Rosemount Tank Gauging System

Always ready for your next challenge

December 2015
Rosemount Tank Gauging System

- Emerson Process Management (prev. SAAB) - the inventor of radar tank gauging
- More than 125,000 radars for large tanks in service

*The world leader in radar tank gauging!*
Developed With the Users...

- Designed together with 250 tank farm operators across the world to minimize their key concerns
...to Address Key Concerns

• Risk of overfill
• Being locked in to one supplier
• Problems with interoperability
• Worries about investing for the future
• Compliance to future rules and regulations
• Ability to deliver accurate storage information at high availability to customers
• High maintenance and installation cost
Rosemount Tank Gauging System

- Boost efficiency
- Improve safety
- Increase accuracy
- Future proof
- Scalable
- Smooth installation
Built on 40 Years of Radar & Tank Gauging Knowledge

- Established 10 GHz FMCW technology
- Taking advantage of well-proven antenna program
  - Developed and improved over 30+ years
  - Drip-off design
  - Low-loss mode in pipes
  - Signal processing optimized for high accuracy Tank Gauging
  - Antennas for all tank types
- Same proven system components where suitable
  - e.g. temperature sensors (single- & multi-point) and pressure transmitters
- Added on the latest technology advancements
  - *Certified safety: SIL3 & SIL2*
  - 2-in-1
  - *OIML R85 certified according to 2008 edition*
  - *Open system (Modbus, OPC, Ethernet, FF, ...)*
  - *WirelessHART*
  - 2-wire devices
Improved Accuracy Reduces Uncertainty
5900S Exceeds OIML R85:2008

Old (R85:1998)

New (R85:2008)

Downwards manual log
Upwards manual log
Downwards autolog
Upwards autolog

(mm)

0 5 10 15 20 25 30

5900S Exceeds OIML R85:2008

Old (R85:1998)

New (R85:2008)
2240S Improves Temperature Accuracy

- Integrated Transmitter & Sensor
- ± 0.05°C accuracy
  - Custody transfer certified
  - 3 or 4-wire RTD elements (optional)
- Up to 16 spot positions
  - Better resolution measuring stratified liquids
- Water Level Sensor
  - Measure free water level at tank bottom
Every Drop Counts

Rosemount 5300/5400 Tank Monitoring System

- Level: Rosemount 5300/5400
- Temp: Rosemount 644 w single point Rosemount 65 sensor

Mechanical Float & Tape tank gauging

- Level: Float & Tape (mechanical)
- Temp: Single point temperature measurement

Volume uncertainty per year & tank

20x40 meter tank, 12 inventories & 24 batches

- 1,200 barrels
- 2,300 barrels
Highest Accuracy Pays Off

Rosemount 5900S high precision tank gauging system

Level: Rosemount 5900S
Temp: Rosemount 2240S w Multiple Spot Rosemount 565 Sensor

Rosemount 5300/5400 Tank Monitoring System

Level: Rosemount 5300/5400
Temp: Rosemount 644 w single point Rosemount 65 sensor

Volume uncertainty per year & tank
20x40 meter tank, 12 inventories & 24 batches

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>160 barrels</td>
<td>1,200 barrels</td>
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</table>

Reduction of inventory uncertainty:
$88,000 per tank per year
Greatly Reduced Uncertainty

- The 5900S-based system typically reduces volume uncertainty by 90% compared to a 5300 or 5400-based system.

90% Reduced Uncertainty
with 5900S-based configuration

5900S

5300/5400

Tape & Float

0% 10% 100% 200%
New Approach to Overfill Prevention Improves Safety
Legacy of Safety Innovation Continues...

• 1976: World’s 1st Radar Level gauge for marine tankers
• 1984: World’s 1st Radar Level Gauge for on-shore Tank Gauging

... 

• 1997: World’s first Radar Level Gauge with TÜV WHG Approval
• 2002: World’s 1st Radar Level Gauge with 2-in-1 and 3-in-1
• 2007: World’s 1st Custody transfer approved SIL2 Radar Gauge
• 2009: World’s 1st Radar Level Gauge with WirelessHart
• 2010: World’s 1st Radar Level Gauge with 2-in-1 and SIL3-Certification
What is 2-in-1?

- 2 radars in 1 housing
- Only one tank opening
- Complete electronic separation
- Operates in parallel
- Easier & faster installation
Taking Safety to a Higher Level

• Two independent and continuous level measurements through one tank opening

• Most common use-cases:
  – Level gauging and overfill prevention combined
  – Safety through redundancy
Rely on Certified Equipment

• 3rd party certified to fulfill:
  – IEC 61508
  – API2350
  – IEC 61511
Single Installation – Dual Use

- ATG and overfill prevention in single tank opening
- Simplest way to become API 2350 & IEC 61511 compliant
Online Verification With 2-in-1 Radar

- An alarm is given if the $\Delta$ exceeds a defined limit.

Blue and Yellow separation exaggerated for visibility.
User benefits with 2-in-1

- **Cost-efficient** safety compliance
- Suitability for overfill prevention **certified** by 3rd parties
  - API 2350 & IEC 61511
  - SIS/SIL certificate
- **Faster** installation & commissioning
  - Fewer devices & device-types
  - Single tank-penetration
  - Single mechanical installation
- Online **verification** with $\Delta$-check
- Measurement has **better** quality
  - High accuracy continuous measurement
- **HiHi, LoLo,** and more alarms in same device
Future Proof System Protects Your Investment
Future Proof Tank Gauging

• A flexible system easily adapted to your future challenges
  – Open system
    • Avoid getting locked in to a specific vendor
    • Select the best device for the job, independently of vendor
  – Scalable
    • Fits your exact needs
    • Easy to upgrade and expand when needed
  – Fulfills the most stringent standards available
    • OIML R85:2008
    • API 2350
    • Certified SIS/SIL, and more...
  – Can be purchased with ready for upgrade
    • 2-in-1
    • SIS/SIL
    • Wireless, and more...
Future Proof Tank Gauging

- Emulation
  - Use Rosemount instruments together with communication protocols from other vendors
  - Install new equipment into legacy systems
  - Avoid rewiring and trenching
  - Upgrade bit by bit & year by year on your Opex budget

- Wireless
  - Cost-efficient installation
  - Utilize more data
  - Automate your tank farm
  - Get redundant communication
Compliant to API Standards

• API standards:
  – 3.1B Automatic Tank Gauging
  – 3.3 LPG measurements
  – 3.6 Hybrid Measurements
  – 7 Temperature Measurements
  – 2350 Overfill Protection
Cost Efficient Tank Gauging With Modular System
Flexible and Scalable System

• Modular system is easily adapted to meet user needs

• No matter if:
  – The terminal is big or small
  – Custody transfer or Tank Monitoring System
  – Mix of tank types
High Performance Tank Gauging

- High performance gauging devices
- Single 2-wire bus on the tank
- Simplified cabling
- All tank devices Intrinsically Safe

→ Safe, fast and cost-efficient installation
→ Faster Return On Investment
Tank Monitoring Systems

- A single 2-wire bus for up to 10 tanks
- Easy to build
  - Faster cabling work
  - Simpler installation
- All tank devices Intrinsically Safe
- Add devices when needed with minimum effort
- Perfect when highest accuracy is not needed

Flexibility to meet any challenge – current and future
Simpler Cabling Reduces Installation Cost
Installation In Existing Systems

Expensive to install new cabling?

Go Wireless!

Stuck with your old system?

Use Emulation!
Field Wiring

- Tank Bus
  - FOUNDATION fieldbus
  - 2-wire
  - Intrinsically Safe
  - Max 12VDC
  - Open standard

RTG scalable system
Wiring Savings

Previous system

RTG scalable system
## Wiring Savings

Diameter 18m, height 24m. US-Installation w/ conduits

<table>
<thead>
<tr>
<th></th>
<th>Standard 4-wire System</th>
<th>RTG 2-wire System</th>
</tr>
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<tbody>
<tr>
<td>Wiring</td>
<td>440 ft.</td>
<td>1191 $</td>
</tr>
<tr>
<td>Conduits</td>
<td>440 ft.</td>
<td>7477 $</td>
</tr>
<tr>
<td>Junction Boxes</td>
<td>2 Pcs</td>
<td>729 $</td>
</tr>
<tr>
<td>Sum</td>
<td>9397 $</td>
<td></td>
</tr>
</tbody>
</table>

**RTG Wiring Savings:** 7427 $
Rosemount Tank Gauging System – Overview
Rosemount Tank Gauging System Components

**Rosemount 5900S**
- Radar Level Gauge
- ± 0.5 mm accuracy
- OIML custody transfer certified
- SIL3 & SIL2 certified
- 2-in-1
- FMCW

**Rosemount 5900C**
- Radar Level Gauge
- ± 3 mm accuracy
- SIL2 certified
- FMCW

**Rosemount 5400**
- Radar Level Gauge
- ± 3 mm accuracy
- SIL2 proven-in-use
- Pulse radar

**Rosemount 5300**
- Radar Level Gauge
- ± 3 mm accuracy
- SIL2 proven-in-use
- Pulse radar
- Guided wave
Rosemount Tank Gauging System Components

**Rosemount 2410**
- Tank Hub
  - Intrinsically Safe power to tank instruments
  - Communication to tank instruments & host/DCS
  - Emulation to tank instruments or host/DCS
  - SIS and non-SIS relays

**Rosemount 2240S**
- Temperature Transmitter
  - ± 0.05°C accuracy
  - Custody transfer certified
  - Water level transmitter
  - 3 or 4 wire RTD
  - Up to 16 temp spot elements

**Rosemount 565/566/765**
- Multi-spot Temperature Sensor
  - Cryogenic (566)
  - Temp & water level (756)
  - Custody transfer
  - 3 or 4 wire RTD
  - Up to 16 temp spot elements

**Rosemount 2460**
- System Hub
  - Ensures fast data update rate
  - Serves up to 64 tanks
  - Flexible and configurable multiple port connectivity
# Rosemount Tank Gauging System Components

## Rosemount 2230
- **Graphical Field Display**
  - Up to 3 per tank
  - Large digits
  - Back lit

## Rosemount 2120/30/60
- **Liquid Level Switch**
  - Vibrating fork
  - Point level
  - Wireless (2160)

## Rosemount 3051S
- **Pressure Transmitter**
  - Precision pressure
  - Used for online density measurement

## Rosemount 644 & 65/68
- **Temperature Transmitter**
  - Single point temperature measurement
  - 3 or 4 wire RTD
Manage Your Tank Farm With TankMaster
The Tank Master Software Package

- 100% in-house development
- 100% in-house support
- Easy to configure at site by users
- 3 versions:
  - WinOpi
  - WinView
  - TankMaster Net
TankMaster WinOpi

*Gain complete insight into your tank farm*

- Complete inventory management software:
  - Operator interface
  - API tables
  - Net standard volumes
  - Custody transfer approvals
  - Batch handling
  - Alarms
  - Reports
  - Redundancy
  - And more…
WinView and TankMaster Net

**TankMaster WinView**
- Excellent for smaller depots and Tank Monitoring Systems
- Basic inventory capabilities
- Observed volume calculation
- Alarms & configuration

**TankMaster Net**
- Inventory overview via internet
- Real-time and secure
- When and where you need it
TankMaster System Setup

- TankMaster system installation example:
Why Buy the Rosemount Tank Gauging System?
Improve Your Plant Performance

With the Rosemount Tank Gauging System, you can:

• Rely on accurate and dependable real-time data
• Stop worrying with certified safety
• Become API 2350 and IEC 61511 compliant quickly and cost efficiently
• Stay in control through OIML certified custody transfer accuracy
• Be confident about future challenges with scalable and open system

*When every drop counts, you can count on radar technology*
Proven Performance

- 10,000+ Rosemount 5900S installations worldwide!

5900S @ New York Terminals, NY

5900S @ LAX airport, CA
Rosemount Tank Gauging System in Service
Public Letter: Rosemount Raptor Tank Gauging System

Nynas is a world leader in the global market for naphthenic speciality oils and one of the largest European suppliers of bitumen. Nynas is now owned in equal parts by Petróleos de Venezuela (PDVSA) and the Finnish oil company Neste Oil Corporation. Neste Oil was before April 2005 operating as a part of the Finnish energy company Fortum. More information is available at our website: www.nynas.com.

Emerson has delivered 23 tank gauges of model Rosemount 5900S with a variety of antennas to our bitumen refinery in Gothenburg, Sweden. All of them are so called 2-in-1 Radar Level Gauges with FMCW-technology. The first 2-in-1 gauge was installed in 2009, and has been working adequately ever since. The gauges are connected to our DeltaV-system, which also has been supplied by Emerson.

Most of the gauges are installed in very difficult applications such as large storage tanks with heated bitumen. The colder ambient temperature chills the tank shell, which result in major condensation on everything inside the tank that not many level technologies can handle. So far, the Raptor Radars have performed according to their specification, and without requiring any maintenance.

We have almost 30 years of experience from radar-based tank gauges. Our conclusion so far has been that the Raptor is a considerable advancement for this technology, especially in terms of safety. Rosemount Raptor is definitely our choice for the future.

Best regards,

Boris Gelin
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To: To Whom It May Concern
From: Mike Johnson    Oiltanking Texas City, L.P.
Subject: Rosemount Tank Gauging System

I have been in charge of installing and the service of all gauging systems, hardware and software in all of our North America terminals.

In my opinion Rosemount Tank Radar has exceed all expectation of accuracy also has been the most reliable and user friendly systems that I have installed. We have all types of Rosemount Tank Radar gauges (TRL, TRL2, Rex, Raptor) and Rosemount Tankmaster and Tankmaster.Net software.

Rosemount Tank Radar has one of the best sales and service departments in the market handling all of our needs in the best professional way possible.

Best Regards

Mike Johnson
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