicator and/or any conversion device, etc. used.

The instrument shall not be adjusted to anything other than as close as practical to zero error, even when these values are within the maximum permissible errors.

## Maximum Permissible Errors

The maximum permissible errors are specified in Schedule 1 of the *National Trade Measurement Regulations 2009*.

FIGURE 5/6B/226 – 1




Schematic drawing of a Promass 300 mass bulk flowmetering system.

FIGURE 5/6B/226 – 2

(a) Promass 300 F series flowmeter

(b) Promass 300 Q series flowmeter

FIGURE 5/6B/226 – 3

Liquiphant FTL50 level indicating device

FIGURE 5/6B/226 – 4


ISOIL Model VEGA T Calculator/Indicator

FIGURE 5/6B/226 – 5

Sealing of Promass 300 Transmitter

FIGURE 5/6B/226 – 6

Promass 500 with F series flowmeter (Variant 1)

FIGURE 5/6B/226 – 7

Rochester Remote Ready Dial, R3D level indicator

FIGURE 5/6B/226 – 8

Promass X series flowmeter (Variant 3)

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