



Australian Government  
Department of Industry,  
Innovation and Science

## National Measurement Institute

36 Bradfield Road, West Lindfield NSW 2070

### Interim Provisional Certificate of Approval No P5/1/7

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 85-1 & 2, Automatic level gauges for measuring the level of liquid in fixed storage tanks, dated November 2012.

This approval becomes subject to review on 1/04/25, 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

## Document History (cont...)

Rev	Reason/Details	Date
2	Pattern and variants reviewed and amended (1.7 Inventory Management) - Variant 2 & 3 Removed (outside scope of NMI R 85-1) – Variant 2 approved (LPG antenna) – Test procedure amended – interim certificate issued	30/06/2020

## CONDITIONS OF APPROVAL

**General**

Instruments purporting to comply with this approval shall be marked with pattern approval number 'NMI P5/1/7' and only by persons authorised by the submitter. (**Note:** The 'P' in the approval number may be a temporary marking.)

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.

**Special Conditions of Approval:**

Automatic Level Gauges measure automatically and display the level of liquid contained in a tank with respect to a fixed reference.

The Automatic Level Gauge shall only be installed on a Fixed Storage Tank that has been designed and calibrated according to the General requirements of NMI Document R 71, Fixed Storage Tanks, dated February 2013.

The metrological purpose of tank level measurements is the application in conjunction with tank calibration tables for the determination of liquid volume received from, delivered to, or contained in stationary storage tanks.

Conversion of the liquid level to volume does not form part of the requirements of NMI Document R 85-1 & 2, as such the pattern has not been assessed for the correct operation of these functions. This Certificate does not constitute or imply approval for the conversion of liquid level to volume functions.

Where the liquid level measurement is converted to volume, the system must use appropriate tank calibration tables for the storage tank to which the Automatic Level Gauge is installed, alongside any other conversion factors applicable to the properties of the liquid being measured. Tank calibration tables must be determined from the calibration of a tank according to the method described in **clause 8.5** of NMI Document R 71, Fixed Storage Tanks, dated February 2013.

**Special Conditions of Approval: (Test Procedure)**

The properties of the fixed storage tank and product being measured by this Automatic Level Gauge may require a different test method to suitably verify the instrument after installation.

The test procedure of this approval requires the National Measurement Institute Australia to be provided with and authorise a procedure for verification of this Automatic Level Gauge **after** its installation on a fixed storage tank and prior to being verified for use for trade.

A procedure shall be provided to the NMI Pattern Approval laboratory. The details of the tank and the installation properties must also be provided, including details of the use of mounting supports, stilling pipes, guidance wires, datum plates, damping or deflector plates as applicable.

**Special Conditions of Approval: (Provisional Approval)**

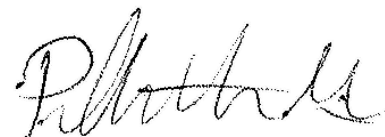
This approval is limited to ten (10) instruments, the locations of which may be obtained from the National Measurement Institute. The submitter shall advise NMI in writing of the proposed location or serial number of each instrument prior to it being initially verified.

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

The submitter 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 submitter 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*.



**Phillip Mitchell**  
A/g Manager  
Policy and Regulatory Services

TECHNICAL SCHEDULE No 5/1/7

**1. Description of Pattern**

**approved on 23/08/13  
amended on 30/06/2020**

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). The pattern may also be known as the Rosemount 5900S automatic level gauge.

**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

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, or the TankMaster system as described in **1.7 Inventory Management** below.

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 type approval option B 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 Inventory Management**

The Rosemount model 2460 System Hub (Figure 5) is a data concentrator and calculator that continuously polls and stores data from field devices. The 2460 System Hub may also transmit the measurement data to TankMaster Software (Figure 5c) operating on a PC-based device operating a Microsoft Windows based operating system. Indication of measurement results is presented in read-only mode on a personal computer screen.

The TankMaster software provides additional facilities including acquisition and summary of measurement data and parameters from multiple connected tank gauges.

The inventory management facilities shall not interact with the system in a way that would cause an incorrect indication of the measurement result of the Raptor Automatic Level Gauge.

## 1.8 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 P5/1/7
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)
Environmental range	... to ... °C (#1 & #2)
Identification of the tanks	.....

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 after installation.

Connected repeating indicating devices shall be marked with the following information:

Pattern approval mark	NMI P5/1/7
Manufacturer's identification mark or trade mark	.....

## 1.9 Verification Provision

Provision is made for the application of a verification mark.

### 1.10 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 30/06/2020

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

- LPG/LNG Antenna (Figure 6)

#### TEST PROCEDURE No P5/1/7

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 as follows:

<b>Prior to installation</b>	1 mm
<b>After Installation</b>	4 mm

#### Tests

##### Prior to installation:

1. Before installation on the tank the instrument shall be checked for conformity with the approved type.
2. A calibration report for the instrument must be available and the verifier of the instrument shall review the results and confirm the instrument is within the required maximum permissible errors above. The calibration report must include the accuracy test as described in clause 8.1.5.2 of NMI Document R 85-1.

The calibration report must be carried out by a test facility with accreditation or certification to perform calibration of Automatic Level Gauges to the requirements of either NMI Document R 85-1 & 2 dated November 2012, or OIML R 85-1 & 2:2008.

3. Ensure the instrument is sealed as described in the Certificate of Approval.

### **After Installation:**

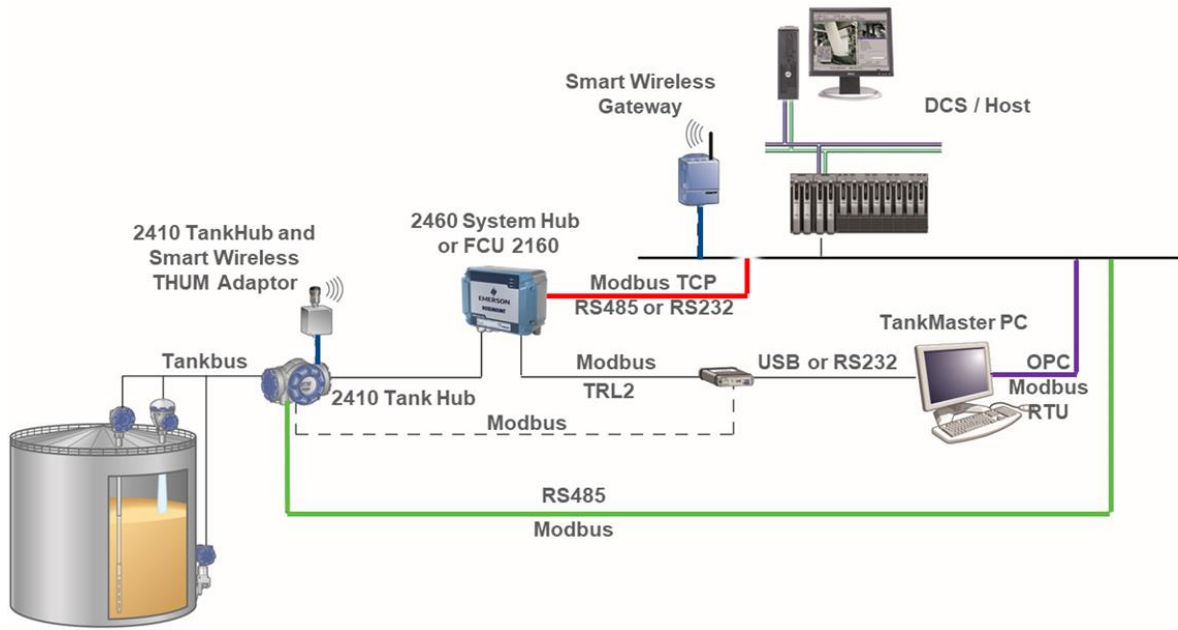
Prior to verification of each installation of an instrument, the National Measurement Institute Australia must be provided and authorise the use of a test procedure method to verify the Automatic Level Gauge after it is installed. See **Special Conditions of Approval: (Test Procedure)**

The verification procedure must also ensure the following:

1. For examination of installation and adjustment of the instrument on the tank, ensure that the requirements of clauses 7.1 to 7.3 of NMI Document R 85-1 are met.
2. Check the conditions of the tank match with the rated operating conditions specified in clause 6.1 of NMI Document R 85-1 and the rated operating conditions described in **1.1 Field of Operation** in the technical schedule of this approval.
3. Following the authorisation of a test procedure, ensure the instrument is within the required maximum permissible errors above.

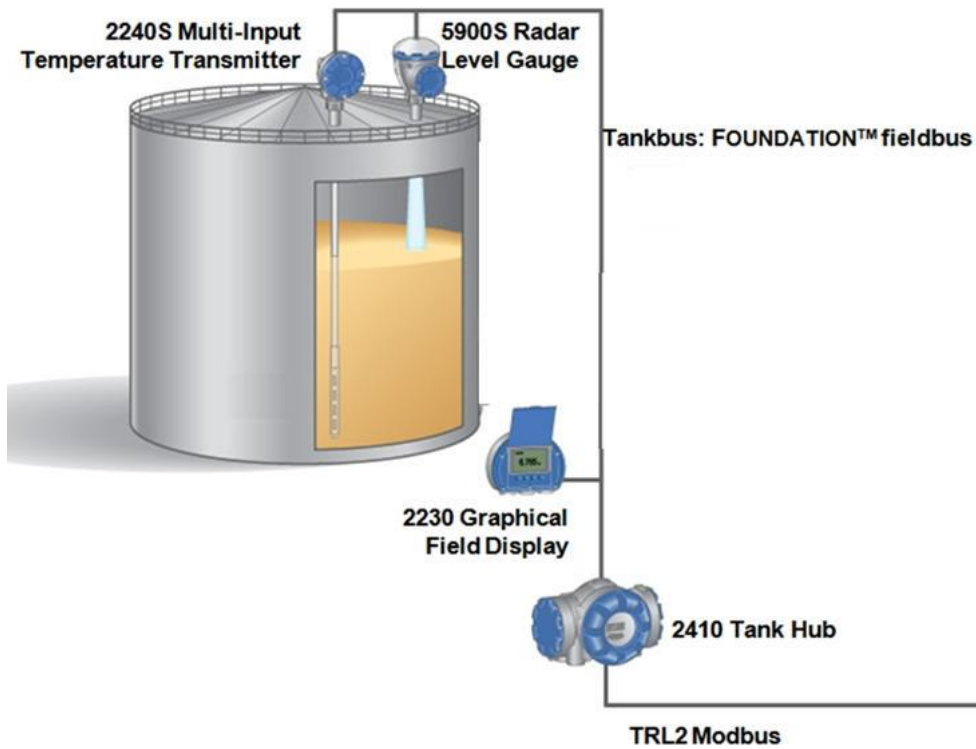


FIGURE 5/1/7 – 1



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

FIGURE 5/1/7 – 2



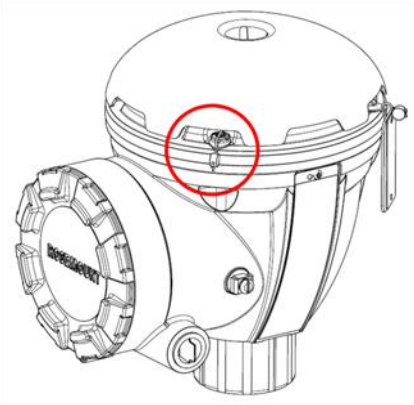
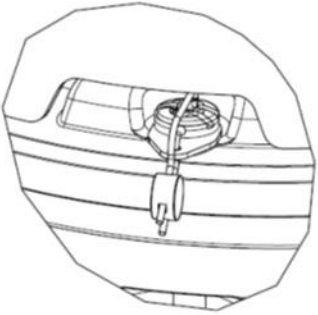
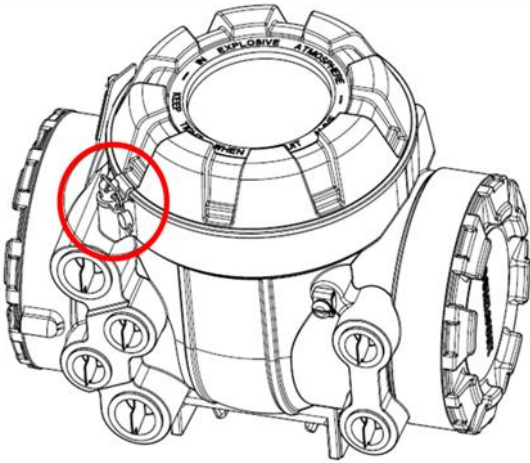
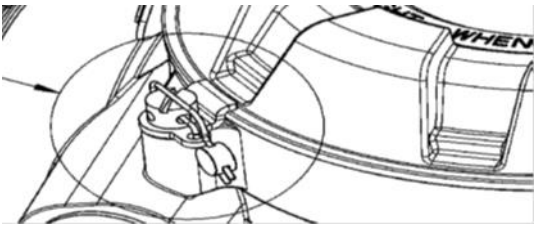
Automatic Level Gauge (ALG) Overview

FIGURE 5/1/7 – 3

	
<p>(a) Rosemount 5900S Tank Radar Gauge</p>	<p>(b) Rosemount 2410 Tank Hub</p>
	 <p>SIL 3 safety</p>
<p>(c) Rosemount 2230 Field Indicator</p>	<p>(d) Rosemount 5900S with Parabolic Antenna</p>
 <p>SIL 3 safety</p>	 <p>SIL 3 safety</p>
<p>(e) Rosemount 5900S with Horn Antenna</p>	<p>(f) Rosemount 5900S with Still-pipe Array Antenna</p>

Various Major Components including Antennas – Pattern and Variant 1

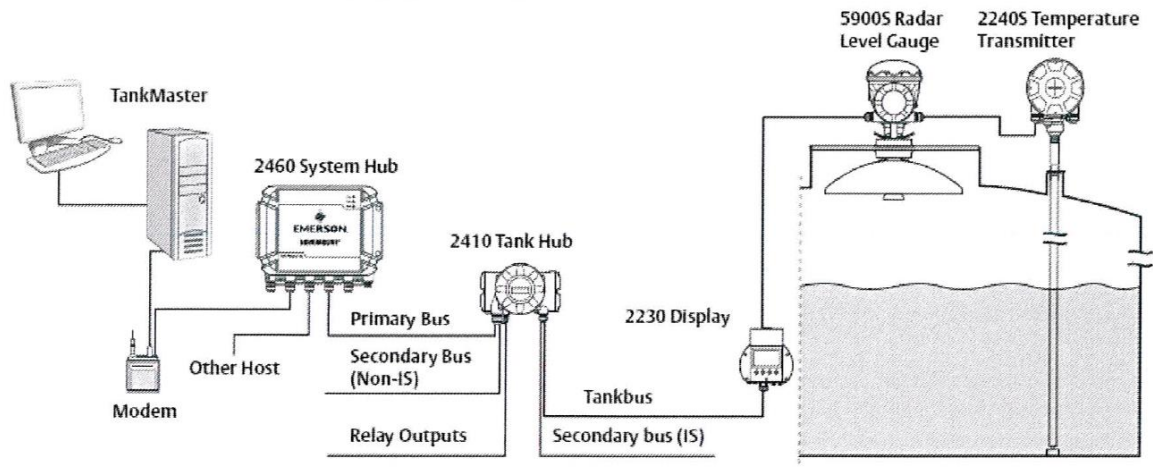
FIGURE 5/1/7 – 4

	
<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



Rosemount 5900S System with 2460 System Hub

FIGURE 5/1/7 – 6



Rosemount 5900S with LPG/LNG Antenna (Variant 2)

~ End of Document ~