Australian Government
National Measurement Institute

Bradfield Road, West Lindfield NSW 2070

Certificate of Approval

No 5/1/6

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

Endress+Hauser Model Micropilot S FMR540 Liquid Level Measuring System

submitted by Endress+Hauser Australia Pty Ltd
Unit 8, 277 Lane Cove Road
North Ryde NSW 2113.

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 85, Automatic level gauges for measuring the level of liquid in fixed storage tanks, dated July 2004.

CONDITIONS OF APPROVAL

This approval becomes subject to review on 1 May 2015, and then every 5 years thereafter.

Instruments purporting to comply with this approval shall be marked with approval number ‘NMI 5/1/6’ and 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.

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The National Measurement Institute reserves the right to examine any instrument or component of an instrument purporting to comply with this approval.

Auxiliary devices used with this instrument shall comply with the requirements of General Supplementary Certificate No S1/0/A.

DESCRIPTIVE ADVICE

Pattern: approved 20 April 2010

- An Endress+Hauser model Micropilot S FMR540 radar type static volume measuring system for fixed tanks.

Variants: approved 3 November 2010

1. An Endress+Hauser model Micropilot S FMR532 radar type static volume measuring system for fixed tanks with stilling well.
2. An Endress+Hauser model Proservo NMS530 displacement type static volume measuring system.

Technical Schedule No 5/1/6 describes the pattern and variants 1 & 2.

FILING ADVICE

The documentation for this approval comprises:

Certificate of Approval No 5/1/6 dated 4 November 2010
Technical Schedule No 5/1/6 dated 4 November 2010 (incl. Test Procedure)
Figures 1 to 3 dated 4 November 2010

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

TECHNICAL SCHEDULE No 5/1/6

Pattern: Endress+Hauser Model Micropilot S FMR540 Liquid Level Measuring System

Submittor: Endress+Hauser Australia Pty Ltd
Unit 8, 277 Lane Cove Road
North Ryde NSW 2113

1. Description of Pattern

The pattern is an Endress+Hauser model Micropilot S FMR540 measuring system for measuring the liquid level in fixed tanks (Figure 1). The system uses PulseMaster version V 01.01.00 HART software.

1.1 Field of Operation

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

- Measuring height range: 0 to 20 m for horn antenna
  0 to 25 m for parabolic antenna
- Ambient temperature range -25 to 55°C
- Liquid temperature range -10 to 50°C
- Liquid pressure range 0 to 600 kPa
- Liquid density range 610 to 1076 kg/m^3
- Power supply range 16 to 36 V DC
- Accuracy class 2

Note: The system is required to be calibrated and used with liquids of similar dielectric constant e.g. petrol, kerosene and distillate.

1.2 Measuring Principle

The level measuring system is based on Frequency Modulated Continuous Wave radar. Signal transmission and reception is achieved by means of a waveguide projecting into the tank and a horn, or parabolic reflector, or planer type antenna.

Microwaves are transmitted towards the surface of the liquid in the tank. The returning echo from the surface is mixed with the transmitted signal, then the frequency difference is determined, normalised with a reference signal and mathematically converted into a distance value (tank liquid level). The level is determined periodically and the value output is displayed in millimetres.

The tank height may be converted to volume by using the tank dimension (radius) which is entered in to the calculator/indicator.

1.3 Component Structure (Figure 1a)

A Micropilot S measuring system includes a level transmitter (with antenna) and a calculator/indicator. The system may also include a temperature sensor and a remote indicator. The radar gauge is a distance measuring device which continuously calculates the liquid level in the tank and sends the information to the data acquisition unit and then to the display.

1.4 Level Transmitter

The model FMR540 level transmitter (Figure 1a) is housed in a flame and explosion proof safety enclosure and may include an integral 4 line, 20 character Endress+Hauser model VU331 liquid crystal display (LCD).

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1.5 Tank Connection Unit

The tank connection unit is a mechanical connection between the tank mounting surface and the level transmitter. It includes a microwave connection, such as an antenna or a waveguide transition, partially integrated in the mechanical connection.

One of the following Endress+Hauser tank connection units is utilised:

(i) A model Micropilot S 540 – horn antenna gauge (DN100 size); or

(ii) A model Micropilot S 540 – parabolic antenna gauge (DN200 and DN250 size).

1.6 Liquid Level Indicating Device

An Endress+Hauser model NRF590 LCD liquid level indicating device (Figures 1c and 1d) or equivalent (#1) is required for displaying information such as height, temperature, density (#2), etc.

(#1) "Equivalent" is defined to mean other proprietary equipment of the same or better specifications requiring no changes to software for satisfactory operation of the complete system including all checking facilities.

(#2) The display of density is not for trade use.

1.7 Calculator/Indicator

The Endress+Hauser Tankvision model NXA820 or NXA821 calculator/indicator (Figures 2a and 2b) is equipped with a matrix LCD for displaying information such as density (#2), temperature, height, etc. Alternatively, any other compatible (#3) NMI-approved calculator/indicator may be used.

(#2) The display of density is not for trade use.

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

1.8 Volume Conversion for Temperature

An electronic volume conversion for temperature facility in the calculator/indicator may be used to convert the measured volume to volume at 15°C. The conversion is based on ASTM-IP-API Petroleum Measurement Tables 54A and 53A for Crude Oil, Tables 54B and 53B for Generalised Petroleum Products and Tables 54D and 53D for Lube Oils.

1.9 Temperature Probe

For temperature measurement applications, an Endress+Hauser model TR10 – AAA3CASAG3100 transmitter or any other 4 to 20 mA temperature transmitter may be used compatible with the temperature range specified in the field of operation.

1.10 Checking Facility

The system verifies data between the calculator/indicator and the probe by performing a checksum for every packet of data as per standard for HART protocol, and the central processing unit raises an alarm if the probe does not respond.

1.11 Markings and Notices

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

Pattern approval mark	NMI 5/1/6
Manufacturer's identification mark or trade mark	…..
Model number	…..
Serial number	…..
Year of manufacture	…..
Ambient temperature range	-25 to 55°C
Liquid temperature range	-10 to 50°C
Liquid pressure range	0 to 600 kPa
Liquid density range	610 to 1076 kg/m^3
Maximum height	….. m (#)
Minimum height	….. m (#)
Accuracy class	2
Environmental class	class C

(#) Determined at verification.

In addition, the type of liquid and the minimum measured quantity for each tank/compartment are indicated/marked.

1.12 Sealing and Verification Provision

Provision is made, outside the safety enclosure, for sealing the activating rod in the transmitter head (for the electronic unit enabling switch).

Provision is also made for the enabling switch in the data acquisition unit to be sealed.

Provision is made for the application of a verification mark.

2. Description of Variants

2.1 Variant 1

An Endress+Hauser model Micropilot S FMR532 Radar type static volume measuring system which is similar to the pattern but uses a model FMR532 level transmitter (Figure 2c) and is only suitable for use with tanks fitted with a stilling well (Figure 2d).

An Endress+Hauser model Micropilot S 53x tank connection unit with a planar antenna gauge (DN150, DN200, DN250, and DN300 size) is utilised.

2.2 Variant 2

With an Endress+Hauser model Proservo NMS530 automatic level gauge (Figure 3). The level measuring system is based on displacement measurement. A small displacer is placed on the liquid medium using a servo motor; the displacer is suspended on a measuring wire which is wound on a finely-grooved drum housing within the instrument. Systems may be with or without a stilling well (Figures 3b and 3c).

The field of operation of the Proservo NMS530 measuring system is the same as for the pattern (as per clause **1.2 Field of Operation**), except for the following:

- Measuring height range: 0 to 28 m

An optional Endress+Hauser model NRF560 LCD liquid level indicating device (Figure 1d) or equivalent (#1) may be fitted.

(#1) "Equivalent" is defined to mean other proprietary equipment of the same or better specifications requiring no changes to software for satisfactory operation of the complete system including all checking facilities.

TEST PROCEDURE

The maximum permissible error at verification/certification is ±0.04% of the liquid level measured or ±2 mm, whichever is greater, i.e. ±2 mm up to 5 m of the liquid level measured and ±0.04% over 5 m.

1. Verification should be carried out at static conditions following a period of normal operation at normal filling and discharge rates, using a verified dip-tape as a reference standard.

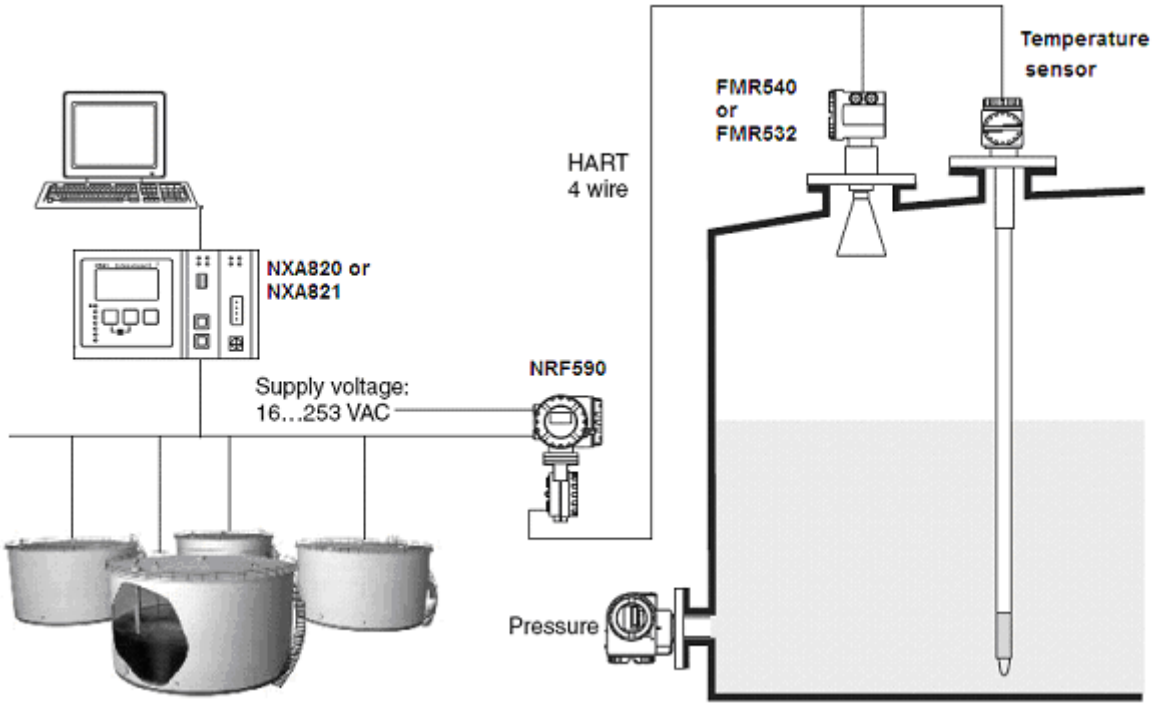
2. A series of comparative readings should be taken over a number of level changes. Readings should be taken following filling as well as emptying operations in approximately equal number. Mixers and/or heaters should be switched off in sufficient time to prevent errors arising from turbulence or convection currents when the readings are taken.

3. Three dip-tape readings should be taken at each level, at closely timed intervals by the same person using the same tape. The dip-tape readings should not differ by more than 1 mm. Failure of either group to be within this limit indicates a procedural error or faulty equipment. The tests should be repeated after corrective action has been taken.

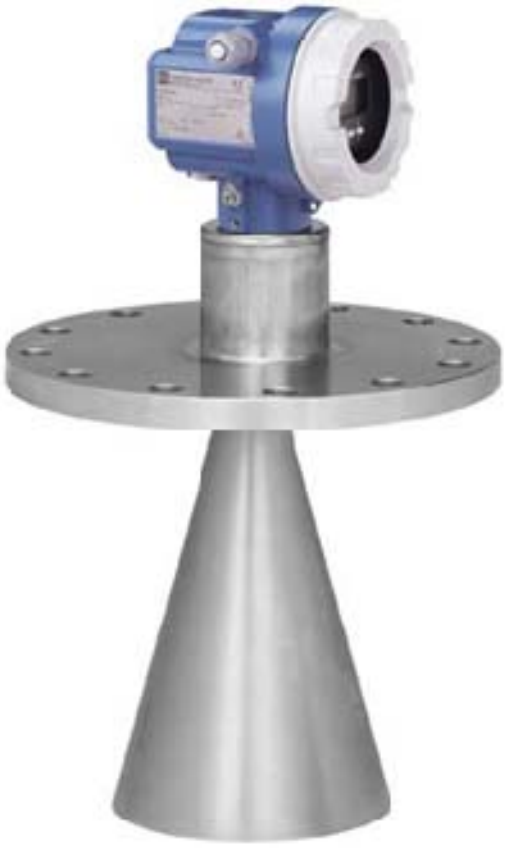
4. For each level, an average of three dip-tape readings and an average of the three indicated by the instrument should be calculated. The difference between these two averages is referred to as the test difference, and should be within the maximum permissible errors.

5. The difference between dip-tape and the instrument readings at all levels should be randomly distributed. A close check of the trend of readings should be made over the period of tests as any tendency for the test differences to increase is indicative of a faulty gauge or installation, which should be corrected before proceeding. It will be found helpful to use graphical or control chart techniques to detect trends.

FIGURE 5/1/6 – 1



(a) Typical Endress+Hauser Tankvision Liquid Level Measuring System With Temperature Sensor



(b) Model FMR540 Level Transmitter (With Horn Antenna)

(c) Model NRF590 Level Indicator

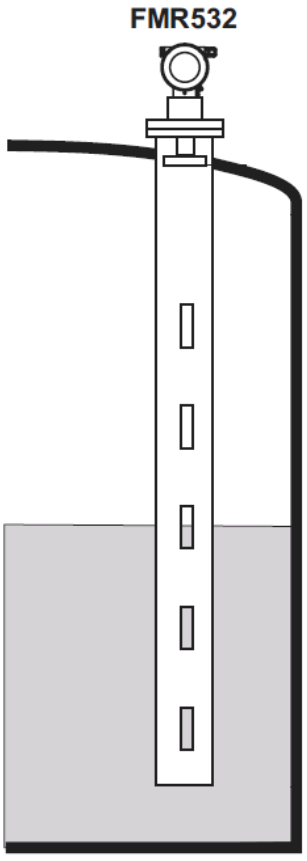
(d) Model NRF560 Level Indicator

FIGURE 5/1/6 – 2

(a) Model NXA820 Calculator/Indicator

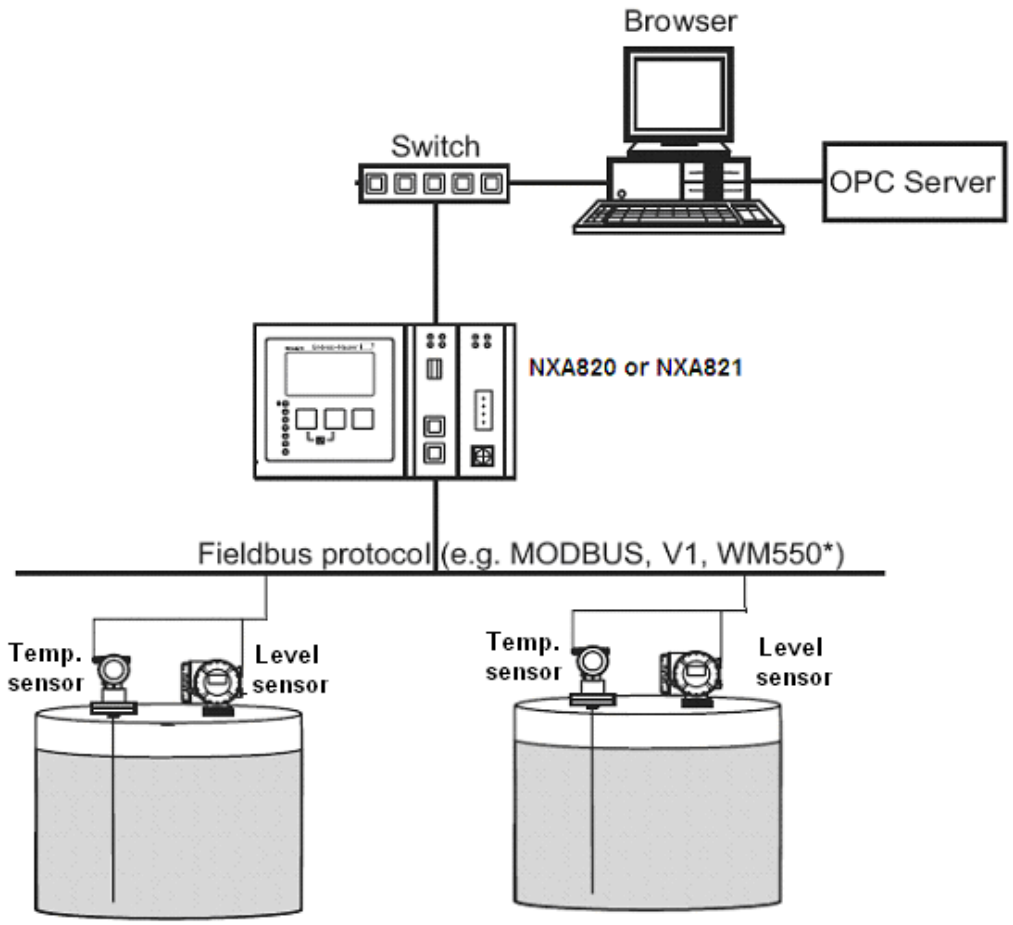
(b) Model NXA821 Calculator/Indicator

(c) Model FMR532 Level Transmitter

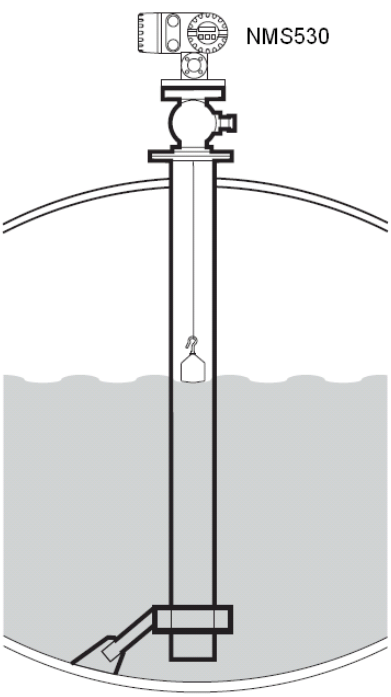


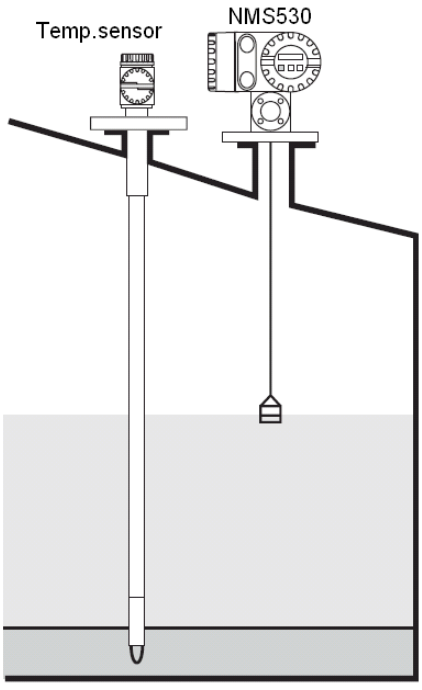
(d) Typical Installation of FMR532 With Stilling Well

FIGURE 5/1/6 – 3



(a) Typical Model Proservo NMS530 System With Temperature Sensors





(b) With Stilling Well (c) Without Stilling Well

Typical Model Proservo NMS530 Systems (Variant 2)