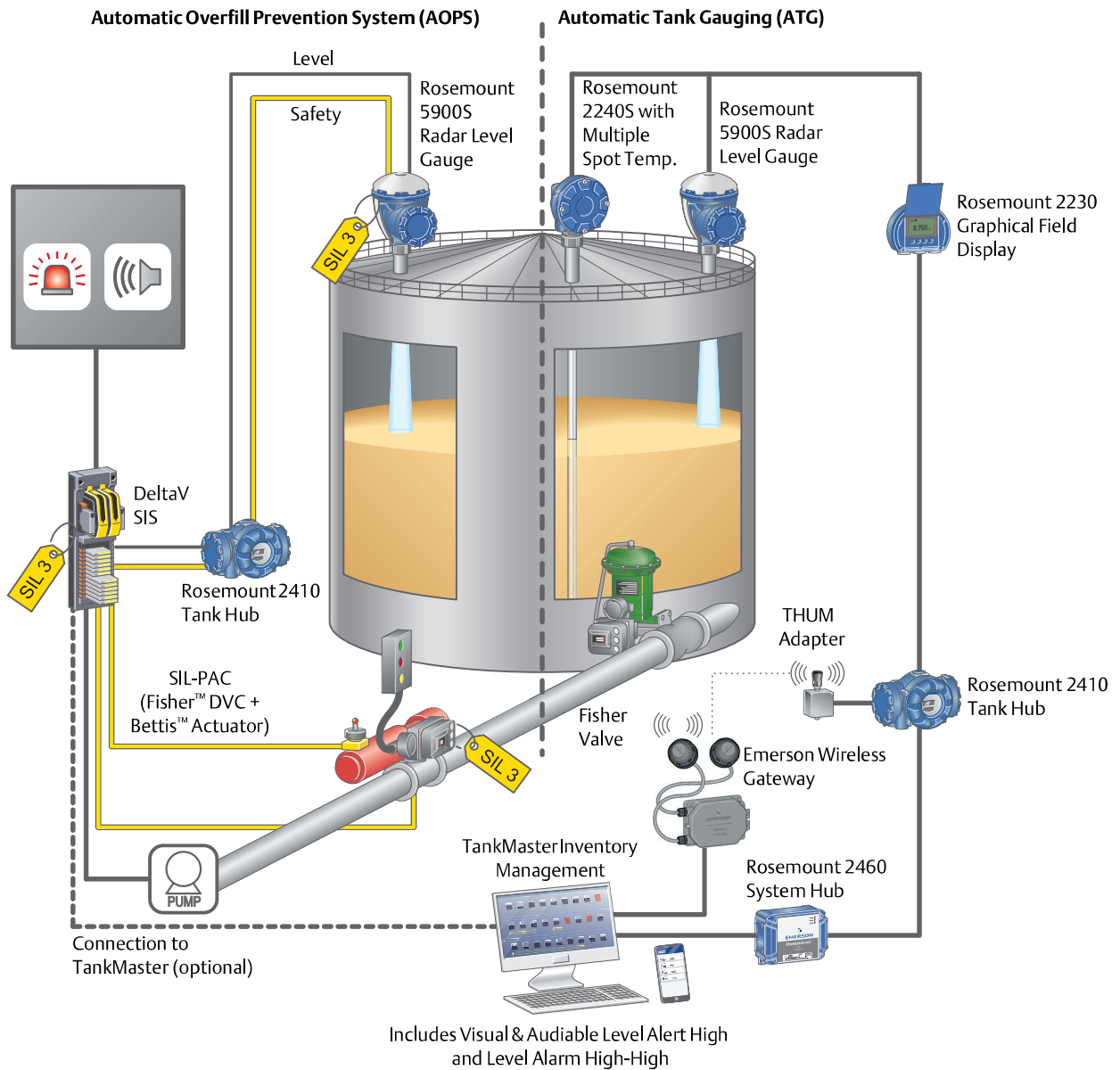


Functional safety configurations for overflow prevention

The process and terminal industries apply independent protection layers (IPLs) to minimize the risk of a potential hazard such as tank overfills.

The Rosemount Tank Gauging System supports a number of SIS (Safety Instrumented Systems) configurations designed for overflow prevention. Which configuration is most suitable depends on a number of factors such as the type of storage tank, existing instrumentation, Safety Integrity Level, etc.

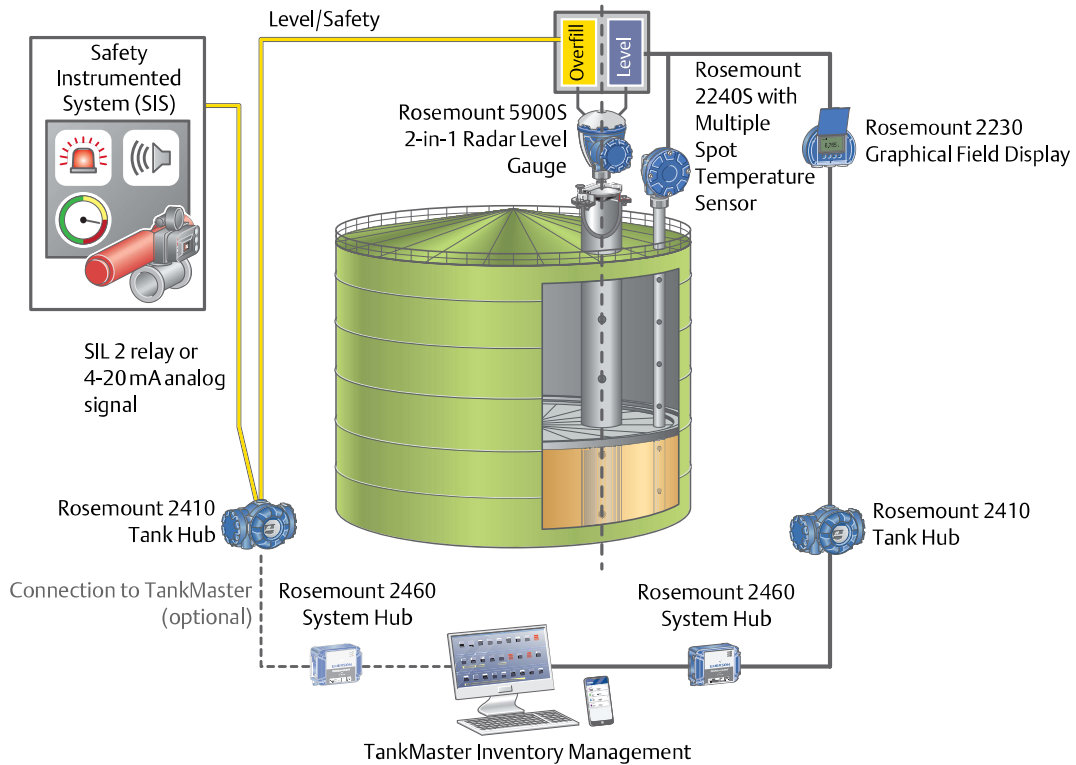
Integrated Emerson Solution for Automatic Overfill Prevention System (AOPS) and Tank Gauging



Floating Roof AOPS 2-in-1

Automatic Overfill Prevention System (AOPS)

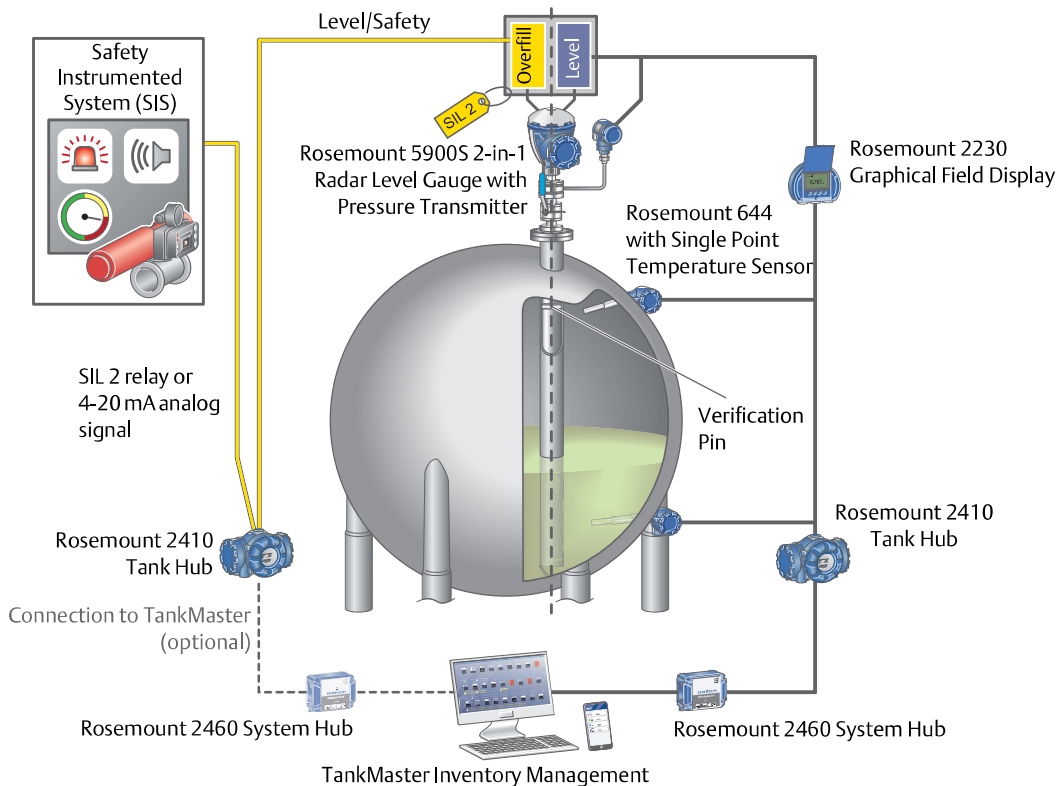
Automatic Tank Gauging (ATG)



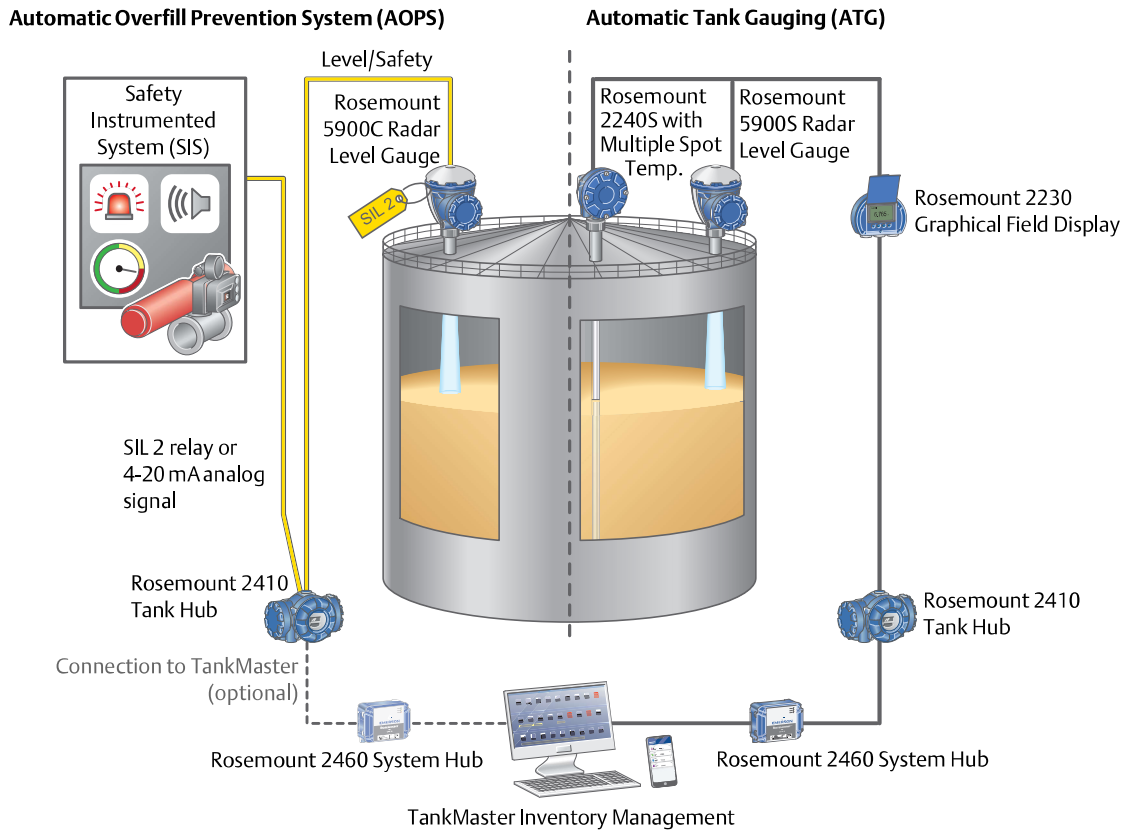
Sphere AOPS 2-in-1

Automatic Overfill Prevention System (AOPS)

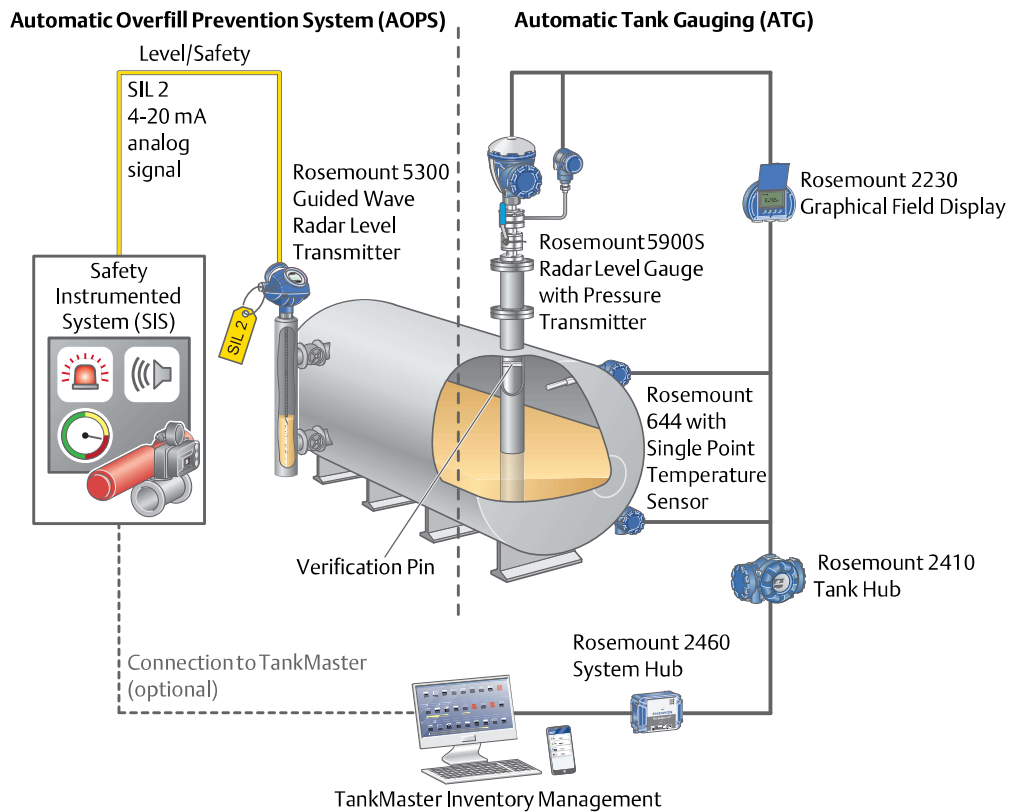
Automatic Tank Gauging (ATG)



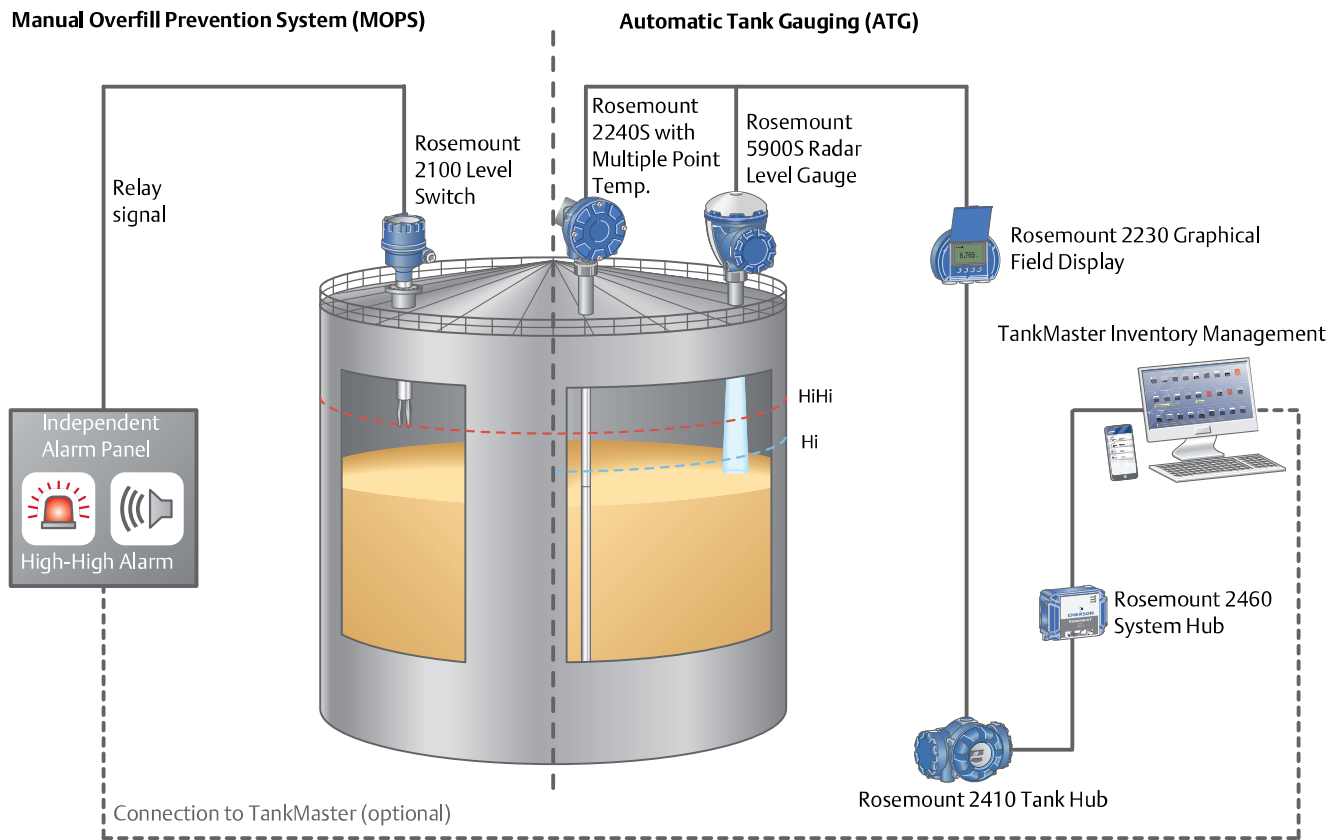
Fixed Roof AOPS



Pressure Vessel AOPS



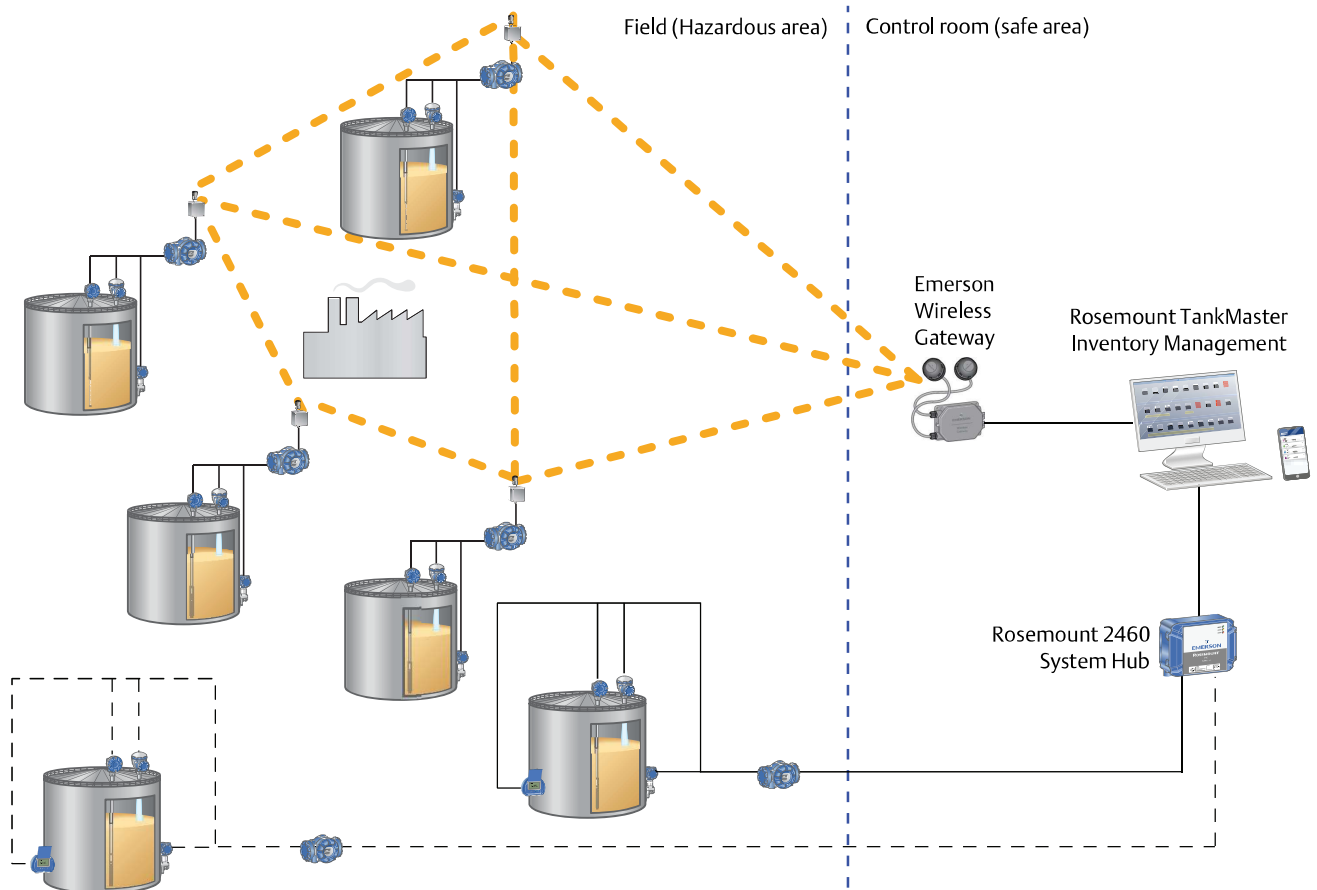
Fixed MOPS 5900S Including Level Switch



Wired and wireless combination

Wired and wireless communication may be combined within the Rosemount Tank Gauging System for most cost-effective access to data. It is possible to connect a wireless Rosemount gauging system to any existing wired tank gauging system.

It is also possible to add a wireless connection to a tank with wired communication to achieve system redundancy (see [Figure on page 6](#)).



Improve system reliability with redundancy

The Rosemount Tank Gauging System supports several redundancy designs, allowing two identical devices for critical operations.

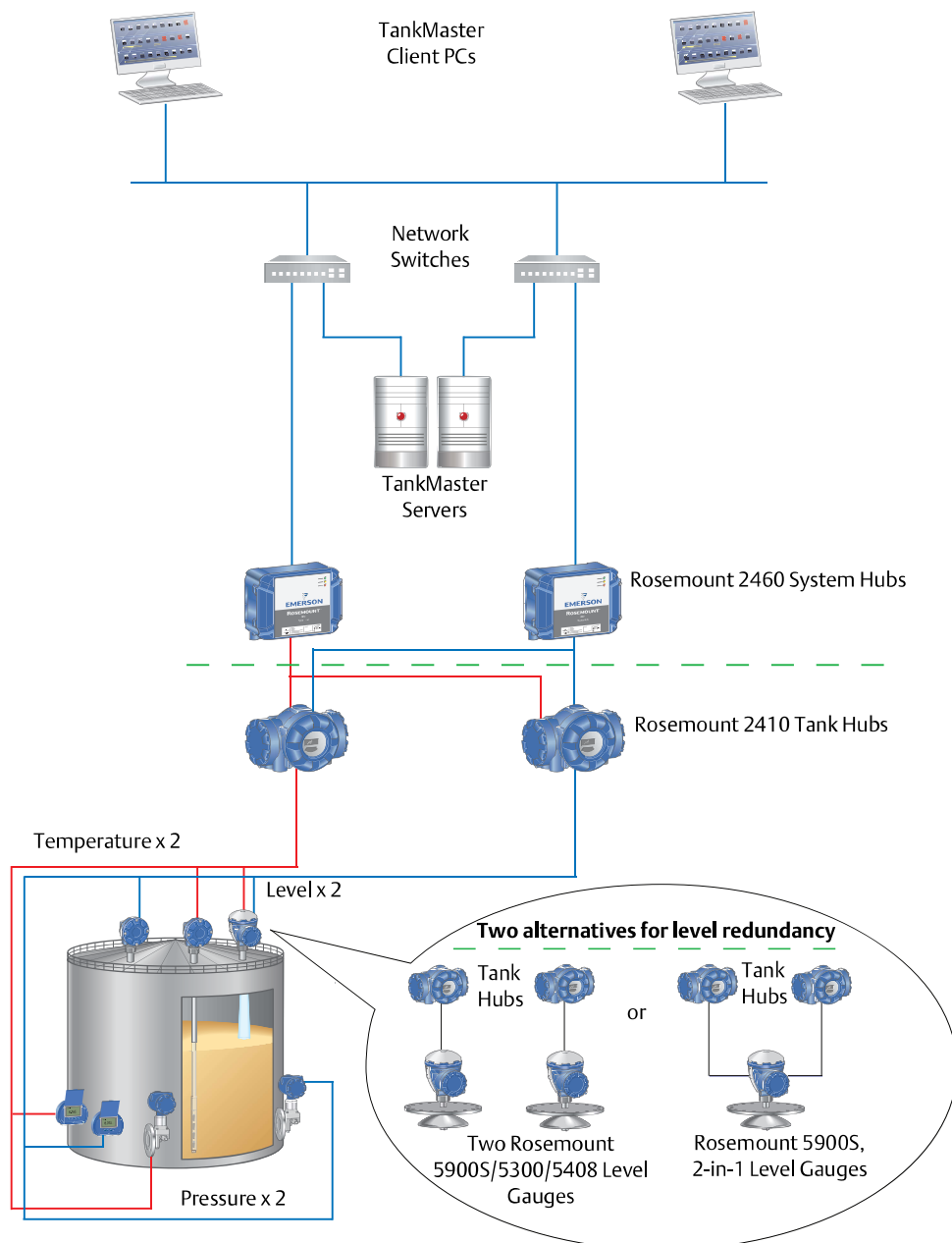
Redundancy can be utilized for some or all equipment, from the control room to the field devices:

- Two TankMaster PCs – both active and separately asking for data, or one primary active and the secondary in hot standby backup mode.
- Two System Hubs – the primary unit is active, the other is in backup mode. A control signal is sent between the two units.

If the backup unit is not receiving it, or if the primary unit is not working properly, a failure message is sent to TankMaster (or a DCS system), and the backup unit is activated.

- Two Tank Hubs – enables two separate Tankbuses on the same tank.
- Tank Device Redundancy – dual-level measurement devices (e.g. two Rosemount 5900 Series gauges or a Rosemount 5900S 2-in-1), dual temperature transmitters with associated sensors, etc.

See illustration below for a fully redundant system.

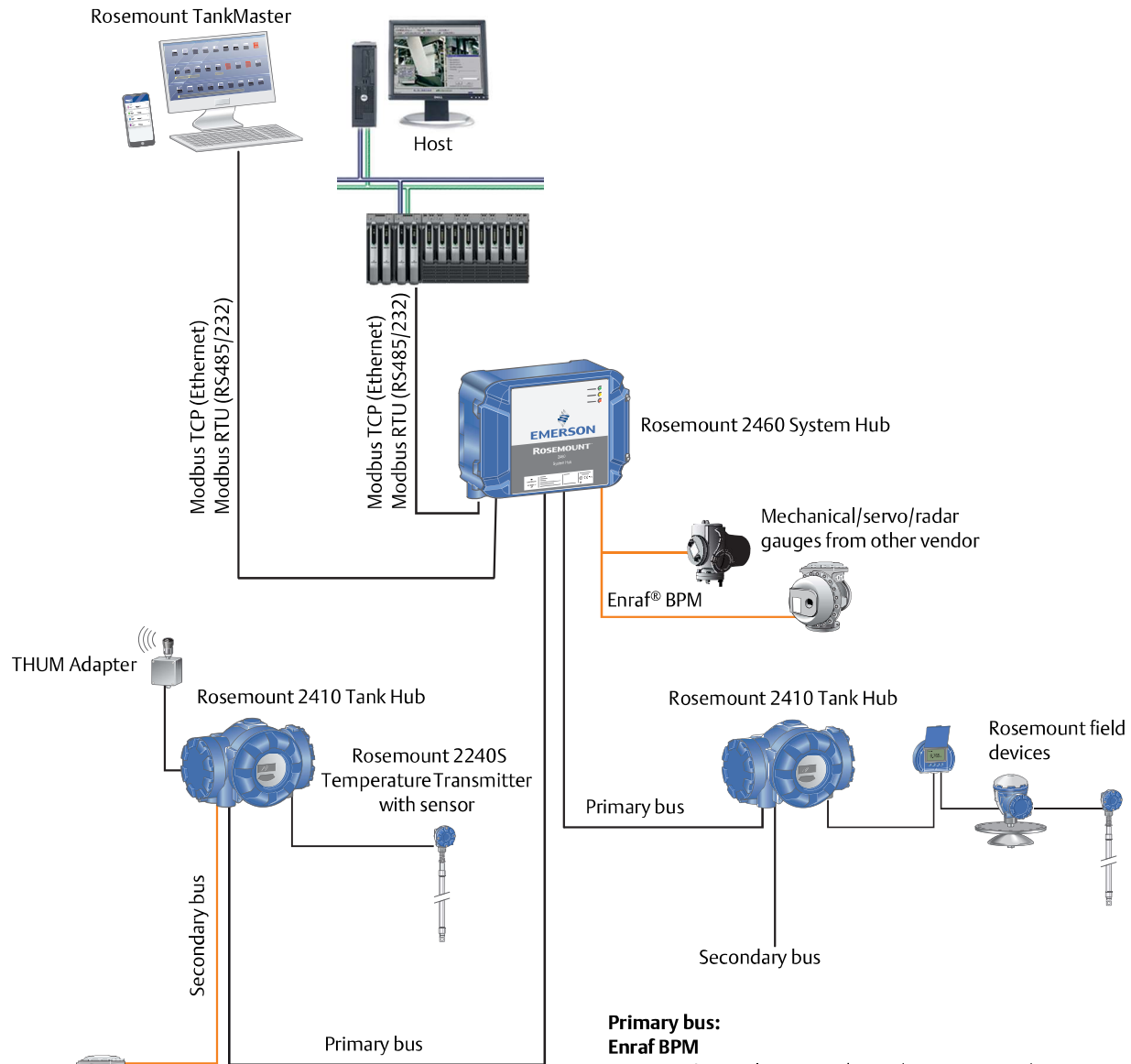


Emulation enables flexible system configuration

The Rosemount 2410 Tank Hub and the Rosemount 2460 System Hub support emulation of field devices from other vendors. In addition, the Rosemount 2460 hub enables exchange of an existing control room operator system to Rosemount TankMaster Inventory Management Software.

The TankMaster software allows the configuration of the emulated field devices. TankMaster can also send commands to the connected servo gauges.

By using the Rosemount 2410 for tanks equipped with other vendor's level devices, you can add a Rosemount 2240S with multiple spot temperature sensors and benefit from getting more measurement data integrated in the system. The Rosemount 2410 Tank Hub also adds wireless capability to the emulated devices, either for primary communication or to achieve redundant communication. Wireless communication enables previously stranded data and diagnostics to be included in the automated tank gauging system.



Up to 10 mechanical/servo/radar gauges from other vendor

- Primary bus:**
- Enraf BPM**
- TRL2, RS485, Analog output/input (passive, non-IS)
- Secondary bus:**
- Enraf BPM, Varec®, Whessoe, L&J, GPE**
- (See Rosemount 2410 model code for complete emulation possibilities)
- TRL2, HART 4-20 mA, *Wireless*HART, Analog output/input (active/passive, IS/non-IS)

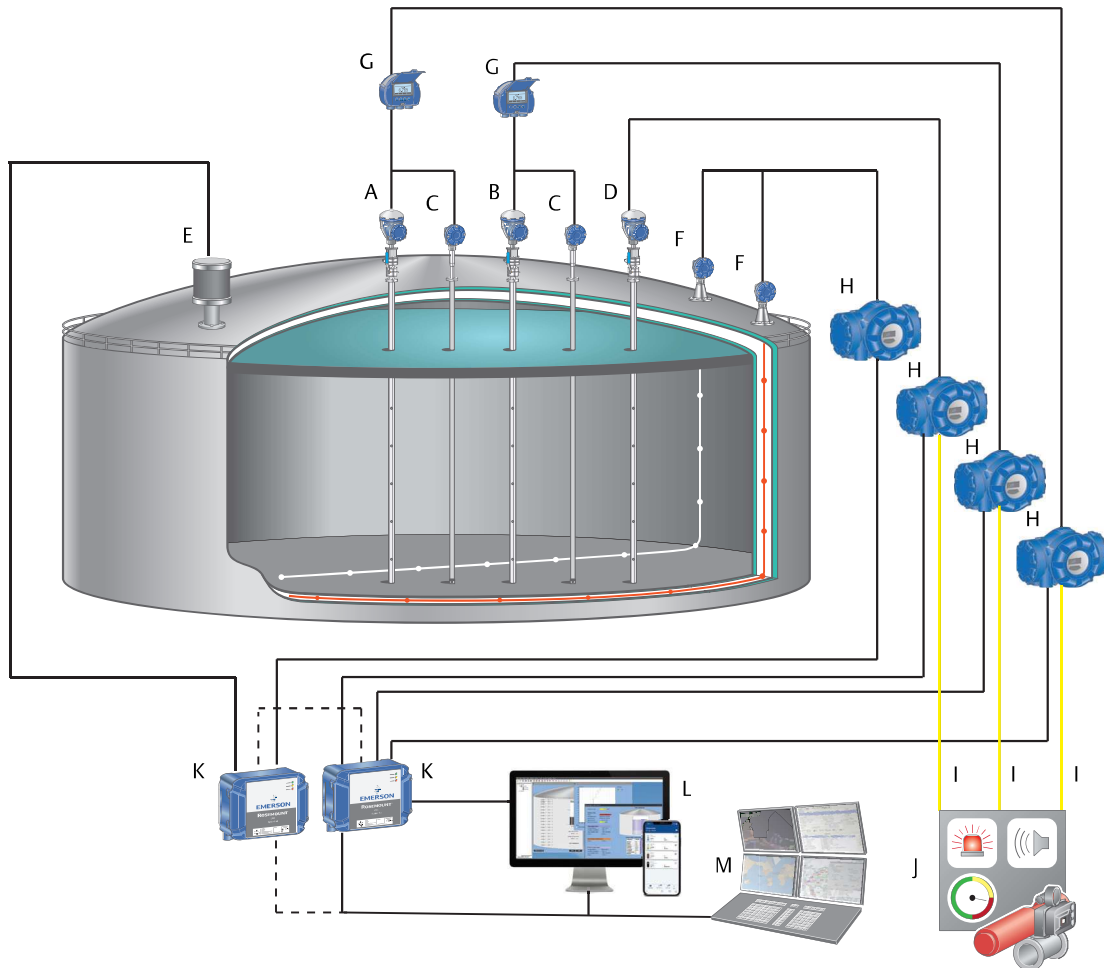
Storage of liquefied gas in full containment tanks

A full containment tank gauging system combines high reliability with high measuring performance and safety functions.

The Rosemount Tank Gauging System provides support for full containment storage tanks, including: cool-down, leak detection and product profile temperature measurements, stratification monitoring and alarm handling as well as optional roll-over prediction.

A full overview of all tank parameters is available in the Rosemount TankMaster Inventory Management. Temperature and density profile views for both current and historical profile values allows operators to detect signs of product stratification.

A typical system configuration for cryogenic and refrigerated storage is illustrated below.

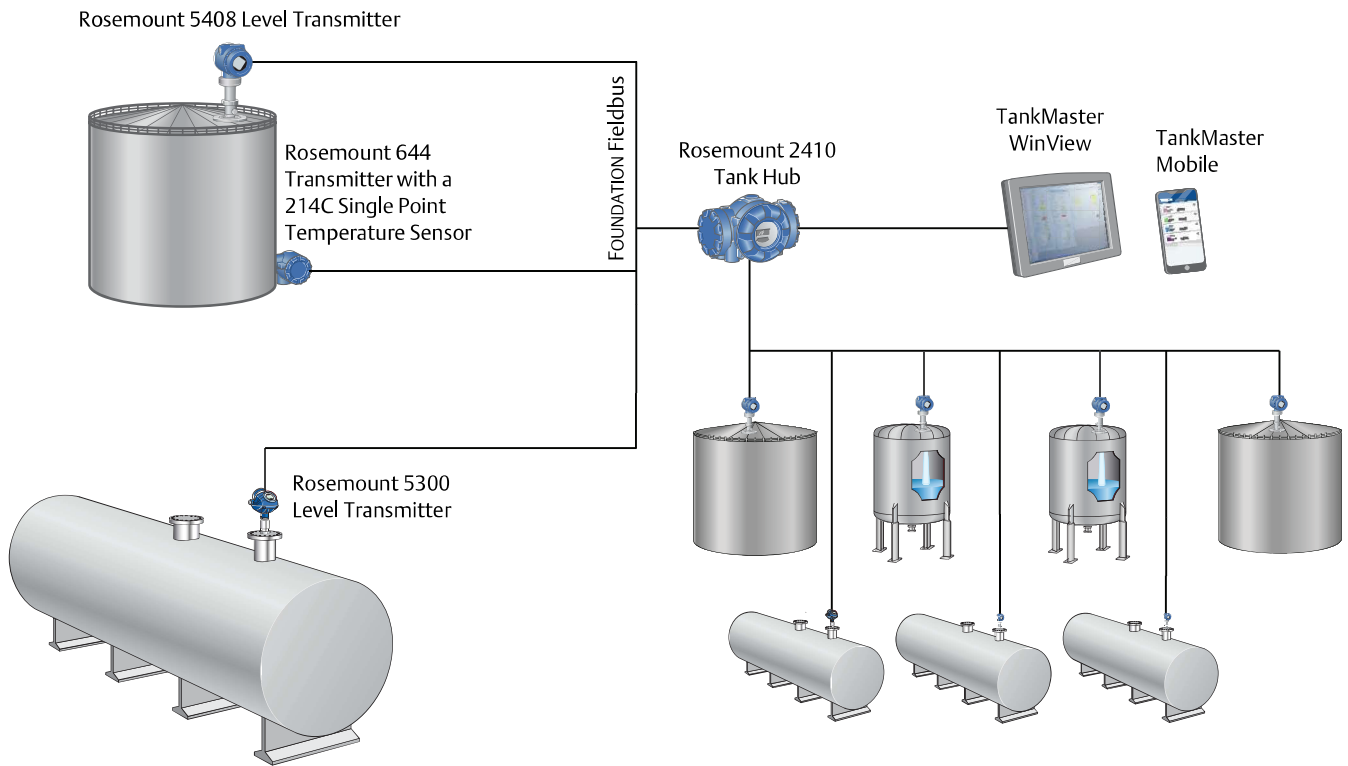


- | | |
|--|--|
| A. Rosemount 5900S (primary level gauge) | H. Rosemount 2410 Tank Hub |
| B. Rosemount 5900S (secondary level gauge) | I. SIL 2/SIL 3 relay or 4-20 mA alarm signal |
| C. Rosemount 2240S temperature transmitter with Rosemount 566 cryogenic multiple spot temperature sensor | J. Independent alarm panel |
| D. Rosemount 5900S (independent continuous level alarm) | K. Rosemount 2460 System Hub |
| E. Level, Temperature, and Density (LTD) Gauge for stratification detection | L. Rosemount TankMaster Software |
| F. Rosemount 2240S temperature transmitter with Rosemount 614 cryogenic spot sensor for cool-down and leak detection | M. DCS/Host system |
| G. Rosemount 2230 Graphical Field Display | |

Operational control with Rosemount 5408 or Rosemount 5300 system configuration

A Rosemount 5300 or Rosemount 5408 system configuration is a cost-efficient alternative for non-inventory grade operational control at tank terminals, as well as applications in the biofuels industry, chemical plants, etc. This configuration is a good choice for medium accuracy applications. For level measurements, Rosemount 5300 (guided wave radar) or Rosemount 5408 (non-contacting radar) is used.

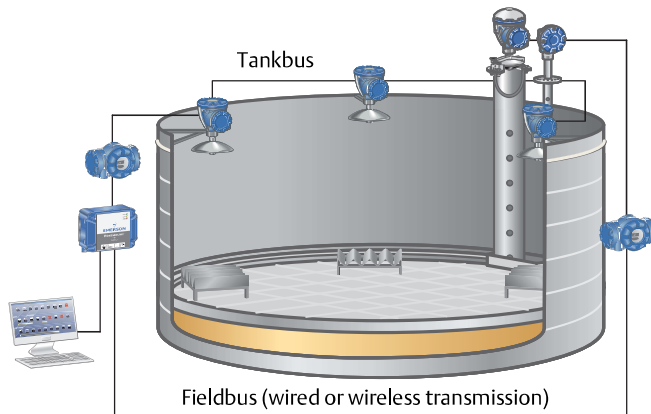
For temperature measurements, the Rosemount 644 Temperature Transmitter with a Rosemount 214C Single Point Temperature Sensor is used. The Rosemount 2240S Temperature Transmitter is an even better alternative if more than one temperature element is required. All values are transferred to the TankMaster WinView tank management software. TankMaster Mobile is used to monitor live inventory data, internally and/or externally.



Floating roof monitoring

Shell-mounted installation with non-contacting radar

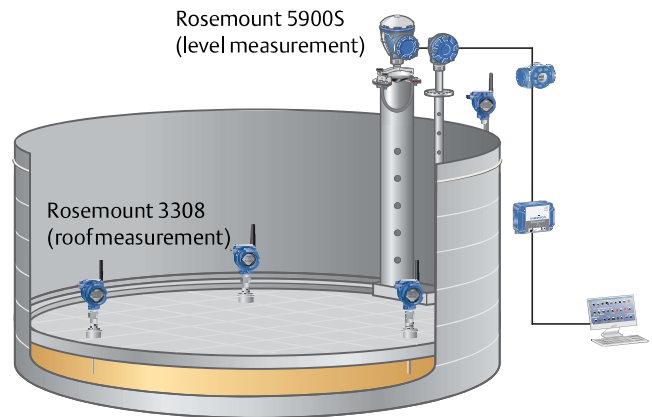
Up to six non-contacting radar transmitters are placed on top of the tank at equal distances. Reflector plates on the floating roof enable measurements without any object protruding from the roof surface. Roof tilt is tracked by comparing the distance between each radar gauge and the floating roof. This non-contacting solution can be retrofitted to existing tank gauging systems without taking the tank out of operation. Adding the tank level measurement as a reference means that roof buoyancy can also be monitored.



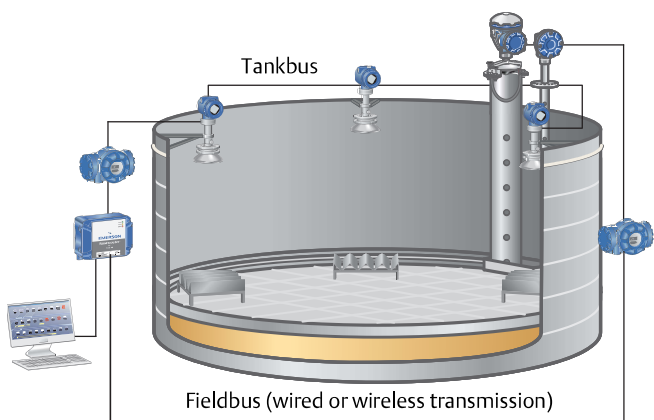
Shell-mounted installation using Rosemount 5900C non-contacting radar.

Roof-mounted installation with guided wave radar

An alternative solution is to use up to six guided wave radar level transmitters directly on the floating roof, with rigid probes penetrating through the roof and into the liquid below. Roof tilt is tracked by comparing the distance from the floating roof down to the product surface. The roof buoyancy is also monitored automatically. An advantage of the on-roof configuration is that it uses wireless transmission, battery power and existing nozzles.



Roof-mounted installation using guided wave radar and WirelessHART® transmission of data.



Shell-mounted installation using Rosemount 5408 non-contacting radar.

Fully automatic solution

Measurement data is transmitted via wired or wireless communication to the control room, where an operator can monitor the roof status and make configurations using the Rosemount TankMaster software. Drain sump monitoring and liquid hydrocarbon detection can be added to the TankMaster roof monitoring function by installing a Rosemount 2160 Wireless Vibrating Fork Detector and a Rosemount 702 Wireless Discrete Transmitter with Liquid Hydrocarbon Detection. Automatic alarms are given for out-of-limit roof tilt, buoyancy, roof sticking, as well as drain sump blocking and hydrocarbon detection.

Specifications

System key performance specifications

Rosemount Tank Gauging System meets or exceeds requirements specified in industry-relevant standards e.g. API MPMS Ch 7.3, Ch 3.1B and Ch 12.1.1, ISO 4266 and OIML R85.

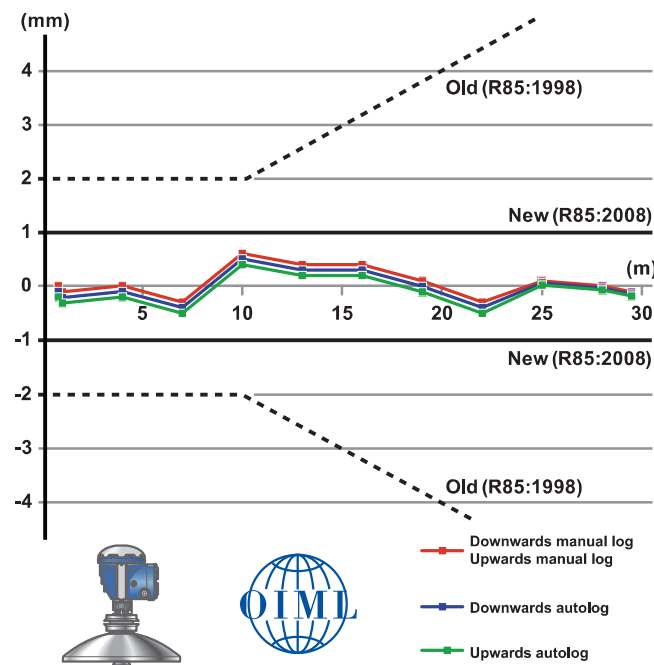
Level measurement

Instrument accuracy Rosemount 5900S

±0.5 mm (0.02 in.)

Instrument accuracy Rosemount 5900C

±2 mm (0.08 in.)



5900S fulfills OIML R85:2008 custody transfer requirements.

Temperature stability of gauge

Typically $\pm 0.5\text{ mm}$ (0.02 in.) in $-40\text{ to }+70\text{ }^\circ\text{C}$ ($-40\text{ to }+158\text{ }^\circ\text{F}$)

Update time of gauge

New measurement every 0.3 s

Update time for wireless systems

Depends on the number of hops to the gateway. Fastest update rate <math>< 8\text{ s}</math> requires devices with direct communication to the gateway.

Repeatability

0.2 mm (0.008 in.)

Maximum level rate

Up to 200 mm/s

Temperature measurement

Rosemount 2240S Multi-input Temperature Transmitter

Temperature conversion accuracy

0.05 °C (0.09 °F) over measuring range and ambient temperature 20 °C (68 °F)

Ambient temperature effect

±0.05 °C (0.09 °F)

Measuring range

-200 to 250 °C (-328 to 482 °F) for Pt-100

Resolution

±0.1 °C (0.1 °F) according to API chapter 7 and 12

Update time

4 s

Temperature sensor calibration

Deviations deriving from the Pt-100 elements are repeatable and can be eliminated with a unique manufacturing calibration procedure, where the Callendar – Van Dusen equation is used. The whole process is computer-controlled and up to 16 elements in each sensor are automatically calibrated at the same time.

Sensor element type

Four-wire Pt-100 spot elements according to IEC/EN 60751.

Number of elements per sensor

1-16

Table 1. Temperature Accuracy for Rosemount 565 or 765 Temperature Sensor

	Cable 20 m	PT-100 [-40 °C (-40 °F)]	PT-100 [70 °C (158 °F)]	Total sensor accuracy [0-70 °C (32 - 158 °F)] ⁽¹⁾
Four-wire connection, 1/6 DIN B	± 0.001 °C (± 0.002 °F)	± 0.13 °C (± 0.234 °F)	± 0.19 °C (± 0.342 °F)	± 0.19 °C (± 0.342 °F)
Four-wire connection, calibrated	± 0.001 °C (± 0.002 °F)	± 0.045 °C ⁽²⁾ (± 0.081 °F)	± 0.025 °C (± 0.045 °F)	± 0.025 °C (± 0.045 °F)

1. Root Mean Square values for wiring error and the largest platinum element error for the given range.
2. X8 calibration extrapolated under use of standard Callendar-Van Dusen C constant from EN 60751.

Table 2. Net Standard Volume (NSV) Uncertainty in a Tank with a Radius of 20 m (66 ft) and a Level of 18.5 m (60.7 ft)

	Total accuracy [0 to +70 °C (32 to +158 °F)]	NSV uncertainty in a 20 m (66 ft) tank and a level at 18.5 m (60.7 ft)
Four-wire connection, 1/6 DIN B	± 0.19 °C (± 0.342 °F)	3.8 m ³ (23.9 bbl)
Four-wire connection, calibrated	± 0.025 °C (± 0.081 °F)	0.5 m ³ (3.1 bbl)

Volume uncertainty comparison

The uncertainty of the calculated net volume depends not only on the accuracy of the devices, but also on the application. Below is an example to compare the difference between typical Rosemount 5900S, 5900C, 5408, and 5300 configurations.

- Crude oil, 887 kg/m³ density at 20 °C (68 °F) product temperature
- Tank height: 10 m (33 ft)
- Tank diameter: 15 m (49 ft)
- Number of inventories per year: 12
- Number of batch transfers per year: 24
- Ambient temperature: 5 to 35 °C (41 to 95 °F)

Under these conditions, the typical measurement accuracy is:

- 5900S: ±1 mm (0.04 in.), 0.17 °C (0.30 °F)
- 5900C: ±3 mm (0.12 in.), 0.17 °C (0.30 °F)
- 5408: ±6 mm (0.24 in.), 1.2 °C (2.2 °F)⁽¹⁾
- 5300: ±10 mm (0.4 in.), 1.2 °C (2.2 °F)⁽¹⁾
- A traditional mechanical tape and float system: ± 25 mm (1 in.), 1.5 °C (2.7 °F)⁽¹⁾

According to API Manual of Petroleum Measurement Standards, chapter 11: considering both level and temperature uncertainty, the total volume uncertainty in liters is shown in Table 3.

Consequently the Rosemount 5900S configuration reduces volume uncertainty in this example with approximately 90% compared to the Rosemount 5300/5408 system configuration.

Moreover, a Rosemount 5300/5408 system configuration reduces the volume uncertainty with approximately 50% compared to a mechanical tape and float system.

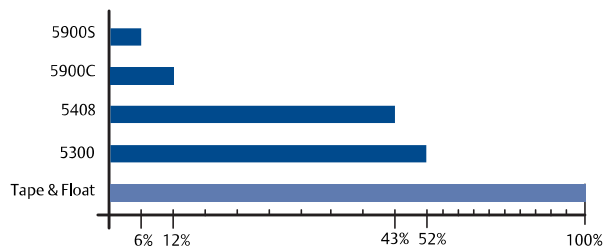
Although calculated for a specific application, this is a representative value for any hydrocarbon storage tank, independent of size.

Table 3. Volume Uncertainty Comparison in Liters (Barrels)

	5900S	5900C	5408	5300	Tape & Float
Per inventory⁽¹⁾	263 (1.7)	565 (3.5)	1960 (12.3)	2229 (14.0)	4732 (29.8)
Per batch⁽¹⁾	304 (1.9)	769 (4.8)	2338 (14.7)	2778 (17.5)	6429 (40.4)
Total uncertainty per year⁽¹⁾⁽²⁾	2404 (15.1)	5729 (36.0)	18250 (114.7)	21332 (134.2)	47891 (301.2)

1. Statistical error, root mean square value (RMS).
2. 12 inventories and 24 batches.

Reduced Uncertainty with 5900 Series Gauges



1. Low estimate. According to API chapter 7: In large tanks not thoroughly mixed, vertical temperature differences of as much as 3 °C (5.4 °F) are normal, and differences of 5 °C (9.0 °F) are common.

Pressure measurement

Reference accuracy Rosemount 3051S

Coplanar pressure transmitter

Up to ±0.025% of span for ultra version, up to ±0.035% of span for classic version.

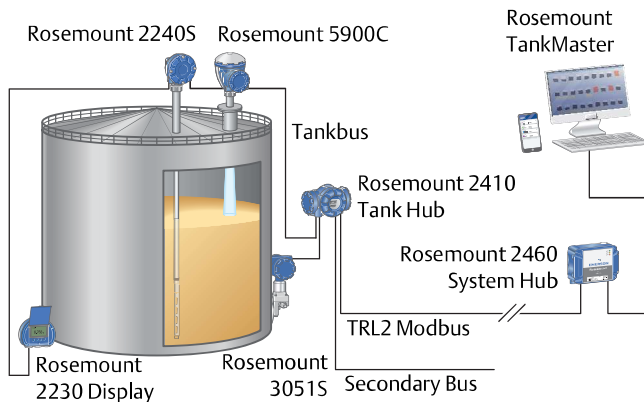
Liquid level pressure transmitter

Up to ±0.055% of span for ultra version, up to ±0.065% of span for classic version.

System design specifications

System layout

Communication on the self-configuring Tankbus connected to the Rosemount 2410 Tank Hub is based on the FOUNDATION Fieldbus. It is also possible to connect previous Rosemount tank gauging devices to the system via Modbus, integrate a wireless system and a system from another vendor (see Table 5).



The below data can give guidance when customizing the system:

- The Rosemount 2410 Tank Hub delivers 250 mA to the Tankbus.
The number of tanks and units connected to the Tank Hub depends on which field devices are connected, and their power consumption. Current requirement per field device is listed in Table 4.
- One Rosemount 2410 Tank Hub per tank is recommended for a Rosemount 5900 Series system configuration.
- Rosemount 2410 Tank Hub supports up to 10 tanks for a Rosemount 5408 system configuration, and up to 5 tanks for a Rosemount 5300 system configuration.
- Minimum voltage supply to the devices is 9 V.

Table 4. Power Budget

Field device	Current consumption (9V)
Rosemount 5900 Series Radar Level Gauge	50 mA
Rosemount 5900S Radar Level Gauge, 2-in-1	100 mA
Rosemount 5300 or Rosemount 5408 Series Radar Level Transmitter	21 mA
Rosemount 2230 Graphical Field Display	30 mA
Rosemount 2240S Multi-input Temperature Transmitter	30 mA including temperature sensors
Rosemount 644 Temperature Transmitter	11 mA
Rosemount 3051S or Rosemount 2051 Pressure Transmitter	18 mA

Examples:

250 mA from the Rosemount 2410 Tank Hub supplies power to:

One tank with:

- One Rosemount 5900S 2-in-1 Radar Level Gauge
- One Rosemount 2240S Multi-input Temperature Transmitter with sensor
- Two Rosemount 2230 Displays
- Two Rosemount 3051S Pressure Transmitters

Five tanks with:

- Five Rosemount 5300 or 5408 Radar Level Transmitters
- Five Rosemount 644 Temperature Transmitters with sensors
- One Rosemount 2230 Display

Six tanks with:

- Six Rosemount 5408 Level Transmitters
- Six Rosemount 644 Temperature Transmitters with sensors
- One Rosemount 2230 Display

Ten tanks with:

- Ten Rosemount 5408 Level Transmitters

Tankbus cable requirements

Recommended cabling is shielded twisted pairs, 0.75 mm² (AWG 18). Other possibilities are shielded twisted pairs, 0.5-1.5 mm² (AWG 22-16). Tankbus cabling must fulfill FISCO cable and installation requirements and be approved for use at minimum 85 °C (185 °F).

FISCO (Fieldbus Intrinsically Safe Concept)

The following cable characteristics are specified for FISCO according to IEC 60079-27.

Table 5. FISCO Cable Characteristics

Parameter	Value
Loop resistance	15 to 150 Ω/km
Loop inductance	0.4 to 1 mH/km
Capacitance	45 to 200 nF/km
Maximum length of each spur ⁽¹⁾ cable	60 m (197 ft) in gas Group IIC
Maximum length of each trunk ⁽²⁾ cable	1000 m (0.60 miles) in gas Group IIC, and 1900 m (1.18 miles) in gas Group IIB

1. The spur is an unterminated part of the network. It is allowed to have an up to 60 m (197 ft) long spur. For longer distances, an alternative network configuration should be considered.
2. The trunk is the part of the network which has terminators at both ends. In the system, a trunk can be the part of the network between the Tank Hub and a segment coupler or the last device in a daisy-chain configuration.

Reuse of existing cabling

It is recommended to install new Tankbus cabling according to the specification above. However, in most cases it is possible to re-use the existing cabling if compliant with FISCO requirements.

Examples

Typical characteristics for such a cable is:

- 0.75 mm² (AWG 18)
- 42 Ω/km (loop resistance)
- 115 nF/km
- 0.65 mH/km

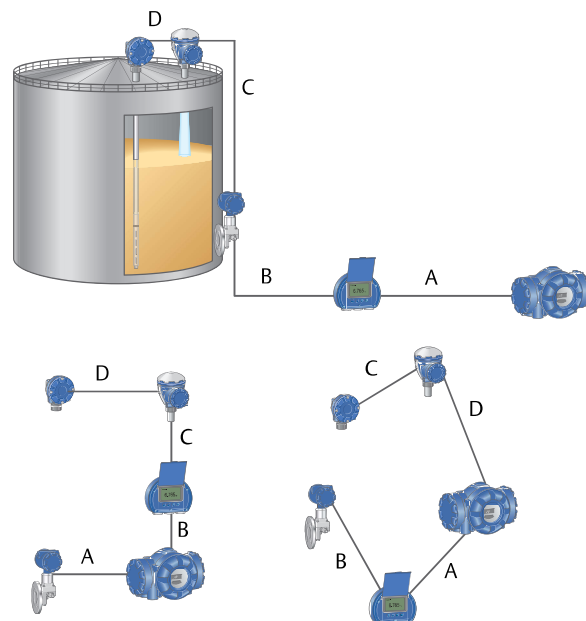
The following examples show the allowed cabling distances for different system configurations. It is assumed that the devices are installed at the end of the cabling for a full load scenario. In reality that is not the case, which is why the allowed distances might be longer.

Maximum Distance with Maximum Power Usage for a Rosemount 5900S Configuration:

The Rosemount 2410 Tank Hub can deliver 250 mA (12.5 VDC) to the devices on the tank. A voltage drop of 3.5 V is allowed. This means that the total worst-case cable resistance can be up to 14 Ω (3.5/0.250). The maximum cable length is 333 m (1092 ft).

Maximum Distance with Typical Power Usage for a Rosemount 5900S Configuration:

A more typical current value is 128 mA for a tank equipped with one Rosemount 5900S gauge, one Rosemount 2230 display, one Rosemount 2240S temperature transmitter, and one Rosemount 3051S pressure transmitter. In this case a cable with a length of 650 m (2130 ft) can be used.



Total cable distance A+B+C+D must not exceed the values in Table 6.

Table 6. Maximum Cabling Distance for a Rosemount 5900 Series Configuration

Cable diameter	Loop resistance	Maximum cabling distance from power source (2410) to all devices on the tank		
		with maximum power usage of 250 mA. Distance in m (ft)	with typical power usage of 128 mA for 5900 Series, 2240S, 2230, 3051S. Distance in m (ft)	with typical power usage of 178 mA for 5900S 2-in-1, 2240S, 2230, 3051S. Distance in m (ft)
20 AWG (0.5 mm ²)	66 Ω/km	212 (695)	414 (1358)	298 (978)
18 AWG (0.75 mm ²)	42 Ω/km	333 (1092)	651 (2136)	468 (1535)
17 AWG (1.0 mm ²)	33 Ω/km	424 (1391)	829 (2720)	596 (1955)
16 AWG (1.5 mm ²)	26 Ω/km	538 (1765)	1000 (3281)	756 (2480)

Maximum Distance with Typical Power Usage for a 5900S 2-in-1 Configuration:

If the tank instrumentation is the same as in the previous example, but instead is equipped with a Rosemount 5900S 2-in-1 gauge, the typical current value is 178 mA. The cable can then be 468 m (1535 ft).

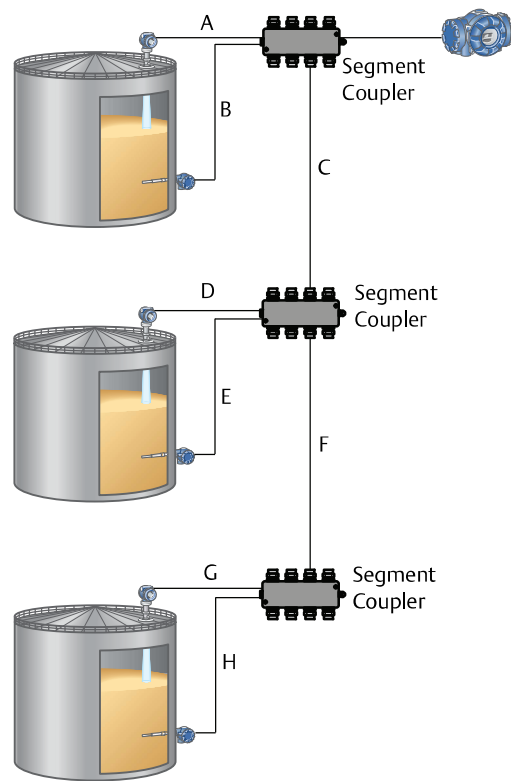
Table 6 is a guide to how long cables are allowed for a Rosemount 5900 Series system configuration with some common cable types.

Maximum Distance with Typical Power Usage for a Rosemount 5300/5408 Configuration:

For a tank equipped with one Rosemount 5300 or Rosemount 5408 Transmitter, and one Rosemount 644 Temperature Transmitter, the typical current value is 31-32 mA. This means the cable can be up to 2604 m (8543 ft).

It is possible to have five such Rosemount 5300-based tanks or up to ten Rosemount 5408-based tanks, connected to one Rosemount 2410 Tank Hub if the total cable length is not exceeded.

Table 7 is a guide to how long cables are allowed for a Rosemount 5300 or Rosemount 5408 system configuration with some common cable types.



Total cable length A+B+C+D+E+F+G+H must not exceed the values given in Table 7.

Table 7. Maximum Cabling Distance for a 5300/5408 Configuration

Cable diameter	Loop resistance	Maximum total cable length from power source (2410) to all devices on the tank, m (ft) with typical power usage of 32 mA per tank with 5300/5408 and 644				
		Five tanks Distance in m (ft)	Four tanks Distance in m (ft)	Three tanks Distance in m (ft)	Two tanks Distance in m (ft)	One tank Distance in m (ft)
20 AWG (0.5 mm ²)	66 Ω/km	331 (1085)	414 (1358)	552 (1811)	828 (2716)	1000 (3281)
18 AWG (0.75 mm ²)	42 Ω/km	520 (1706)	651 (2135)	868 (2847)	1000 (3281)	1000 (3281)
17 AWG (1.0 mm ²)	33 Ω/km	662 (2171)	828 (2716)	1000 (3281)	1000 (3281)	1000 (3281)
16 AWG (1.5 mm ²)	26 Ω/km	841 (2759)	1000 (3281)	1000 (3281)	1000 (3281)	1000 (3281)

TRL2 field bus cable recommendations

In a Rosemount Tank Gauging System, the Rosemount 2410 Tank Hub communicates with a Rosemount 2460 System Hub using the TRL2 Modbus protocol.

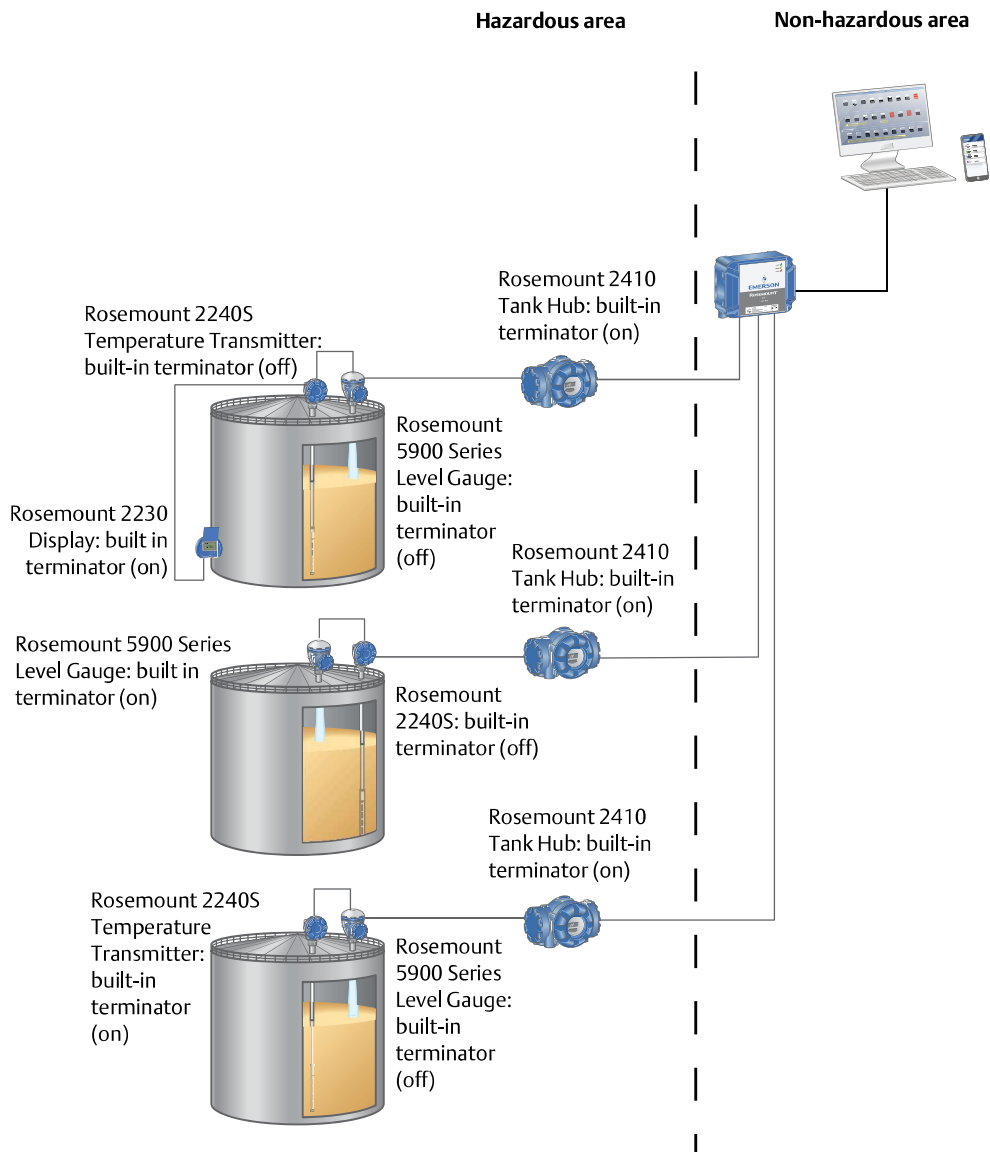
The TRL2 field bus requires twisted and shielded pair wiring with a minimum area of 0.50 mm² (AWG 20 or similar).

The maximum length of the TRL2 field bus is approximately 4 km (2.5 miles). The TRL2 field bus can normally use existing cables in the tank area.

Typical Tankbus wiring in a Rosemount 5900 Series system configuration

Available installation configurations enable easy and cost-efficient cabling. The Rosemount Tank Gauging System has a daisy chain feature for convenient wiring of the Tankbus.

The devices in a Rosemount 5900 Series system configuration have an on/off selectable built-in bus terminator (the last device on the bus must be terminated).



No external segment couplers or bus terminators are needed when the last device on the bus is a Rosemount 5900 Series gauge, a Rosemount 2240S, or a Rosemount 2230.

System certifications

Refer to each device PDS/Reference manual for details.

Accuracy/legal metrological approvals

- OIML R 85 edition 2008
- Algeria, ONML
- Australia, NMI
- Belgium, BMS
- Bulgaria, Type Approval
- China, CPA
- Croatia, Custody Transfer Certificate
- Czech Republic, CMI
- Estonia, TJA
- France, LNE
- Germany, PTB Eich
- India, W&M
- Indonesia, MIGAS
- Italy, Ministero dello Sviluppo Economico
- Kazakhstan, GOST
- Malaysia, SIRIM
- Norway, Justervesenet
- Poland, GUM
- Portugal, IPQ
- Russia, GOST
- Serbia, Custody Transfer Certificate
- Switzerland, METAS
- The Netherlands, NMI
- Tunisia, ANM

Hazardous location certifications

- ATEX
- IECEx
- FM-US
- FM-Canada
- Inmetro (Brazil)
- KC (South Korea)
- EAC/GOST (Russia, Belarus, Kazakhstan)
- NEPSI (China)
- PESO (India)
- CML (Japan)

Safety/overflow protection approvals

- IEC 61508 certified SIL 2 and SIL 3 capable (depending on device)
- TÜV/DIBt WHG for overflow protection (Germany)
- SVTI for overflow protection (Switzerland)
- Vlare II for overflow protection (Belgium)

Appendix A

Technical documentation for the Rosemount Tank Gauging System

Product data sheets

- Rosemount 5900S Radar Level Gauge (00813-0100-5900)
- Rosemount 5900C Radar Level Gauge (00813-0100-5901)
- Rosemount 5300 Level Transmitter (00813-0100-4530)
- Rosemount 5408 Level Transmitter (00813-0100-4408)
- Rosemount 2240S Multi-input Temperature Transmitter (00813-0100-2240)
- Rosemount 565/566/765 Multiple Spot Temperature and Water Level Sensors (00813-0100-5565)
- Single Point Temperature Measurement (00813-0100-5102)
- Rosemount 214C Temperature Sensors (00813-0500-2654)
- Rosemount 3051S Pressure Transmitter (00813-0300-4801)
- Rosemount 2230 Graphical Field Display (00813-0100-2230)
- Rosemount 2140 and 2140:SIS Level Detectors (00813-0100-4140)
- Rosemount 2160 Wireless Level Switch Vibrating Fork (00813-0100-4160)
- Rosemount 2410 Tank Hub (00813-0100-2410)
- Rosemount 2460 System Hub (00813-0100-2460)
- Rosemount Tank Gauging Accessories (00813-0100-5101)
- Rosemount Control Cabinets (00813-0100-1860)
- Emerson Wireless Gateway (00813-0300-4410)
- Emerson Wireless 775 THUM Adapter (00813-0100-4075)
- Rosemount TankMaster Inventory Management Software (00813-0100-5110)
- Rosemount TankMaster Mobile Inventory Management Software (00813-0100-5120)

Reference manuals

- Rosemount 5900S Radar Level Gauge (00809-0100-5900)
- Rosemount 5900C Radar Level Gauge (00809-0100-5901)
- Rosemount 5300 Level Transmitter (00809-0100-4530)
- Rosemount 5408 Level Transmitter with FOUNDATION Fieldbus Protocol (00809-0300-4408)
- Rosemount 2240S Multi-input Temperature Transmitter (00809-0100-2240)
- Rosemount 644 Temperature Transmitter with FOUNDATION Fieldbus Protocol (00809-0400-4728)
- Rosemount 3051S Series Pressure Transmitter with FOUNDATION Fieldbus Protocol (00809-0200-4801)
- Rosemount 2230 Graphical Field Display (00809-0100-2230)
- Rosemount 2140 Level Detector Vibrating Fork (00809-0100-4140)
- Rosemount 2140:SIS Level Detector (00809-0100-4140)
- Rosemount 2160 WirelessHART Vibrating Fork Liquid Level Switch (00809-0100-4160)
- Rosemount 2410 Tank Hub (00809-0100-2410)
- Rosemount 2460 System Hub (00809-0100-2460)
- Emerson Wireless Gateway (00809-0200-4410)
- Emerson Wireless 775 THUM Adapter (00809-0100-4075)
- Rosemount TankMaster Software Installation (00809-0400-5110)
- Rosemount Tank Gauging System Configuration (00809-0300-5100)
- Rosemount TankMaster WinOpi Inventory Management Software (00809-0200-5110)
- Rosemount TankMaster WinView Tank Management Software (00809-0300-5110)
- Rosemount Floating Roof Monitoring (00809-0500-5100)
- Rosemount Tank Gauging Wireless System (00809-0100-5200)
- Rosemount TankMaster Mobile Inventory Management Software User Guide (00809-0100-5120)
- Rosemount TankMaster Mobile Inventory Management Installation Manual (00809-0200-5120)
- Rosemount TankMaster Mobile Security Manual (00809-0300-5120)

Appendix B

When to use Rosemount 5900S or Rosemount 5900C in a Tank Gauging system

For more information, see “Radar level device selection” on page 45.

Rosemount Tank Gauging System Configuration: The Rosemount 5900S or 5900C gauge is recommended for high performance solutions for custody transfer, inventory control, oil/product movement & operations, and overfill prevention & leak detection		
Features	Rosemount 5900S	Rosemount 5900C
Accuracy		
Instrument accuracy	± 0.5 mm (0.02 in.) ⁽¹⁾	± 2 mm (0.8 in.) ⁽¹⁾
Typical system performance	± 1.0 mm (0.04 in.) or less	± 3 mm (0.12 in.)
Safety		
SIL 3	Yes, certified	No
SIL 2	Yes, certified	Yes, certified
Overfill prevention approvals	Yes, TÜV/DIBt WHG and other national approvals ⁽²⁾	Yes, TÜV/DIBt WHG and other national approvals ⁽²⁾
Proof-testing	Yes, extended & certified	Yes, extended & certified
Relay outputs for direct control	Yes	Yes
System output		
Spot temperature	Yes	Yes
Average temperature	Yes	Yes
Free water level	Yes	Yes
Pressure	Yes	Yes
Total observed volume (TOV)	Yes	Yes
Gross observed volume (GOV)	Yes	Yes
Gross standard volume (GSV) ⁽³⁾	Yes	Yes
Net standard volume (NSV) ⁽³⁾	Yes	Yes
Density	Yes	Yes
Mass	Yes	Yes
Alarm handling	Yes	Yes
Batch handling feature	Yes	Yes
On-line density	Yes	Yes
Scheduled on-line reports	Yes	Yes
Legal metrological approvals		
OIML R85	Yes	No
NMI, PTB	Yes	No
Redundancy		
2-in-1 radar gauge	Yes	No
Communication		
Emulation	Yes	Yes
Wireless field network	Yes	Yes

1. At reference conditions.
2. Requires a Rosemount 2410 Tank Hub with applicable safety output.
3. According to API/ISO.

When to use Rosemount 5900C or Rosemount 5408 in a Tank Monitoring system

For more information, see “Radar level device selection” on page 45.

Features	Rosemount Tank Monitoring System Configuration: The Rosemount 5900C gauge or the Rosemount 5408 transmitter is recommended for oil/product movement & operations and overfill prevention	
	Rosemount 5900C	Rosemount 5408 with signal output code U
Accuracy		
Instrument accuracy	± 2 mm (0.08 in.) ⁽¹⁾	± 2 mm (0.08 in.) ⁽¹⁾
Typical system performance	± 3 mm (0.12 in.)	± 6 mm (0.24 in.)
Safety		
SIL 3	No	No ⁽²⁾
SIL 2	Yes	No ⁽²⁾
Overfill prevention approvals	Yes, TÜV/DIBt WHG and other national approvals ⁽³⁾	Yes, national approvals
Proof-testing	Yes, extended & certified (TankMaster WinSetup)	No ⁽²⁾
Relay outputs for direct control	Yes	No
System output		
Spot temperature	Yes	Yes
Average temperature	Yes	No
Free water level	Yes	No
Pressure	Yes	No
Total observed volume (TOV)	Yes	Yes
Gross observed volume (GOV)	Yes	No
Gross standard volume (GSV) ⁽⁴⁾	Yes	No
Net standard volume (NSV) ⁽⁴⁾	Yes	No
Density	Yes	No
Mass	Yes	No
Alarm handling	Yes	Yes
Batch handling feature	Yes	No
On-line density	Yes	No
Scheduled on-line reports	Yes	No
Legal metrological approvals		
OIML R85	No	No
NMI, PTB	No	No
Redundancy		
2-in-1 radar gauge	No	No
Communication		
Emulation	Yes	Yes
Wireless field network	Yes	Yes

1. At reference conditions.
2. Only available for Rosemount 5408 with Signal output code H.
3. Requires a Rosemount 2410 Tank Hub with applicable safety output.
4. According to API/ISO.

Appendix C

Radar level device selection

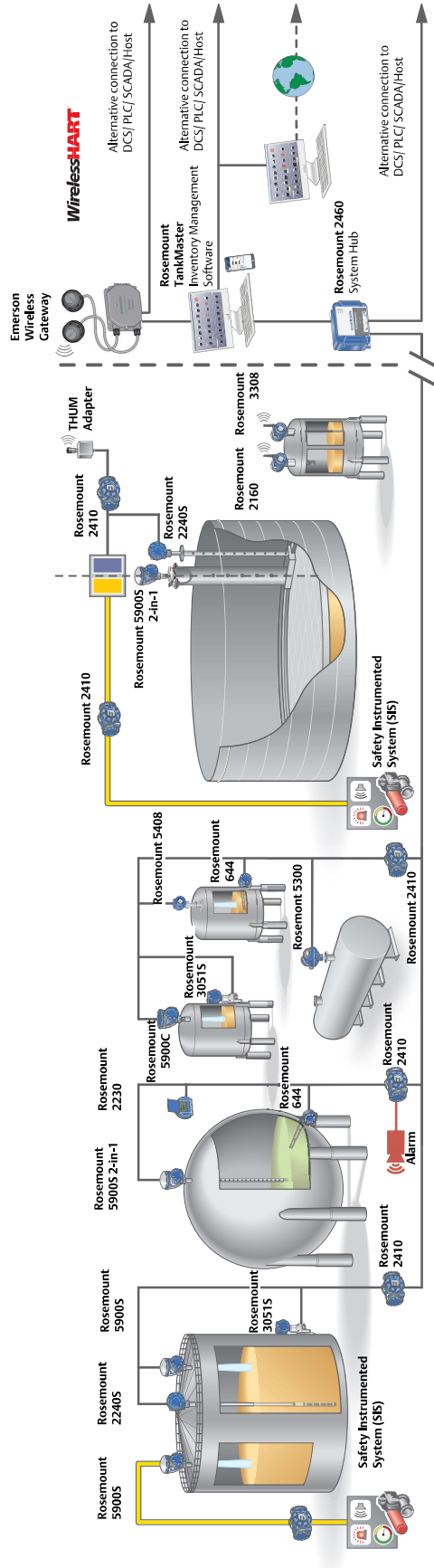
Below is a guideline on which radar level device and antenna/probe to use for various tanks and applications. In general, use Rosemount 5900S for custody transfer and inventory control, which requires highest accuracy and reliability.

See “When to use Rosemount 5900S or Rosemount 5900C in a Tank Gauging system” on page 43 and “When to use Rosemount 5900C or Rosemount 5408 in a Tank Monitoring system” on page 44 for more guidance.

Tank and Application	Recommended	Second Choice	Alternative Choice
Fixed Roof Tanks			
18 in. or larger nozzle, no disturbing objects in tank	Rosemount 5900S with parabolic antenna	Rosemount 5900C with parabolic antenna	Rosemount 5408 with parabolic antenna or Rosemount 5301 with flexible twin ⁽¹⁾ /single lead probe
8 in. to 17 in. nozzle, no disturbing objects in tank	Rosemount 5900S with horn antenna	Rosemount 5900C with cone antenna	Rosemount 5408 with parabolic or Rosemount 5301 with flexible twin ⁽¹⁾ /single ⁽²⁾ lead probe
4-6 in. nozzle, no disturbing objects in tank	Rosemount 5900C with cone antenna	Rosemount 5408 with 4-in cone antenna	Rosemount 5301 with flexible single lead probe
2-3 in. nozzle, no disturbing objects in tank	Rosemount 5900C with 1-in or 2-in still-pipe antenna	Rosemount 5301 with flexible single lead probe	Rosemount 5408 with 2-in. or 3-in cone antenna
Objects in tank	Rosemount 5900S with parabolic antenna	Rosemount 5900C with parabolic antenna	Rosemount 5301 with coaxial ⁽¹⁾⁽³⁾ , flexible twin ⁽¹⁾ or single lead probe or Rosemount 5408 with parabolic
5-12 in. still-pipe	Rosemount 5900S with still-pipe array antenna	Rosemount 5900C with still-pipe array antenna	Rosemount 5301 with flexible single lead probe and a centering disk
2-4 in. still-pipe measurement	Rosemount 5900C with 1-in or 2-in still-pipe antenna	Rosemount 5900C with cone antenna	Rosemount 5301 with flexible single lead probe and centering disks ⁽⁴⁾
Floating Roof Tanks			
5-12 in. still-pipe	Rosemount 5900S with still-pipe array antenna	Rosemount 5900C with still-pipe array antenna	Rosemount 5301 with flexible single lead probe and a centering disk
Measurement towards tank roof	Rosemount 5900S with parabolic antenna	Rosemount 5900C with parabolic antenna	Rosemount 5408 with parabolic antenna
Bullet/Sphere Shaped Tanks			
Pressurized LPG sphere, > 6 m (20 ft)	Rosemount 5900S with LPG/LNG antenna	Rosemount 5900C with LPG/LNG antenna or 2-in still-pipe antenna	Rosemount 5301 with flexible twin lead probe ⁽¹⁾ and centering disks
Pressurized LPG bullet, < 6 m (20 ft)	Rosemount 5900S with LPG/LNG antenna	Rosemount 5900C with LPG/LNG antenna or 1-in ⁽⁵⁾ or 2-in still-pipe antenna	Rosemount 5301 with coaxial probe ⁽¹⁾ or flexible twin lead probe
Other bullet tanks (e.g. additive tanks) < 6 m (20 ft)	Rosemount 5900S with LPG/LNG antenna	Rosemount 5900C with 1-in or 2-in still-pipe antenna	Rosemount 5301 with coaxial probe ⁽¹⁾
Water Interface Measurement			
Upper Liquid Level + Free Water Interface Level	Rosemount 5900S and a 765 water level sensor ⁽⁶⁾	Rosemount 5900C and a 765 water level sensor ⁽⁶⁾	Rosemount 5302 with flexible twin lead ⁽¹⁾⁽⁷⁾ or coaxial ⁽¹⁾⁽³⁾ probe or Rosemount 5302 with flexible single lead probe ⁽⁸⁾

1. For clean products, with no risk for build-up.
2. Special considerations for 10 in. or larger nozzles. Consult factory.
3. Best alternative choice for measuring distance up to 6 m (20 ft).
4. Maximum 20 m (66 ft). Centering disks required to be placed along the probe, with a separation distance of 5 m (16 ft).
5. Maximum 3 m (10 ft).
6. When the free water interface level is < 1000 mm (3.3 ft).
7. Upper liquid thickness typically up to 25 m (82 ft) for oil/water interface.
8. Upper liquid thickness typically up to 15 m (49 ft) for oil/water interface.

High-Performance Bulk Liquid Measurement and Overflow Prevention Solutions



- Rosemount 59005** Radar Level Gauge (2-in-1 option available)
- Rosemount 59005** Still-pipe Array
- Rosemount 59005** Horn
- Rosemount 59005** LPC/LNG
- Rosemount 59005** 2-in-1
- Rosemount 5900C** Radar Level Gauge
- Rosemount 5900C** Still-pipe Array
- Rosemount 5900C** Cone
- Rosemount 5900C** LPC/LNG
- Rosemount 22405** Multi-input Temperature Transmitter
- Rosemount 22405** Rosemount 765 Multiple Spot Temperature and Water Level Sensor
- Rosemount 22405** Rosemount 565/566 Multiple Spot Temperature Sensors
- Rosemount 2140/2160** Liquid Level Switches
- Rosemount 2140/2160** Rosemount 2410 Tank Hub
- Rosemount 5408** Radar Level Transmitter
- Rosemount 5408** Rosemount 2230 Graphical Field Display
- Rosemount 5408** Rosemount 3051S Pressure Transmitter
- Rosemount 3308** Wireless Guided Wave Radar Level Transmitter
- Rosemount 3308** Rosemount 644 Temperature Transmitter with 214C Single Point Sensor

For more information: www.emerson.com

© 2021 Emerson. All rights reserved.

Emerson Terms and Conditions of Sale are available upon request.
The Emerson logo is a trademark and service mark of Emerson Electric Co.
Rosemount is a mark of one of the Emerson family of companies. All other
marks are the property of their respective owners.