Preliminary

Reference Manual
300520EN, Rev AA
November 2009

Rosemount 5900

Radar Level Gauge

HART® FIELD COMMUNICATIONS PROTOCOL

FOUNDATION®

ROSEMOUNT® Tank Gauging

www.rosemount-tg.com

EMERSON™ Process Management

Rosemount 5900

Radar Level Gauge

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

For equipment service or support needs, contact your local Emerson Process Management/Rosemount Tank Gauging representative.

Spare Parts

Any substitution of non-recognized spare parts may jeopardize safety. Repair, e.g. substitution of components etc, may also jeopardize safety and is under no circumstances allowed.

Rosemount Tank Radar AB will not take any responsibility for faults, accidents, etc caused by non-recognized spare parts or any repair which is not made by Rosemount Tank Radar AB.

Specific FCC Requirements (USA only)

Rosemount 5900 generates and uses radio frequency energy. If it is not installed and used properly, that is, in strict accordance with the manufacturer´s instructions, it may violate FCC regulations on radio frequency emission.

Rosemount TankRadar 5900 has been FCC certified under test conditions which assume a metallic tank. Installation on a non-metallic tank is not certified, and is not allowed.

The FCC certificate for Rosemount 5900 requires that the tank is closed as far as emitted radio energy is concerned. Tanks with open manholes, external-floating-roof tanks without still pipes etc. are not covered by the certificate.

Cover Photo: 5900_coverphoto.tif

Table of Contents

Section 1 Introduction

1.1 SAFETY MESSAGES

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

⚠WARNING

Failure to follow these installation guidelines could result in death or serious injury:

- Make sure only qualified personnel perform the installation.
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Explosions could result in death or serious injury:

- Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

⚠WARNING

Any substitution of non-recognized parts may jeopardize safety. Repair, e.g. substitution of components etc., may also jeopardize safety and is under no circumstances allowed.

1.2 SYMBOLS

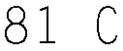
The CE marking symbolises the conformity of the product with the applicable European Community Directives.

The EC-Type Examination Certificate is a statement of a Notified Certification Body declaring that this product meets the Essential Health and Safety Requirements of the ATEX directive

The FM APPROVED Mark indicates that the equipment is approved by FM Approvals according to applicable Approval Standards and is applicable for installation in hazardous locations

Protective Earth

Ground



External cabling must be approved for use in min. 81°C

1.3 MANUAL OVERVIEW

This manual provides installation, configuration, and maintenance information for the Rosemount 5900 Series Radar Level Gauge.

Section 2: Overview

- Gauge components
- System overview
- Antenna types
- Installation procedure

Section 3: Installation

- Installation considerations
- Mechanical installation
- Electrical installation

Section 4: Configuration

- Basic configuration
- Configuration using TankMaster WinSetup
- LPG configuration

Section 5: Operation

- Viewing measurement data
- Alarm handling

Section 6: Service and Troubleshooting

- Serivce functions
- Troubleshooting
- Device and measurement status
- Error and warning codes

Appendix A: Reference Data

- Specifications
- Ordering Information

Appendix B: Product Certifications

- European ATEX Directive information
- FM approvals
- Labels
- Drawings

Appendix C: Advanced Configuration

- Tank scan
- Empty tank handling
- Surface echo tracking
- Filter settings

1.4 SERVICE SUPPORT

To expedite the return process contact the nearest *Emerson Process Management/Rosemount Tank Gauging* representative.

1.5 PRODUCT RECYCLING/ DISPOSAL

Recycling of equipment and packaging should be taken into consideration and disposed of in accordance with local and national legislation/regulations.

The label below is put on Rosemount Tank Gauging products as a recommendation to customers if scrapping is considered.

Recycling or disposal should be done following instructions for correct separation of materials when breaking up the units.

Figure 1-1. A green label is placed on the housing of the level gauge

1.6 PACKING MATERIAL

Rosemount Tank Radar AB is fully certified according to ISO 14000 environmental standards. By recycling the plywood boxes material used for shipping our products you can contribute to take care of the environment.

1.6.1 Reuse

Experience has shown that NEFAB ExPak packaging can be used 4-5 times.

1.6.2 Recycling

After careful disassembly the plywood sides may be reused. Metal waste may be converted.

1.6.3 Energy recovery

Products which have served their time may be divided into wood and metal components and the wood can be used as fuel in sufficient ovens.

Due to its low moisture content (approximately 7%) this fuel has a higher calorific value than ordinary wood fuel (moisture content approximately 20%).

When burning interior plywood the nitrogen in the adhesives may increase emissions of nitrogen oxides to the air 3-4 times more than when burning bark and splinter.

NOTE!
Landfill is not a recycling option and should be avoided.

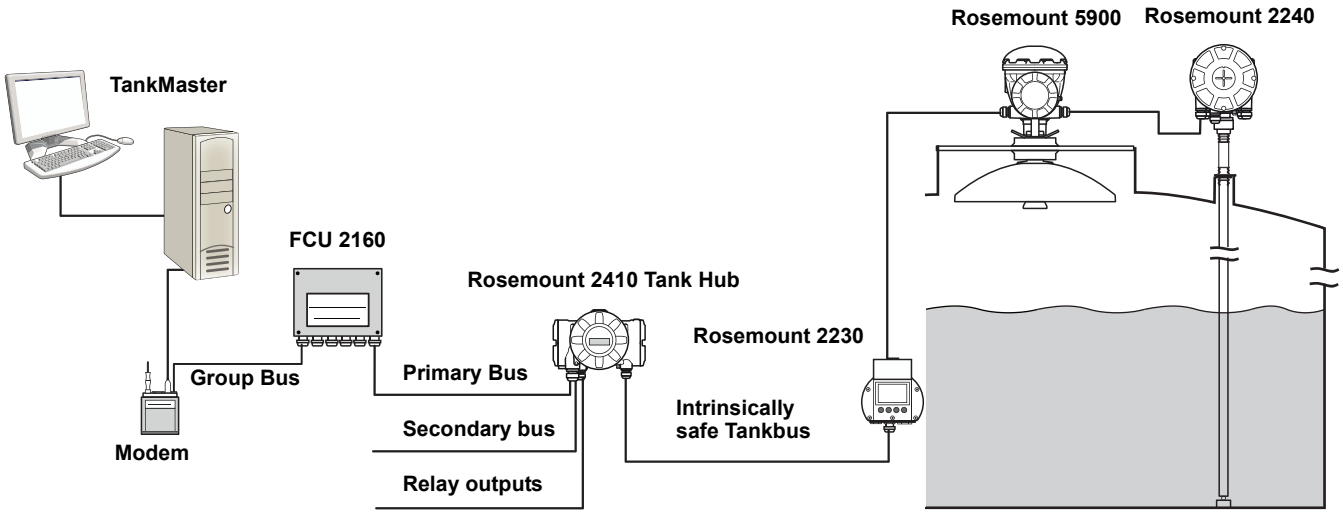
Section 2 Overview

2.1 INTRODUCTION

The *Rosemount 5900* is a two-wire radar level gauge for high accuracy non-contact measurements. The gauge continously emits a radar signal with varying frequency towards the product surface. This allows very accurate level measurements by processing the different frequencies between the emitted and received radar signals.

The *Rosemount 5900* is an integral part of the flexible *Rosemount Raptor* system. The advanced and robust design makes it suitable for a vast range of applications. It is capable of high accuracy level measurements as well as handling obstacles that may interfere with measurement signals.

Figure 2-1. System integration

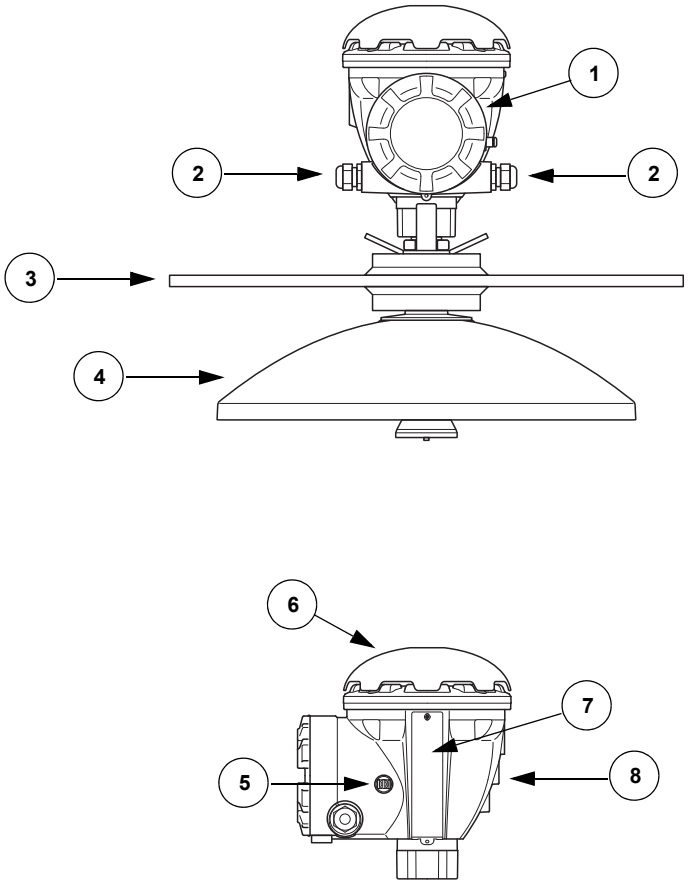


The *Rosemount 5900* delivers measurement data and status information to a Rosemount 2410 tank hub via the intrinsically safe Tankbus.

Data from a group of tanks is buffered by a 2160 Field Communication Unit (FCU), and is distributed via the Group Bus to a TankMaster PC, or a host system, whenever the FCU receives a request for data.

2.2 COMPONENTS

Figure 2-2. *Rosemount 5900* components



1. Terminal compartment
2. Cable entries
3. Flange
4. Antenna
5. Grounding terminal
6. Weather protection hood
7. Label
8. Transmitter head with signal processing electronics

2.3 SYSTEM OVERVIEW

Rosemount Raptor is a revolutionary, state-of-the art, inventory and custody transfer radar tank level gauging system. It is developed for a wide range of applications at refineries, tank farms and fuel depots, and fulfills the highest requirements on performance and safety.

The *Rosemount Raptor* product portfolio includes a wide range of components to build small or large customized tank gauging systems. The system includes various devices, such as radar level gauges, temperature transmitters, and pressure transmitters for complete inventory control. Such systems are easily expanded thanks to the modular design.

Rosemount Raptor is a versatile system that is compatible with and can emulate all major tank gauging systems. Moreover, the well-proven emulation capability enables step-by-step modernization of a tank farm, from level gauges to control room solutions.

It is possible to replace old mechanical or servo gauges with modern *Rosemount Raptor* gauges, without replacing the control system or field cabling. It is further possible to replace old HMI/SCADA-systems and field communication devices without replacing the old gauges.

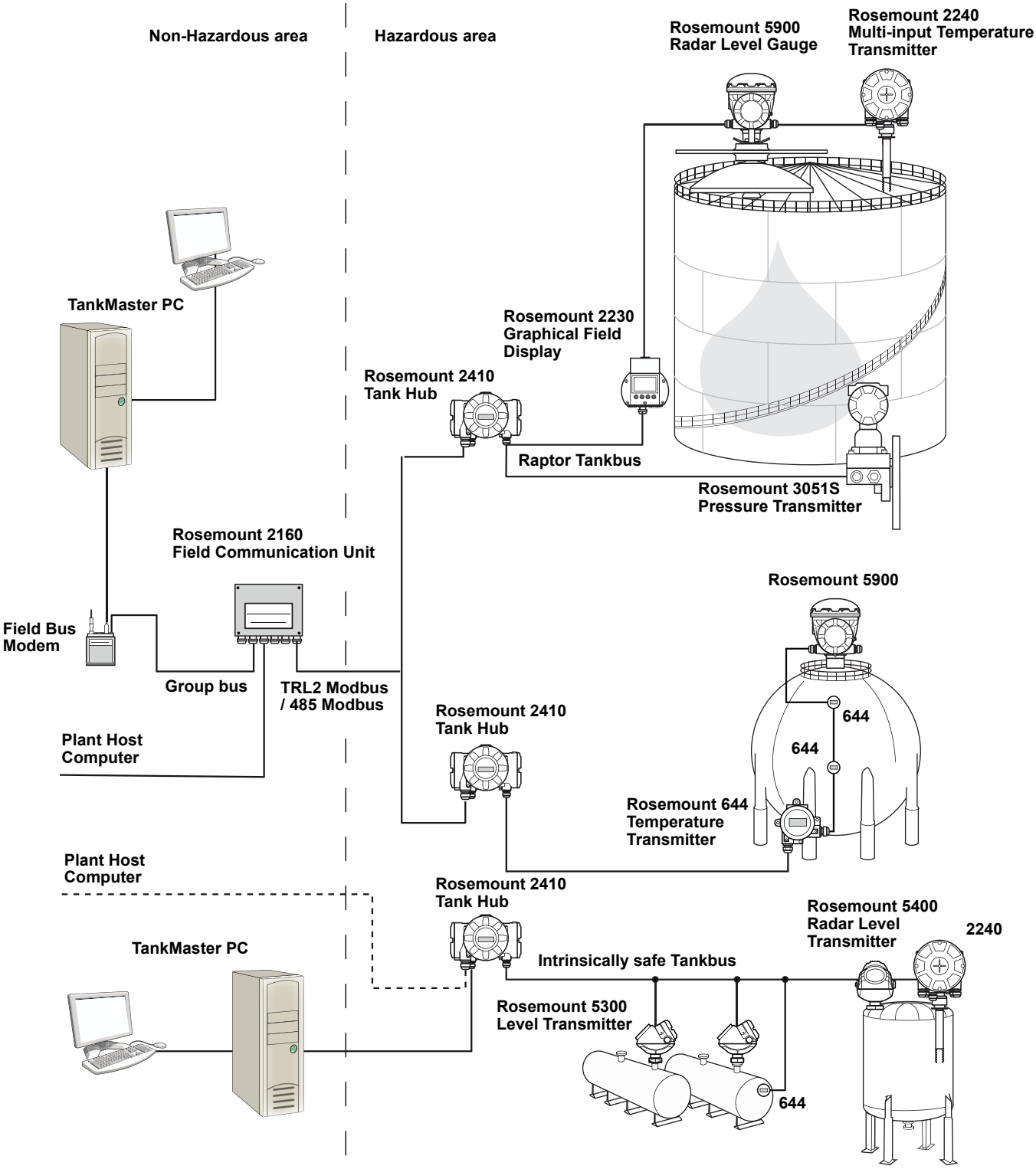
There is a distributed intelligence in the various system units which continously collect and process measurement data and status information. When a request for information is received an immediate response is sent with updated information.

The field devices on the tank communicate over the intrinsically safe *Rosemount Raptor* Tankbus. The Tankbus is based on a standardized fieldbus, the FISCO(1) FOUNDATION™ fieldbus, and allows integration of any device supporting that protocol. By utilizing a 2-wire field bus the power consumtion is minimized. The standardized field bus also enables integration of other vendors' equipment on the tank.

The flexible *Rosemount Raptor* system supports several combinations to achieve redundancy, from control room to the different field devices. Redundant network configuration can be achived at all levels by doubling each unit and using multiple control room work stations.

(1) See reference document IEC/TS 60079-27

Figure 2-3. Raptor system architecture



TankMaster HMI Software

TankMaster is a powerful Windows-based Human Machine Interface (HMI) for complete tank inventory management. It provides configuration, service, set-up, inventory, and custody transfer functions for *Rosemount Raptor* systems and other supported instruments.

TankMaster is designed to be used in the Microsoft® Windows XP and Vista environment providing easy access to measurement data from your Local Area Network.

The *TankMaster WinOpi* program lets the operator monitor measured tank data. It includes alarm handling, batch reports, automatic report handling, historical data sampling as well as inventory calculations such as Volume, Observed Density and other parameters. A plant host computer can be connected for further processing of data.

The *TankMaster WinSetup* program is a graphical user interface for installation, configuration and service of the different devices in the *Rosemount Raptor* system.

Rosemount 2160 Field Communication Unit

The 2160 field communication unit (FCU) is a data concentrator that continuously polls and stores data from field devices such as radar level gauges and temperature transmitters in a buffer memory. Whenever a request for data is received, the FCU can immediately send data from a group of tanks from the updated buffer memory.

Rosemount 2410 Tank Hub

The Rosemount 2410 tank hub acts as a power supply to the connected field devices in the hazardous area using the intrinsically safe Raptor Tankbus.

The Rosemount 2410 tank hub collects measurement data and status information from field devices on a tank. It has two external buses for communication with various host systems.

Rosemount 5900 Radar Level Gauge

The *Rosemount 5900* radar level gauge is an intelligent instrument for measuring the product level inside a tank. Different antennas can be used in order to meet the requirements of different applications. The 5900 can measure the level of almost any product, including bitumen, crude oil, refined products, aggressive chemicals, LPG and LNG.

The *Rosemount 5900* sends microwaves towards the surface of the product in the tank. The level is calculated based on the echo from the surface. No part of the 5900 is in actual contact with the product in the tank, and the antenna is the only part of the gauge that is exposed to the tank atmosphere.

The 5900 *2-in-1* option makes the radar level gauge redundant to electric circuit failure. Two separate radar units in the same transmitter head allows two independent level measurements using one antenna.

Rosemount 2240 Multi-Input Temperature Transmitter

The *Rosemount 2240* multi-input temperature transmitter can connect up to 16 temperature spot sensors and an integrated water level sensor.

Rosemount 2230 Graphical Field Display

The *Rosemount 2230* graphical field display presents inventory tank gauging data such as level, temperature, and pressure. The four softkeys allow you to navigate through the different menus to provide all tank data, directly in the field. The *Rosemount 2230* supports up to 10 tanks.

Rosemount 644 Temperature Transmitter

The Rosemount 644 is used with single spot temperature sensors.

Rosemount 3051S Pressure Transmitter

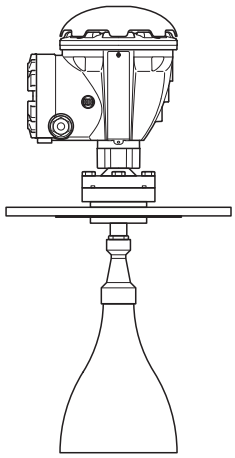
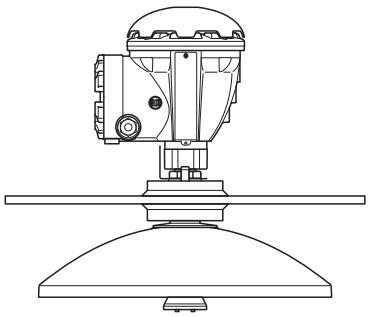
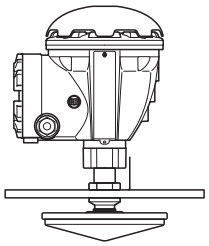
The 3051S series consists of transmitters and flanges suitable for all kinds of applications, including crude oil tanks, pressurized tanks and tanks with / without floating roofs.

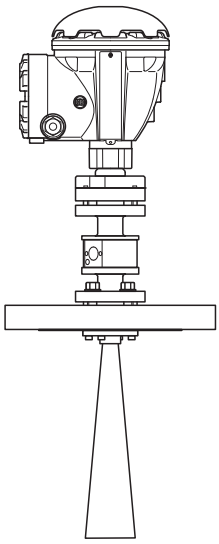
When a radar level gauge is connected to a pressure transmitter near the bottom of the tank, the density of the product can be calculated and presented. One or more pressure transmitters with different scalings can be used on the same tank to measure vapor and liquid pressure.

Rosemount 2180 Field Bus Modem

The Rosemount 2180 field bus modem (FBM) is used for connecting a TankMaster PC to the TRL/2 communication bus. The 2180 is connected to the PC using either the RS232 or the USB interface.

2.4 ANTENNAS

	The *Rosemount 5900* with horn antenna is designed for an 8” antenna to be used in small size openings on fixed roofs tanks. The 5920 is designed for measurements of a variety of oil products and chemicals. However, for bitumen/asphalt and similar products the Parabolic antenna is recommended.
	The *Rosemount 5900* with parabolic antenna measures level of all types of liquids, from light products to bitumen/asphalt. The gauge is designed for mounting on tanks with fixed roofs and has custody transfer accuracy. The design of the parabolic antenna provides extreme tolerance against sticky and condensing products. The narrow beam of this antenna makes it very suitable in narrow tanks with internal structures.
	The *Rosemount 5900* with still pipe array antenna is used on tanks with still pipes and with all products suited for still pipes. The gauge uses a low-loss radar propagation mode which virtually eliminates the influence of the still pipe condition. Measurement is made with highest accuracy even when the pipe is old, rusty and covered with deposits. The Still Pipe Gauge fits 5”, 6", 8", 10" and 12" pipes. It can be mounted on an existing still pipe and there is no need to take the tank out of operation during installation. There are two versions of the 5900 with still pipe array antenna: fixed and hinged hatch. The hinged hatch enables full pipe size product sampling or verification hand-dips.



The *Rosemount 5900* with LPG/LNG antenna is designed for level measurements in LPG and LNG tanks. A 4” still pipe is used as a wave guide for the measurement and prevents a wavy or boiling surface from disturbing the measurement. Radar signals are transmitted inside the pipe towards the surface.

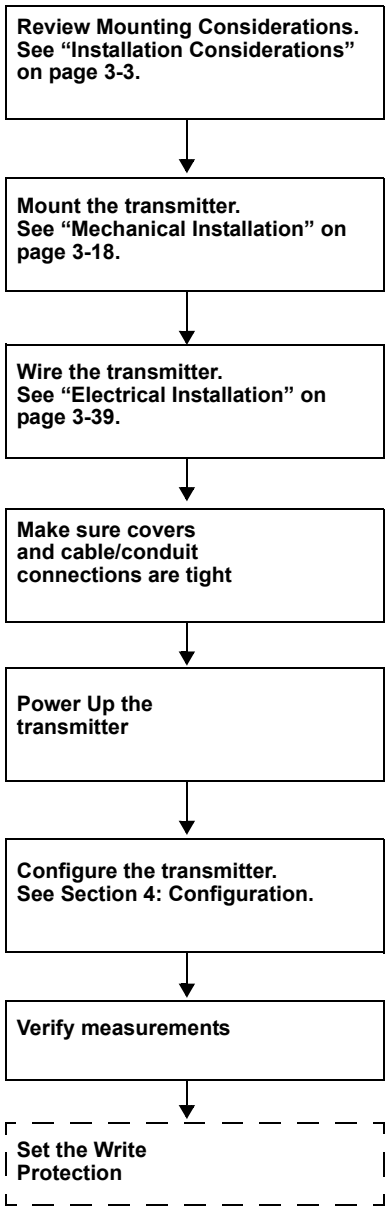
The pressure sealing is a quarts window approved for use in pressure vessels. As standard the gauge is also equipped with a fire-proof block valve and a vapor space pressure sensor.

The Rosemount 5960 is available in two versions, a 150 PSI version and a 300 PSI version.

The patented reference pin function enables verification of measurement without opening the tank. By setting the gauge into “test mode” the measured distances are compared with the actual distances.

2.5 INSTALLATION PROCEDURE

Follow these steps for proper installation:



Section 3 Installation

3.1 SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

⚠WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury:

Make sure only qualified personnel perform the installation.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Do not perform any service other than those contained in this manual unless you are qualified.

To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

Substitution of components may impair Intrinsic Safety.

⚠WARNING

Explosions could result in death or serious injury:

Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.

Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

⚠WARNING

High voltage that may be present on leads could cause electrical shock:

Avoid contact with leads and terminals.

Make sure the main power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

3.2 INSTALLATION CONSIDERATIONS

When finding an appropriate location on the tank for a Rosemount 5900 radar level gauge, the conditions of the tank must be carefully considered. The 5900 should be installed so that the influence of disturbing objects is kept to a minimum, preferably outside the radar signal beam.

Ensure that environmental conditions are within specified limits as listed in “Specifications” on page A-1.

Chapters 3.2.1 to 3.2.4 describe requirements and recommendations to consider when installing a Rosemount 5900 radar level gauge with different antenna types.

3.2.1 Horn Antenna Requirements

The Rosemount 5920 with horn antenna must be installed so that there are no pipes or other obstacles that could prevent the radar beam from reaching the tank bottom unobstructed. There are two flanges available; a horizontal flange for vertical installation, and an inclined flange for installation close to the tank wall.

Please refer to mechanical installation drawings for more information on the installation requirements of the Horn Antenna and service space requirements.

Nozzle Requirements

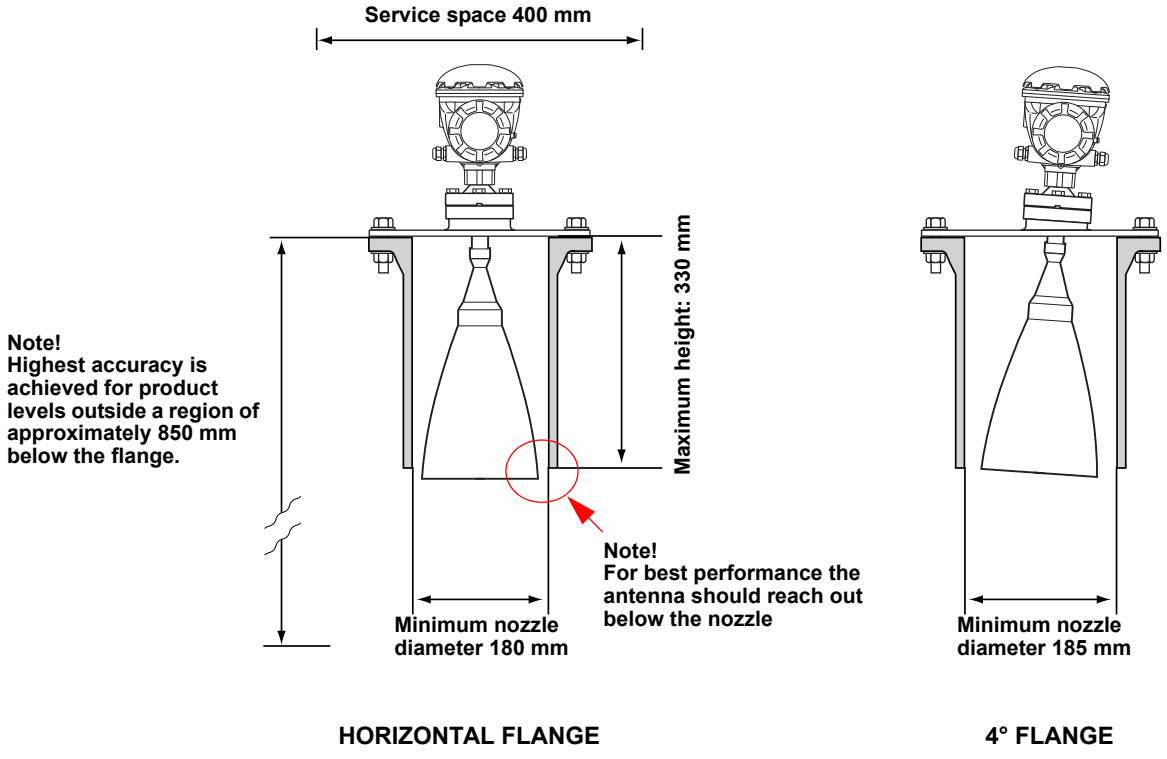
Maximum nozzle height 330 mm.

Minimum nozzle diameter:

Table 3-1. Minimum nozzle diameter for the 5900 with horn antenna

Flange	Minimum nozzle diameter (mm)
Horizontal flange	180
4° flange	185

Figure 3-1. Nozzle requirements for the Horn Antenna Gauge



Free Space Requirements

There are two flanges available for the Horn Antenna Gauge. One flange has an inclination of 4° and the other is horizontal. See installation drawing for flange dimensions.

The horizontal flange can be used if the wall does not intrude into the 30° wide radar beam of the Rosemount 5900. If a vertical antenna axis installation is not possible without the tank wall intruding into the radar beam, the 5900 has to be directed away from the wall by using the 4° flange. The inclination is necessary to ensure maximum accuracy.

The minimum free space distance **L**:

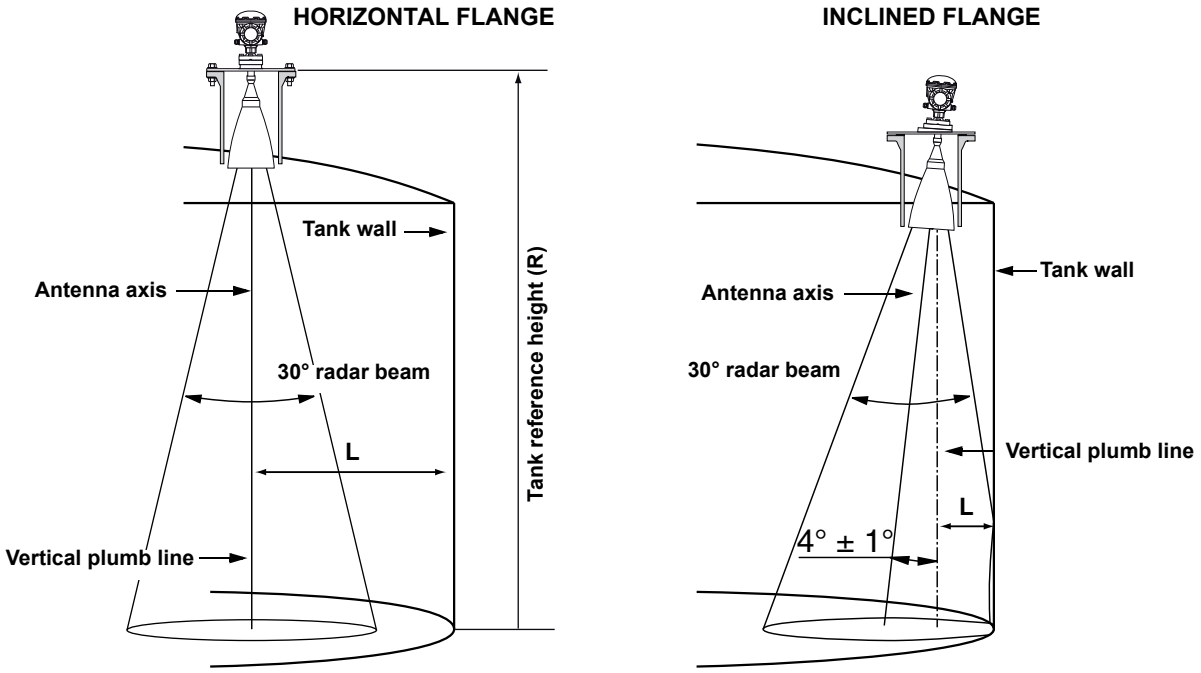
Table 3-2. Minimum distance L to tank wall for the 5900 with horn antenna

Flange	Minimum distance L to tank wall (m)
Horizontal flange	Rx0.27 (R=tank reference height)
4° flange	0.8(1)

(1) In exceptional cases the 5900 with Horn antenna can be installed closer to the tank wall if required. Please contact Emerson Process Management / Rosemount Tank Gauging for advice.

In certain cases, when maximum accuracy is not required, the horizontal flange can be used even if the wall intrudes into the radar beam. In doubtful cases, please contact Emerson Process Management / Rosemount Tank Gauging or one of its representatives for advice.

Figure 3-2. Two different flange options are available

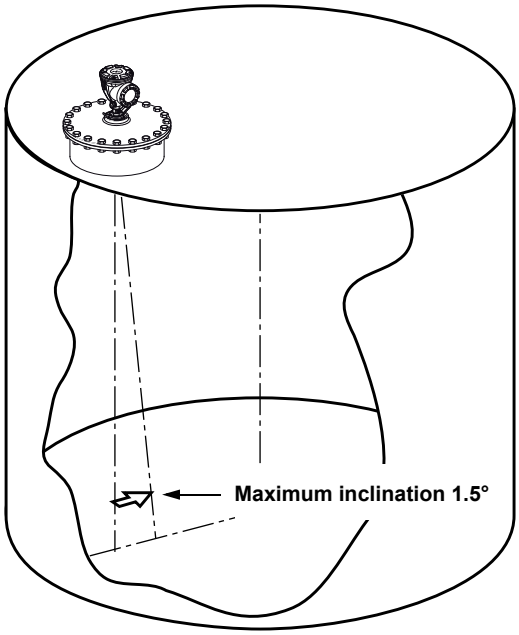


3.2.2 Parabolic Antenna Requirements

Inclination

The inclination of the Rosemount 5900 with parabolic antenna should not exceed 1.5 ° towards the center of the tank. For products with high condensation such as bitumen/asphalt applications, the radar beam should be directed vertically without any inclination.

Figure 3-3. Maximum inclination with parabolic antenna



Flange Requirements

The Rosemount 5900 with Parabolic antenna is mounted on the tank nozzle by using the Flange Ball. It is designed for easy adjustment of gauge inclination within the specified limits.

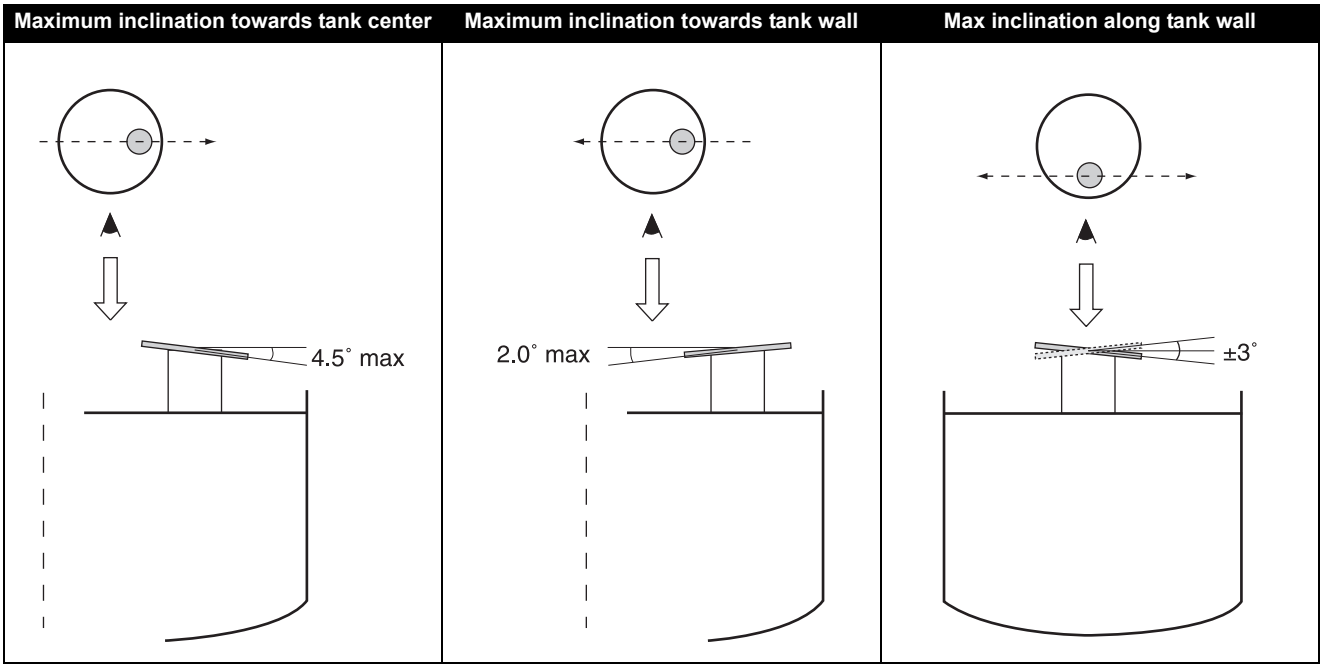
There are two versions of the Flange Ball: T30 and T38-W. Model T 38-W is welded on the flange. Model T 30 is attached to the flange with a nut. The Flange Ball has to be mounted on the tank flange prior to mounting the gauge on the tank nozzle.

Certain flange requirements have to be fulfilled in order to ensure that the radar beam is not disturbed by the tank wall, and maximum signal strength is reflected from the product surface back to the level gauge.

With **Flange Ball Model T30** the tank flange has to meet the following inclination requirements (see Figure 3-4) in order to allow proper adjustment of the antenna:

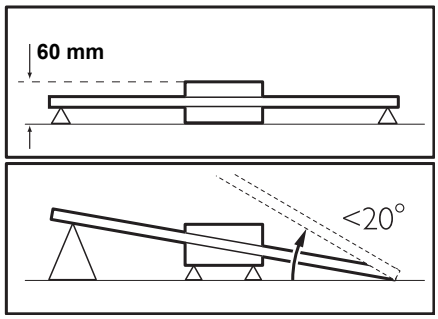
- maximum 4.5° away from the tank wall
- maximum of 2° towards the tank wall
- within ±3° horizontally along the tank wall

Figure 3-4. Maximum inclination of tank flange



Flange Ball T38-W can be welded at a maximum angle of 20° between the flange and the Flange Ball surface.

Figure 3-5. Maximum inclination of welded flange with Flange Ball T38W

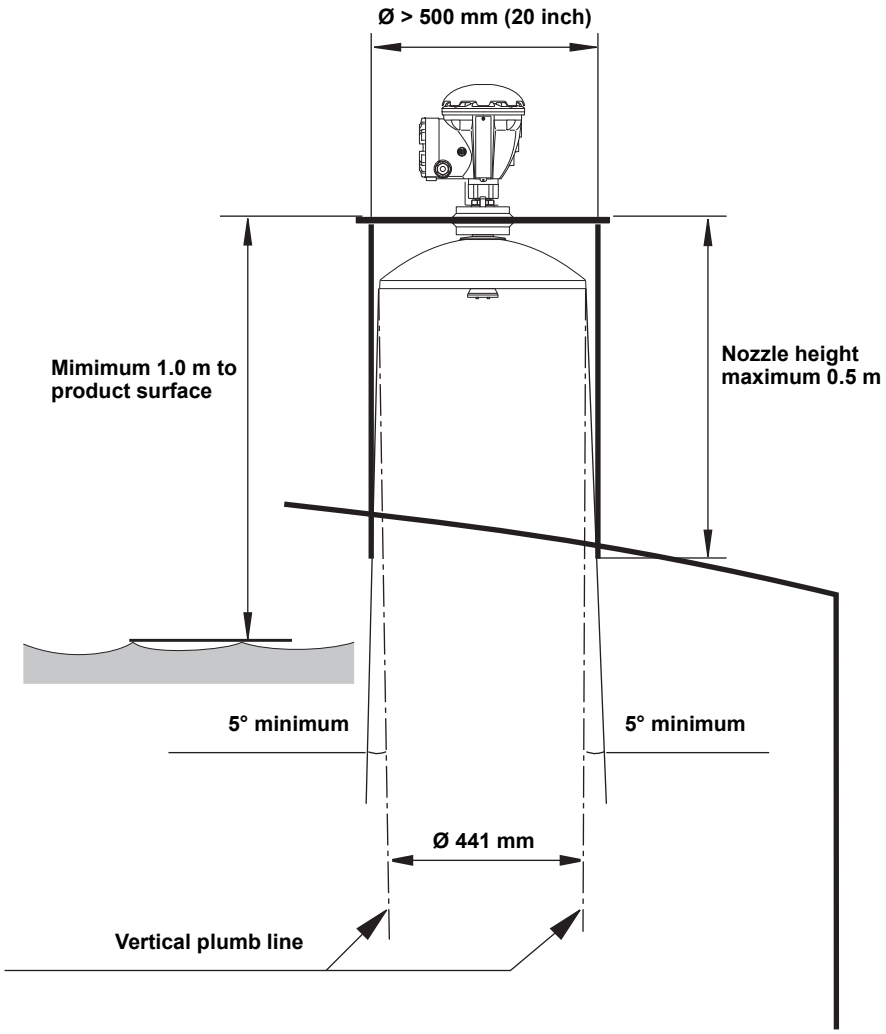


Nozzle Requirements

When using a Ø 20" nozzle the height of the nozzle must not exceed 0.5 meter. There has to be a free passage for the radar beam within a 5° angle from the edge of the parabolic reflector to the lower end of the nozzle. Nozzles with larger diameter may be higher than 0.5 meter as long as the 5° requirement is fulfilled.

From the flange to the product surface the distance should not be less than 1.0 m. Highest accuracy is obtained from product levels 1.0 meter below the flange downwards

Figure 3-6. Nozzle requirements for the Rosemount 5900 with Parabolic antenna

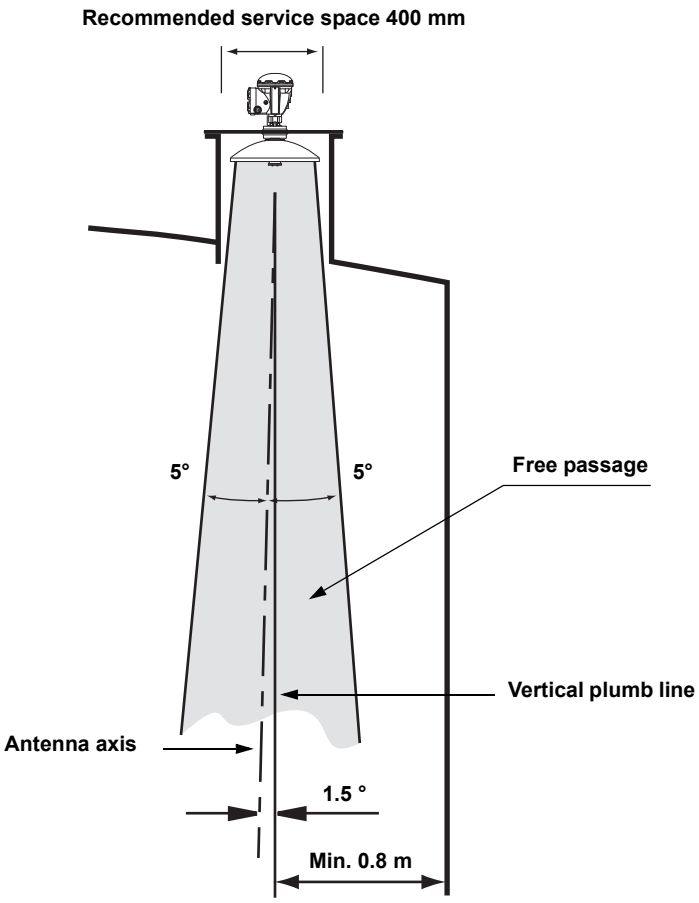


Free Space Requirements

The radar beam of the Parabolic Antenna Gauge is 10° wide. Obstacles (construction bars, pipes larger than Ø 2", etc.) within the radar beam are generally not accepted, as these may result in disturbing echoes. However, in most cases, a smooth tank wall or heating coils will not have any significant influence on the radar beam.

The distance from the tank wall to the antenna axis should be at least 0.8 m.

Figure 3-7. Free space requirements for the Rosemount 5900 with Parabolic antenna



For evaluation contact Emerson Process Management / Rosemount Tank Gauging.

3.2.3 Still Pipe Antenna Requirements

This instruction covers installation of the Rosemount 5900 Still-pipe Array antenna available for pipe size 5, 6, 8, 10 and 12 inch.

The Rosemount 5900 is designed for still-pipe mounting and can be mounted on existing still-pipe flanges without taking the tank out of operation.

There are two versions available in order to suit various requirements for easy installation and maintenance:

- The Rosemount 5900 Still-pipe Array antenna Fixed version.
  This version has a flange for easy mounting when there is no need for opening the still-pipe for hand dipping.
- The Rosemount 5900 Still-pipe Array antenna Hinged Hatch version.
  This version is suitable when the still-pipe needs to be opened for hand dipping.

Still Pipe Requirements

The Rosemount 5900 Still-pipe Array antenna fits 5", 6", 8", 10" and 12" flanges and pipes. The adaption is accomplished by selecting a suitable Still-pipe Array antenna. The gauge has a flange to seal the tank.

The still pipe must be vertical within 0.5° (0.2 m over 20 m).

Table 3-3 shows the wide range of schedules and pipe inner diameters that the Array antennas can be mounted in.

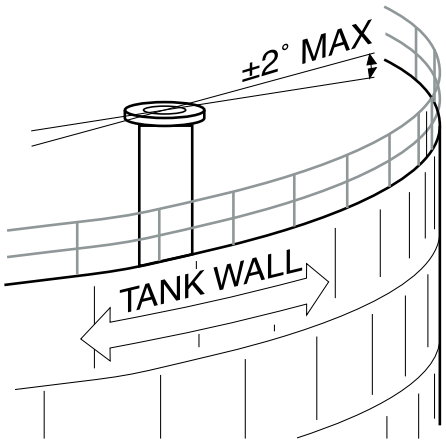
Table 3-3. Antenna size and corresponding pipe inner diameter

Antenna size (mm)	Pipe	
	Size	Inner diameter (mm)
120.2	5" SCH10-SCH60	134.5 - 125.3
145.2	6" SCH10-SCH60	161.5 - 150.3
189	8" SCH20-SCH80	206.3 - 193.7
243	10" SCH10-SCH60	264.7 - 247.7
293.5	12" SCH 10-40-XS	314.7 - 298.5

Flange Requirements

The Rosemount 5900 Still-pipe Array antenna fits flanges of size 5", 6", 8", 10" and 12". The gauge has a flange for sealing the tank. The flange must be horizontal within ±2°.

Figure 3-8. The flange must be horizontal within ±2°



Recommended Installation

When constructing new tanks, an 8" still pipe or larger is recommended. This is especially relevant in tanks with sticky, viscous products. Before manufacturing a new still pipe, we recommend that you contact Emerson Process Management / Rosemount Tank Gauging for advice.

For highest performance, the total area of the slots or holes in the still pipe must not exceed the values shown in Table 3-4 below. The listed values refer to the total area of the holes over the entire length of the pipe, regardless of its length. In some cases it is possible to allow a larger total area than stated in Table 3-4. When the limits are exceeded, please contact Emerson Process Management / Rosemount Tank Gauging for advice.

Table 3-4. Maximum area of the slots or holes

Pipe Dimension (inch)	5	6	8	10	12
Max Area of Slots or Holes (m^2)	0.1	0.1	0.4	0.80	1.2

Free Space

The following free space is recommended for mounting the Still-pipe gauge:

Figure 3-9. Free space requirements for 5900 with Array antenna Fixed version

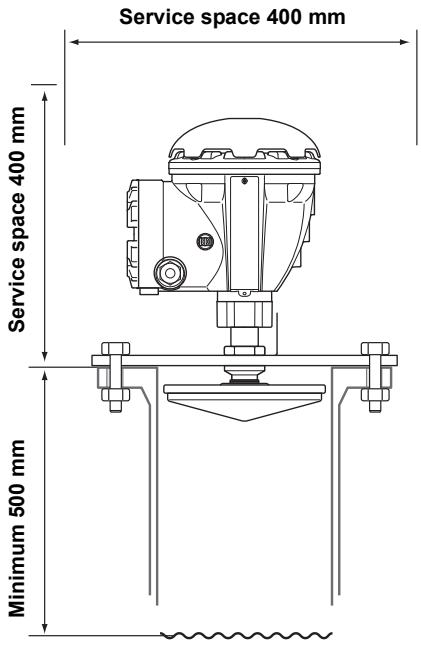
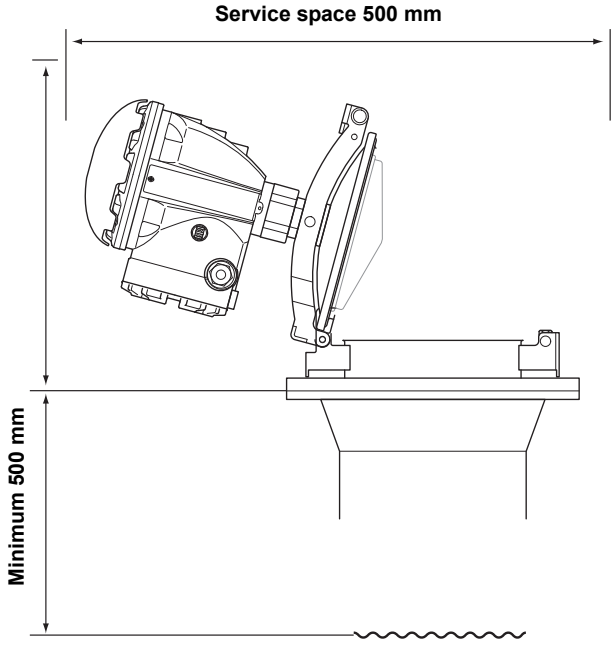


Figure 3-10. Free space requirements for 5900 with Array antenna Hinged H atch version



3.2.4 LPG/LNG Antenna Requirements

Temperature and Pressure Measurement

A prerequisite for high accuracy level-measurements in LPG/LNG tanks is that temperature and pressure measurements are made. The Rosemount 5900 transmitter can interface pressure sensors and up to six temperature sensors.

Still Pipe

A still-pipe must be installed prior to the gauge installation. The still-pipe is customer supplied and should be manufactured according to the installation drawings.

Three types of steel pipe can be used:

- DN100
- 4" SCH 10 stainless steel pipe
- 4" SCH 40 stainless steel pipe

When ordering the gauge specify the pipe type in the Required System Information (RSI) form.

The still-pipe must be vertical within ±0.5° and the customer flange must be horizontal within ±1° as illustrated in Figure 3-12 on page 3-14.

The still-pipe is manufactured with a number of holes in order to provide pressure equalization so that the product level inside the pipe is equal to the level in the rest of the tank. The diameter of the holes should be 20 mm or 3/4".

All holes in the upper pipe section must be placed along a line on one side of the pipe and aligned with a bolt hole on the pipe flange as illustrated in *Figure 3-11 on page 3-14*. The position of the holes must be clearly marked on the pipe flange. The Reference Pin must be directed towards the bolt hole. The flange marking is used to properly align the gauge with the Reference Pin, see *Figure 3-11*.

See the *Raptor System Configuration Manual*, Document No. 300510EN, for more information on configuration and verification of the 5900 with LPG/LNG antenna.

Figure 3-11. Reference pin installation

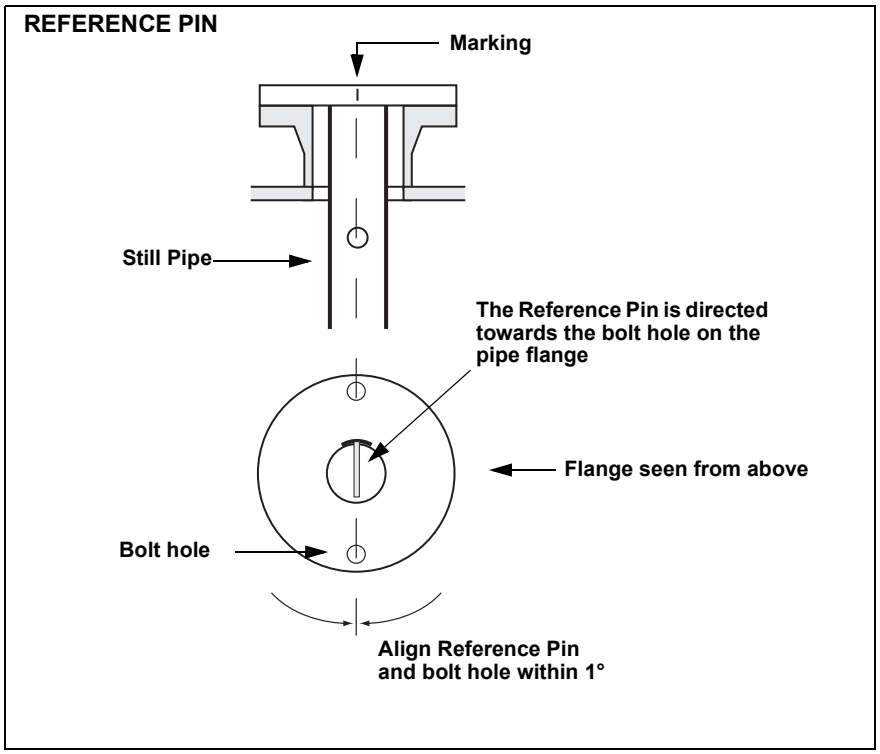
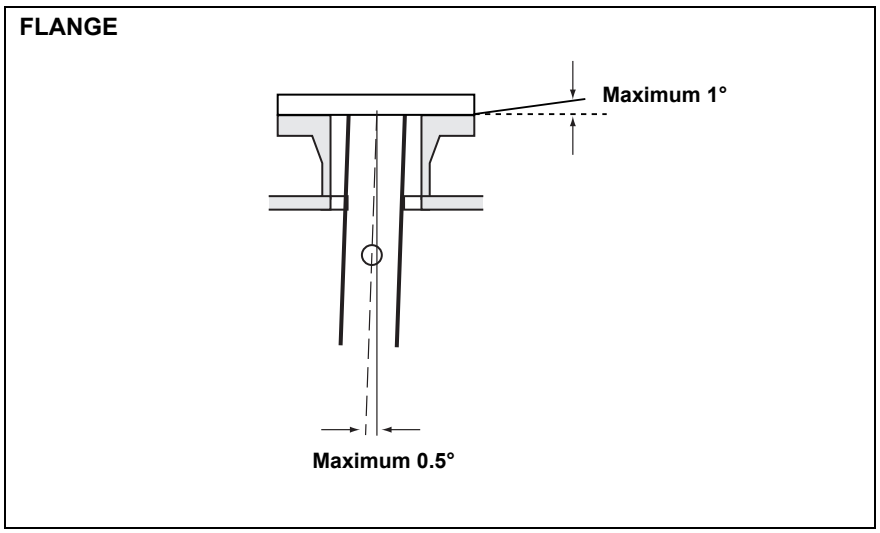


Figure 3-12. Still-pipe and flange inclination requirements



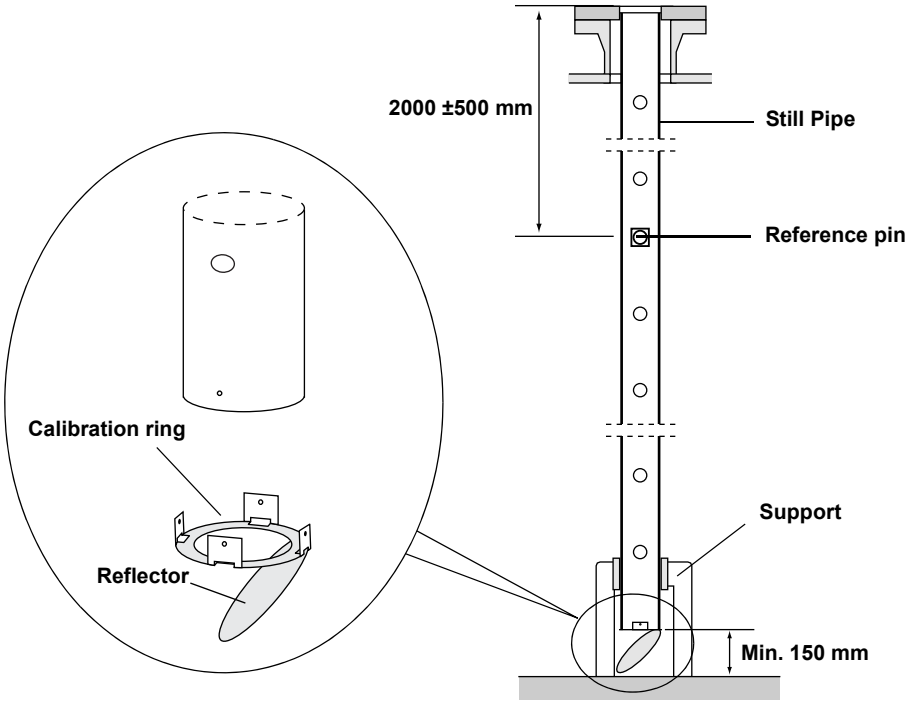
Reference Pin and Reflector

One of the holes on the still-pipe is used for mounting a **Reference Pin** which enables verification of the measurement when the tank is pressurized.

The **Reflector** is mounted at the lower end of the still-pipe and is integrated with a ring that is used for calibrating the gauge during the installation phase when the tank is empty.

See installation drawings for LPG/LNG Still-pipe for information on where to put the reference pin in the still-pipe. Installation instructions are enclosed with the reference pin and reflector.

Figure 3-13. Still-pipe with reflector and reference pin



The reflector can be attached to the Still Pipe by using one of three methods:

- Welding
- M4 screw and nut
- Riveting

For pipe dimensions 4 inch SCH 40 and DN 100 an extra ring is needed for the reflector as illustrated below in Figure 3-14 and Figure 3-15:

Figure 3-14. Mounting the reflector on pipe 4 inch SCH 40

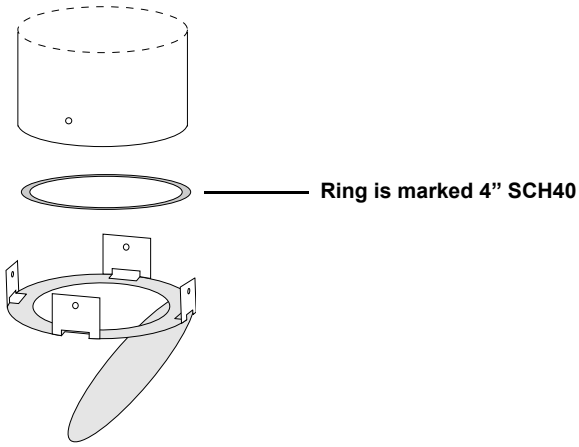
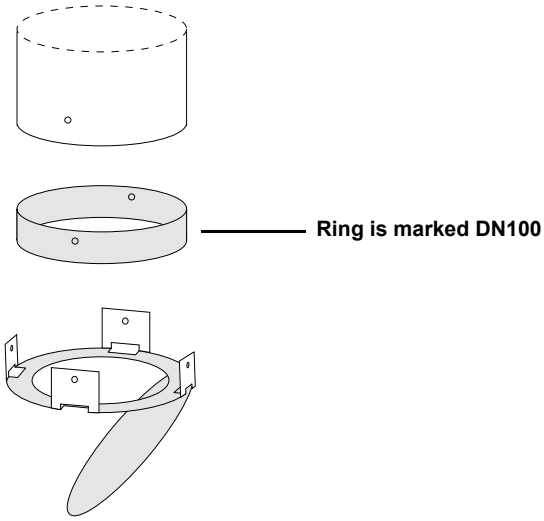


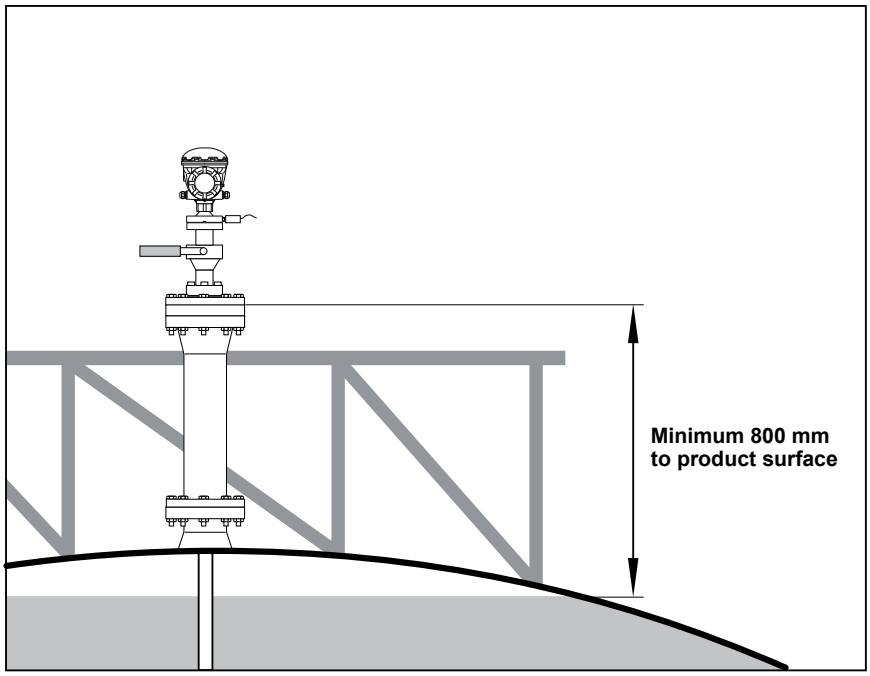
Figure 3-15. Mounting the reflector on pipe DN 100



Extension Pipe for Minimum Distance.

The radar level gauge should be placed so that there is always 800 mm or more between the flange and the maximum product level. If the tank is filled above the maximum product level, an extension pipe can be mounted to raise the radar level gauge so that it measures correctly all the way up to the maximum level, see Figure 3-16.

Figure 3-16. Rosemount 5900 with extension pipe

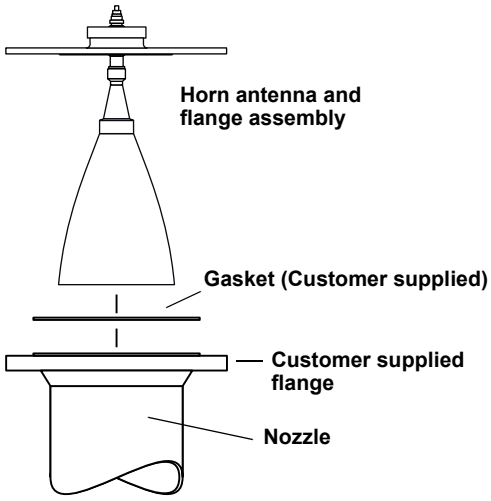


3.3 MECHANICAL INSTALLATION

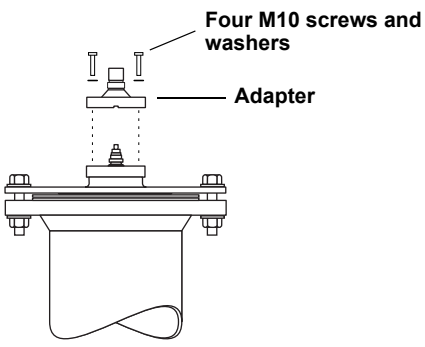
3.3.1 Horn Antenna

Follow this instruction when installing the Rosemount 5900 with Horn Antenna. See “Horn Antenna Requirements” on page 3-4 for information on mounting considerations before installing the gauge on the tank.

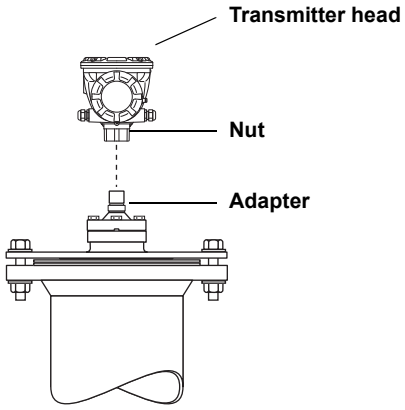
NOTE!
When determining conduit dimensions (if used), note that the Horn Antenna Gauge may be inclined 4° towards the center of the tank (see Figure 3-2 on page 3-5). Use flexible conduits close to the Radar Tank Gauge.



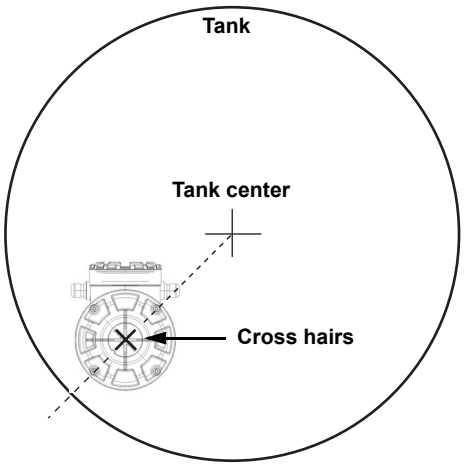
1. Check that all parts and tools are available before carrying them up to the tank roof.
2. Put a gasket on the socket and carefully insert the horn antenna and flange assembly.
3. Tighten the flange onto the socket by using suitable screws and nuts (customer supplied).



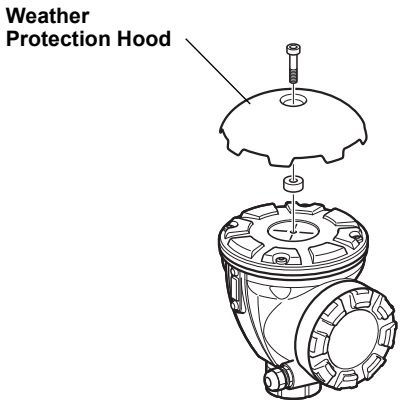
4. Put the adapter on the flange. Tighten the four M10 screws with washers by hand so that the adapter can be rotated.



5. Put the transmitter head onto the antenna adapter.
6. Ensure that the guide pin inside the transmitter head base fits the groove on the adapter.
7. Tighten the nut that connects the transmitter head to the adapter.



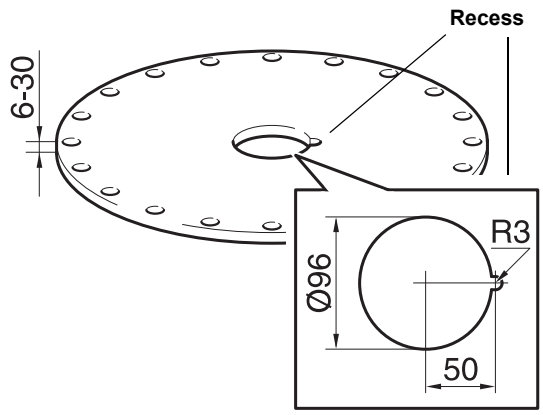
8. Ensure that the gauge is directed so that the cross hairs on top of the transmitter head points towards the center of the tank.
9. Tighten the adapter screws (4 × M10).



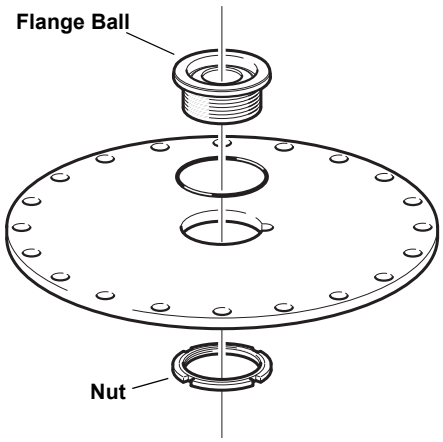
10. Put the Weather Protection Hood on top of the transmitter head and tighten the screw.
11. Connect the electrical cabling and configure the gauge by using the TankMaster WinSetup software (see the *Raptor System Configuration Manual*, Document No. 300510EN)

3.3.2 Parabolic Antenna

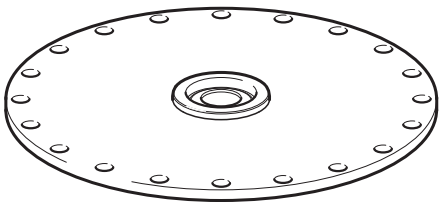
Mounting the Flange Ball model T30



1. Use a flange of thickness 6 - 30 mm.
2. Make sure that the diameter of the hole is 96 mm.
   Make a small recess at one side of the flange hole.



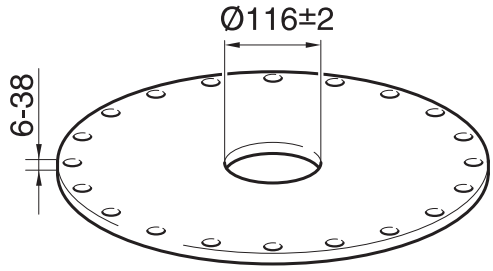
3. Put the O-ring on the flange and insert the Flange Ball into the hole. Make sure that the pin on the side of the Flange Ball fits into the recess on the flange.



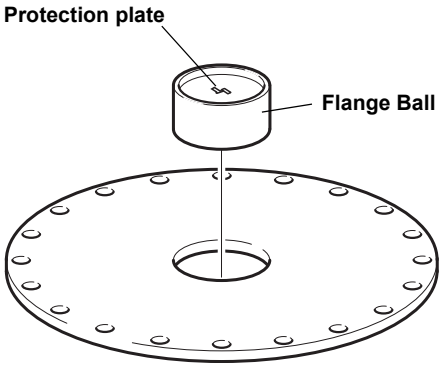
4. Tighten the nut so that the Flange Ball fits tightly to the flange (torque 50 Nm).

Mounting the Flange Ball model T38-W

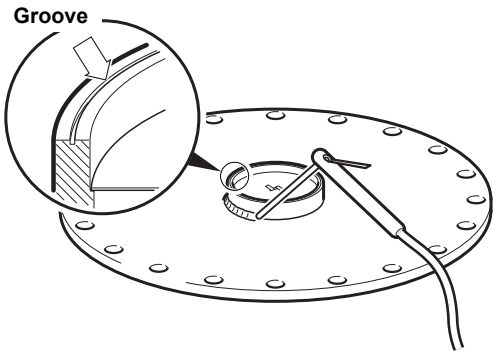
The Flange Ball T38 is welded to the flange. To mount the T38 do the following:



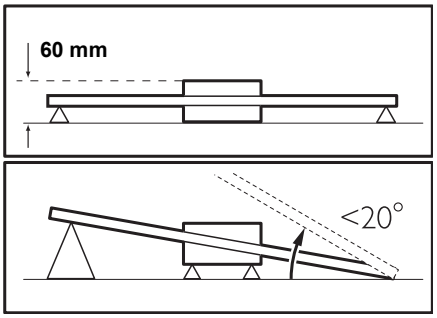
1. Make sure that the diameter of the hole is 116 ± 2 mm.



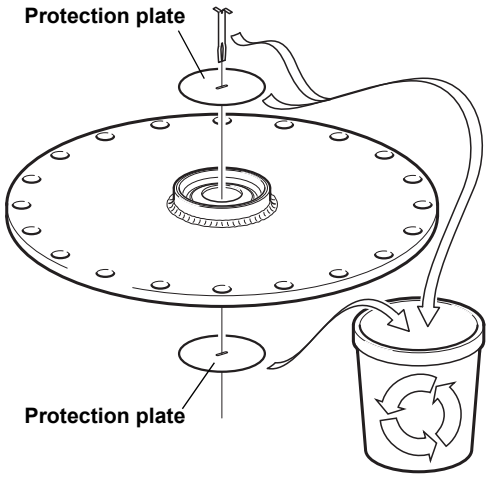
2. Let the protection plates remain on the Flange Ball until the welding is finished. These plates protect the surface of the Flange Ball from welding sparks.



3. Make sure that the Flange Ball is mounted in such a way that the grove is directed upwards when the flange is mounted on the tank nozzle.



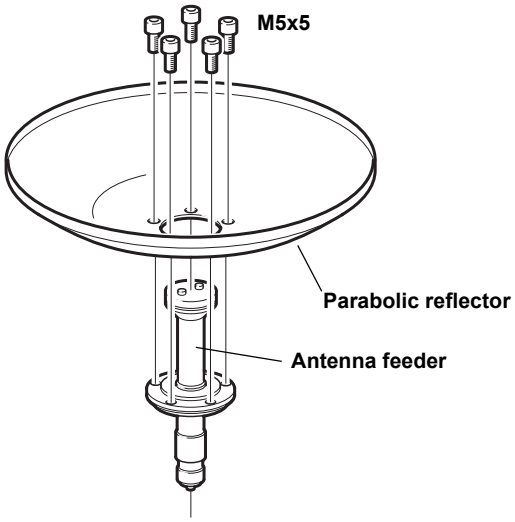
4. If the tank flange is inclined, make sure that the Flange Ball is welded so that the Flange Ball is horizontal when it is mounted on the tank. The tank flange inclination should not exceed 20 degrees.



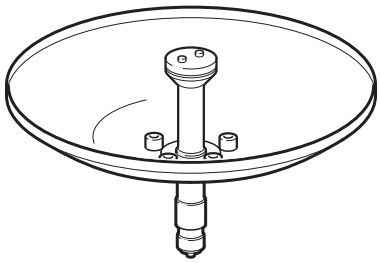
5. Remove the protection plates when the Flange Ball is welded to the flange.

Mounting the Parabolic Antenna

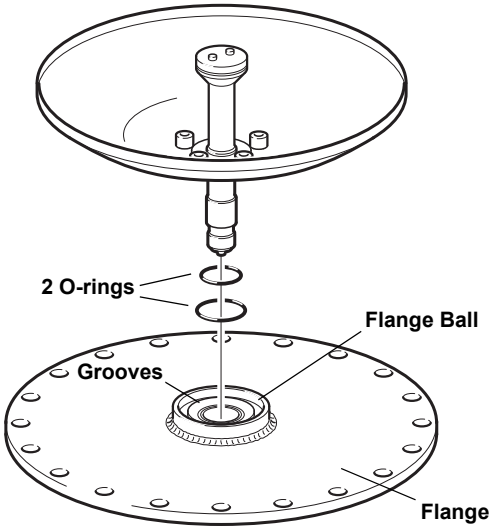
Follow this instruction when installing the the Parabolic antenna. See “Parabolic Antenna Requirements” on page 3-6 for considerations before installing the gauge on the tank.



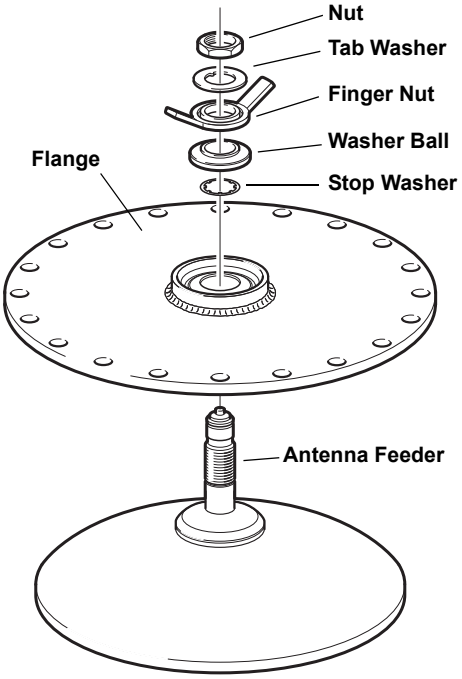
1. Check that all parts and tools are available before carrying them up to the tank top.
2. Fit the Parabolic Reflector onto the Antenna Feeder and mount the five M5 screws



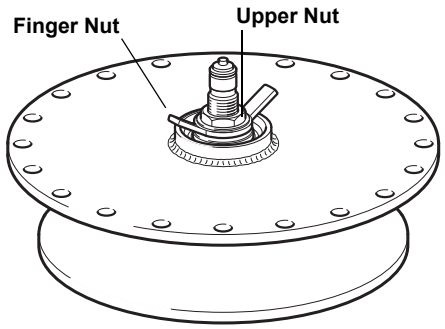
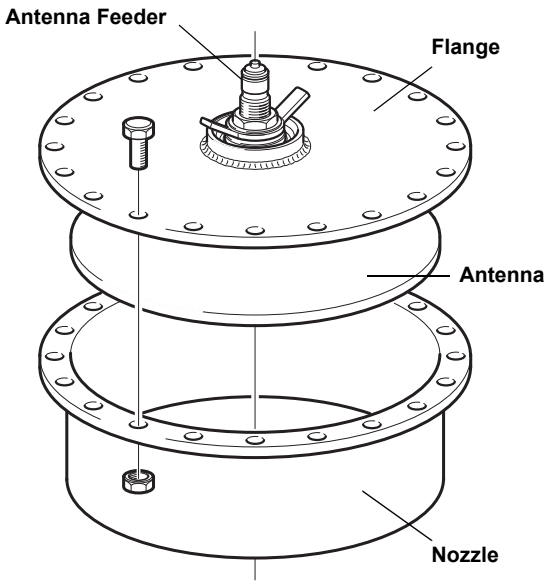
3. Tighten the screws.

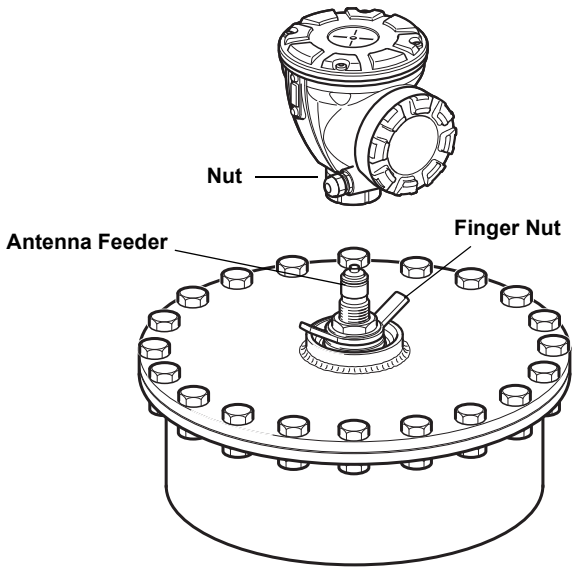


4. Put the two O-rings in the grooves on the upper surface of the Flange Ball.

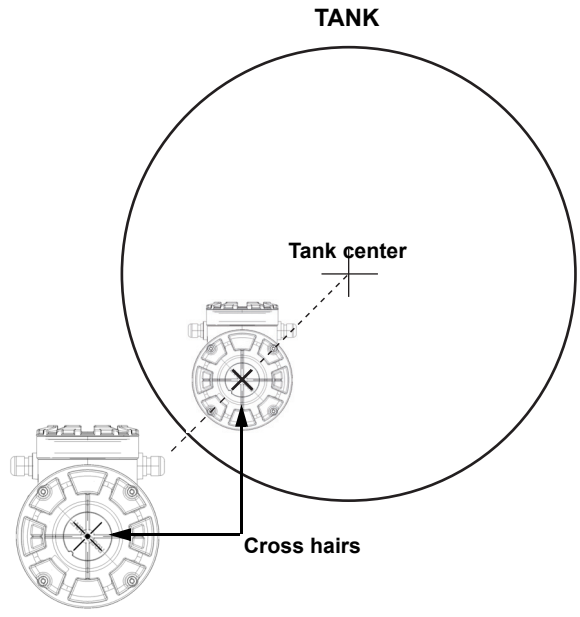


5. Turn the flange around and insert the antenna feeder into the flange hole. Mount the washers and nuts.

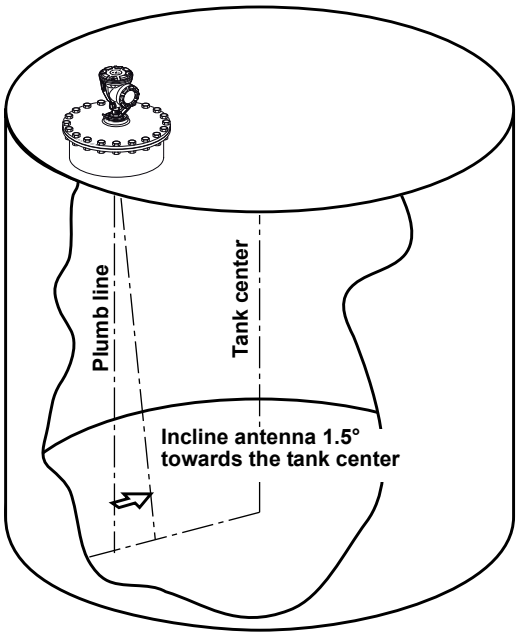
	6. Tighten the finger nut and the upper nut by hand.
	7. Place the antenna and flange assembly on the tank nozzle and tighten the flange screws.



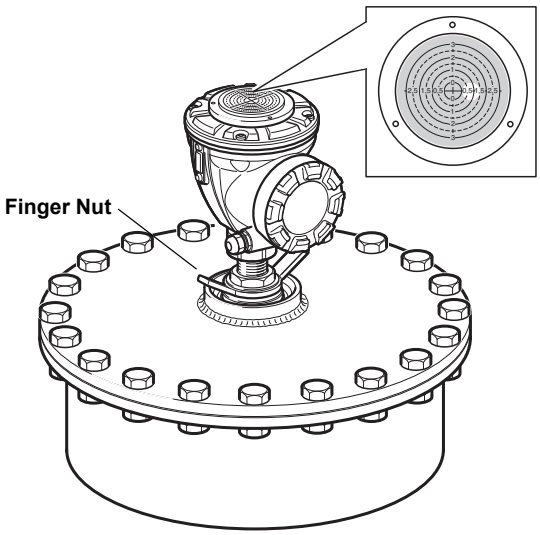
8. Put the gauge on the antenna feeder. Ensure that the guide pin inside the base of the transmitter head fits the groove on the antenna feeder.
9. Tighten the nut that connects the transmitter head to the antenna.



10. Loosen the finger nut slightly.
11. Rotate the gauge so that the cross hairs on top of the 5900 head is directed towards the center of the tank.



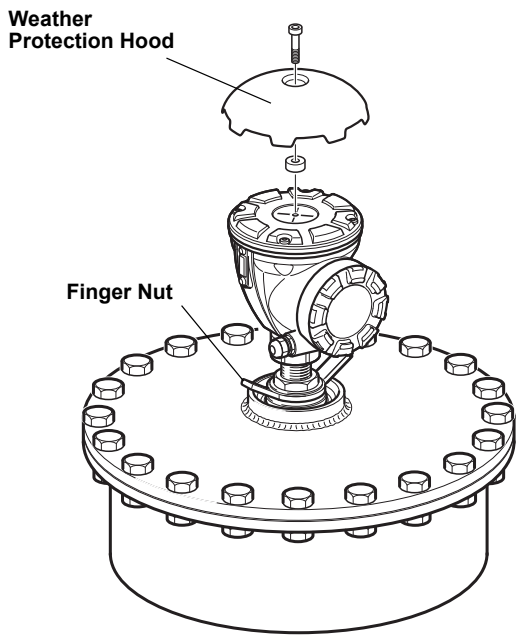
12. Use the marks on the Washer Ball to adjust the gauge so that the antenna is inclined roughly 1.5° towards the center of the tank.
Note: For bitumen tanks, the gauge should be mounted with 0° inclination.
13. Tighten the finger nut.



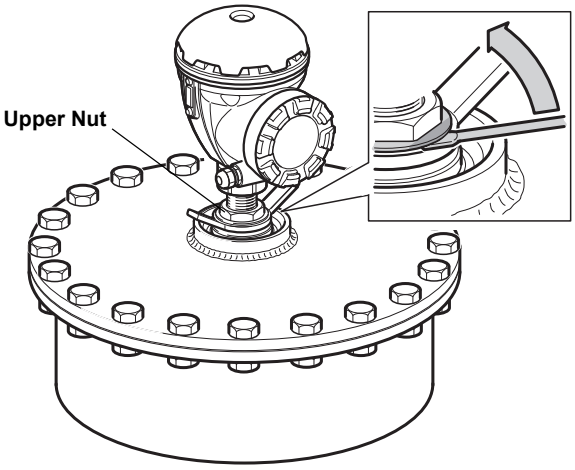
14. Place the level on top of the transmitter head and check that the inclination of the gauge is 1.5° towards the tank center. If not, loosen the finger nut and adjust the gauge.

Note: Make sure the air bubble touches, but doesn´t overlap the 1.5° mark.

Note: For bitumen tanks, the gauge should be mounted with 0° inclination.
15. Tighten the finger nut firmly.



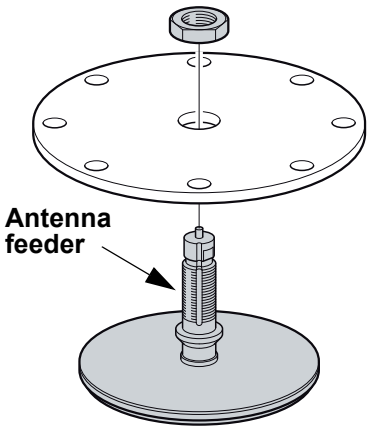
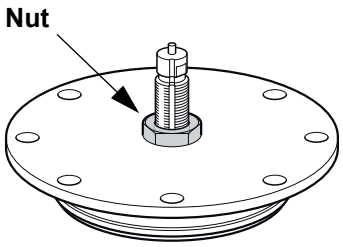
16. Put the Weather Protection Hood on top of the transmitter head and tighten the screw.

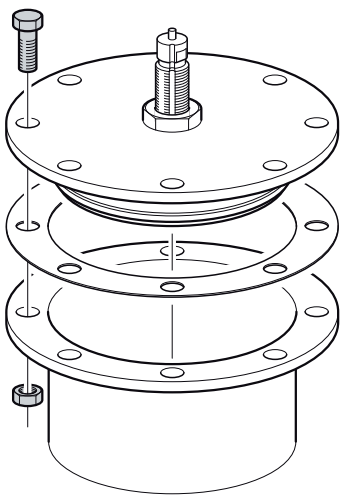


17. Tighten the upper nut to lock the finger nut, and secure by folding the tab washer over the nut.
18. Connect the electrical cabling and configure the gauge by using the TankMaster WinSetup software (see the *Raptor System Configuration Manual*, Document No. 300510EN).

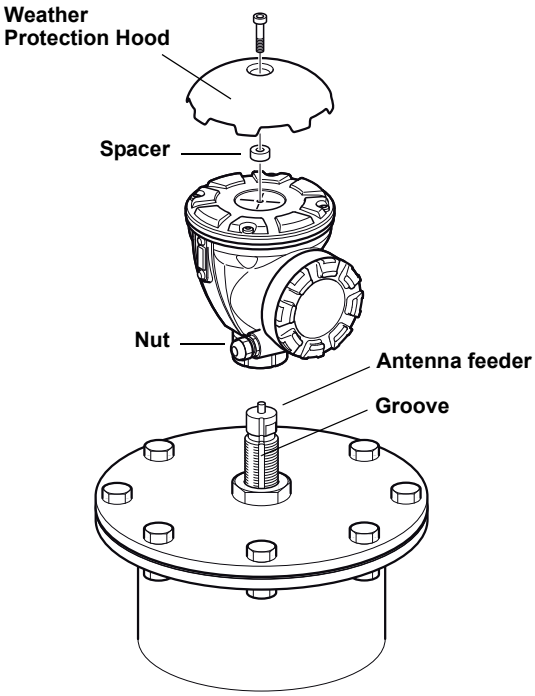
3.3.3 Array Antenna - Fixed version

Follow this Step by Step instruction when installing the Array Antenna Fixed version. See “Still Pipe Antenna Requirements” on page 3-10 for information on mounting considerations before installing the gauge on the tank.

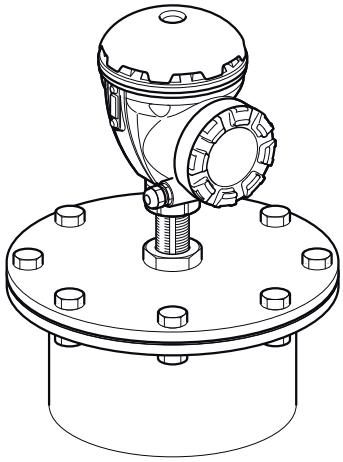
	1. Insert the antenna feeder into the flange hole.
	2. Tighten the nut. Secure by folding the tab washer over the nut.



3. Put the antenna and flange assembly on the tank nozzle and tighten the flange screws.



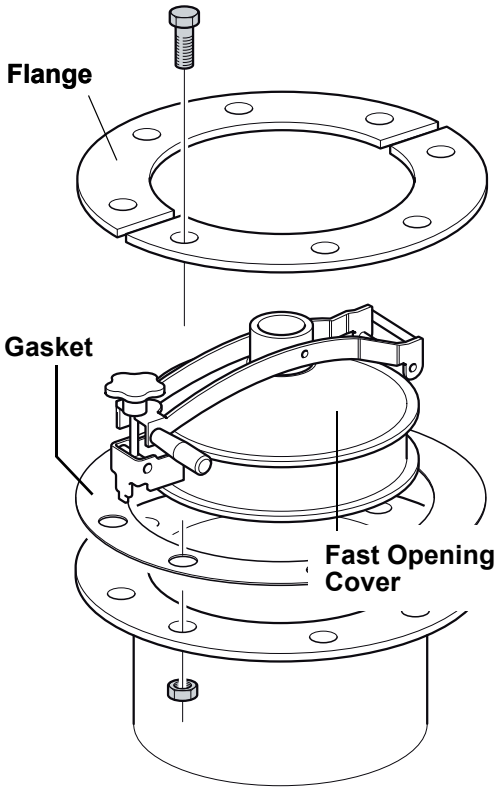
4. Carefully put the gauge on top of the antenna feeder and tighten the nut. Ensure that the guide pin inside the base of the transmitter head fits the groove on the antenna feeder.
5. Put the Weather Protection Hood on top of the transmitter head and tighten the screw.



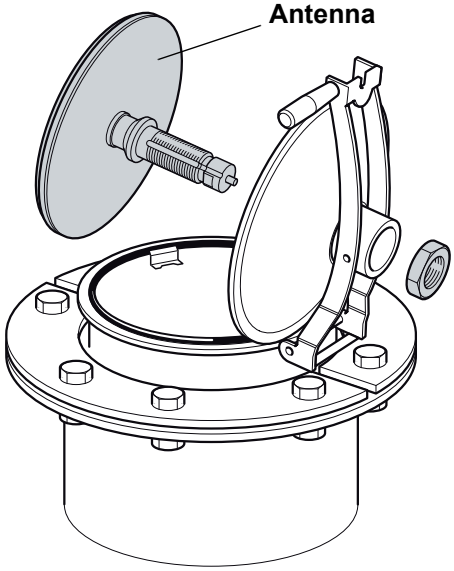
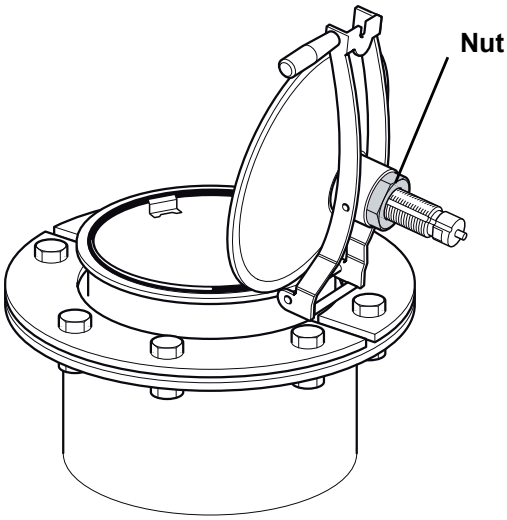
6. Connect the electrical cabling and configure the 5900 by using the TankMaster WinSetup software, see the *Raptor System Configuration Manual* (Document No. 300510EN).

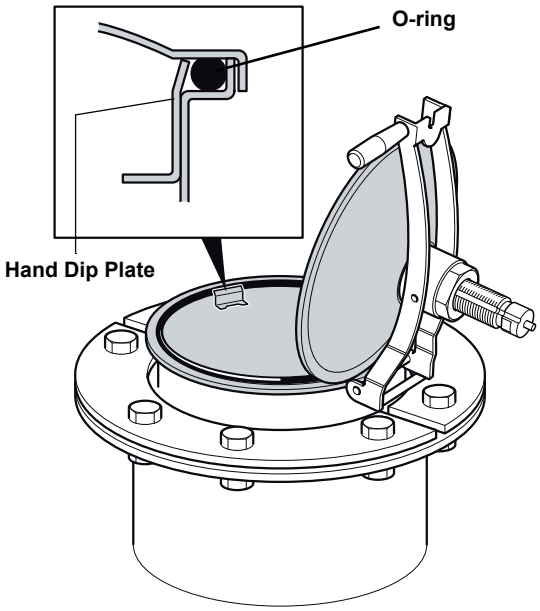
3.3.4 Array Antenna - Hinged Hatch

Follow this instruction when installing the the Array antenna Hinged Hatch version.

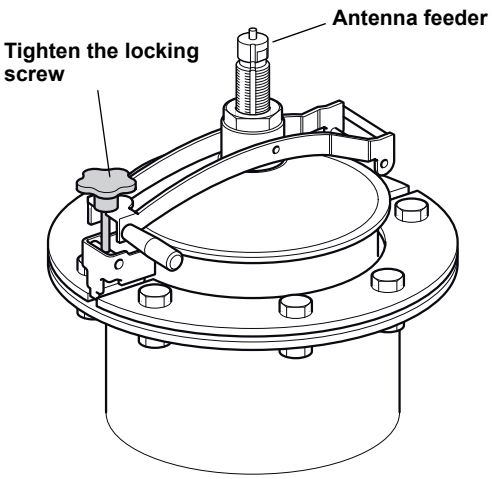


1. Mount the Fast Opening Cover and flange on the nozzle. The flange consists of two parts mounted on each side of the cover. (There is also a version available with a flange welded on the cover).
2. Tighten the flange screws.

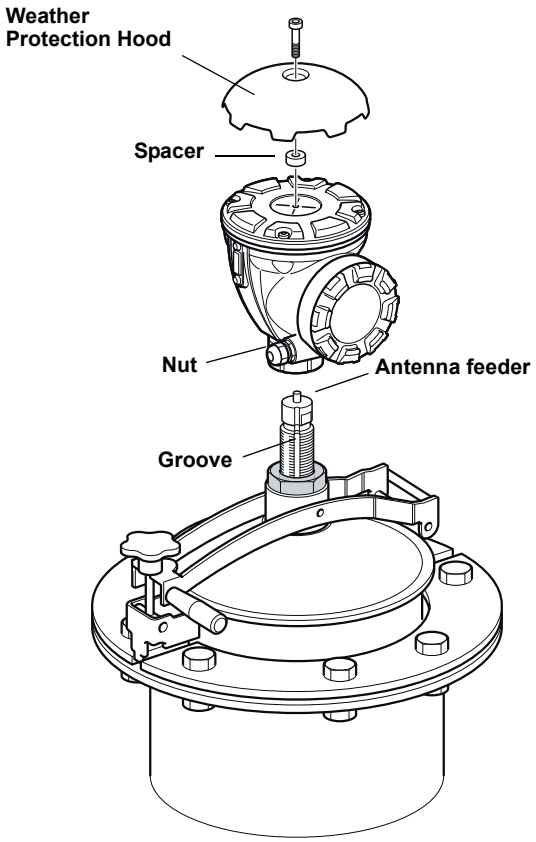
	3. Mount the antenna on the lid.
	4. Tighten the nut which holds the antenna to the lid.



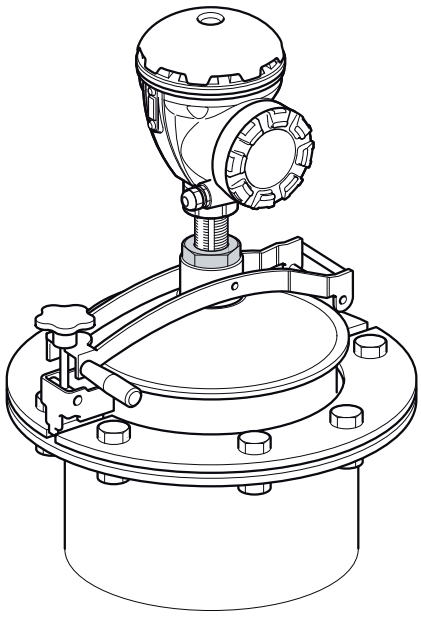
5. Check that the O-ring is properly seated all around the cover and is pressed down behind the Hand Dip Plate.



6. Close the lid and tighten the locking screw.



7. Carefully put the gauge on top of the antenna feeder and tighten the nut. Ensure that the guide pin inside the base of the transmitter head fits the groove on the antenna feeder.
8. Put the Weather Protection Hood on top of the transmitter head and tighten the screw.

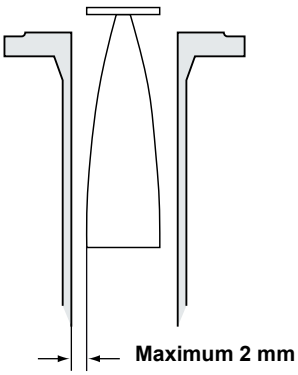


9. Connect the electrical cabling and configure the gauge by using the TankMaster WinSetup software (see the *Raptor System Configuration Manual*, Document No. 300510EN)

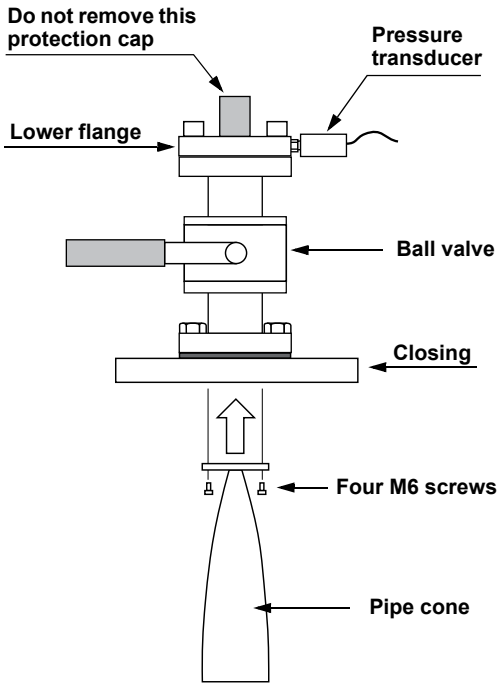
3.3.5 LPG/LNG Antenna

Follow this step by step instruction when installing the LPG/LNG antenna. See “LPG/LNG Antenna Requirements” on page 3-13 for information on mounting considerations before installing the gauge on the tank.

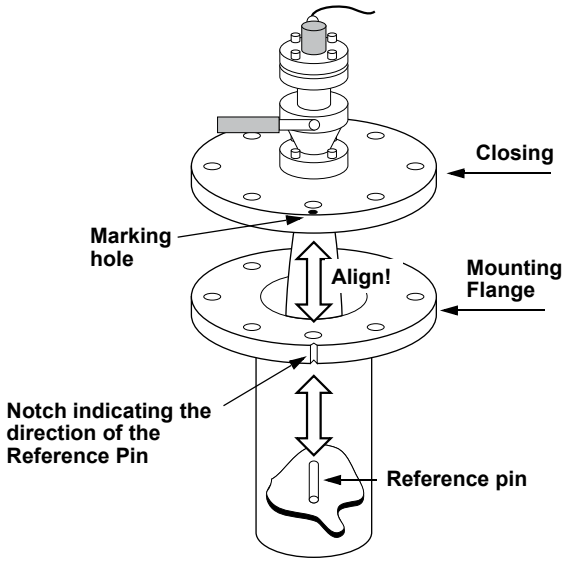
NOTE!
There must be a mark on the pipe flange to show the direction of the reference pins in the still pipe. Carefully check that the Closing is mounted in the appropriate angle relative to that mark.



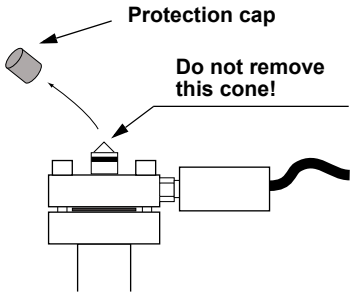
1. Ensure that all parts and tools are available before carrying them to the tank top.
2. Install the still pipe according to mechanical installation drawing 9150072-924.
3. Check that the Cone antenna fits into the still pipe. The gap between the Cone antenna and the pipe must not exceed 2 mm.



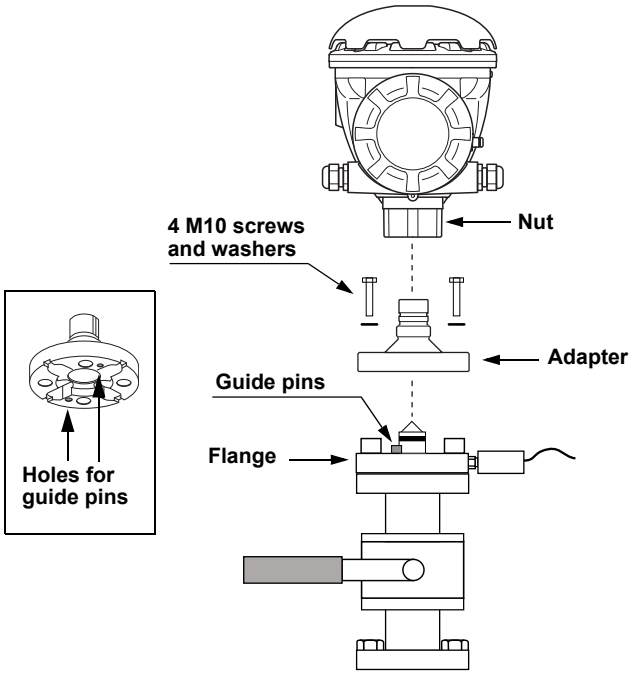
4. Mount the Pipe Cone onto the Closing using four M6 Allen head screws. Be careful when handling the Closing and Pipe Cone assembly. It is important that the Pipe Cone is undamaged. Do not remove the yellow protective cap.



5. Place a gasket (customer supplied) on the Mounting Flange.
6. Carefully fit the Pipe Cone into the still pipe and tighten the Closing onto the Mounting Flange (customer supplied screws and nuts).
7. Direct the Closing so that the marking hole aligns with the notch or mark on the pipe flange.
8. The tank is now sealed and can, as far as Rosemount Tank Gauging equipment is concerned, be pressurized



9. Remove the yellow protection cap. Do not remove the rubber cone.



10. Put the adapter on the flange and tighten the four M10 screws with washers.
    Ensure that the guide pins enter the holes in the adapter.
11. Fit the Transmitter Head on the adapter and tighten the nut that connects the transmitter head to the antenna
12. Connect the electrical cabling and configure the gauge by using the TankMaster WinSetup software, see the *Raptor System Configuration Manual* (Document no. 300510EN).
13. Configure the gauge for LPG measurements (see *"LPG Configuration" on page 4-9*).

3.4 ELECTRICAL INSTALLATION

3.4.1 Cable/conduit entries

The electronics housing has entries for ½ - 14 NPT. Optional M20×1.5, minifast and eurofast adapters are also available. The connections are made in accordance with local or plant electrical codes.

Make sure that unused ports are properly sealed to prevent moisture or other contamination from entering the terminal block compartment of the electronics housing.

NOTE!
It is recommended that a sealant is used on the cable entry threads to prevent water from entering the housing interior.

NOTE!
Use the enclosed metal plugs to seal unused ports. The orange plastic plugs mounted at delivery are not sufficient as seal!

3.4.2 Grounding

The housing should always be grounded in accordance with national and local electrical codes. Failure to do so may impair the protection provided by the equipment. The most effective grounding method is direct connection to earth ground with minimal impedance. There are three grounding screw connections provided. Two are located inside the Field Terminal side of the housing and the third is located on the housing. The internal ground screws are identified by a ground symbol: ⏚.

NOTE!
Grounding the transmitter via threaded conduit connection may not provide sufficient ground.

Grounding - Foundation Fieldbus

Signal wiring of the fieldbus segment can not be grounded. Grounding out one of the signal wires will shut down the entire fieldbus segment.

Shield Wire Ground

To protect the fieldbus segment from noise, grounding techniques for shield wire usually require a single grounding point for shield wire to avoid creating a ground loop. The ground point shall be located at the power supply.

The *Raptor* devices are designed for “daisy-chain” connection of shield wiring in order to enable a continuous shield throughout the Tankbus network.

3.4.3 Cable Selection

Use shielded twisted pair wiring for the Rosemount 5900 Series in order to comply with EMC regulations and to ensure good fieldbus performance is achieved. The cables must be suitable for the supply voltage and approved for use in hazardous areas, where applicable. In the U.S. explosion-proof conduits may be used in the vicinity of the vessel.

Use 22 AWG to 18 AWG in order to minimize the voltage drop to the transmitter.

The FISCO(1) FOUNDATION™ fieldbus specification requires that cables for the Raptor Tankbus comply with the following parameters:

Table 3-5. FISCO cable parameters

Parameter	Value
Loop resistance	15Ω/km to 150Ω/km
Loop inductance	0.4 mH/km to 1 mH/km
Capacitance	45 nF/km to 200 nF/km
Maximum length of each spur cable	60 m in apparatus class IIC and IIB
Maximum cable length including trunk and spurs	1000 m in apparatus class IIC and 1900 m in apparatus class IIB

3.4.4 Hazardous Areas

When the Rosemount 5900 level gaugeis installed in hazardous area, local regulations and specifications in applicable certificates must be observed.

3.4.5 Power Requirements

The Rosemount 5900 is powered over the intrinsically safe Tankbus by the Rosemount 2410 tank communication unit. The 2410 feeds the intrinsically safe fieldbus segment by acting as a FISCO power supply on the Tankbus.

3.4.6 Power Budget

The Rosemount 2410 tank hub delivers 250 mA to the Tankbus. The number of tanks served by the 2410 depends on the type of connected field devices and their power consumption(2). Power consumption per field device is listed in Table 3-6 below:

Table 3-6. Power consumption for various Raptor devices

Field device	Power consumption
5900S Radar Level Gauge	50 mA
5300T or 5400T Series Radar Level Gauge	20-25 mA
Rosemount 2230 Graphical Field Display	25 mA
Rosemount 2240S Multi-input Temperature Transmitter	30 mA including MST and WLS
Rosemount 644 Temperature Transmitter	11 mA
Rosemount 3051 Pressure Transmitter	17.5 mA

The Rosemount 2410 tank hub supports a maximum of one tank for a 5900S-based configuration. In a 5300T- or 5400T-based configuration up to 10 tanks are supported.

(1) See also the reference document IEC/TS 60079-27

(2) May be fewer than the 16 devices per segment, stated in the FOUNDATION™ fieldbus standard.

3.4.7 The Raptor Tankbus

The Raptor system is easy to install and wire. Devices can be “daisy-chained” thus reducing the number of external junction boxes.

In a Raptor system devices communicate with a Rosemount 2410 tank hub via the intrinsically safe Tankbus. The Tankbus complies with the FISCO(1) FOUNDATION fieldbus standard. The Rosemount 2410 acts as power supply to the field devices on the Tankbus.

Termination

A terminator is needed at each end of a FOUNDATION Fieldbus network. Generally, one terminator is placed in the fieldbus power supply, and the other one in the last device in the fieldbus network.

NOTE!
Ensure that there are **two** terminators on the fieldbus.

In a Raptor system the Rosemount 2410 tank hub acts as power supply. Since the 2410 normally is the first device in the fieldbus segment, the built-in termination is enabled at factory

Other Raptor devices such as the Rosemount 5900 radar level gauge, the Rosemount 2230 graphical display, and the Rosemount 2240 multi-input temperature transmitter also have built-in terminators which can easily be enabled by inserting a jumper in the terminal block when necessary.

Segment design

When designing a FISCO fieldbus segment a few requirements need to be considered. Cabling has to comply with FISCO requirements as described in “Cable Selection” on page 3-40.

You will also have to ensure that the total operating current of the connected field devices is within the output capability of the Rosemount 2410 tank hub. The 2410 is able to deliver 250 mA. Consequently, the number of field devices has to be considered so that the total current consumption is less than 250 mA, see “Power Budget” on page 3-40.

Another requirement is to ensure that all field devices have at least 9 V input voltage at their terminals. Therefore you will have to take into account the voltage drop in the fieldbus cables.

Distances are normally quite short between the Rosemount 2410 tank hub and field devices on the tank. In many cases you can use existing cables as long as the FISCO requirements are fulfilled (see “Cable Selection” on page 3-40).

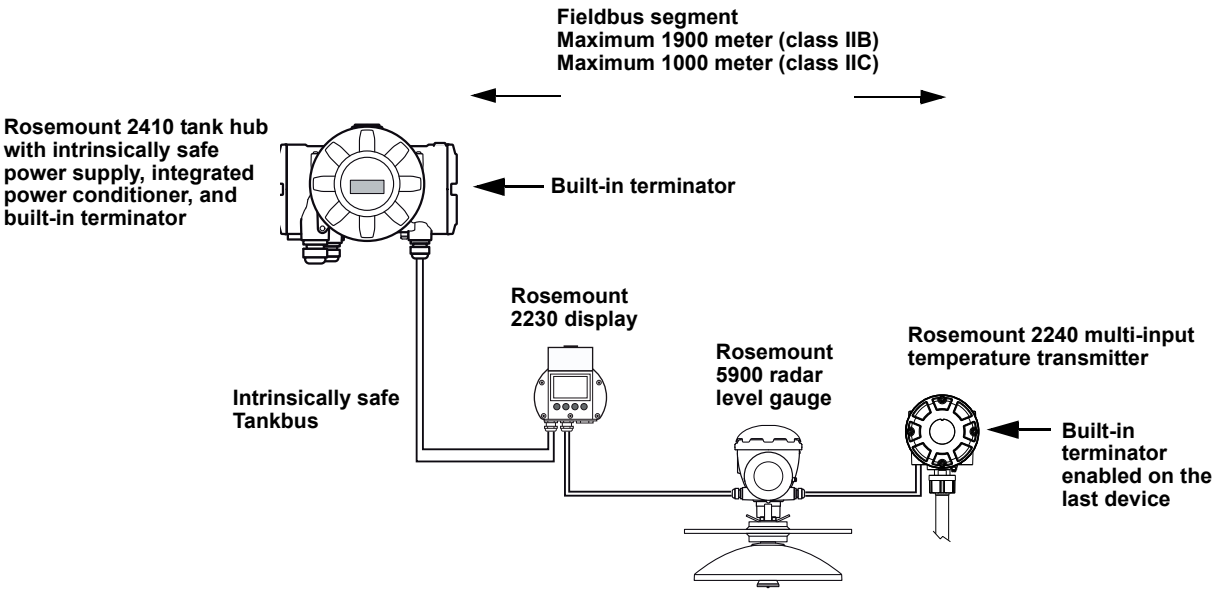
See “The Raptor Tankbus” on page 3-7 in the *Rosemount 2410 Reference Manual* (Document no. 305030EN) for more information on segment design of a Raptor system.

(1) FISCO=Fieldbus Intrinsically Safe Concept

3.4.8 Typical installations

The example below (Figure 3-17) illustrates a Raptor system with terminators at both ends of the fieldbus segment as required in a FOUNDATION fieldbus system. In this case terminators are enabled in the Rosemount 2410 tank hub and a Raptor field device at the end of the network segment.

Figure 3-17. Example of a Raptor Tankbus connection for a single tank



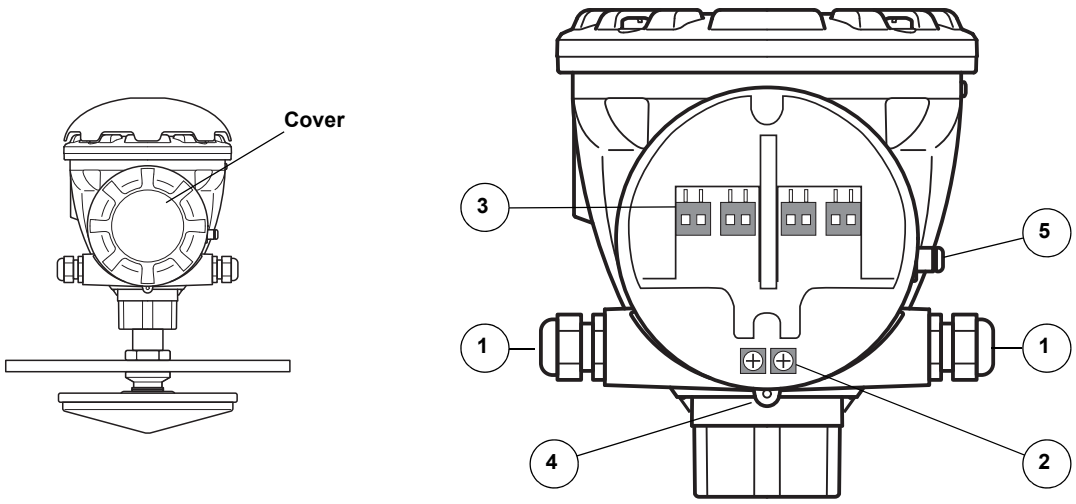
See “Typical installations” on page 3-10 in the *Rosemount 2410 Reference Manual* (Document no. 305030EN) for more Raptor system installation examples.

3.4.9 Wiring

To connect the Rosemount 5900 Series transmitter:

⚠ 1. Make sure that the power supply is switched off.
2. Remove the cover on the terminal compartment.
3. Run the wires through the appropriate cable gland/conduits.
   Install wiring with a drip loop. The bottom of the loop must be lower than the cable entry.
4. Connect wires as described in “Terminal Blocks” on page 3-44.
5. Connect the positive lead to the terminal marked (+) and the negative lead to the terminal marked (-).
6. Use the enclosed metal plug to seal any unused port.
⚠ 7. Replace the cover. Make sure that the cover is fully engaged.
8. Tighten the conduit/cable gland.
   Note that adapters are required for M20 glands.
9. Switch on the power supply.

Figure 3-18. Terminal compartment



① Cable glands
② Internal Ground screws
③ Terminals for signal and power supply
④ Locking screw (Flameproof version)
⑤ External Ground screw

3.4.10 Terminal Blocks

Figure 3-19. Rosemount 5900 terminal compartment

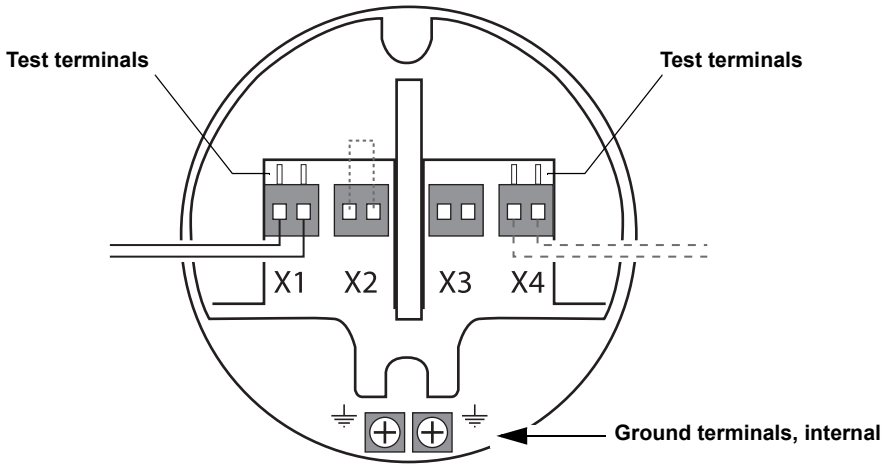


Table 3-7. Standard terminal block connections for the 5900

Connection	Standard
X1: Tankbus in	Intrinsically safe Tankbus input, power and communication
X2: Terminate on	The integrated line terminator is connected over the Tankbus when a jumper is placed in the terminal block
X3: Shield loop through	Cable shield daisy-chain connector (not grounded)
X4: Tankbus out	Tankbus output connected to X1 for optional daisy-chain connection to other devices
Test terminals	Test terminals for temporary connection of a handheld communicator such as the Rosemount 375 Field Communcator

The X1 terminal is connected to the intrinsically safe Raptor Tankbus.

A jumper on the X2 terminal enables the built-in termination. The termination should be used if the Rosemount 5900 gauge is installed at the end of a Tankbus network. See “The Raptor Tankbus” on page 3-41 for more information on how to terminate the Raptor Tankbus.

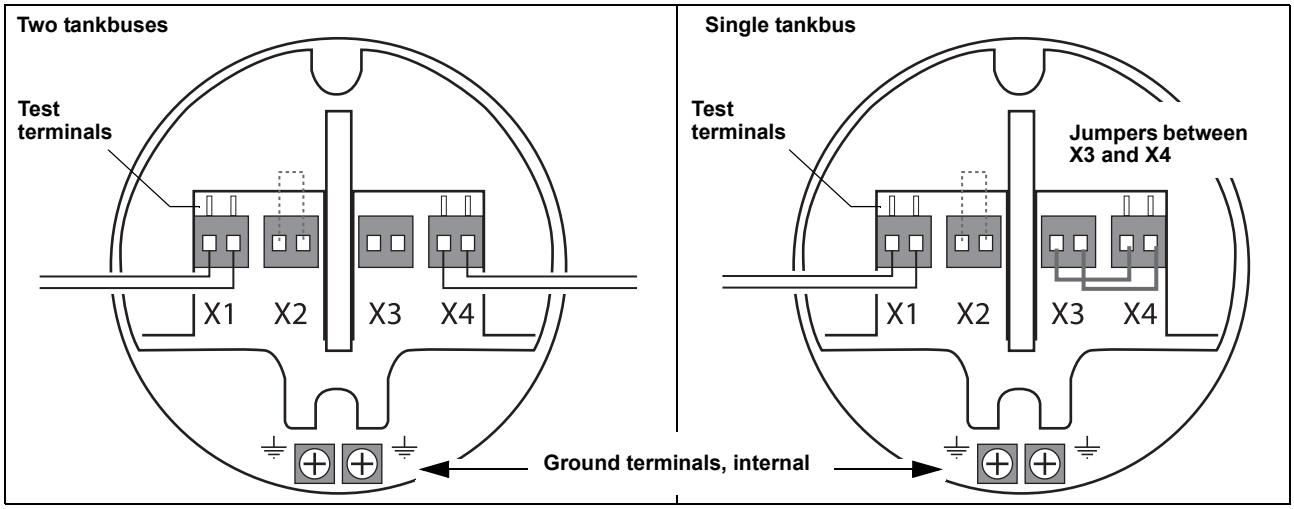
The X3 terminal is used for connecting the cable shield in order to enable a continuous shield throughout the Tankbus network.

The X4 terminal can be used for “daisy-chain” connection to other Raptor devices such as the 2240 tank temperature multiplexer, or the 2230 tank display unit, see also Figure 3-22 on page 3-47.

Terminal Block Two-in-One Version

The Rosemount 5900 Two-in-One version can be connected to a single Tankbus or two separate Tankbuses.

Figure 3-20. Terminal compartment.2-in-1 version



When using two separate tankbuses, connect X1 to Tankbus 1 and X4 to Tankbus 2.

Table 3-8. Terminal Block connections for the 5900 with two tankbuses

Connection	Two-in-One / Two tankbuses
X1: Primary Tankbus in	Intrinsically safe Tankbus input for level gauge 1, power and communication
X2: Terminate on	Termination for primary tankbus . The integrated line terminator is connected over the Tankbus when a jumper is placed in the terminal block.
X3: Primary Tankbus out	Primary Tankbus output connected to X1 for optional daisy-chain connection to other devices
X4: Secondary Tankbus in	Intrinsically safe Tankbus input for level gauge 2, power and communication
Test terminals	Test terminals for temporary connection of a handheld communicator such as the Rosemount 375 Field Communcator

Connect to X1 when using a single tankbus, and jumpers between X3 and X4.

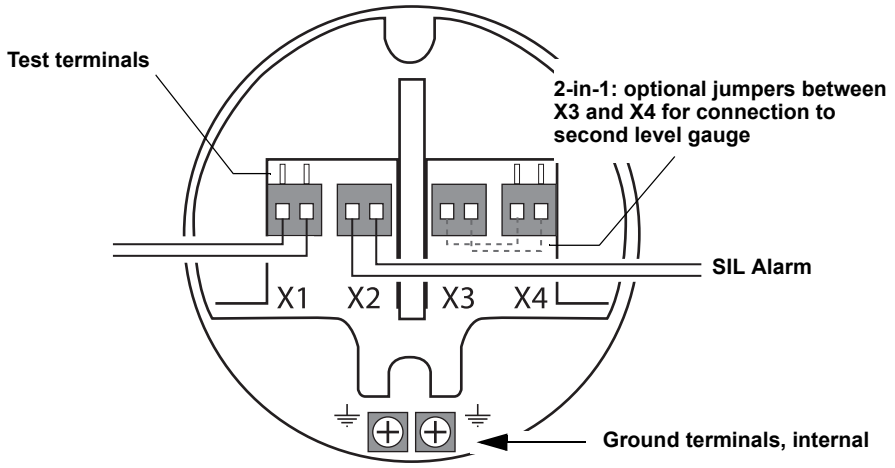
Table 3-9. Terminal Block connections for the 5900 with single tankbus

Connection	Two-in-One / Single tankbus
X1: Primary Tankbus in	Intrinsically safe Tankbus input, power and communication
X2: Terminate on	Termination for primary tankbus . The integrated line terminator is connected over the Tankbus when a jumper is placed in the terminal block.
X3: Primary Tankbus out	Jumpers between X3 and X4
X4: Secondary Tankbus in	
Test terminals	Test terminals for temporary connection of a handheld communicator such as the Rosemount 375 Field Communcator

Gauge Terminal Block SIL Safety System

The Rosemount 5900 has a SIL alarm output which is connected to the Rosemount 2410 Tank Hub.

Figure 3-21. Terminal compartment



For the 2-in-1 SIL version of the Rosemount 5900, optional jumpers are placed between terminals X3 and X4 for connection to the second radar level gauge.

Table 3-10. Terminal Block connections for the 5900 with SIL option

Connection	SIL Safety System
X1: Primary Tankbus in	Intrinsically safe Tankbus input, power and communication
X2: Alarm	**SIL alarm output** (connect to Exi terminal block on Rosemount 2410 Tank Hub)
X3: Primary Tankbus out	Optional jumpers between X3 and X4 for connection to second level gauge of the Rosemount 5900 / 2-in-1 version
X4: Secondary Tankbus in	
Test terminals	Test terminals for temporary connection of a handheld communicator such as the Rosemount 375 Field Communcator

3.4.11 Wiring Diagrams

The standard version of the Rosemount 5900 has a single intrinsically safe fieldbus input. The 5900 has a built-in termination by short circuiting the X2 connector.

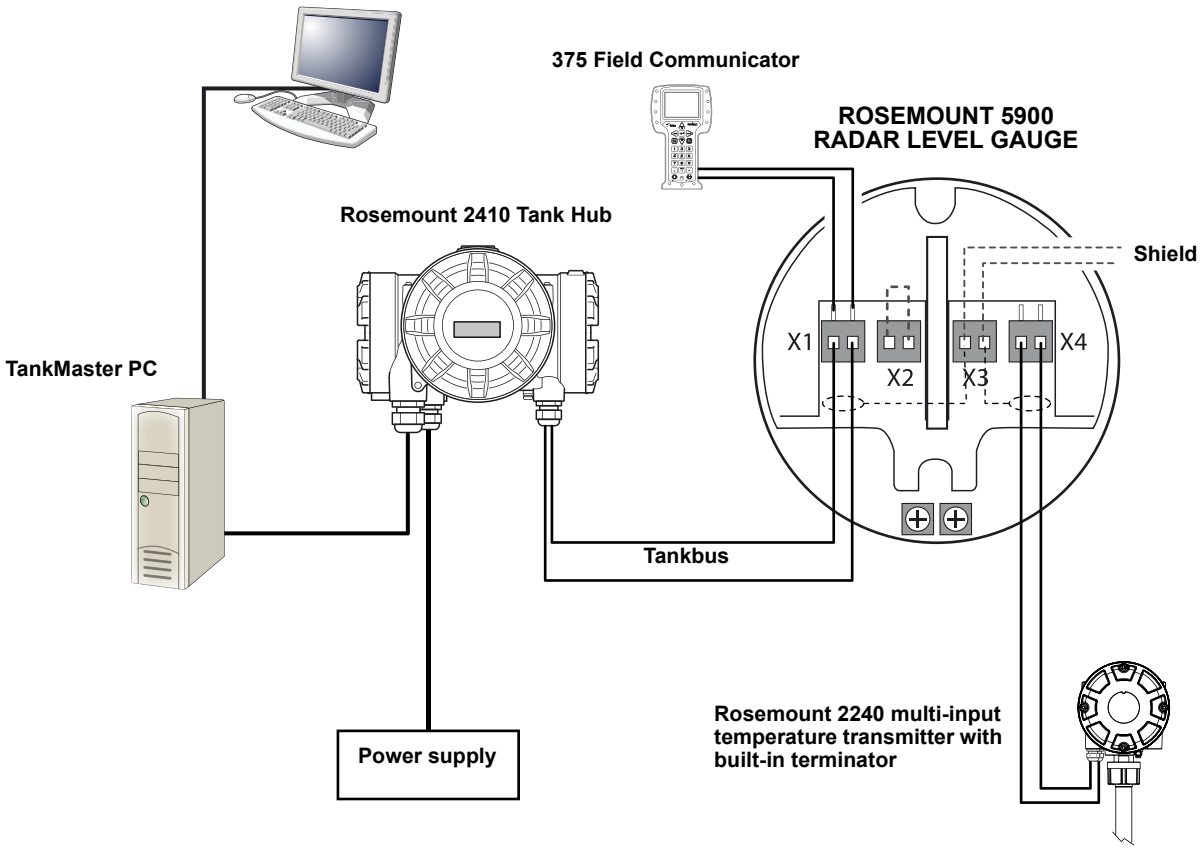
An intrinsically safe output on connector X4 can be used for “daisy-chain” connection to other devices in a Raptor system.

Connector X3 is used for a fieldbus input/output cable shield connection (separated from chassis ground).

Figure 3-22 illustrates a typical wiring diagram with a Rosemount 5900 level gauge connected to a Rosemount 2240 multi-input temperature transmitter. In this example the termination is enabled in the 2240 transmitter since this is the last device on the Tankbus (see “The Raptor Tankbus” on page 3-41).

In case you prefer to connect the 2240 to the 2410 tank hub, you may “daisy-chain” the 5900 to the 2240, and terminate the Tankbus by a jumper in terminal X2 on the 5900 terminal block.

Figure 3-22. Rosemount 5900 standard wiring diagram



See also “Terminal Blocks” on page 3-44 for information on terminal block connections.

The Rosemount 5900 2-in-1 version

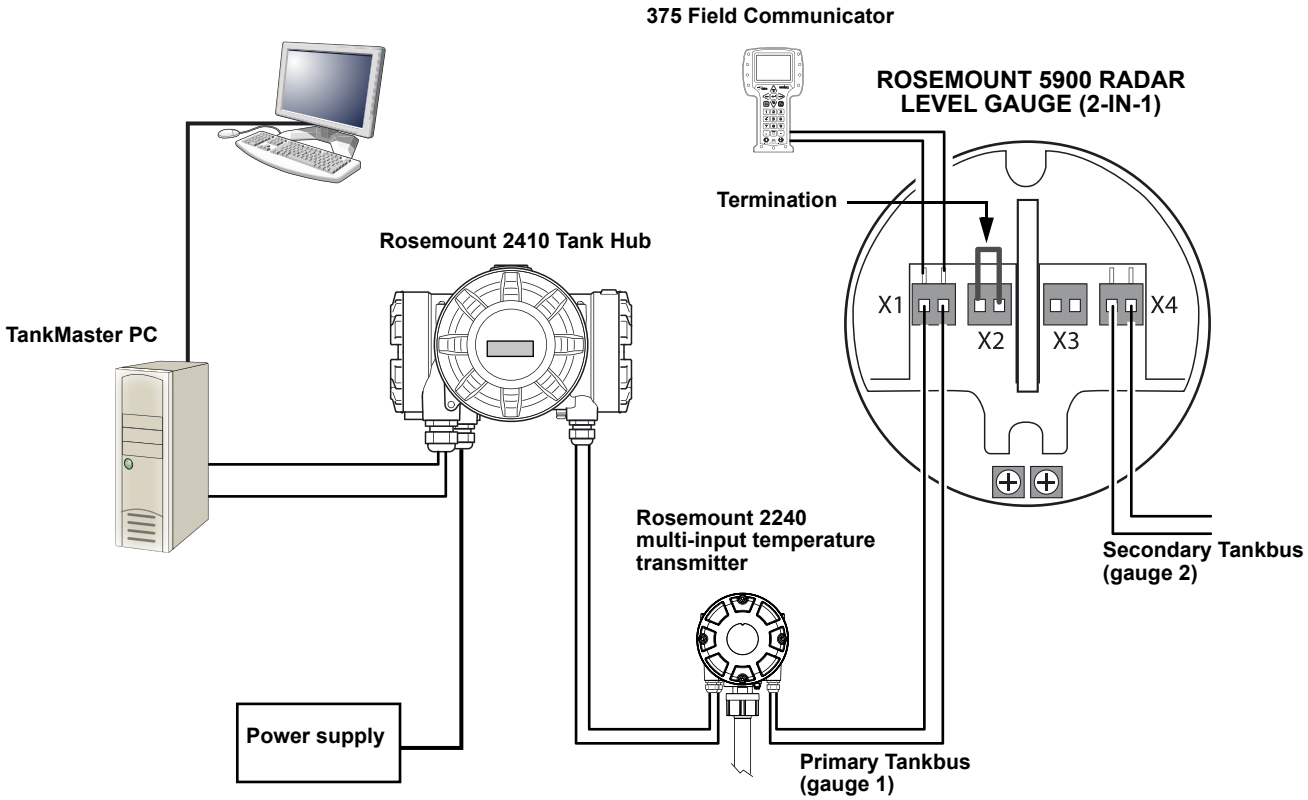
The 2-in-1 version of the Rosemount 5900 has two separate level gauges placed in the same housing. One of the tankbuses can be terminated.

The 2-in-1 version can be connected to two separate tankbuses as illustrated in Figure 3-23 and 3-24, or to a single tankbus as illustrated in Figure 3-25 on page 3-50.

Terminal X1 is an intrinsically safe tankbus input for level gauge 1, and terminal X4 connects to the second level gauge.

Figure 3-23 illustrates a wiring diagram with a 2-in-1 version of the Rosemount 5900 level gauge which is “daisy-chained” to a Rosemount 2240 multi-input temperature transmitter. Note that the Primary Tankbus is terminated in the 5900 terminal block (X2).

Figure 3-23. Rosemount 5900 wiring diagram for 2-in-1 version with two tankbuses



See also “Terminal Blocks” on page 3-44 for information on terminal block connections.

In Figure 3-24 a Rosemount 2240 transmitter is “daisy-chained” to a 2-in-1 version of the Rosemount 5900 level gauge.

The termination is enabled in the 2240 terminal block.

Figure 3-24. Wiring diagram for Rosemount 5900 2-in-1 version with two tankbuses

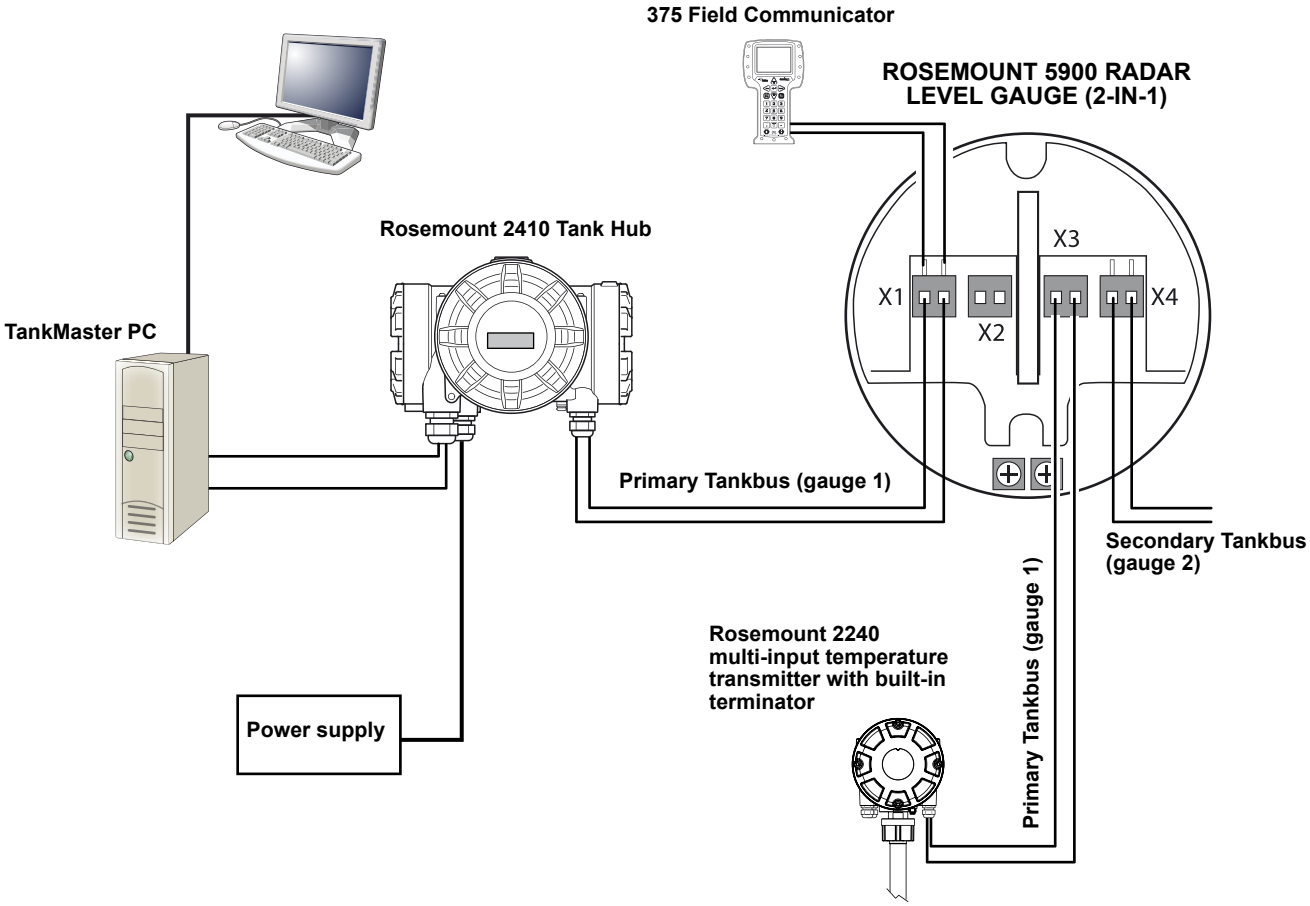
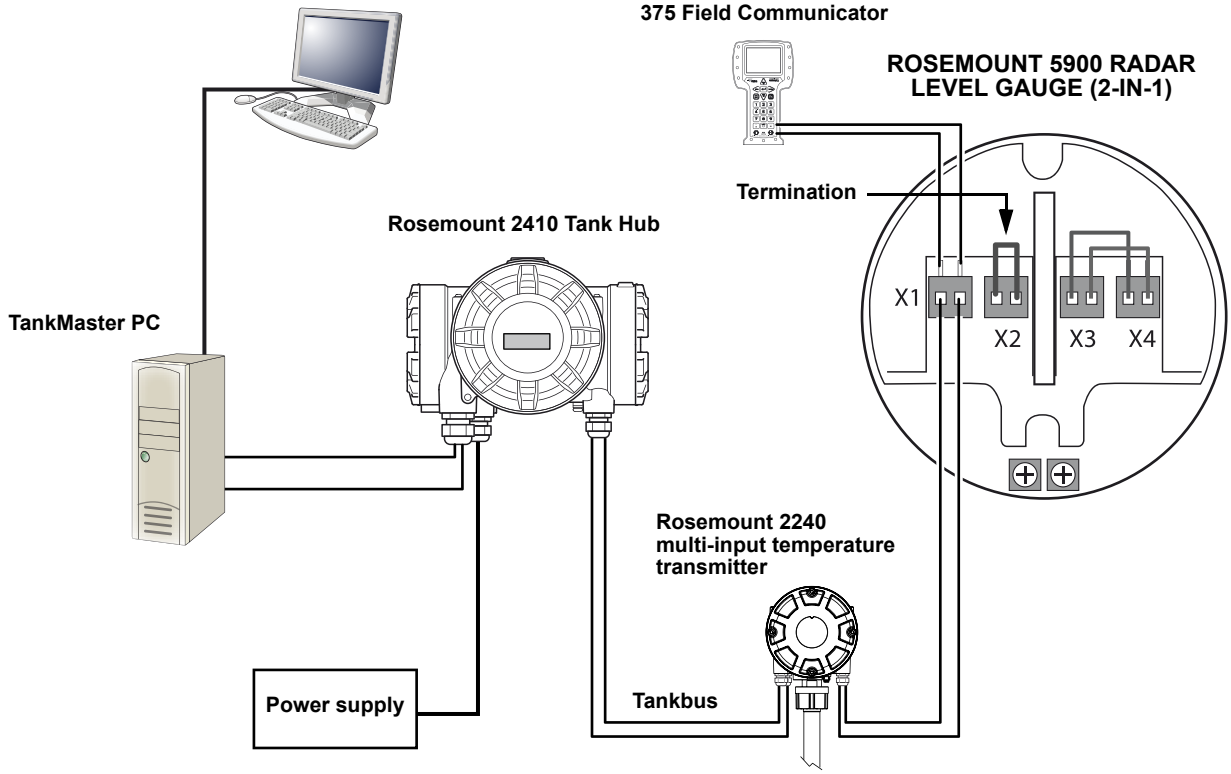


Figure 3-25 illustrates the 2-in-1 version of the Rosemount 5900 with a single intrinsically safe tankbus connected to both level gauges via terminal X1 by setting a jumper between X3 and X4.

The Tankbus termination is enabled in the 5900 terminal block (X2).

Figure 3-25. Rosemount 5900 wiring diagram for 2-in-1 version with a single tankbus



Section 4 Configuration

4.1 SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

⚠WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury:

Make sure only qualified personnel perform the installation.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Do not perform any service other than those contained in this manual unless you are qualified.

Substitution of components may impair Intrinsic Safety.

⚠WARNING

Explosions could result in death or serious injury:

Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.

Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

4.2 OVERVIEW

Installation and configuration of a *Raptor* system is a simple and straight-forward procedure. It basically includes the following steps:

1. Setting up communication protocol and communication parameters.
2. Configuration of Field Communication Unit.
3. Configuration of Rosemount 2410 tank communication unit.
4. Configuration of measurement devices such as the Rosemount 5900 level gauge.
5. Calibration.

A detailed description of how to install and configure a Rosemount 5900 by using the *TankMaster WinSetup* software is given in the *Raptor System Configuration* manual (Document no. 300510EN).

The *TankMaster WinSetup* configuration is the recommended tool for installation and configuration of a Rosemount 5900. The 5900 can be installed as part of the procedure when installing a Rosemount 2410 tank communication unit. This is the standard procedure when a new *Raptor* system is installed:

a. Install and configure the 2410 tank communication unit by using the device installation wizard in TankMaster WinSetup.
b. Finish the 2410 installation with “offline” installation of the 5900 level gauge.
c. Configure the 5900 level gauge via the *Properties* window.

If a 5900 is added to an existing system the Rosemount 2410 Tank Database must be updated before the 5900 is configured. The Tank Database maps the 5900 to the tank on which it is installed.

NOTE!
If the system contains a Field Communication Unit (FCU) it has to be installed and configured before other devices such as level gauges and temperature multiplexers.

The Rosemount 5900 supports basic configuration which is sufficient in most cases. There are a number of advanced configuration options available as well, which may be used for special applications when further fine-tuning is needed.

4.2.1 Basic Configuration

Basic configuration includes specifying parameters for a standard configuration which is sufficient in most cases. It includes the following items:

- Measurement Units
- Tank geometry; tank height, tank type, tank bottom type, pipe diameter, hold off disance, calibration distance etc.
- Process conditions; rapid level changes, turbulence, foam, solids, product dielectric range
- Volume; standard tank types, strapping table

4.2.2 Advanced Configuration

The Rosemount 5900 supports a number of advanced functions for optimizing performance in advanced applications. Some applications may need further configuration in addition to the basic configuration. This may be due to the properties of the product or the tank shape.

Disturbing objects and turbulent conditions in the tank may also require advanced measures to be taken.

Advanced functions supported by the Rosemount 5900 and the Rosemount TankMaster program:

- Tank scan
- Empty tank handling
- Surface echo tracking
- Filter settings

4.2.3 Configuration Tools

There are several tools available for configuration of a Rosemount 5900 level gauge:

- Rosemount TankMaster Winsetup
- Rosemount 375 Field Communicator

The TankMaster Winsetup is a user-friendly software package that includes basic configuration options as well as advanced configuration and service functions.

4.3 BASIC CONFIGURATION

4.3.1 Tank Geometry

The following parameters are used for tank geometry configuration of a Rosemount 5900 level gauge:

Figure 4-1. Illustration of the various tank geometry parameters

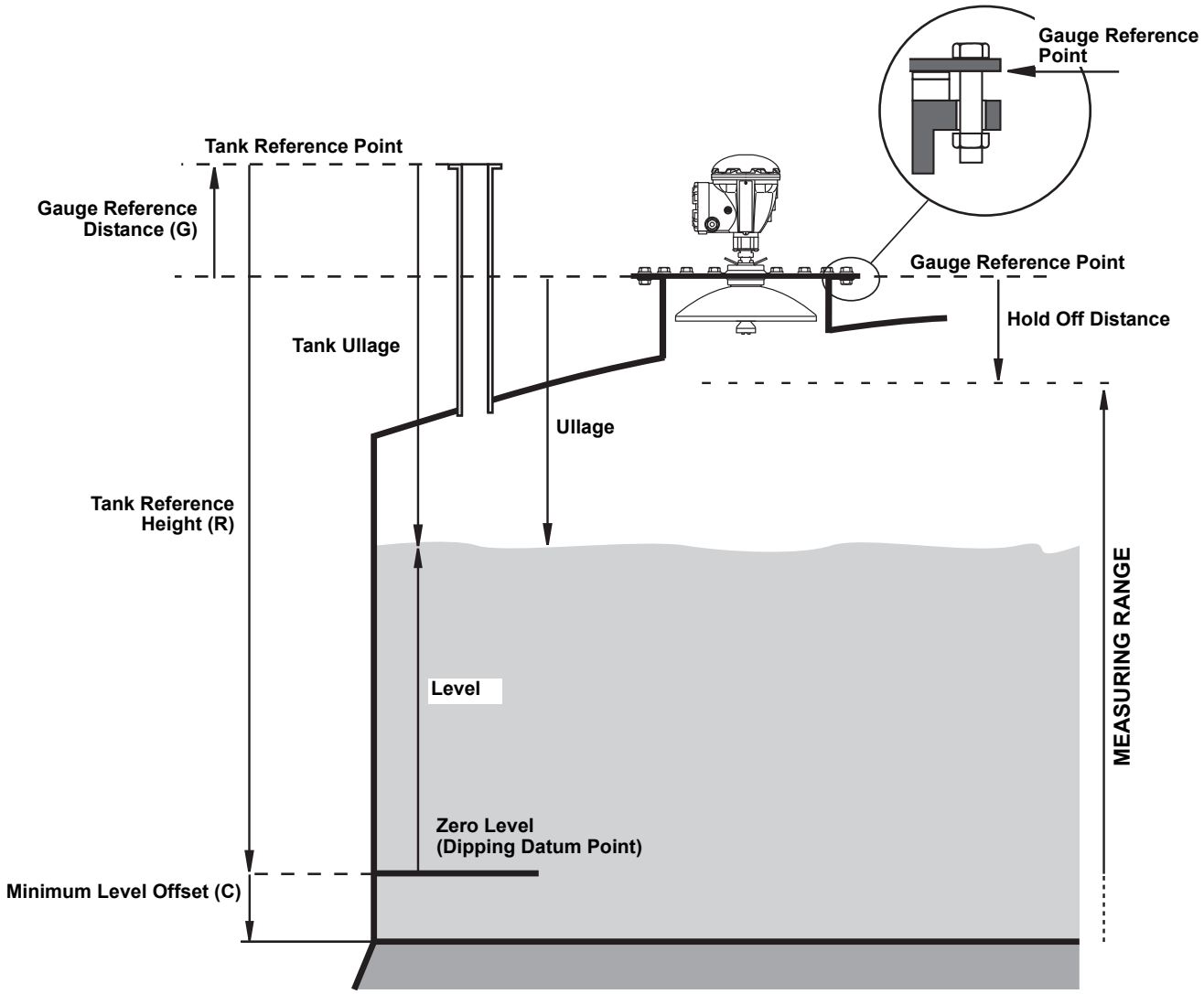


Table 4-1. Definition of tank geometry parameters

Tank Height (R)	Distance from Tank Reference Point to Zero level
Gauge Reference Distance (G)	Distance from Tank Reference Point to the Gauge Reference Point
Minimum Level Offset (C)	Distance from Zero Level to tank bottom
Hold Off Distance	Defines how close to the Gauge Reference Point levels can be measured

Tank Reference Height (R)

The Tank Reference Height (R) is the distance from the hand dipping nozzle (Tank Reference Point) to the Zero Level (Dipping Datum Plate) close to, or at the bottom of the tank.

Gauge Reference Distance (G)

The RTG Reference Distance (G) is the distance between the Tank Reference Point and the RTG Reference Point, which is located at the top surface of the customer's flange or manhole cover on which the gauge is mounted.

For Still Pipe Gauges the Gauge Reference Point is located at the hand-dip mark on the Still Pipe Gauge Stand.

G is positive if the Tank Reference Point is located above the Gauge Reference Point. Otherwise G is negative.

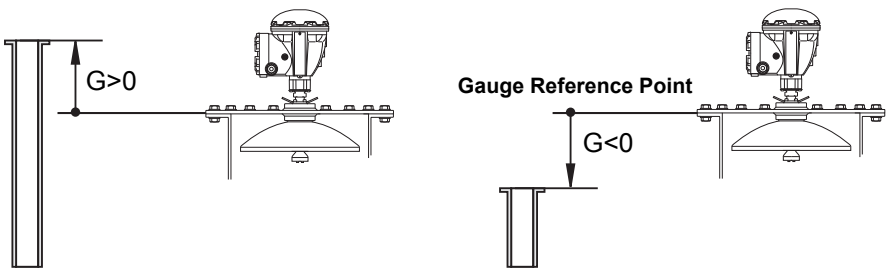
Minimum Level Offset (C)

The Minimum Level Distance (C) is defined as the distance between the Zero Level (Dipping Datum Point) and the Minimum Level of the product surface (tank bottom). By specifying a C-distance, the measuring range can be extended to the bottom of the tank.

If C>0, negative level values will be displayed when the product surface is below the Zero Level. Select the **Show negative level values as zero** check box if you want levels below the Zero Level to be displayed as Level=0.

Measurements below the Zero Level will not be approved if the C-distance=0, i.e. the RTG will report an invalid level.

Figure 4-2. Definition of RTG Reference Distance



Hold Off Distance

The Hold Off distance defines how close to the Gauge Reference Point a level value is accepted. Normally the **Hold Off** distance does not need to be changed. However, if there are disturbing echoes in the upper part of the tank, for example from the tank nozzle, you can increase the Hold Off distance in order to avoid measurements in the region close to the antenna.

Calibration Distance

Use this variable to adjust the transmitter so that measured product levels match hand dipped levels. Normally a minor adjustment is necessary when the gauge is installed due to, for example, a minor deviation between the actual tank height and the value stored in the transmitter database.

Pipe Diameter

When a Rosemount 5900 level gauge is installed in a still pipe, the inner diameter of the pipe must be specified. The Pipe Diameter is used to compensate for the lower microwave propagation speed inside the pipe. An incorrect value results in a scale factor error. If locally supplied still pipes are used, make sure the inner diameter is noted before the pipe is installed.

4.3.2 Environment

Foam

You can use this parameter to optimize the gauge for conditions with weak and varying surface echo amplitudes such as foam. When the foam is light and airy the actual product level is measured. For heavy and dense foam the transmitter measures the level of the upper surface of the foam.

Turbulent Surface

Splash loading, agitators, mixers, or boiling products may cause a turbulent surface. Normally the waves in a tank are quite small and cause local rapid level changes. By setting the Turbulent Surface parameter the performance of the transmitter will be improved when there are small and quickly changing amplitudes and levels.

Rapid Level Changes

Optimize the level gauge for measurement conditions where the level changes quickly due to filling and emptying of the tank. The Rosemount 5900 is able to track level changes of up to 1.5 inch/s (40 mm/s). The *Rapid Level Changes* funtion allows the 5900 to track level changes of up to 8 inch/s (200 mm/s).

The *Rapid Level Changes* function shall not be used in normal conditions when the product surface moves slowly.

Solid Products

Setting this parameter optimizes the transmitter for solid products, for example concrete or grains, which are not transparent for radar signals. For instance, this parameter can be used when the application is a silo with product build-up.

Product Dielectric Range

The Dielectric Constant is related to the reflectivity of the product. This parameter can be used to optimize measurement performance. However, the level gauge will still be able to perform well even if the actual Dielectric Constant differs from the configured value.

4.3.3 Tank Shape

The **Tank Type** and **Tank Bottom Type** parameters optimize the Rosemount 5900 for various tank geometries and for measurements close to the tank bottom.

4.4 CONFIGURATION USING ROSEMOUNT TANKMASTER

It is recommended that the Rosemount 5900 is configured by using the *TankMaster Winsetup* configuration tool. Winsetup supports installation of the Rosemount 5900 by one of the following methods:

- as part of the installation and configuration procedure of a Rosemount 2410 tank hub
- by using the TankMaster installation wizard

When a 5900 is installed as part of a 2410 installation procedure, it needs to be configured in a separate stage.

See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on using the *TankMaster WinSetup* software to configure a Rosemount 5900 level gauge.

There are a number of advanced configuration options available which are not included in the basic configuration wizard. See *Section C: Advanced Configuration* for information on how to use the various advanced options such as Tank Scan, Empty Tank Handling, Surface Echo Tracking and Filter Settings.

4.4.1 Installation Wizard

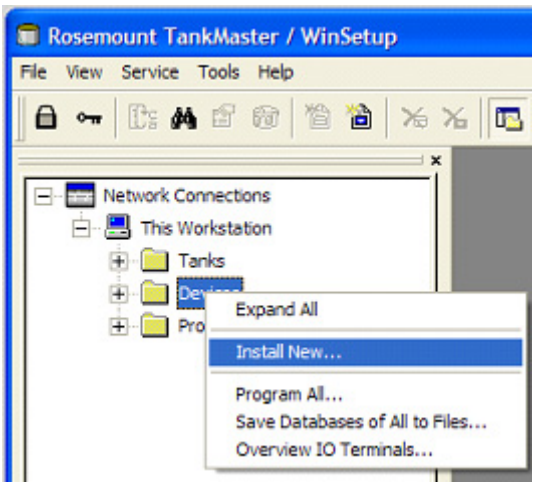
A Rosemount 5900 is typically installed as part of the installation procedure when installing a Rosemount 2410 tank communication unit in TankMaster WinSetup. Then the 5900 appears in the WinSetup workspace and is configured via the *Properties* window. See the *Rex II System Configuration Manual* (Document no. 300510EN) for more information.

The 5900 can also be installed by using the *TankMaster WinSetup* installation wizard. The installation wizard in *WinSetup* is a tool that facilitates installation and configuration of Rosemount 5900 and other devices.

NOTE!
In case the Rosemount 5900 level gauge was installed offline via a Rosemount 2410 tank communication unit, it needs to be configured separately via the *Properties* window.

To install a Rosemount 5900 do the following:

1. Start the installation wizard in TankMaster WinSetup.



2. Select the **Devices** folder.
3. Click the right mouse button and select **Install New**.
4. Follow the instructions.

See the *Rex II System Configuration Manual* (Document no. 300510EN) for more information on using the TankMaster WinSetup program to configure the Rosemount 5900.

4.5 LPG CONFIGURATION

4.5.1 Preparations

Ensure that all mechanical installations are made according to instructions, and that all external sensors such as pressure and temperature sensors are properly connected.

Make sure that the position of the reference pin is accurately measured and the inner diameter of the still-pipe is available.

Before the actual LPG configuration can take place, install the tank and the level gauge in TankMaster WinSetup as described in the *REX II System Configuration Manual* (Document no. 300510EN). Ensure that the appropriate tank and device types are selected and that the temperature and pressure sensors are properly configured. Check that the gauge communicates with the TankMaster PC.

Highly pressurized vapor above the product surface affects the progation speed of microwaves. The Rosemount 5900 gauge is able to compensate for this, thus avoiding deviations in measured level due to the vapor.

When the gauge is installed on the tank, and the tank is still empty, calibrate the gauge and configure for LPG measurements.

Installing a Rosemount 5900 for LPG measurements can roughly be divided into the following steps:

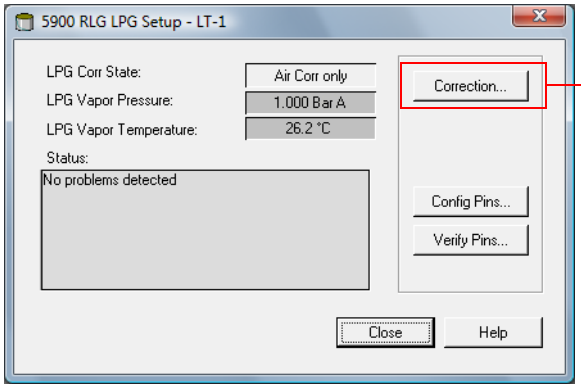
a. Mechanical installation. Install the 5900 gauge on the still-pipe. Measure the position of the reference pin.
b. Start up. In TankMaster Winsetup configure the 5900 according to the standard procedure for installing a Rosemount 5900 level gauge.
c. Calibration.
d. Configuration of temperature and pressure sensors.
e. Configuration of test pin.
f. Verification of LPG measurements.
g. Setting up the correction method that applies to the particular type of product that is stored in the tank.

4.5.2 LPG Configuration

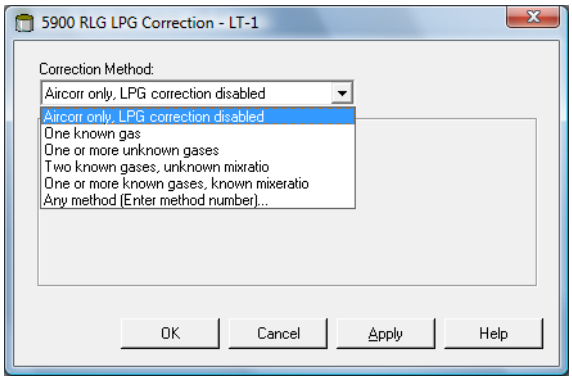
In the following description it is assumed that the Rosemount 5900 LPG gauge is installed on the tank, and that a basic configuration is done as described in the *Rex II System Configuration Manual* (Document no. 300510EN). Then it needs to be configured for LPG measurements. Do the following:

1. Ensure that the tank is empty.
2. Check that the ball valve (optional) on the gauge is open.

In the TankMaster WinSetup work space choose the *Logical View* tab. Select the icon that represents the radar level gauge, click the right mouse button and choose **LPG Setup**.



3. In the *LPG Setup* window click the **Correction** button.



Choose **Air Correction Only** from the list of correction methods and click the OK button.

NOTE!
The Air Correction Only option shall only be used when the tank atmosphere contains air and no other gases.

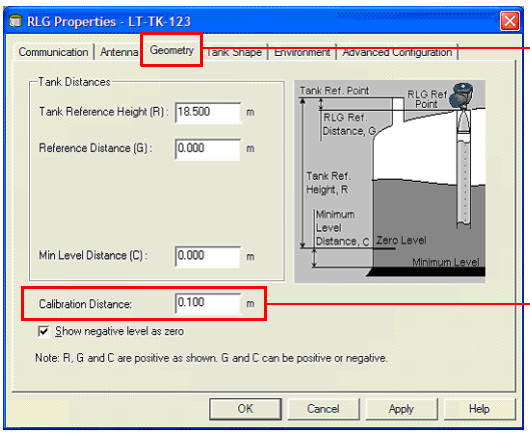
When the LPG configuration is finished, the correction method needs to be changed to a correction method that applies to the particular type of product that is used.

4. Calibrate.

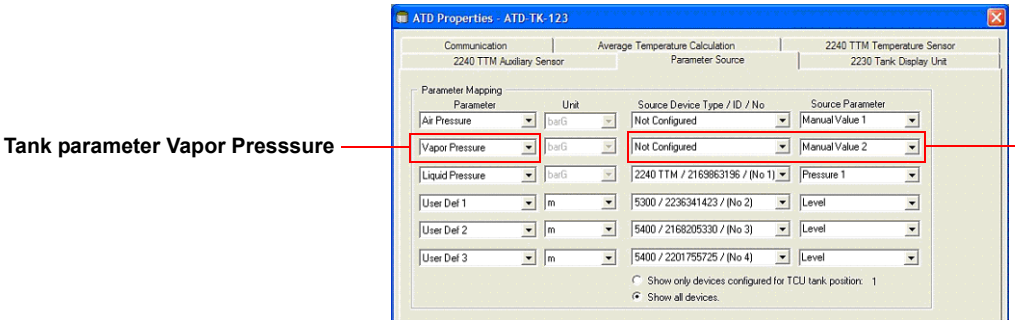
Make sure that there is no liquid above the calibration ring (or bottom plug) at the end of the pipe.

Check the Ullage value measured by the transmitter:
Ullage = Tank Height **R**- Product Level **L**.

If the Ullage value is not equal to the actual distance between the RTG Reference Point and the calibration ring, open the *TankMaster WinSetup Properties* window (right-click the device icon and choose Properties), choose the *RTG Geometry* tab and adjust the **Calibration Distance**:



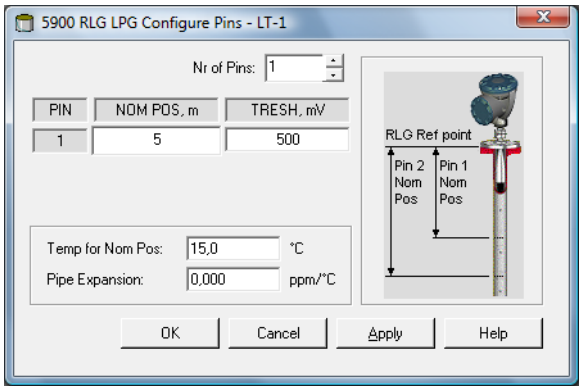
5. Choose Vapor Pressure source device.
   Open the *ATD Properties* window and select the *Parameter Source* tab. This tab lets you map tank parameters such as **Vapor Pressure** to source devices connected to the tankbus.



NOTE!
Pressure is not required for correction method **One or more known gases, known mixratio** (see step 9 on page 4-15).

6. When a Rosemount 2240 tank temperature multiplexer is used, the vapor temperature is automatically mapped to the average temperature of all spot sensors above the product surface. In case you like to map a specific sensor, open the *ATD Properties* window and select the *Parameter Source* tab to choose the desired temperature source device.

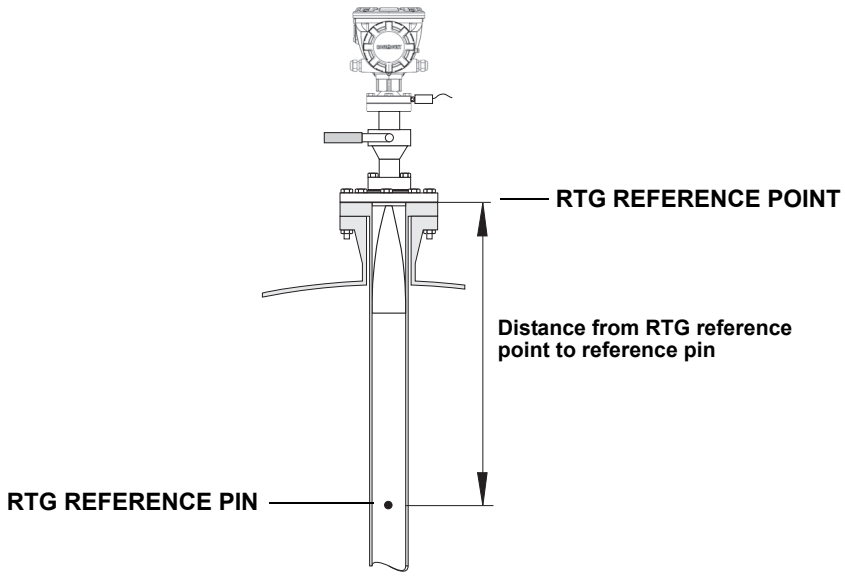
7. Configure the reference pins.
   In the *LPG Setup* window click the **Config Pins** button to open the *LPG Configure Pins* window:



   Enter the reference pin position. The position is measured from the *RTG Reference Point* to the actual position of the reference pin.

Since hand dipping can not be performed in high pressurized tanks, Emerson Process Management / Rosemount Tank Gauging has developed a unique method to verify level gauging in such tanks. The method is based on measurements in a special radar wave propagation mode against a fixed reference pin in order to verify the measurement.

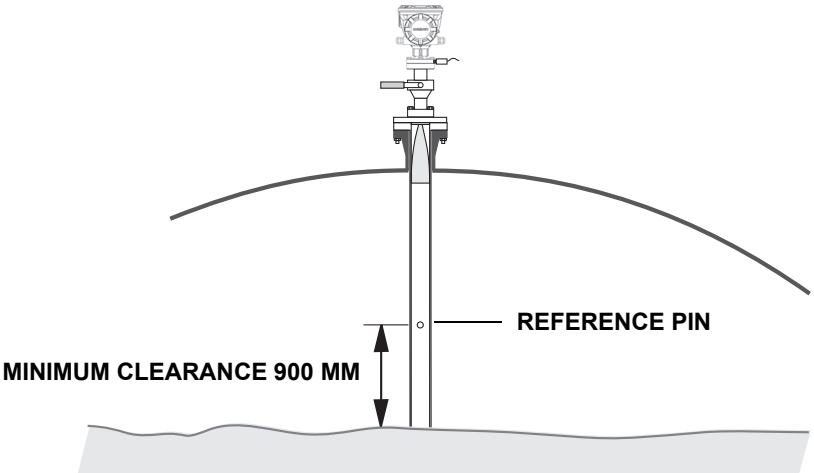
NOTE!
The value entered in the **Nominal Pos** field refers to the mechanical distance from the RTG reference point to the actual reference pin. This value will only act as a starting point for the following verification process in which the **electrical distance** from the RTG reference point to the reference pin is calculated. In most cases the electrical distance deviates from the actual mechanical distance.



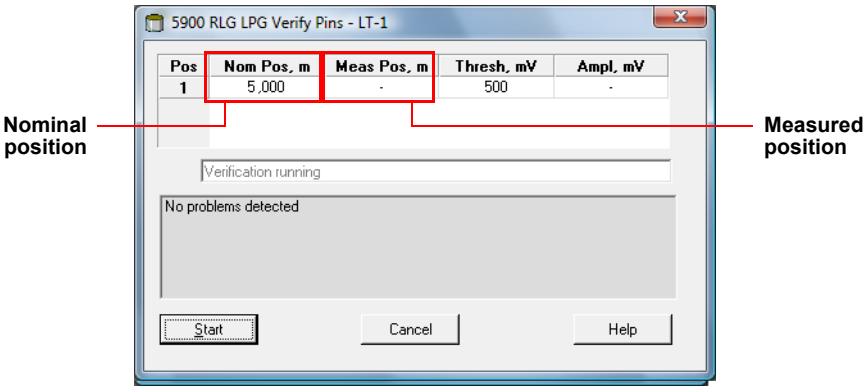
Make sure that the Threshold value is 500 mV.

The amplitude of the echo from the reference pin must be above the threshold value in order to appear in the *LPGVerify* window (see *"Verify the gauge measurement." on page 4-14*). In case the reference pin does not show up, it is possible to use a smaller threshold value. Check that the product level is not above the reference pin.

NOTE!
When the product surface is close to a reference pin, the radar echoes from the reference pin and the product surface interfere. This may reduce the accuracy of the measured distance to the reference pin. It is recommended that verification is not performed if the distance between a reference pin and the product surface is less than 900 mm.



8. Verify the gauge measurement.
   a. Ensure that the reference pin appears in the *LPG Setup* window. In the *LPG Setup* window click the **Verify Pins** button:

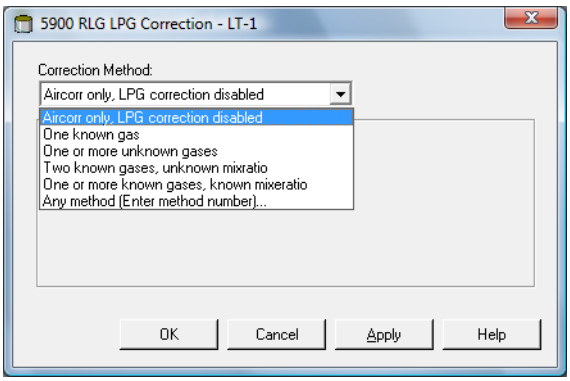


   b. In the *LPG Verify Pins* window click the **Start** button to start the verification process.
   c. When verification is finished, the position appears in the **Measured Position** field.
   d. Note the position of the reference pin that is presented in the Measured Position field. If the position deviates from the **Nominal Position**, return to the *LPG Configure Pins* window (in the *LPG Setup* window click the **Config Pins** button, see step 7 on page 4-12) and enter the measured position in the **Nominal Position** field.

NOTE!
The nominal position that was entered the first time refers to the **mechanical distance**. The measured position refers to the **electrical distance** which is the distance “seen” by the level gauge.

   e. In the *LPG Verify Pins* window click the Start button again to start a new verification. Repeat steps **b** to **d** until the nominal position in the *RTG LPG Configure Pins* window is close to the measured position that appears in the *LPG Verify Pins* window.

9. Choose correction method.
   There are several options available depending on the number of products and product type.
   In the *LPG Setup* window click the **Correction** button:



Choose one of the following correction methods:

a. Air Correction.
   This method should only be used when there is no vapor in the tank, i.e. when the tank is empty and contains air only. It is used in the initial step when calibrating the 5900.

b. One known gas.
   This method may be used when there is only one gas type in the tank. It provides the highest accuracy among the different correction methods. Note that even small amounts of another gas reduces the accuracy.

c. One or more unknown gases.
   Use this method for hydrocarbons, for example Propane/Buthane, when the exact mixture is not known.

d. Two gases with unknown mixratio.
   This method is suitable for a mixture of two gases even if the mixratio is not known.

e. One or more known gases with known mixratio.
   This method may be used when there is a well known mixture of up to 4 products in the tank.

Now the Rosemount 5900 gauge is ready to measure the product level when the tank is put into operation.

Section 5 Operation

5.1 SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

⚠WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury:

Make sure only qualified personnel perform the installation.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Do not perform any service other than those contained in this manual unless you are qualified.

⚠WARNING

Explosions could result in death or serious injury:

Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.

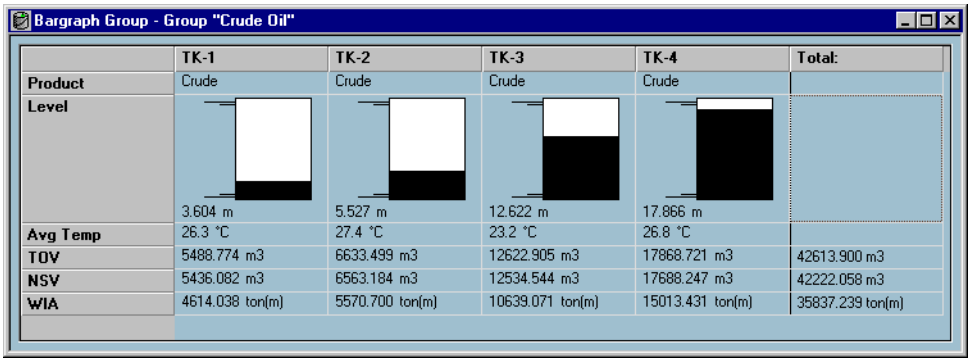
Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

5.2 VIEWING MEASUREMENT DATA

The Rosemount TankMaster program has several options for viewing measurement and inventory data for single tanks and for tank groups. TankMaster also offers the option to create custom views with your own set of parameters. See the *TankMaster WinOpi Reference Manual* (Document No. 303028EN) for more information.

Figure 5-1. Example of a bargraph view in TankMaster WinOpi



5.3 ALARM HANDLING

The *Rosemount TankMaster WinOpi* program supports a wide range of alarm functions. Alarms can be set for various measurement data such as Level, Average Temperature, and Vapor Pressure. Alarm limits can also be set for inventory data such as Net Standard Volume.

Active alarms can be shown in the Alarm Summary window. The Alarm Log lets you view alarms that are no longer active. The Alarm Log can be saved to disk for future reference.

See the *TankMaster WinOpi Reference Manual* (Document No. 303028EN) for more information.

Section 6 Service and Troubleshooting

6.1 SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

⚠WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury:

Make sure only qualified personnel perform the installation.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Do not perform any service other than those contained in this manual unless you are qualified.

To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

Substitution of components may impair Intrinsic Safety.

⚠WARNING

Explosions could result in death or serious injury:

Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.

Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

6.2 SERVICE

6.2.1 Viewing Input and Holding Registers

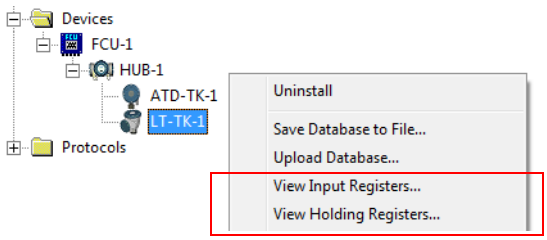
Measured data is continuously stored in **input registers** of the Rosemount 5900 radar level gauge. By viewing the Input registers you can check that the device is working properly.

The **holding registers** store various parameters which are used to configure the 5900 gauge for various applications.

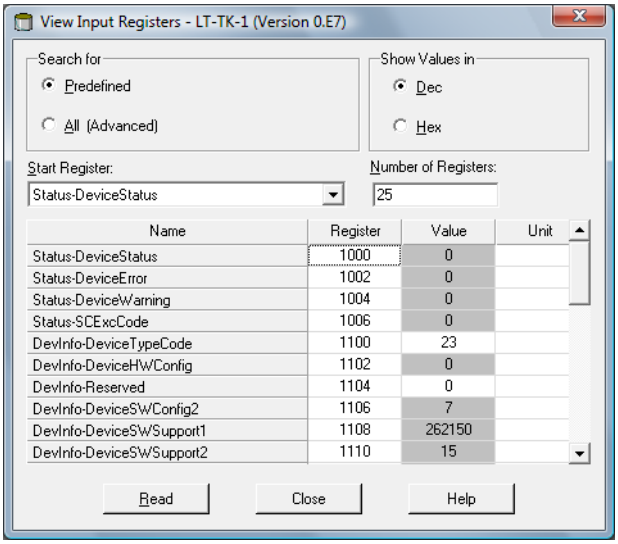
By using the Rosemount TankMaster *WinSetup* program, holding registers can be edited simply by typing a new value in the appropriate value input field. Some holding registers can be edited in a separate window. In this case individual data bits can be changed.

To view input or holding registers of a device do the following:

1. Start the TankMaster **WinSetup** program.
2. In the TankMaster WinSetup workspace window select the 5900 gauge.



3. Click the right mouse button and choose the **View Input/View Holding Registers** option, or from the **Service** menu choose **Devices/View Input/View Holding Registers**.



4. Choose **Predefined** to see a basic selection of registers. Choose the **All** option to view a range of registers by your own choice.
   For the **All** option, you have to specify a range of registers by setting a start value in the **Start Register** input field, and the total number of registers to be displayed in the **Number of Registers** field (1-500).
5. Click the **Read** button. Now the Value column is updated with the current register values.

See the *Raptor System Configuration* manual *(Document No. 300510EN)* for more information on how to edit holding registers.

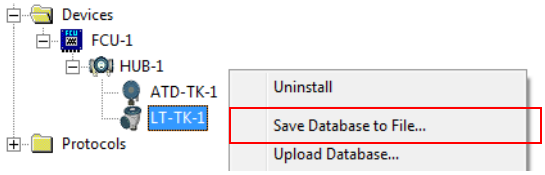
6.2.2 Backing Up the Gauge Configuration

Input and holding registers of the Rosemount 5900 can be stored on disk. This can be useful for backup purposes and troubleshooting. You can save a predefined set of holding registers to make a backup copy of the current gauge configuration. The backup file can be used to restore the transmitter configuration at a later stage.

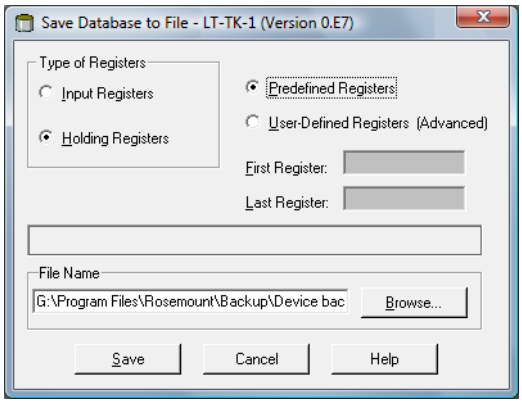
Single device

To save the current configuration to file for a single device do the following:

1. Start the TankMaster **WinSetup** program.
2. In the WinSetup workspace window, click the right mouse button on the 5900 icon.



3. Choose the **Devices/Save Database to File** option.
   This option is also available from the **Service/Devices** menu.

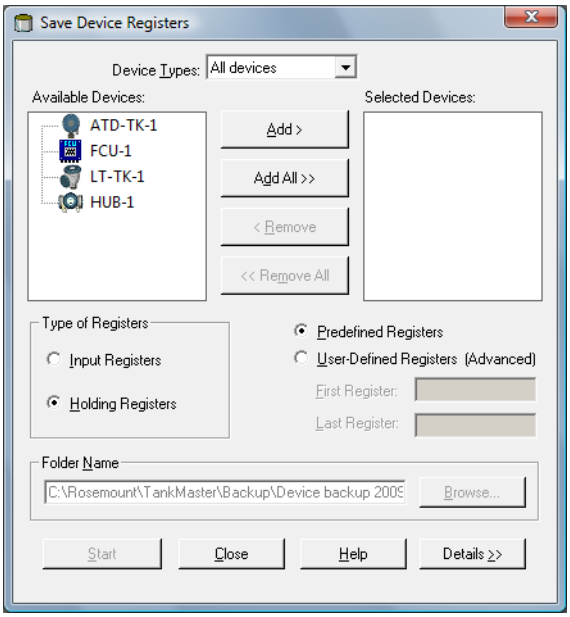


4. Choose the **Holding Registers** and **Predefined Registers** options (the User-Defined option should only be used for advanced service).
5. Click the **Browse** button, select a folder and type a name for the backup file.
6. Click the **Save** button to start saving the database registers.

Multiple devices

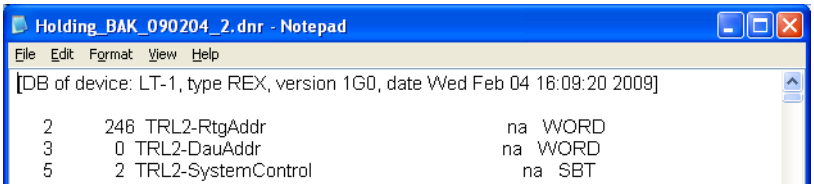
To save a backup copy of the current configuration for multiple devices, do the following:

1. Start the TankMaster **WinSetup** program.
2. In the TankMaster WinSetup workspace window select the *Devices* folder.
3. Click the right mouse button and choose the **Devices/Save Database of All to Files** option.
   This option is also available from the **Service/Devices** menu.



4. Select a device from the **Available Devices** pane and click the **Add** button in order to move it to the **Selected Devices** pane. Repeat for all devices you wish to include.
5. Choose the **Holding Registers** and **Predefined Registers** options (the User-Defined option should only be used for advanced service).
6. Click the **Browse** button, select a folder and type a name for the backup file.
7. Click the **Start** button to save the database backup.

The backup file can be viewed as a text file in a word processing program such as the Microsoft Notepad:

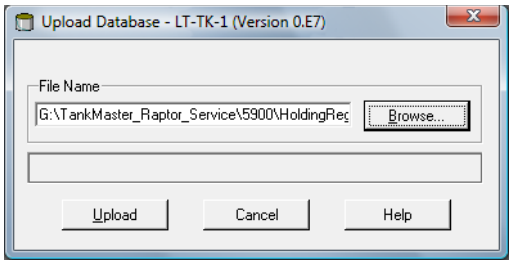


6.2.3 To Recover a Backup Configuration Database

TankMaster WinSetup lets you replace the current Holding Register database with a backup database stored on disk. This can be useful, for example, if you want to recover lost configuration data.

To load a Holding Register database do the following:

1. Select the device in the *Workspace* window for which you want to load a new database.
2. Click the right mouse button and choose the **Devices/Upload Database** option, or from the **Service** menu choose **Devices/Upload Database**.



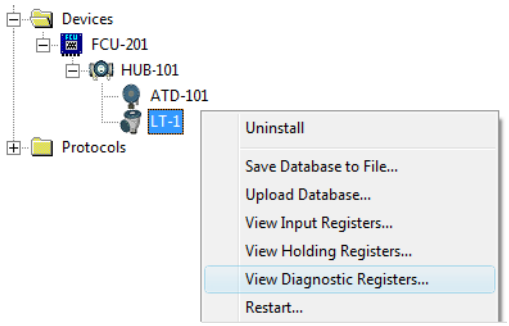
3. Click the **Browse** button and choose a database file to be uploaded, or type a path and file name.
4. Click the **Upload** button.

6.2.4 Diagnostics

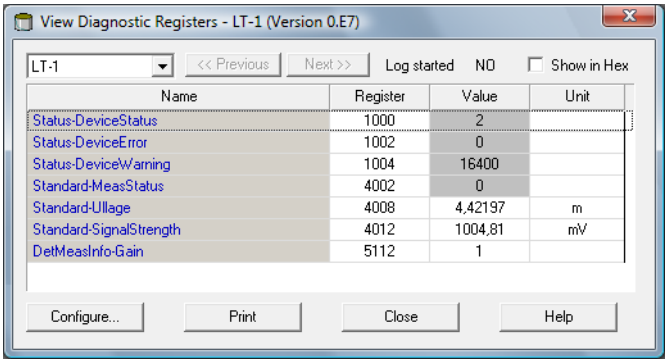
The *TankMaster WinSetup* program lets you view the current device status. The *View Diagnostic Register* window shows a selection of database registers that gives you an instant view of how the gauge operates. You may also configure the window by adding registers of special interest.

To view and configure the diagnostic registers:

1. Select the 5900 gauge icon in the *TankMaster WinSetup* workspace.



2. Click the right mouse button and choose **View Diagnostic Registers**.



The register values in the diagnostics window are of read only type. They are loaded from the device as the window is opened.

A grey background color of the table cell in the Value column means that the register is of either Bitfield or ENUM type. An expanded Bitfield/ENUM window can be opened for this type of register. Double-click the cell to open the Expanded Bitfield/ENUM window.

If needed, the values can be presented as hexadecimal numbers. This applies to registers of the Bitfield and ENUM types. Select the **Show in Hex** check box to present Bitfield and ENUM registers as hexadecimal numbers.

The **Configure** button lets you open the *Configure Diagnostic Registers* window where you can change the list of registers to be displayed in the *View Diagnostic Registers* window. See the *Raptor System Configuration Manual (Document No. 300510EN)* for more information.

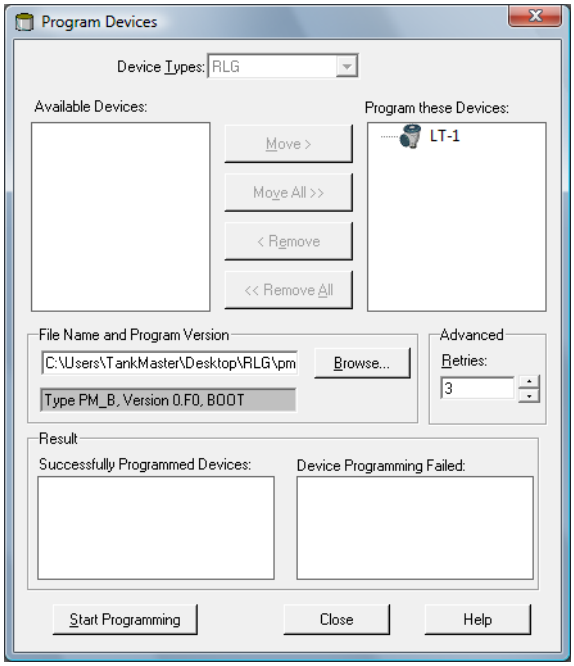
The *Configure Diagnostic Registers* window also has a **Log Setup** button for access to the *Register Log Scheduling* window which allows you to setup a log schedule for automatic start and stop of register logging. See “Logging Measurement Data” on page 6-12 for more information.

6.2.5 Upgrading the Gauge Software

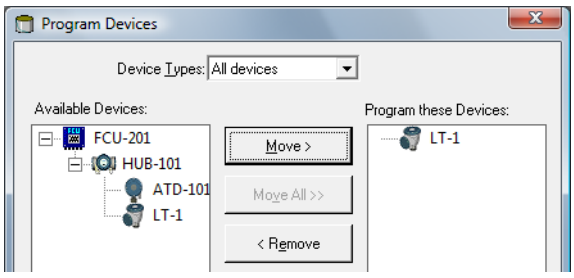
TankMaster WinSetup includes the option to upgrade Rosemount TankRadar gauges with new application and boot software.

To upload a new program do the following:

1. Ensure that the 5900 level gauge has a stable communication with TankMaster.
2. In the *TankMaster WinSetup* workspace window (Logical View) open the **Devices** folder and select the 5900 level gauge to be upgraded (or select the Devices folder to allow multiple devices programming).
3. Click the right mouse button and choose the **Program** option (**Program All** option for multiple devices programming).



4. The 5900 will automatically appear in the *Program These Devices* pane
5. In case the **Devices** folder was selected for multiple programming, choose the 5900 gauge to be programmed from the **Available Devices** pane and click the **Move** button.



6. Repeat for each device to be programmed.
   Use the **Remove** button if you want to change the list of devices to be programmed.