Hydrostatic Tank Gauging System
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.

The contents, descriptions and specifications within this manual is subject to change without notice. Rosemount TankRadar AB accepts no responsibility for any errors that may appear in this manual.

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 TankRadar REX 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 REX 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 TankRadar REX 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: Cover_system_layout.eps
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Section 1  Getting Started

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1.1 INTRODUCTION

Hydrostatic Tank Gauging (HTG) is a pressure measuring method used mostly in the refining, petrochemical and chemical industries. The method is simple: pressure readouts from transmitters in the tank are used to calculate the weight of the product.

This document describes the system overview, installation and operation of the TankMaster HTG System developed by Rosemount Tank Gauging.

The HTG System is an extension to the already existing TankMaster System. For instructions how to install, configure and use the TankMaster system, see Rosemount TankMaster WinSetup User’s Guide [Ref. no. 303027 EN] and Rosemount TankMaster WinOpi User’s Guide [Ref. no. 303028 EN].

1.2 DEFINITIONS AND ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTG</td>
<td>Hydrostatic Tank Gauging</td>
</tr>
<tr>
<td>FCU</td>
<td>Field Communication Unit</td>
</tr>
<tr>
<td>GOV</td>
<td>Gross Observed Volume</td>
</tr>
<tr>
<td>GSV</td>
<td>Gross Standard Volume</td>
</tr>
<tr>
<td>LAN</td>
<td>Local Area Network</td>
</tr>
<tr>
<td>DS4</td>
<td>Director Series 4</td>
</tr>
<tr>
<td>NSV</td>
<td>Net Standard Volume</td>
</tr>
<tr>
<td>RTG</td>
<td>Radar Tank Gauge</td>
</tr>
<tr>
<td>TCP/IP</td>
<td>Transmission Control Protocol/Internet Protocol</td>
</tr>
<tr>
<td>TCT</td>
<td>Tank Capacity Table</td>
</tr>
<tr>
<td>TOV</td>
<td>Total Observed Volume</td>
</tr>
<tr>
<td>VCF</td>
<td>Volume Correction Factor</td>
</tr>
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</table>
2.1 INTRODUCTION

The TankMaster HTG system is an intelligent direct mass measuring system. It takes advantage of the high precision pressure transmitters installed at different levels in the tank. HTG uses product hydrostatic pressure measurements to derive both the specific gravity and liquid level.

Figure 2-1. System Layout
2.1.1 Components

**DS4**
The Director Series 4 (DS4) is a gateway for enabling operational data to be acquired, transformed and utilized through full TCP/IP communication. The DS4 polls the transmitters for Primary Values (PV) and Secondary Values (SV) and sends information to the TankMaster network.

The DS4 is factory configured.

**Pressure and Temperature Transmitters**
Rosemount pressure and temperature transmitters support the DS4 with measurement data. Different types and numbers of transmitters are used depending on tank configuration. For example, a tank with vapor pressure requires three transmitters for online measurement. Two transmitters measuring the liquid pressure and one at the top measuring the vapor pressure.

All transmitter configuration is done using 275/375 handheld communicator or AMS suite software.

**WinOpi**
The program supports data display of mass data as well as data entry. In order to display special HTG windows and HTG values, a special hardware key with HTG option is needed.

**TankServer**
The TankServer calculates the mass value and other variables and handles the alarms. It also polls the DS4 for the PVs and SVs. In order for the TankServer to calculate HTG values, a special hardware key with the HTG option is needed.

**Electrical interface**
The electrical interface uses RS-232 or RS-485 standard interface. A modem is needed for converting the RS-485 to RS-232.

2.1.2 Communication

**TankMaster to DS4**
TankMaster communicates via Modbus protocol to the DS4 devices. It polls the registers where the DS4 has cashed PV and SV from the transmitters.

**DS4 to HART transmitters**
The DS4 polls PV and SV from the transmitters using HART protocol.

**OPC compatibility**
TankMaster uses OPC Data Access 2.0, an open industry standard. With the OPC standard it is easy to import information from other OPC clients.
2.2 FUNCTION

HTG uses product hydrostatic pressure measurements to derive both specific gravity and liquid level. A typical HTG system uses three pressure transmitters: one near the bottom of the tank, another above the first, and a third at the top.

Comparison of the pressure readouts from the two submerged transmitters are used to calculate the specific gravity of the liquid thus generating mass and density. The liquid level can be determined by comparing readouts from the transmitter above the liquid level (which measures the vapor pressure in the tank) and the transmitter at the bottom.

As a complement the temperature measurement is needed to get the standard volume.
Section 3  

Installation

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3.1 SOFTWARE CONFIGURATION

For a complete installation do the following:

1. “Configure Preferences” on page 3-1.
2. “Configure the ModbusMaster protocol” on page 3-3.
3. “Install Device DS4” on page 3-5.

Before doing the configuration for the HTG system perform the WinSetup installation, see *Rosemount TankMaster WinSetup User’s Guide*.

Step 1 Configure Preferences

In this step important parameters for units, volume correction, gravity, air density and Tank Capacity Table (TCT) are set.

NOTE!

It is important to set parameters in the Preferences before continuing with the device and tank installation. The installed tanks will otherwise display incorrect values.

1. Select the desired server (for example “This Workstation”) in the TankMaster WinSetup workspace.

2. Right click and select **Setup**.
3. Choose System Units and remaining parameters as correct as possible. Click **OK**.

These parameters are important when setting up tanks and performing the calculations.
Step 2. Configure the ModbusMaster protocol

The ModbusMaster protocol must be configured in order for the network connection to work. Do the following to enable the ModbusMaster protocol in WinSetup:

1. In the WinSetup workspace open the Protocols folder.

2. Select the protocol icon that corresponds to the protocol to be configured.

3. Click the right mouse button and select Properties.

4. Select the desired channel.

5. Click the Properties button.
6. Select the Communication tab and configure the communication parameters: Baud Rate: **19200**, Modem: **RS-232**, Stop bits: **1** and Parity: **None**. Make sure that the **Enable Channel** check box is selected. Check that **Port** is set to the COM port that the DS4 is connected to.

7. Click **OK**. The ModbusMaster protocol configuration is now finished.
Step 3. Install Device DS4

TankMaster does not support the HART protocol. The HTG system uses the DS4 for transforming the HART protocol to the Modbus protocol. In WinSetup the DS4 must be installed as a new device before a tank can be installed.

1. Start the Device Installation Wizard, see Chapter 3.7 in Rosemount TankMaster WinSetup User’s Guide. Click OK if the following message appears: “If your TankRadar system configuration has FCU you must install it first ...”

Figure 3-6. Select device

2. Choose device type - DS4. Specify a name for the device in the corresponding Tag input field. In this installation example the name is DS4-1 but any name can be specified. If you want to install the DS4 before the actual device is connected to the field bus, select the Install Offline check box.

3. Click the Next button.

Figure 3-7. Establish communication
4. Check that the **Communication Channel** and **Modbus Address** are correct and click the **Verify Communication** button to make sure that communication is established.

5. Click **Next**. The communication will be tested again. Click **OK** in the dialog box.

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6. Select **HBI Port** and **Channel**. There are two HBI Ports with two channels on each port. Check that all channels have been configured before moving on.

7. Click the **Get Value Units** button. For each HART Poll Address select **Device Type** and type a **Tag name**. Check that the value units are correct.

8. If Secondary Value is used unmark the **PV Only** check box.

9. Click the **Next** button.

10. Read summary and then click the **Finish** button.

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**Figure 3-8. Channel Configuration window**

**Figure 3-9. The installed DS4 appears in the WinSetup Workspace.**
Step 4. Tank installation

Continue with tank installation. The tank type will be selected by the user as a HTG-tank (three choices).

1. Start the Tank Installation Wizard, see Chapter 3.5 in Rosemount TankMaster WinSetup User’s Guide.

Figure 3-10. Install tank in WinSetup workspace

2. Choose one of the three optional types of HTG tanks: HTG fixed roof, HTG floating roof or HTG floating blanket. Also enter appropriate Tag-name. Click Next.

Figure 3-11. Tank HTG configuration

3. Select channels to associate with the tank as input for Liquid Pressure, Vapor Pressure and Temperature. Check the units for each device before clicking Next.
4. Click **Finish** and view the tank in the WinSetup workspace.

Figure 3-12. The installed channels appear in the WinSetup workspace after the tank installation is finished.
4.1 TANK HTG CALCULATIONS

Position of the pressure sensors are set in the Tank HTG Calculations window that can be found in WinSetup.

1. Select the HTG-tank in WinSetup Workspace window.

2. Right click and select the HTG Tank Setup option.
3. Type the sensor positions for Vapor Pressure and Liquid Pressure. It is important that these figures are given with high accuracy. Enter the HTG Reference Point in the Ho Distance field. The Ho Distance parameter is equal to zero if the Datum Plate is used as HTG Reference Point, otherwise the Ho Distance is equal to the distance between the HTG Reference Point and the Datum Plate.

The Thresholds settings can be used to avoid HTG calculations in a measurement range where the pressure sensor accuracy is low. The $P1-P2$ threshold sets the lower limit for how close to the P1 sensor HTG calculations are performed. The $P2-P3$ threshold sets a similar limit for the P2 sensor.

Installation Temperature is the temperature inside the tank at the time when the sensor positions were measured.

**NOTE!**

*It is important to type the positions with three decimals.*

*The positions should always be measured to the centre of the sensor pressure membrane.*

*The HTG reference point can have the same position as the Datum Plate.*

4. Click OK.
4.2 TANK CAPACITY SETUP

The tank geometry is defined in a Strapping Table, also called Tank Capacity Table, which converts the product level to the corresponding volume.

To create a Tank Capacity Table do the following:

1. Select the HTG-tank in WinSetup Workspace window.

2. Right click and select the Tank Capacity option.

Figure 4-3. Tank Capacity in WinSetup Workspace

Figure 4-4. Tank Capacity Table
3. Enter the corresponding level and volume values.

**NOTE!**
*Sump Volume is the volume below the Zero Level, see Rosemount TankMaster WinOpi User’s Guide. Base Temp is the temperature in the tank when the strapping table was created.*

4. Click **OK**.
4.3 VOLUME CALCULATION SETUP

To configure the tank for volume calculations do the following:

1. Select the HTG-tank in the WinSetup Workspace window.

2. Right click and select Tank Volume Calculation option.

Figure 4-5. WinSetup Workspace

Figure 4-6. Tank Volume Calculation Setup window
3. Select desired Product. Inventory calculations are based on various parameters which are specified in the Product Table. The Product Table can be extended with new products when needed. See *Rosemount TankMaster WinOpi User’s Guide* for a description of how to edit the Product Table.

**NOTE!**
*If a vapor product is specified then type the vapor density in the Vapor Density Setup.*
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5.1 DEVICE ALARMS AND TANK ALARMS

The possible alarms in the HTG system are Hi, Lo or CFail. CFail is a communication failure, and means that TankMaster is not able to communicate with the device at the moment. Hi and Lo means that the live values from the transmitters or the calculated values from TankMaster are too high or too low compared with a user defined limit. See “Set level alarm limits or sensor alarm limits for HTG-tanks” on page 5-2 for how to set these limits. The values received from the different field devices are continuously checked against the alarm limits. If a value has passed an alarm limit, it will be activated after a delay time given by the Delay Time option.

The alarm status is shown with a flashing bright red color in the Alarm Summary window. When the operator has accepted the alarm the status is shown in dark red color.

In order to disable an alarm the parameter that caused the alarm must pass below the alarm limit and an extra amount specified by the Hysteresis value. When these conditions are fulfilled the alarm reset is delayed an amount of time given by the Delay Time.
5.2 ALARM CONFIGURATION

5.2.1 Set level alarm limits or sensor alarm limits for HTG-tanks

The following section describes how to set alarm limits for HTG-tanks. This is similar to the alarm handling described in the Rosemount TankMaster WinOpi User’s Guide.

To set or change the alarm limits for a HTG-tank do the following:

1. Select the HTG-tank in the WinOpi Workspace window.

Figure 5-1. Select Alarm Limits

2. Right click the tank and select the Alarm Limits option.

Figure 5-2. Alarm Limits. Note the sensor values for the pressure sensors.

3. Set desired Alarm Limits. Alarm Limits for Level values refer to the calculated values based on input from the various pressure sensors. Alarm Limits for Sensors refer to the actual measurement values that are presented by the pressure sensors. Click the OK button.

For explanations of Leak and Hysteresis see Chapter 5 in Rosemount TankMaster WinOpi User’s Guide.
5.2.2 Set volume alarm limits for a HTG-tank

1. Select the HTG-tank in the WinOpi Workspace window.

2. Right click the tank and select the Volume Alarm Limits option.

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**Figure 5-3. Select Volume Tank Limits**

**Figure 5-4. Volume Alarm Limits**
3. Set the desired Alarm Limits for Net Standard Volume (See the *Rosemount TankMaster WinOpi User’s Guide* for a description of standard volumes). The Flow Rate alarm can be set to indicate an uncontrolled flow in or out of the tank.

4. Click the **OK** button.
Section 6 Viewing Tank Data

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6.1 TANK INVENTORY

Summary of levels, volumes, weights, product, temperature and pressure can be viewed in the Tank Inventory window.

1. Select the tank in the WinOpi Workspace window.

2. Right click the tank and select View Tank > Inventory.
6.2 REPORTS


Reports can be published automatically at a predefined schedule. They can also be distributed by an operator at any moment. Reports can be printed, emailed or saved to file.