



Bradfield Road, West Lindfield NSW 2070

Certificate of Approval

No 5/1/7

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.

Rosemount Tank Radar AB Model Raptor 5900S Liquid Level Measuring System

submitted by Emerson Process Management Australia Pty Ltd
471 Mountain Highway
Bayswater VIC 3153

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.

This approval becomes subject to review on 1/09/18, and then every 5 years thereafter.

DOCUMENT HISTORY

Rev	Reason/Details	Date
0	Pattern & variants 1 to 3 approved – certificate issued	23/08/13
1	Pattern amended (markings) – certificate issued	13/09/13

CONDITIONS OF APPROVAL

General

Instruments purporting to comply with this approval shall be marked with pattern approval number 'NMI 5/1/7' and only by persons authorised by the submitter.

It is the submitter'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.

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

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

A handwritten signature in black ink, appearing to read 'A Rawlinson', with a horizontal line underneath.

Dr A Rawlinson

TECHNICAL SCHEDULE No 5/1/7

1. Description of Pattern

approved on 23/08/13

The pattern is a Rosemount Tank Radar AB model Raptor 5900S Automatic Level Gauge static volume measuring system with parabolic antenna for measuring the liquid level in fixed tanks (Figure 1).

1.1 Field of Operation

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

- Measuring height range: 0.8 to 30 m for all antennas
- Ambient temperature range -40 to +70°C
- Liquid temperature range -40 to +230°C
- Liquid pressure range 0 to 1000 kPa
- Power supply range 24 to 48 V DC, or 48 to 240 VAC
- Accuracy class 2

Note: The system is required to be calibrated and used with petroleum products.

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 parabolic reflector type antenna.

The radar gauge transmits microwaves towards the surface of the liquid. The microwave signal has a continuously varying frequency, around 10 GHz for the model 5900S. When the signal has travelled down to the liquid surface and back to the antenna, it is mixed with the signal that is being transmitted at that moment. The transmitted radar signal has a linear frequency variation.

The reflection from the liquid surface has a slightly different frequency compared with the signal transmitted from the antenna when the reflection is received. The difference in frequency is measured, and it is directly proportional to the distance to the liquid surface which corresponds to the tank liquid level.

The tank level is displayed on a local indicator and/or transmitted to ancillary devices for display or control.

1.3 Automatic Level Gauge (ALG) Overview (Figure 2)

The model Raptor Automatic Level Gauge (ALG) scalable level measuring system includes a Rosemount model 5900S Radar Level Gauge, and a Rosemount model 2410 Tank Hub calculator/power supply. The ALG display may be fitted to the 2410 Tank Hub or optionally a Rosemount 2230 field display may be used as an additional, or alternate ALG display to the indicator in the model 2410. Level information is provided by the Tank Hub via TRL/2, RS485 Modbus, or Foundation Fieldbus (ullage only) protocols, optional Enraf or RS485 Modbus protocols, and/or Ethernet via WirelessHART.

1.4 Level gauge Head

The Rosemount model 5900S level gauge transmitter head (Figure 3a) includes the microwave transmitter/receiver and a parabolic antenna (Figure 3d). The transmitter is supplied with custody transfer type approval option R and interfaces to the model 2410 Tank Hub.

1.5 Calculator/Power Supply

The Rosemount model 2410 Tank Hub (Figure 3b) collects measurement data and status information from the 5900S and has two external bus for communications.

1.6 Indicator

The indicator may be located in the Rosemount model 2410 tank hub and/or a Rosemount model 2230 Field Display (Figure 3c) for indicating liquid height, tank volume, and average tank temperature.

1.7 Descriptive 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 5/1/7
Manufacturer's identification mark or trade mark
Model number
Serial number
Year of manufacture
Liquid temperature range	... to ... °C (#1 & #2)
Liquid pressure range	... to ... kPa (#1 & #2)
Maximum height m (#2)
Minimum height m (#2)
Accuracy class	class 2
Environmental class	class C

In addition, for each tank/compartiment, the type of liquid and the minimum measured quantity are indicated/marked, either together with the above markings or in a separate clearly visible location.

(#1) As specified by user for the application; otherwise as per clause **1.1 Field of Operation**.

(#2) Determined at verification.

1.8 Verification Provision

Provision is made for the application of a verification mark.

1.9 Sealing Provision

Provision is made for sealing the model 5900S Level Gauge and the model 2410 Tank Hub (Figure 4).

2. Description of Variant 1

approved on 23/08/13

Alternate antennas as listed below may be used for different tank installation or application requirements as recommended by the manufacturer:

- Horn Antenna (Figure 3e)
- Still-pipe Array Antenna (Figure 3f)

3. Description of Variant 2

approved on 23/08/13

Depending on the application, temperature measurement may be one or more single point measurement(s) using a temperature sensor and a Rosemount model 644 temperature transmitter (Figure 5a) (or other 4 to 20 mA temperature transmitter) for each temperature sensor, or a model 2240S multi-point temperature transmitter (Figure 5b) with a multi-spot temperature sensor to determine average temperature. A combination multi-spot temperature/water level sensor enables average temperature and free water to be measured. The model 2240S is used with one of the following temperature sensors.

- Model 565 (NLI) multi-spot temperature sensor (Figure 5c)
- Model 566 (NVL-cryo) multi-spot temperature sensor (LNG)
- Model 765 (WLS) multi-spot temperature (with Water Level Sensor) (Figure 5d).

4. Description of Variant 3

approved on 23/08/13

Measured tank volume conversion to volume at 15°C is performed using TankMaster software. 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. Requires TankMaster software and PC (Figure 6), multi-spot tank temperature measurement (variant 2), a model 2180 Field Bus Modem to interface the TRL/2 data protocol to the TankMaster PC, and optionally a model 2160 Field Communication Unit for data concentration that continuously polls and stores data from field devices for a multi-tank application.

TEST PROCEDURE No 5/1/7

Instruments shall be tested in accordance with any relevant tests specified in the National Instrument Test Procedures.

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

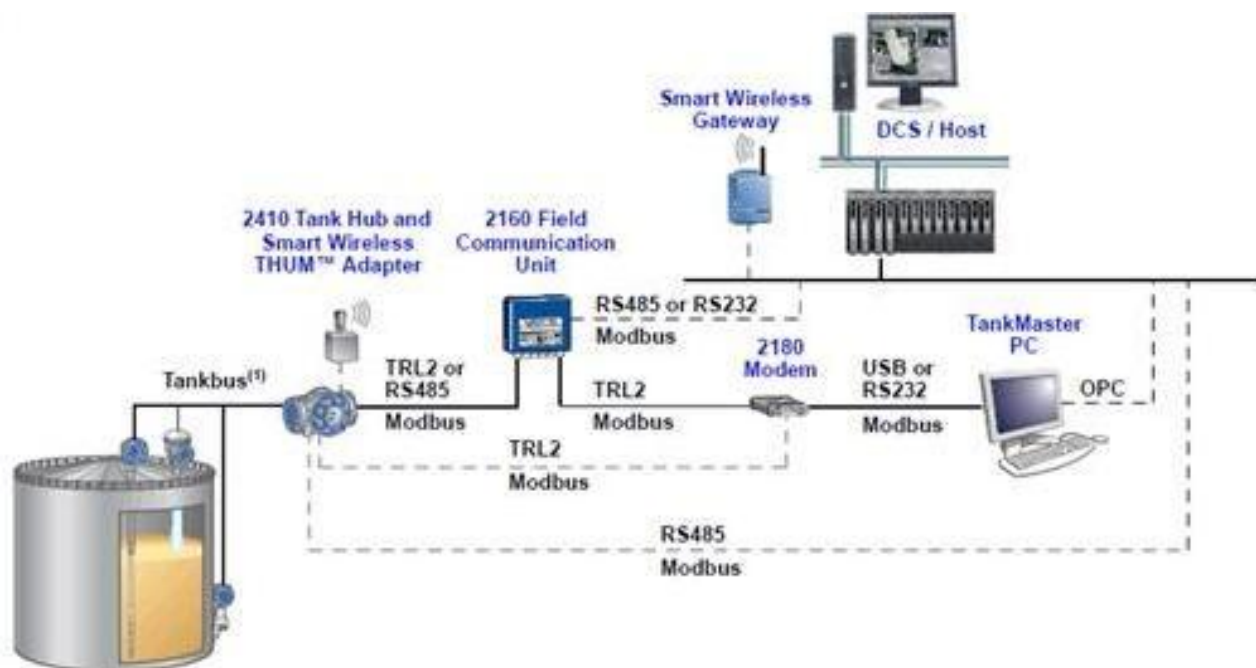
The maximum permissible errors are specified in Schedule 1 of the National Trade Measurement Regulations 2009.

Tests

The maximum permissible error at verification/certification is $\pm 0.04\%$ 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 $\pm 0.04\%$ over 5 m.

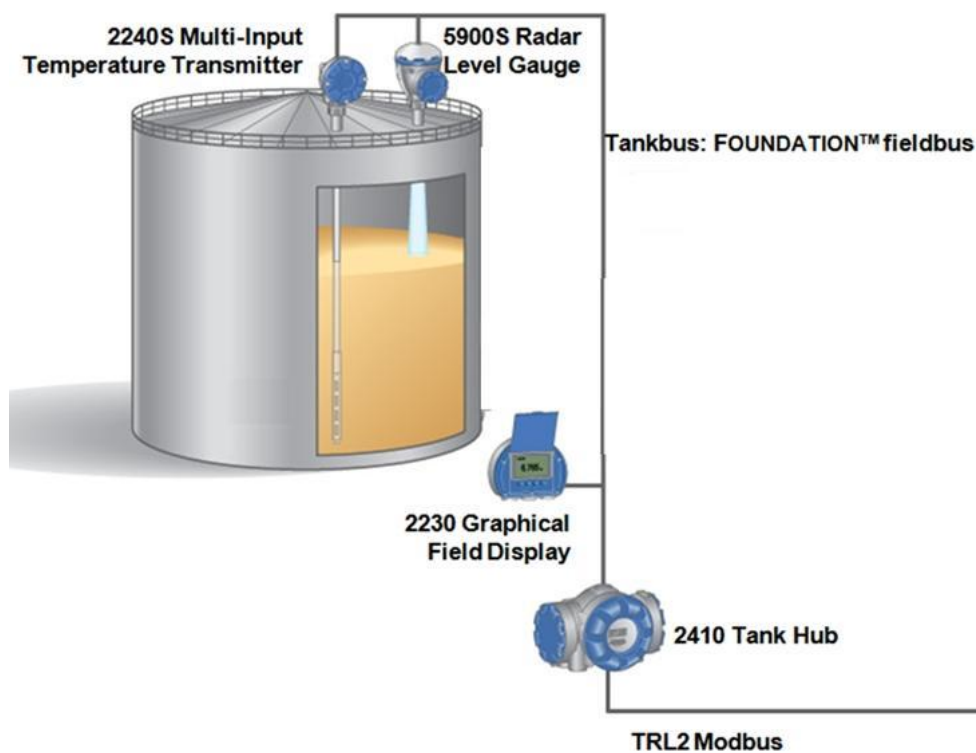
1. Verification should be carried out at static conditions following a period of normal operation at normal filling and discharge rates, using a verified dip tape as a reference standard.
2. A series of comparative readings should be taken over a number of level changes. Readings should be taken following 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 5/1/7 – 1



Rosemount Tank Radar AB Model Raptor 5900S Liquid Level Measuring System

FIGURE 5/1/7 – 2



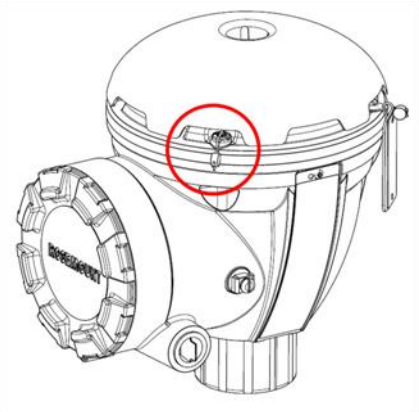
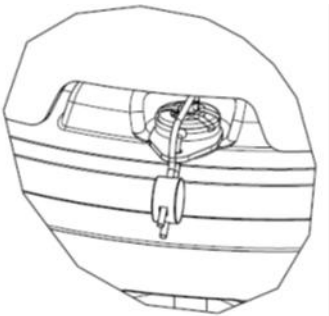
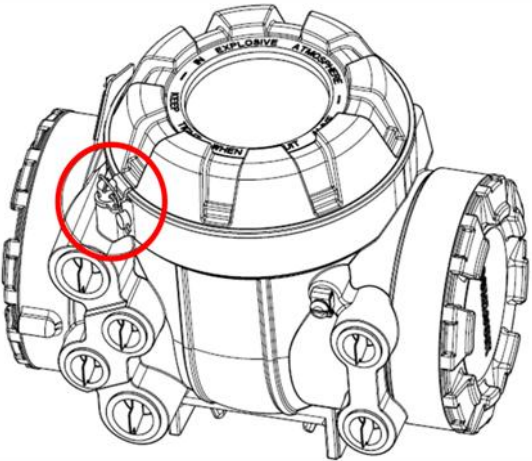
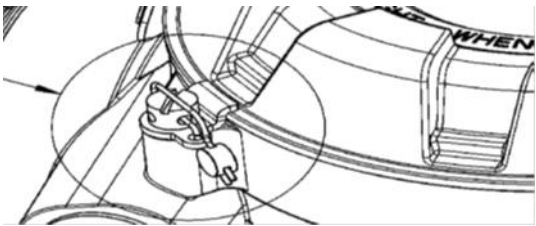
Automatic Level Gauge (ALG) Overview

FIGURE 5/1/7 – 3

	
(a) Rosemount 5900S Tank Radar Gauge	(b) Rosemount 2410 Tank Hub
	
(c) Rosemount 2230 Field Indicator	(d) Rosemount 5900S with Parabolic Antenna
	
(e) Rosemount 5900S with Horn Antenna	(f) Rosemount 5900S with Still-pipe Array Antenna





Various Major Components including Antennas – Pattern and Variant 1

FIGURE 5/1/7 – 4

	
<p>(a) Typical Sealing of Rosemount 5900S Radar Level Gauge</p>	<p>(b) Typical Sealing of Rosemount 5900S Radar Level Gauge (detail)</p>
	
<p>(c) Typical Sealing of Rosemount 2410 Tank Hub</p>	<p>(d) Typical Sealing of Rosemount 2410 Tank Hub (detail)</p>

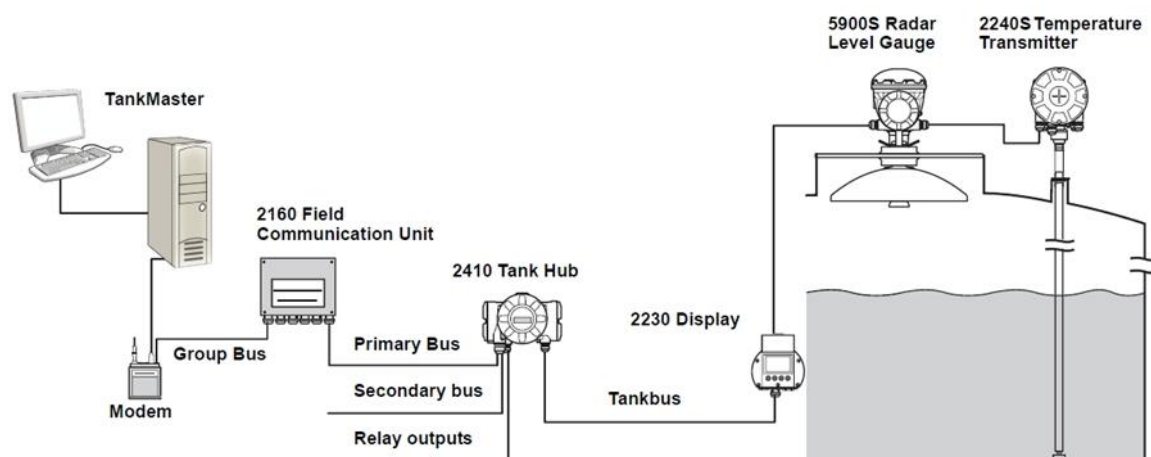
Typical Sealing of Radar Level Gauge and Tank Hub

FIGURE 5/1/7 – 5

	
(a) Rosemount 644 Temperature Transmitter with Single Point Sensor	(b) Rosemount 2240S Multi-input Temperature Transmitter
	
(c) Rosemount 2240S Temperature Transmitter with Model 565/566 Multi-spot Temperature Sensor	(d) Rosemount 2240S Temperature Transmitter with Model 765 Multi-spot Temperature and Water Level Sensor

Various Temperature Sensors – Variant 2

FIGURE 5/1/7 – 6



Rosemount 5900S System for Volume Conversion (Variant 3)

~ End of Document ~