Reference Manual
00809-0100-4731, Rev FA
April 2003

APEX™ and APEX™ SENTRY Radar Gauges

HART® FIELD COMMUNICATIONS PROTOCOL

ROSEMOUNT®

www.rosemount.com

EMERSON™
Process Management

Reference Manual
00809-0100-4731, Rev FA
April 2003

APEX™ and APEX Sentry™ Radar 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.

Within the United States, Rosemount Inc. has two toll-free assistance numbers.

Customer Central: 1-800-999-9307(*7:00 a.m. to 7:00 p.m. CST)*
Technical support, quoting, and order-related questions.

North American1-800-654-7768 (*24 hours a day – Includes Canada)*
Response Center: Equipment service needs.

For equipment service or support needs outside the United States, contact your local Rosemount representative.

⚠CAUTION

The products described in this document are NOT designed for nuclear-qualified applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact your local Rosemount Sales Representative.

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USING THIS MANUAL

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All information included refers to both the APEX Radar Gauge and the APEX Sentry Radar Gauge unless otherwise stated.

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- Mounting, wiring, and field configuration instructions

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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

Explosions could result in death or serious injury:

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

Before connecting a HART-based 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.

⚠WARNING

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

Make sure only qualified personnel perform these procedures.

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

As a matter of routine, shut off the APEX Radar Gauge and all other equipment in the tank before you enter the tank.

OVERVIEW

The APEX and APEX Sentry Radar Gauges use a radar signal to measure the level of liquid in a vessel. Because the radar gauge is mounted on top of a vessel and its components do not contact the product, it is a dependable alternative to a standard insertion device that can become broken or corroded when inserted into the process. The APEX Radar Gauge also works well in turbulent, aerated, solids-laden, viscous, or corrosive liquids, and thick pastes or slurries.

The advanced 24 GHz frequency technology in the gauges significantly increases the reliability of your level measurement for a wide range of tank level applications. The gauges use radar technology based on frequency modulated continuous wave (FMCW) transmission of microwaves. Radar (microwave) signals are sent from the gauge to the surface of the material and reflected back to the gauge receiver. The receiver evaluates the frequency difference between the transmitted and returned signals. The gauge analyzes the signals to determine the distance to the product surface.

The 24 GHz frequency and advanced electronics allow the radar gauges to use a small antenna and maintain a narrow beamwidth. The small, lightweight antenna simplifies installation while the narrow beamwidth allows unwanted echoes from vessel obstructions such as agitators, heat exchangers, filling pipes, baffles, thermowells, and intermittent filling streams to be avoided. The narrow beam also increases mounting flexibility because the gauge can be mounted on existing flanges located close to tank walls.

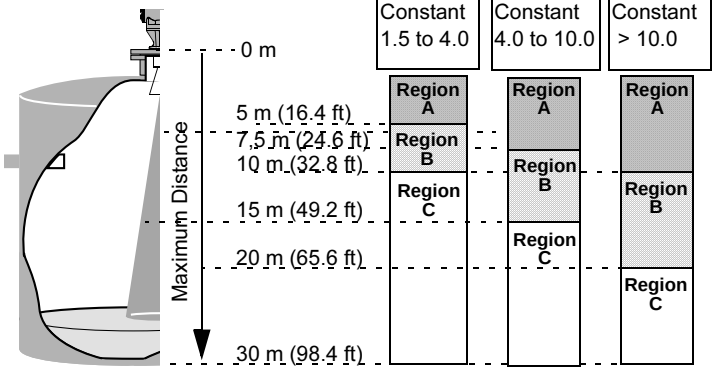
Which Radar Gauge is Best for Your Level Measurement Application?

Step 1. Dielectric vs. Distance

Choose the appropriate shaded region for the application.

Dielectric Constant, ε_r	Liquid Examples
1.5 - 4.0(1)	Hydrocarbons, petrochemicals, freons, vegetable oils, toluene, ...
4.0 - 10.0	Organic or concentrated acids, organic solvents, ...
> 10.0	Water-based fluids, alcohols, dilute acids, acetone, glycols, ...

(1) Consult Factory when dielectric less than 4



Step 2. Liquid Surface Quality

Match surface quality with shaded region from Step 1.

Dielectric vs. Distance Region (from Step 1.)	CALM No waves, storage	MOVING Mild rolling, no splashing, surface unbroken	TURBULENT Heavy agitation, vapors, filling, splashing, or reactions
Region A	Possible SENTRY- go to Step 3.	Possible SENTRY- go to step 3.	APEX(1)
Region B	Possible SENTRY- go to step 3.	APEX	APEX
Region C	APEX	APEX	APEX

Surface Quality

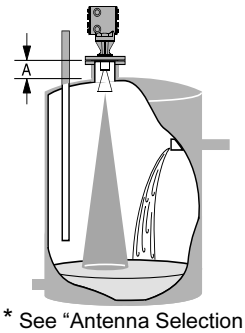
Step 3. Tank Geometry

Is flange height (A) ⩽ 0,5 m (19.6 in)?*

— AND —

Is the radar beam free of any obstructions, such as fill tubes, baffles, or exposed agitators?

YES	APEX Sentry
NO	APEX only



NOTE: To meet most telecommunications requirements, the APEX and APEX Sentry Radar Gauges must be installed on enclosed or vented metal tanks. However, other tank types may be approved in country of final destination. Refer to product manual (document number 00809-0100-4731) for detailed information.

* See "Antenna Selection Guidelines" on page A-1

LEVEL-APEX_07A, APEX_08A, APEX_011A

Components of the APEX and APEX Sentry Radar Gauges

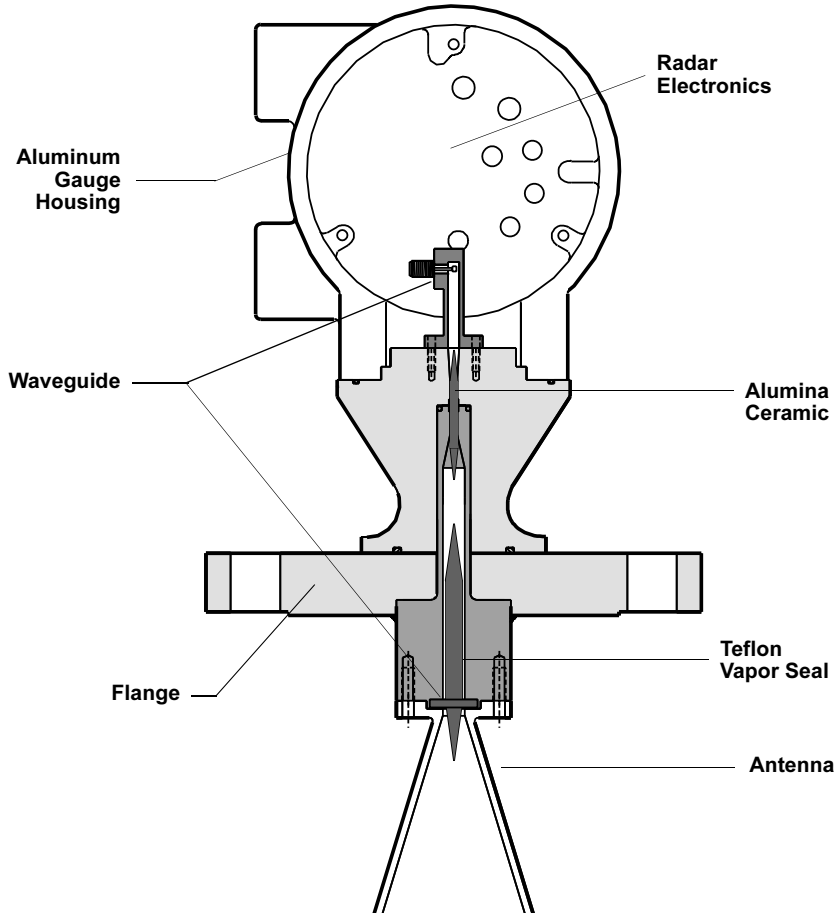
The top of the APEX and APEX Sentry Radar Gauges is an aluminum *gauge housing* (see Figure 1-1). The gauge housing includes advanced radar electronics for signal processing.

The *radar electronics* is the heart of the gauge. It produces an electromagnetic wave by using an oscillator that converts direct current (dc) power into a radar signal. It also receives the return signal.

The radar signal passes from the electronics through a *waveguide* containing an alumina ceramic process barrier. The waveguide is the entire path from the electronics to the antenna.

The *antenna* is a cone-shaped device made of stainless steel. The antenna controls the signal beamwidth by helping to keep the radar signal focused on its target (the product in the tank) so it does not spread out over the entire vessel and give false echoes. A larger antenna provides a more focused, narrow beam. (Refer to Appendix A: Reference Data for further information regarding beamwidth.)

Figure 1-1. Cross-sectional View of the APEX Radar Gauge

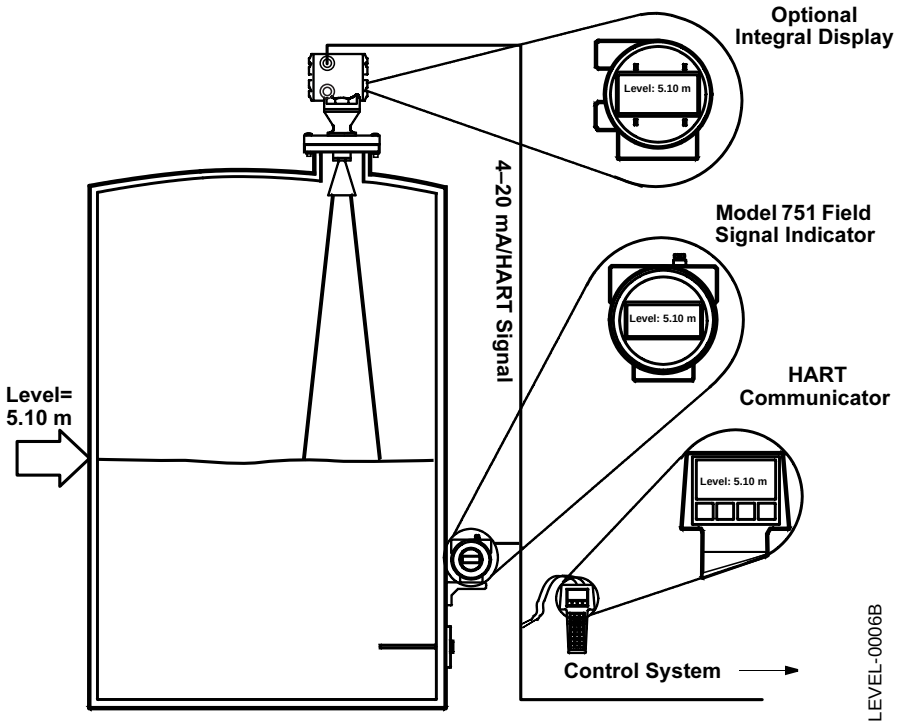


SYSTEM ARCHITECTURE

The output of the APEX and APEX Sentry Radar Gauges is a 4–20 mA analog signal superimposed with a digital HART signal. As a result, the primary variable (4–20 mA output) can be configured to represent either level (APEX and APEX Sentry Radar Gauges) or calculated volume (APEX Radar Gauge only), with up to three additional variables available through the HART signal.

In addition to using the HART Communicator, you can view level and volume variables using an optional Integral Display on the gauge or a Model 751 Field Signal Indicator as a remote display (see Figure 1-2).

Figure 1-2. APEX System Architecture and Display Options



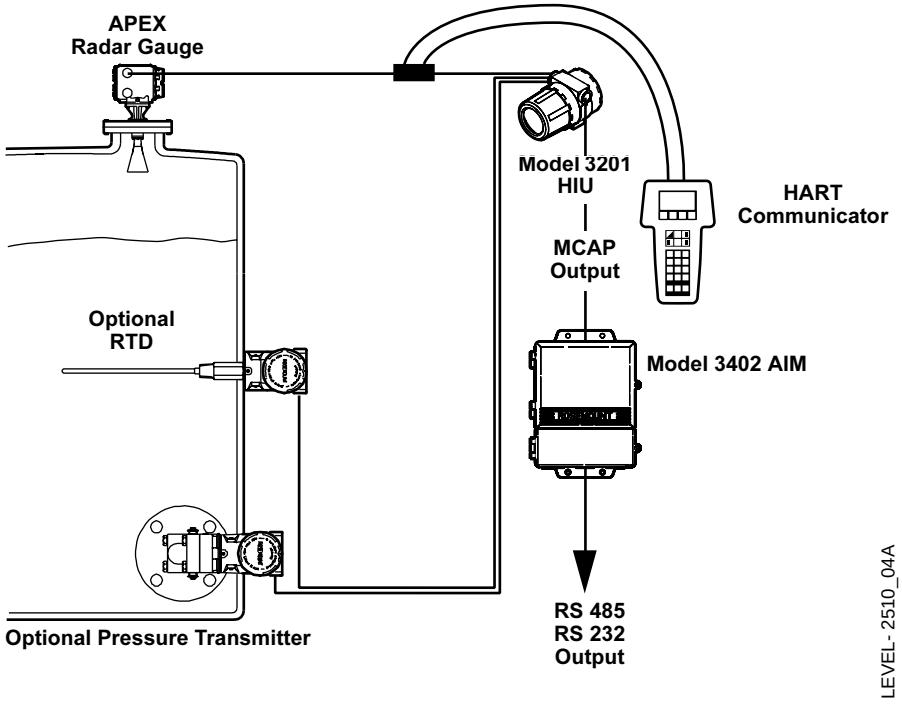
APEX /Hybrid System Overview (APEX Radar Gauge Only)

To maximize the number of available on-line inventory measurements, you can install and combine an APEX Radar Gauge with a Rosemount industry-leading pressure transmitter to create a *hybrid system* (see Figure 1-3). A hybrid system offers the best advantages from both level-based and pressure-based tank gauging systems:

- Offers all the advantages of the APEX and HTG technologies
- Provides level, volume, mass, and true average density measurements
- Enhances plant safety since no manual operations are necessary
- Handles traditional problems such as density stratification

For further installation details, please see page 2-1, and refer to the certified wiring diagrams provided.

Figure 1-3. Hybrid System Option



Addressing Concerns about Exposure to The APEX and APEX Sentry Radar Gauges

The Federal Communications Commission has issued a bulletin called *Questions and Answers About Biological Effects and Potential Hazards of Radio frequency Radiation* (OET Bulletin No. 56, Third Edition, January 1989). This document states a recommended power density limit of 5 mW/cm^2 in the frequency range of 1.5–100 GHz. This limit is based on a 1982 ANSI guideline for a time-averaged exposure for humans.

The maximum power density emitted from APEX and APEX Sentry Radar Gauges is approximately 1.1 mW/cm^2, which is below the ANSI guideline. When the gauge is mounted in a metal vessel, the emissions external to the vessel are much lower than the 1.1 mW/cm^2 measured at the antenna.

For additional information about the safety of radar signals, see Appendix A: Reference Data.

SERVICE SUPPORT

If you have reason to believe that your APEX or APEX Sentry Radar Gauge may need to be returned for service, please contact a Level Applications Support Specialist at Rosemount Customer Central (1-800-999-9307). They will help you determine the best course of action, and may transfer you to either an Order Administrator or to the Rosemount North American Response Center (NARC) to arrange the return of your gauge for service or repair.

NOTE
Most radar problems encountered in the field are applications-related, and can best be dealt with while the gauge is installed.

The representative arranging the return will ask for product model and serial numbers, and will provide a Return Material Authorization (RMA) number. The center will also ask for the name of the process material to which the product was last exposed. If the material to which the product was last exposed is a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned products.

The representative arranging your return will detail the additional information and procedures necessary to return products exposed to hazardous substances.

Section 2 Installation

NOTE
All information included refers to both the APEX Radar Gauge and the APEX Sentry Radar Gauge unless otherwise stated.

This section contains instructions for installing the APEX and APEX Sentry Radar Gauges, including gauge mounting, wiring, and field configuration using the APEX integral display or a HART Communicator.

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

Explosions could result in death or serious injury:

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

Before connecting a HART-based 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

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.

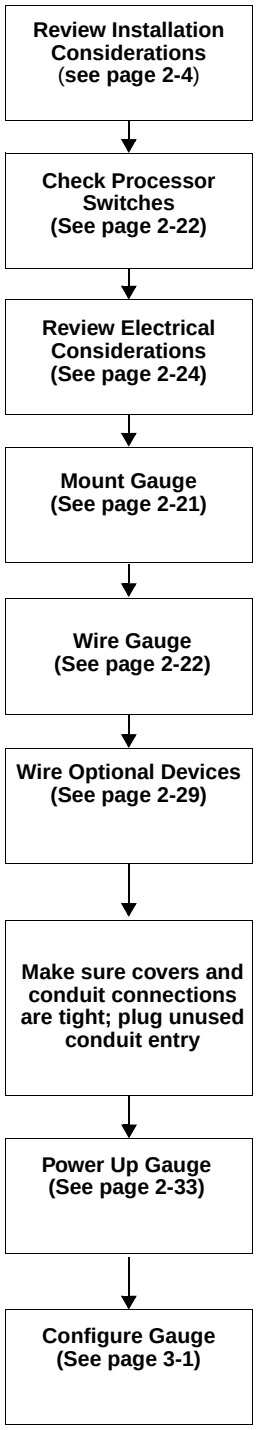
High voltage that may be present on leads could cause electrical shock:

Avoid contact with leads and terminals.

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

BEFORE YOU INSTALL

Follow these steps for proper installation:



CONSIDERATIONS

This section includes information you should consider before installing the APEX and APEX Sentry Radar Gauges in the field. It includes information on the following:

- Telecommunications agency requirements
- Unpacking the gauge
- Mounting requirements
- Vessel and process characteristics to consider

For information about configuring the radar gauge using a HART Communicator, refer to Section 3: Configuration.

Telecommunications Agency Requirements

Rosemount APEX and APEX Sentry Radar Gauges have been approved for installation in closed metal tanks, including those that are vented to the atmosphere. (See "Tank Requirements" below.) Tanks must be closed (or vented) to contain radar emissions which can otherwise interfere with aeronautical aviation. Installation shall be done by trained installers. The radar gauges must be securely bolted to a standard tank flange in strict compliance with the manufacturer's instructions.

Failure to properly install the device could constitute an impermissible modification of the device. In such an event, the responsibility is placed on the modifying party to ensure compliance with telecommunications regulations, and Rosemount shall have no liability whatsoever resulting from unauthorized installation of the device.

Operation Requirements

The use of this device is on a "no-protection, no-interference" basis. That is, the user shall accept government operations of high-powered radar in the same frequency band which may interfere with or damage this device. On the other hand, devices found to interfere with Government operations will be required to be removed at the user's expense.

APEX and APEX Sentry Radar Gauges installed in the United Kingdom operate between 24.15-26.05 GHz. All other APEX and APEX Sentry Radar Gauges operate between 24.05 GHz and 26.05 GHz.

In certain countries, the radar gauge must be switched off when opening the access door to the tank. Any usage in tanks made of non-metallic materials is prohibited.

Underground tanks with all exposed surfaces metallized are sufficient to contain radar emissions.

Tank Requirements

In the United States only, APEX and APEX Sentry Radar Gauges may also be installed on enclosed or vented concrete tanks with a minimum wall thickness of 2.5 inches.

In purchasing an APEX or APEX Sentry Radar Gauge, you agree to install the device in accordance with these conditions.

At the time of this printing, Rosemount Inc. has received the appropriate telecommunications approval for sale in the countries shown on page A-13.

If you have any questions about what constitutes proper installation, please contact Rosemount Customer Central at 1-800-999-9307.

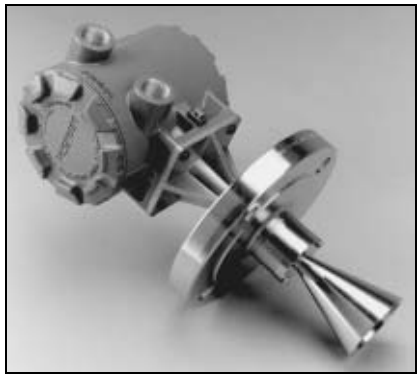
Unpacking the APEX and APEX Sentry Radar Gauges

1. Remove the gauge from the shipping container, taking care not to damage the contents.
2. Place the gauge on its side on a flat surface as in Figure 2-1.

NOTE
Do not stand the radar gauge upright on its antenna. Be careful not to damage any part of the antenna during bench inspection or installation.

3. Inspect the unit and report any shipping damage to the carrier.

Figure 2-1. APEX Radar Gauge



Installation Considerations

Before you install an APEX or APEX Sentry Radar Gauge, be sure to consider your specific mounting requirements, vessel characteristics, and process characteristics. Review the following information to ensure a trouble-free, safe, and accurate installation.

The gauge has an Installation Category II (Overvoltage Category) with pollution degree 2 classification.

Process Characteristics

Dielectric Constant

Dielectric constant is a measure of a material's ability to reflect a radar signal. Materials with dielectric constants below 3.0 reflect only a small fraction of the radar signal. Therefore, special care must be taken when measuring low dielectric fluids.

The gauge can measure fluids with a dielectric constant as low as 1.8 if vessel conditions are favorable. For example, water-based compounds tend to have high dielectrics (water has a dielectric of approximately 80), while hydrocarbons are low. In cases with low dielectrics, it is important to verify that the dielectric is high enough for radar to measure. For information on dielectric constants when using an APEX Radar Gauge, refer to Table 2-1 on page 2-6. If you are unable to determine the dielectric constant for your process, or if you are measuring a process with a dielectric constant lower than 3.0, contact Rosemount Customer Central at 1-800-999-9307 for assistance.

Table 2-1. Sample list of dielectric constants

Dielectric Constant Ranges for Chemicals Listed					
Less Than 1.8	**1.8 to 4.0**	**4.0 to 10.0**	**10.0 to 15.0**	**15.0 to 20.0**	**More than 20.0**
carbon dioxide	acetylene	acetic acid	benzyl alcohol	ammonia	acetone
cyclopentane	asphalt	bromobutane	butyl nitrate	butanol	ethanol
ethylene	benzene	butyl alcohol	carveol	cyclohexanol	ethylene glycol
methane	butane	chlorobenzene	creosol	diacetone alcohol	glycerine
jp4 (military fuel)	carbon tetrachloride	chloroform	dimethyl oxalate	dichloro ethane	glycol
propane	cocaine	chlorotoluene	ethylene chloride	isopropyl alcohol	hydrazine
	freons	cresol	hexanol	lactic acid	hydrogen peroxide
	kerosene	dibutyl phtalate	iodine	methylamine	hydrogen cyanide
	napthalene	dichlorobutane	methylamine	methyl ethyl ketone	latex
	octane	ethylamine	phenol	nitroglycerin	methanol
	oleic acid	nicotine	pyridine	sulfur dioxide	molasses
	petroleum oils	phosphorus	tripropyl phosphate		propanol
	stearic acid	phosgene	vinyl isocyanate		sorbitol
	styrene	sulfur			water
	sulfur	toluene diisocyanate			
	toluene				
	vegetable oils				

Foam and Vapors

Foam may affect the gauge performance because it can reduce the radar signal being reflected. The effect is highly dependent on the particular characteristics of the foam. In general, the APEX Radar Gauge reads the top of the foam if it is sufficiently reflective. The APEX Sentry Radar Gauge is not for use in applications with foam.

Changing Density, Temperature, or Pressure

The level accuracy is not affected by changes in the density, temperature, or pressure of the product.

Turbulence or Vortices

The gauge uses advanced signal processing, reducing the effects of turbulence and vortices. However, the greater the turbulence or vortex the larger the effect because they disturb the product surface where the signal is being reflected. With vortices caused by agitators, you need to be aware of the “swell” effect. That is, the product surface will rise in the vessel when sufficiently agitated and the radar output will measure this rise. The APEX Sentry Radar Gauge is not for use in turbulent applications. Refer to Figure 2-18 on page 2-22 for further information.

Coating, Condensate, or Corrosion

The functionality of the gauge may be affected by coating, condensate, or corrosion, depending on the type of process in the vessel. When conditions produce heavy condensation or coating, or when the process is corrosive to 316 SST or alumina ceramic, Rosemount suggests using a process “window” with the gauge to protect the antenna and waveguide.

VESSEL CHARACTERISTICS

Mount the gauge where it will have a clear view of the tank surface, but not in the top center of the vessel (Figure 2-10).

Figure 2-2. Vessel Characteristics That May Affect the Level Reading

POOR PLACEMENT **PREFERRED PLACEMENT**

NOTE
When using an APEX Sentry Radar Gauge, it is necessary for 100% of the beam cone to contact the liquid surface.
Refer to Table 2-2 on page 2-8 for further information.

Table 2-2. Beamwidth versus Distance from flange face to tank bottom

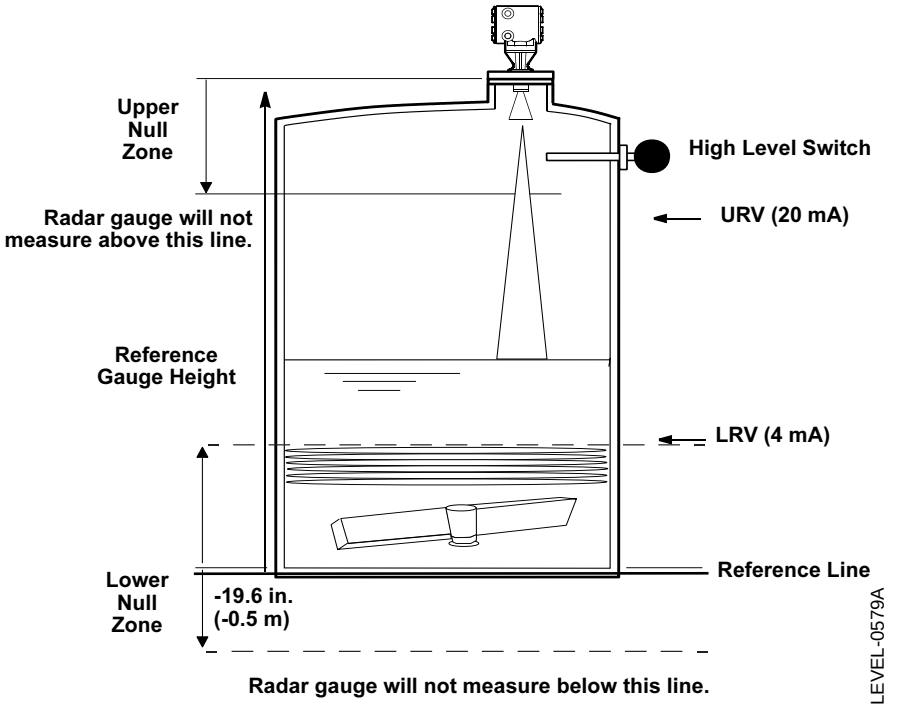
Distance (D) from gauge	Radius (r) from Flange Centerline to Beamwidth Edge		
	2-in. Antenna	3-in. Antenna	4-in. Antenna
ft (m)	ft (m)	ft (m)	ft (m)
2 (0.6)	0.4 (0.12)	0.2 (0.07)	0.2 (0.06)
4 (1.2)	0.8 (0.25)	0.5 (0.15)	0.4 (0.11)
6 (1.8)	1.2 (0.37)	0.7 (0.22)	0.6 (0.17)
8 (2.4)	1.6 (0.49)	1.0 (0.29)	0.7 (0.22)
10 (3.0)	2.0 (0.62)	1.2 (0.37)	0.9 (0.28)
15 (4.6)	3.0 (0.93)	1.8 (0.55)	1.4 (0.42)
20 (6.1)	4.1 (1.23)	2.4 (0.73)	1.8 (0.56)
25 (7.6)	5.1 (1.54)	3.0 (0.92)	2.3 (0.70)
30 (9.1)	6.1 (1.85)	3.6 (1.10)	2.8 (0.84)
35 (10.7)	7.1 (2.16)	4.2 (1.28)	3.2 (0.98)
40 (12.2)	8.1 (2.47)	4.8 (1.46)	3.7 (1.12)
45 (13.7)	9.1 (2.78)	5.4 (1.65)	4.1 (1.26)
50 (15.2)	10.1 (3.09)	6.0 (1.83)	4.6 (1.40)
55 (16.8)	11.1 (3.40)	6.6 (2.01)	5.1 (1.54)
60 (18.3)	12.2 (3.70)	7.2 (2.20)	5.5 (1.68)
65 (19.8)	13.2 (4.01)	7.8 (2.38)	6.0 (1.82)
70 (21.3)	14.2 (4.32)	8.4 (2.56)	6.4 (1.96)
75 (22.9)	15.2 (4.63)	9.0 (2.75)	6.9 (2.10)
80 (24.4)	16.2 (4.94)	9.6 (2.93)	7.4 (2.24)
85 (25.9)	17.2 (5.25)	10.2 (3.11)	7.8 (2.38)
90 (27.4)	18.2 (5.56)	10.8 (3.30)	8.3 (2.52)
95 (29.0)	19.2 (5.86)	11.4 (3.48)	8.7 (2.66)
100 (30.5)	20.3 (6.17)	12.0 (3.66)	9.2 (2.80)

General Vessel Considerations

Heating Coils and Agitators

If the vessel contains heating coils or agitators (see Figure 2-2), they may create noise when the radar signal bounces off of them. The noise level is less if the signal contacts a non-flat surface (for example, round pipe, angled blade, etc.) that causes the signal to scatter rather than directing it back to the antenna. To avoid these problems, try to make sure that heating coils or agitators are below the minimum product level or within the null zones (see Figure 2-3 on page 2-9 and Figure 2-3 on page 2-9).

Figure 2-3. User-Programmable "Null" Zones for APEX and APEX Sentry Radar Gauges



Cables, Floats, Baffles, or Trays

Cables, floats, baffles, or trays can introduce noise into the radar signal. A vertical cable or rounded surface causes minimal effect because the radar signal is scattered rather than directed back to the antenna. To reduce the amount of noise from cables, floats, baffles, or trays, position the gauge such that the beam will not contact them.

Inlet Pipes or Flows

The level reading may be affected by the process flowing into the vessel. To lessen the effects, mount the radar gauge so the beam signal does not contact the inlet pipe or flow (Figure 2-2).

Center of tank installations should be avoided, off-center installations are preferred (Figure 2-4).

Figure 2-4. Example of off center tank installation.

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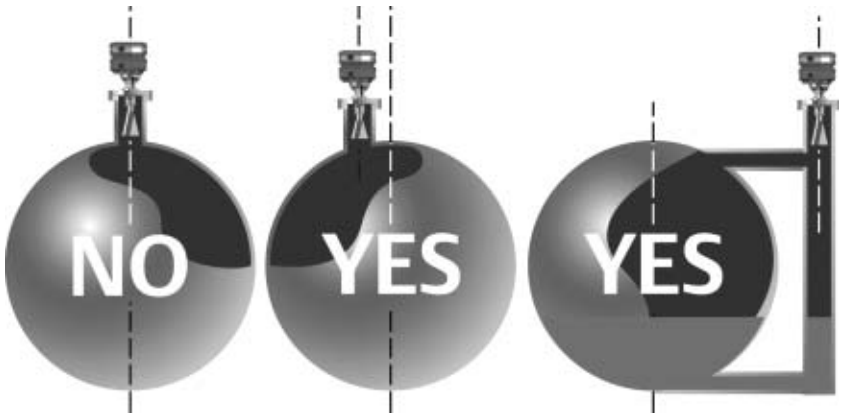
NOTE
Center of the tank installations should be avoided.

Specific Tank Shapes

Spherical Vessel Considerations

Figure 2-5. Spherical vessel installation



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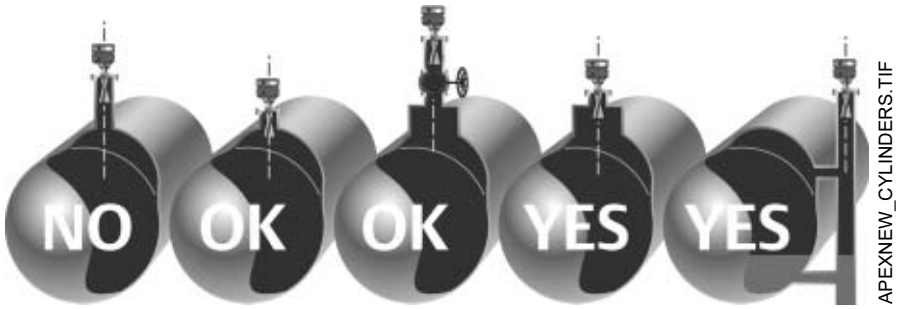
NOTE
Spheres should never have top-center installation options.

Horizontal Vessel Mounting Surface

Horizontal cylinders often only have top-center connection options. If this is the case, then the end of the antenna should be down into the vessel or mounted in a widened area such as a manhole cover. Recessing the antenna into a nozzle is not recommended (Figure 2-6).

Figure 2-6. Possible horizontal vessel mounting options

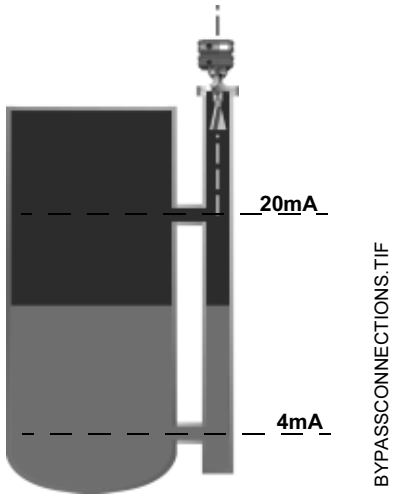


Stilling Well, Bypass Cage, and Bridle Connection Considerations

Apex and Apex Sentry can be mounted on bypass cages, bridles, and stilling wells. Non-slotted stilling wells are preferred. If holes must be present, then 1 inch diameter holes approximately 0.5 meters apart are acceptable.

Higher dielectric materials (such as water-based compounds) in a stilling well or bypass cage will create a strong return signal to the gauge. For this reason smaller antennas should be used. Lower dielectric materials, (such as hydrocarbons and solvents) will attenuate the signal so the antenna size should be as large as possible for the bypass pipe or stilling well.

Figure 2-7. 3 inch or 4 inch bypass cages can be used.



- Stilling wells should be non-slotted. The signal will be stronger because it is contained within the stilling well. With higher dielectric fluids it is possible for the signal to be too strong. If this is the case, try using a smaller antenna.
- At the low end of the well or bridle, especially with joints or bends in pipes the level or distance may be incorrect due to false reflections. Fill with fluid to cover the area.

Nozzle Considerations

Non-horizontal Mounting Surface

In most applications, the gauge should be mounted perpendicular to the level surface. It is acceptable to have the mounting flange up to 2° off from perpendicular. In applications with low dielectric constants or long measuring ranges, mounting the radar gauge with the flange horizontal to the product level becomes more important in order to receive an adequate return signal (Vessel Characteristics on page 2-7). For more information regarding mounting considerations, contact Rosemount Customer Central at 1-800-999-9307.

Figure 2-8. Example of Non-horizontal mounting

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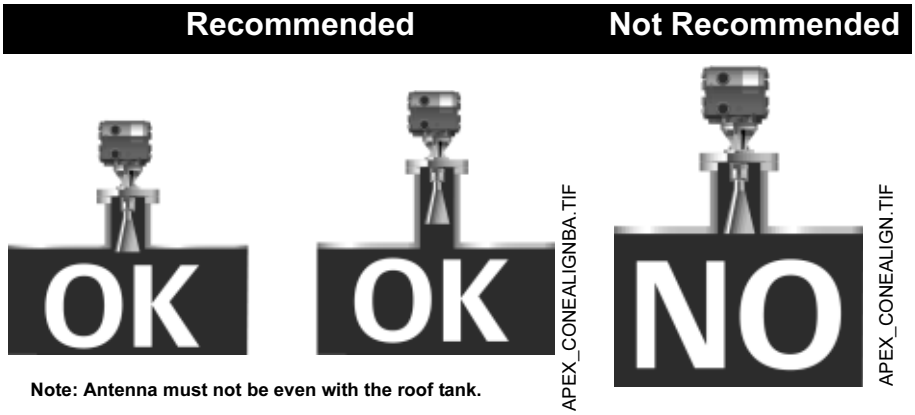
Tank Nozzle Considerations

Nozzles should be wide open and smooth without any intersecting lines. The nozzles should not be too long because it will cause a reflection and attenuate signal. Valves can be used as long as they are open and smooth (no reducers, lips, or rough edges).

- Nozzles should be open and smooth; no weld lines or ledges should protrude inside the nozzle, and there should be no restrictions.
- Maximum length of nozzle: 1m for 3 and 4 inch antennas, and 0.3m for 2 inch antennas.
- Full port valves may be used.
- The antenna can be recessed in the nozzle or can extend into the vessel. However, the end of the antenna should never be even with the roof of the tank (Figure 2-9).

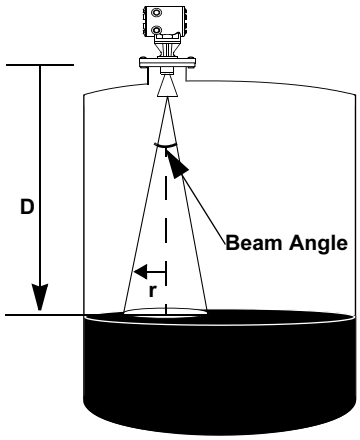
Figure 2-9. Tank Nozzle Recommendation



The gauge should be mounted so antenna extends 1 inch or more into the tank, or is recessed into the nozzle by 1 inch or more.

Figure 2-10. Example of multiple nozzle function
Note: Do not install an APEX Radar Gauge where there is a T-intersection in the mounting nozzle.

Figure 2-11. Beamwidth vs. Distance from APEX and APEX Sentry Radar Gauge to Tank Bottom



Example: the beam radius (r) at the bottom of a 10-foot (3.05 m) (D) vessel would be 0.9 ft (0.28 m) for a 4-inch antenna.

LEVEL-0038A

Antenna Size	Beam Angle
2-in.	22.9°
3-in.	13.7°
4-in.	10.5°

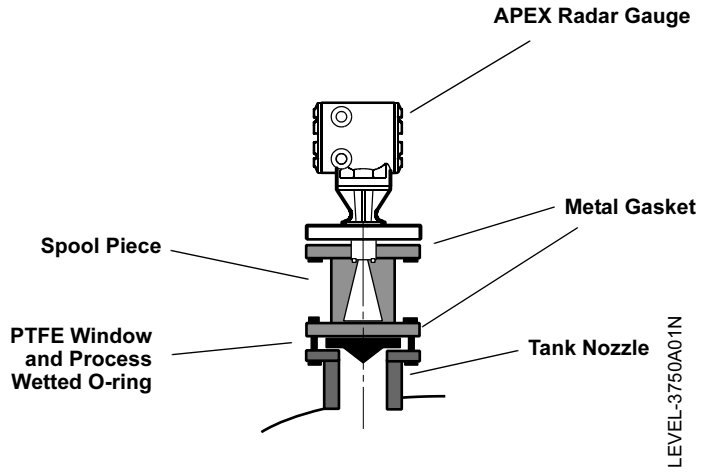
NOTE
A larger antenna yields a tighter and more concentrated signal. This is an important consideration when using the gauge in various applications with such characteristics as agitation and/or low dielectric constants.

PROCESS WINDOWS

The process window typically consists of a PTFE cone that goes below the gauge antenna and fits in the tank nozzle (see Figure 2-12).(1) Condensation and coating run off of the cone and corrosive processes cannot reach the antenna. Window installation requires a spool piece that surrounds the antenna. (See page A-9 for further information.) **The length of the spool piece should allow the end of the antenna to be within 1 inch (25mm) of the window.**

Install the window as shown on page 2-16 and page 2-17.

Figure 2-12. Using a PTFE Process Window with the APEX Radar Gauge



NOTE
Make sure the metal gaskets are installed and the flange bolts are torqued properly to keep moisture out of the spool piece. Bolts should be re-tightened 24 to 48 hours after initial installation to ensure a tight seal, to prevent moisture from entering the area, and to meet the pressure needs.

Consult the factory for temperature and pressure limits when using a process window. See page A-6 for APEX Radar Gauge and process window pressure and temperature ratings.

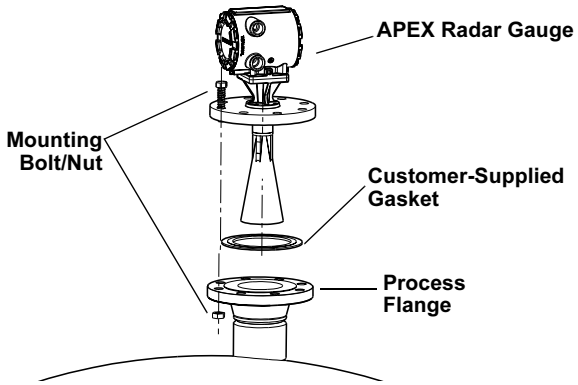
Installing without a Process Window
If you are installing the gauge *without* a process window, refer to Figure 2-13 and follow these steps:

1. Place a gasket on top of the tank flange. (Choose a gasket type according to process compatibility.)
2. Position the antenna into the tank flange standoff.
3. Check to see that the gauge is positioned so the conduit openings face the proper direction for wiring.
4. Secure the gauge flange to the tank flange.
5. Tighten the flange bolts when the gauge is properly positioned.

(1) Further window information is detailed on page 2-16 and page 2-17.

NOTE
The tightening torque is dependent on the strength of the stud bolts and the pressure rating of the vessel.

Figure 2-13. Diagram for Installation **without a Process Window**



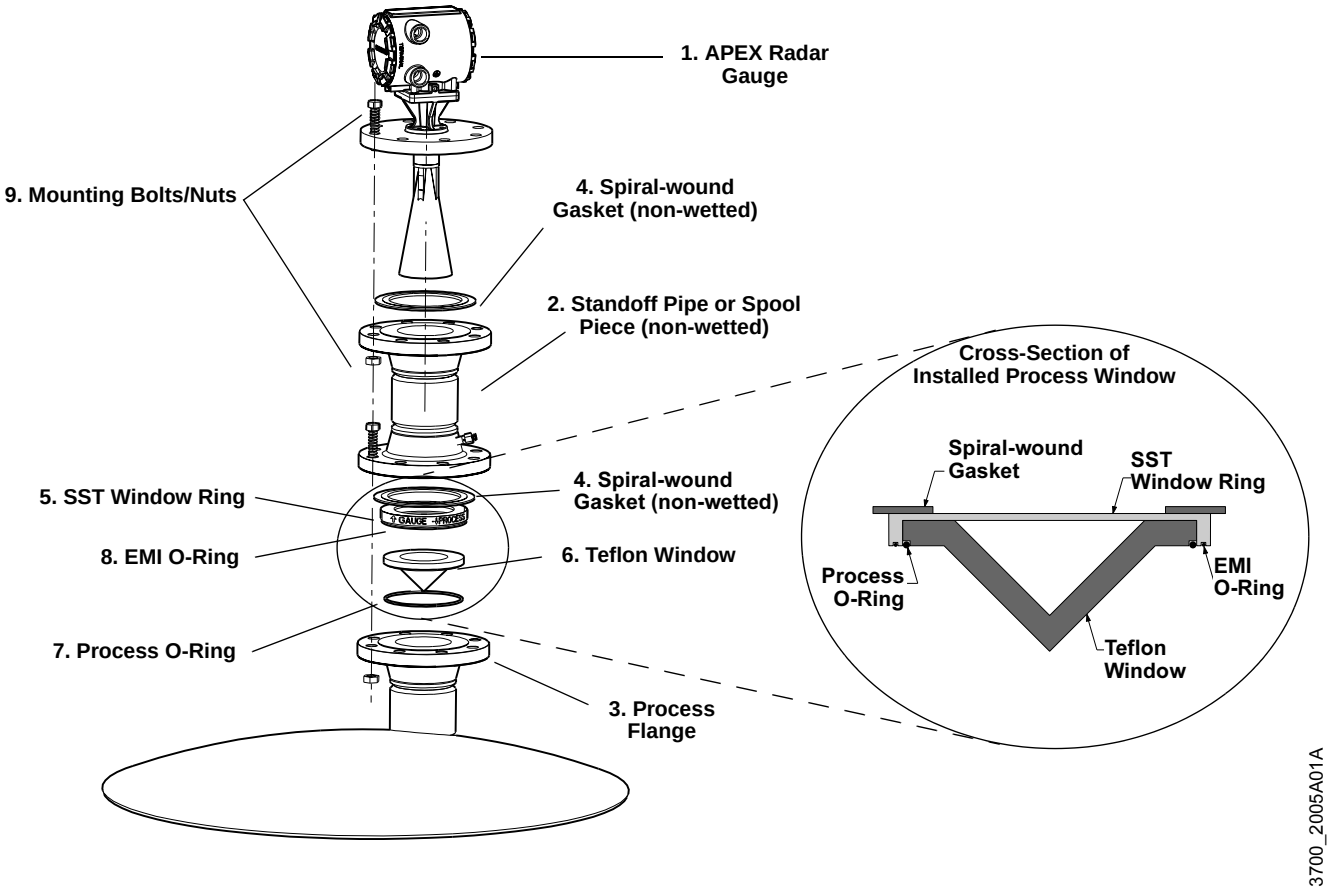
Installing with a Process Window
If you are installing the gauge *with* a process window, refer to Figure 2-14 and follow these steps:

NOTE
Make sure the metal gaskets are installed and the flange bolts are torqued properly to keep moisture out of the spool piece. Bolts should be re-tightened 24 to 48 hours after initial installation.

1. Seat the process O-ring (7) into the groove on the window (6), and center the window on the process flange without letting the O-ring slip out of its position in the groove.
2. Make sure that the EMI gasket (8) is seated in the stainless steel window ring (5), place the window ring over the window, and center a spiral-wound gasket (4) over the window ring.
3. Center the standoff pipe or spool piece (2) on the flange. Put two of the bolts (9) in opposite sides and hand tighten. Look inside the spool piece to verify that the Teflon window is centered on the flange. (See Figure 2-15 on page 2-19.)
4. Once the Teflon window is centered, use the rest of the mounting bolts and nuts to finish attaching the spool piece to the tank flange. **A misaligned window will severely hinder gauge performance.** Tighten the bolts to 75-100 ft-lbs (102-136 N-m).

NOTE
Visually inspect down the center of the spool to assure the window is centered.

Figure 2-14. Diagram for Installation **with a Process Window**



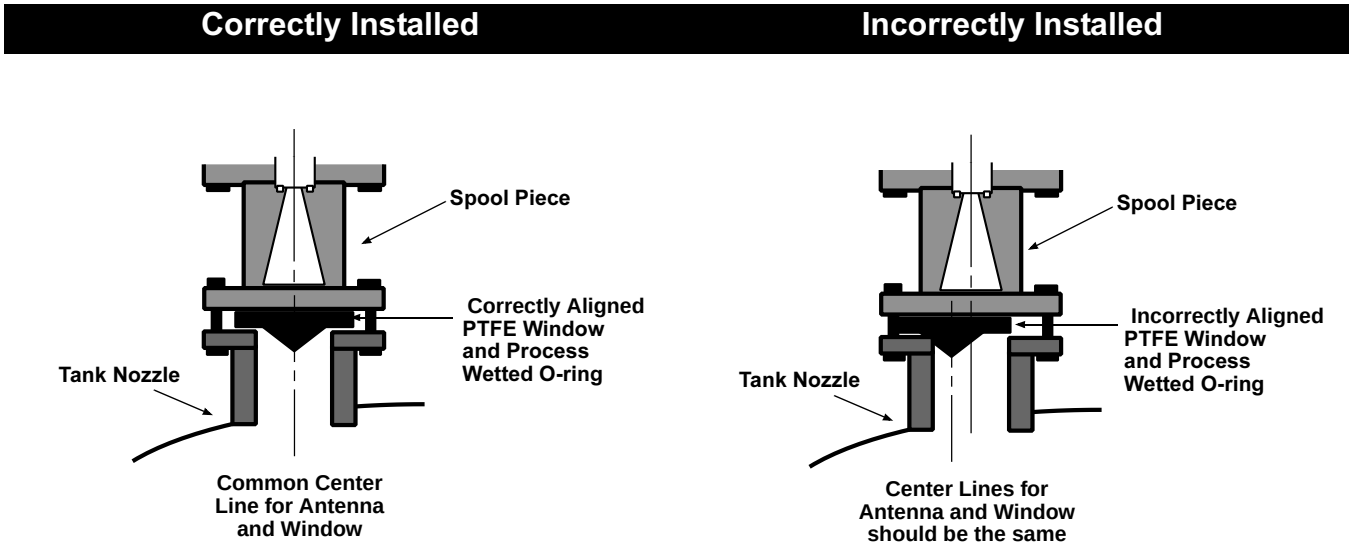
5. Center the second spiral-wound gasket (4) on top of the standoff pipe/spool piece.
6. Attach the radar gauge(1) to the standoff pipe or spool piece using the bolts and nuts as shown. Tighten the bolts to 75-100 ft-lbs (102-136 N-m).

NOTE
Intermittent purge lines are acceptable. Either purging onto the antenna to flush away material or onto the window for periodic cleaning. See Figure 5-1 on page 5-3 for more detailed information.

NOTE
When a process window is used, the window and spool piece heights will need to be incorporated into the Reference Gauge Height and Upper Null Zone. Refer to the definitions on page 3-8 for more information.

NOTE
It is possible to use a standoff pipe/spool piece supplied by a source other than Rosemount; however, it is suggested that when the APEX and APEX Sentry Radar Gauges are mounted, the end of the antenna be no more than 1-inch from the face of the window. For antenna lengths, refer to dimension “D” in Dimensional Drawings on page A-9.

Figure 2-15. Window Centering – Radar Gauge with Installed Isolation Window



The APEX and APEX Sentry Radar Gauges are typically factory configured, so in most situations, gauge adjustments are minimal. To ensure proper operation, review the following information before installing the gauge. If, however, your gauge was not configured at the factory, or if you need to reconfigure the gauge for any reason, please note that the gauge can be configured on the bench prior to installation or in the field. (Refer to Section 3: Configuration.)

MECHANICAL INSTALLATION

Mounting Considerations

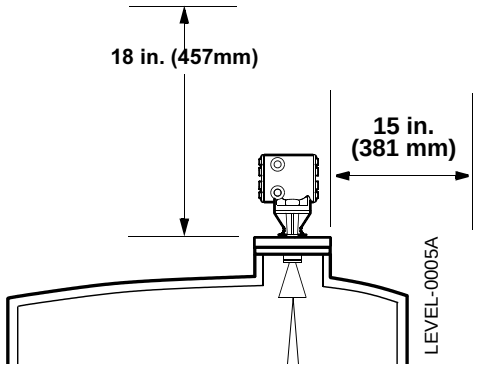
Flange Sizes

The radar gauge mounts on the top of a vessel using a 2-, 3-, 4-, or 6-inch ASME B 16.5 (ANSI) Class (DN 50, DN 80, DN 100, or DN 150) flange. (Flange size is specified at the time of order.)

Access Clearances

Recommended access clearances for the gauge are shown in Figure 2-16.

Figure 2-16. APEX and APEX Sentry Radar Gauge Access Clearances



Wall, Nozzle, or Standoff Clearance

If the radar signal comes in contact with a wall, nozzle, or standoff, it may cause noise in the level signal. Even though the advanced signal processing of the radar gauge is designed to filter out this noise, try to keep the noise level at a minimum by installing the gauge an acceptable distance from obstructions. To ensure the proper clearance for your vessel height and beamwidth, review Table 2-2 on page 2-8.

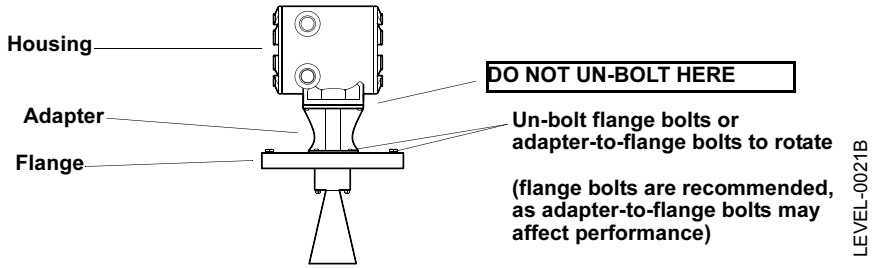
NOTE
When installing an APEX Sentry Radar Gauge, refer to Figure 2-17 on page 2-21 for further mounting requirements. 100% of the beam cone must contact the liquid surface for accurate measurement.

NOTE
Do not mount the radar gauge in the top-center of a vessel. Off-center mounting is preferred.

MOUNTING THE GAUGE

NOTE
If the electronics housing needs to be rotated, **do not un-bolt the adapter-to-housing bolts!** Either un-bolt the flange bolts or the adapter-to-flange bolts and rotate as needed. If the housing is rotated at the housing-to-adapter connection, the gauge will be irreparably damaged, and the warranty invalidated. (See Figure 2-17.) Flange bolts are suggested for use; performance may be affected if adapter bolts are used.

Figure 2-17. Rotating the Electronic Housing



⚠ Mount the radar gauge vertically on a 2-, 3-, 4-, or 6-inch ANSI Class (DN 50, DN 80, DN 100, or DN 150) flange on top of the vessel. Make sure only qualified personnel perform the installation.

NOTE
To ensure long life for your radar gauge, and to comply with hazardous location installation requirements, tighten covers on both sides of the electronics housing to achieve metal-to-metal contact.

⚠ **Refer to Safety Messages on page 2-2 for more information.**

ELECTRICAL INSTALLATIONS

Check Processor Switches

Electronic boards are electrostatically sensitive. Failure to observe proper handling precautions for static-sensitive components can result in damage to the electronic components. Do not remove the APEX or APEX Sentry electronic boards. The gauges are calibrated with particular boards; swapping boards will negatively affect accuracy.

Table 2-3. APEX Radar Gauge Switch Settings

Switch Bank	Description	Default Setting	Position Settings
Switch 1	4–20 mA Alarm Output	High (ON)	ON = High, OFF = Low
Switch 2	Security Write Protection	Disabled (OFF)	ON = Enabled, OFF = Disabled

Table 2-4. Analog Output: Standard Alarm Values vs. Saturation Values

Level	4–20 mA Saturation Values	4–20 mA Alarm Value
Low	3.9 mA	3.75 mA
High	20.8 mA	21.75 mA

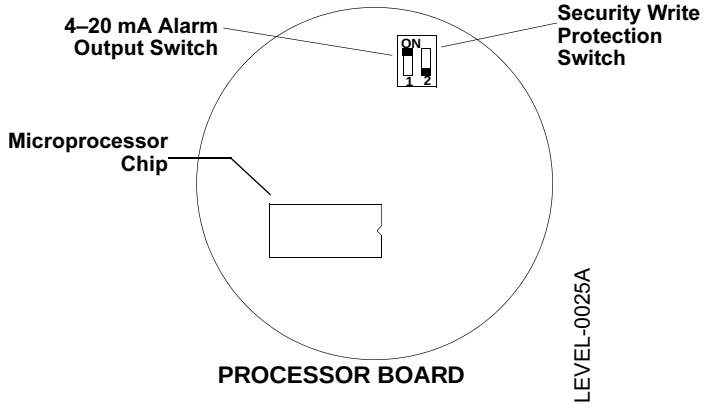
Table 2-5. Analog Output: NAMUR-Compliant Alarm Values vs. Saturation Values (option codes C4 or CN)

Level	4–20 mA Saturation Values	4–20 mA Alarm Value
Low	3.8 mA	3.6 mA
High	20.5 mA	21.0 mA

The gauge monitors its own operation. This automatic diagnostic routine is a timed series of checks repeated continuously. If the diagnostic routine detects a failure in the gauge, the 4–20 mA output is driven upscale (high) to 21 mA or downscale (low) to 3.75 mA, depending on the position of Switch 1.

Security write protection prevents unauthorized access to configuration data through the optional integral display or HART Communicator.

Figure 2-18. Radar Gauge Processor Switch Settings



To set the switches, follow these steps:

⚠ 1. To access the switch bank on the microprocessor board (Figure 2-18), remove the cover opposite the terminal side, or remove the optional integral display (if installed) from the gauge. **Do not remove the gauge cover in explosive atmospheres when the circuit is alive**.

2. To set the 4–20 mA alarm output to low, move Switch 1 to the OFF position. High (ON) is the factory default setting (see Figure 2-18).
3. To enable the security write protection feature, move Switch 2 to the ON position (top). The OFF (low) option is the factory default setting (see Figure 4-1).
4. Reinstall the display (if necessary) or replace the cover.

Electrical Considerations

Conduit Connections

The electronics housing has two ports for ¾–14 NPT conduit connections. Adapters are also available for PG 13.5 or CM20 conduit. These connections are made in a conventional manner in accordance with local or plant electrical codes. Be sure to properly seal unused ports to prevent moisture or other contamination from entering the terminal block compartment of the electronics housing.

NOTE
To ensure long life for your radar gauge, and to comply with hazardous location installation requirements, tighten covers on both sides of the electronics housing to achieve metal-to-metal contact.

NOTE
In some applications it may be necessary to install conduit seals and arrange for conduits to drain to prevent moisture from entering the wiring compartment.

Grounding the Gauge Housing

⚠ The electronics housing should always be grounded in accordance with national and local electrical codes. Use the equipment only as specified in this manual. Failure to do so may impair the lightning and transient protection provided by the equipment. The most effective grounding method is to connect the grounding lug on the gauge directly to earth ground with 1 ohm or less impedance.

The Internal Ground Connection (Protective Ground Connection), located inside the FIELD TERMINALS side of the electronics housing, is the Internal Ground Connection screw. This screw is identified by a ground symbol: ⏚ .

NOTE
Grounding the gauge case via threaded conduit connection may not provide sufficient ground.

⚠ **Refer to Safety Messages on page 2-2 for more information.**

Transient Protection

The APEX and APEX Sentry Radar Gauges include transient protection and comply with IEC 61000 4-5. Transient protection increases the ability of the APEX and APEX Sentry Radar Gauges to withstand electrical transients induced by lightning, welding, or heavy electrical equipment.

External Power Shut-off Switch

The wiring should include an external power shut-off switch or an external circuit breaker. This device should be located near the gauge.

ELECTRICAL CONSIDERATIONS

APEX and APEX Sentry Radar Gauges accept ¾–14 NPT male conduit fittings. PG 13.5 and CM 20 adapters are optional. If necessary and permissible, use flexible conduits close to the gauge.

The gauge output is 4–20 mA superimposed with a HART signal and shielded, twisted pair wiring is required.

Cable Selection

Power supply cables must be suitable for the supply voltage and approved for use in hazardous areas, where applicable. For instance, in the U.S., explosion-proof conduits must be used in the vicinity of the vessel. Use 12 AWG to 18 AWG wire. Using smaller than 18 AWG wire can cause too much voltage drop to the gauge. Refer to Figure 2-19 on page 2-25 to determine the correct wire size according to the length of the wire run and available supply voltage.

Use wire rated for the proper temperature application. For connections in ambient temperatures above 140 °F (60 °C), use a wire rated for 176 °F (80 °C).

Power Requirements

Screw terminals in the radar gauge provide connections for dc or ac power, secondary inputs and outputs, grounding, and loop testing.

Gauges cannot share common power supplies in a series. Each gauge needs to have separate wire pairs from the power supply. The loop wires can be multidropped. Approximately 0.44 amp is required for running the gauge and 1 amp is required for startup. Each APEX and APEX Sentry Radar Gauge consumes approximately 8 watts.

⚠ Avoid contact with leads and terminals.

The operating current will vary depending on power supply size. For example, the operating current using a 24 vdc supply will equal 0.33 amps:

$$\left(\frac{8W}{24V} = 0.33amps\right)$$

NOTE
The gauge requires an *additional* power supply (as indicated in Table 2-6 on page 2-25) to power the 4–20 mA loop.

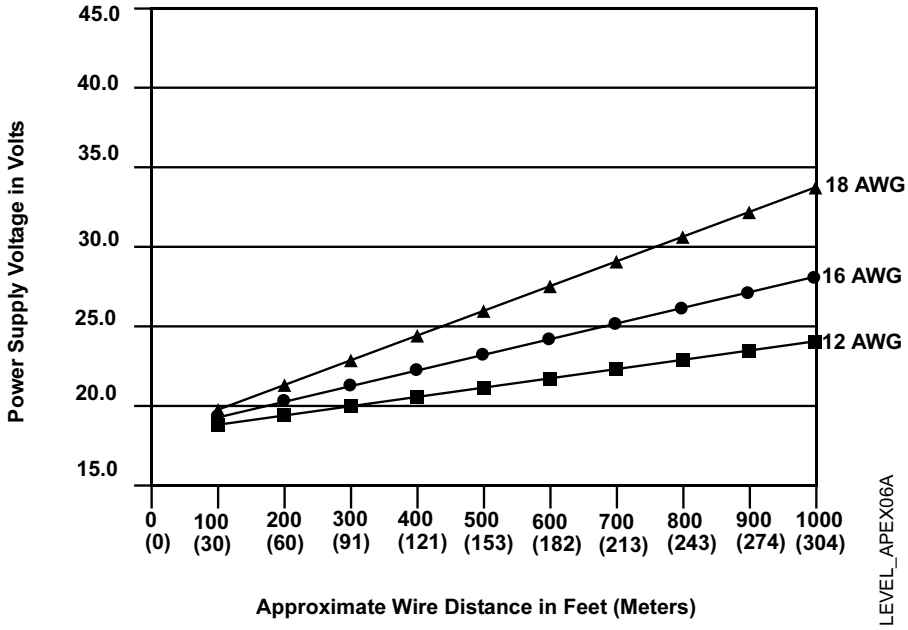
NOTE
To ensure long life for your radar gauge, and to comply with hazardous location installation requirements, tighten covers on both sides of the electronics housing to achieve metal-to-metal contact.

⚠ **Refer to Safety Messages on page 2-2 for more information.**

Table 2-6. APEX and APEX Sentry Radar Gauge Power Requirements

Power Supply	dc	ac
Main Power Supply	18–36 V dc	90–250 V ac 50/60 Hz
Loop Power Supply for 4–20 mA	10.5–55 V dc	10.5–55 V dc

Figure 2-19. Main Power Supply Voltage vs. Wire Length Required



Power vs. Distance Requirements

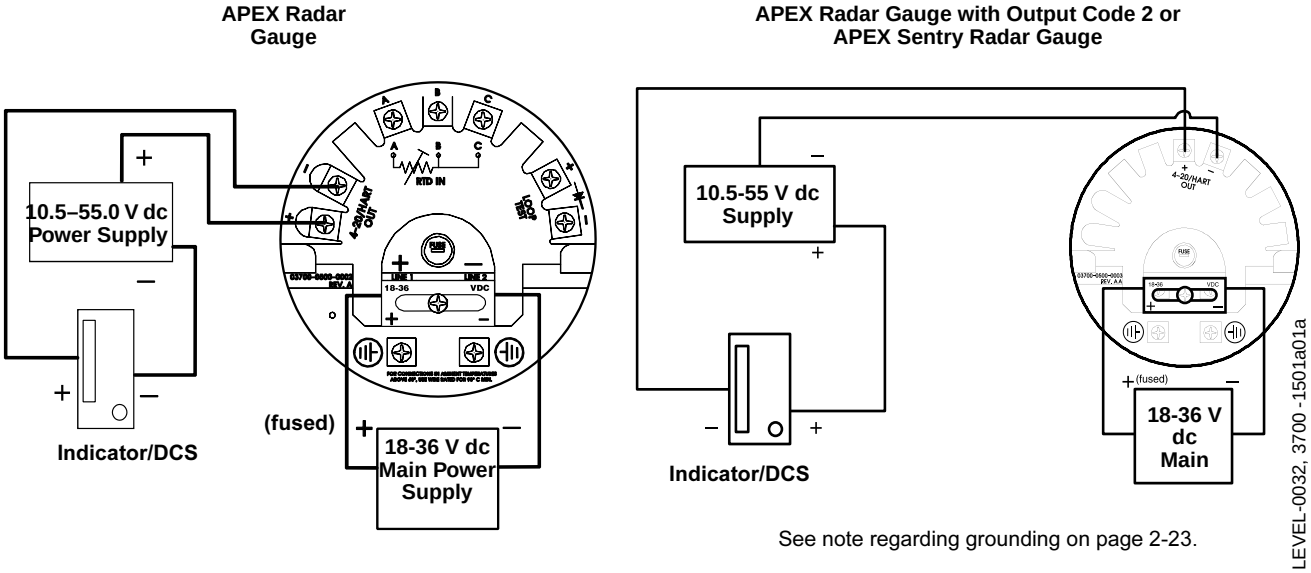
Hazardous Locations

APEX and APEX Sentry feature an explosion-proof housing. Each gauge is clearly marked with a label indicating the certification it carries. See Appendix B: Product Certificates for specific approval information.

DC Main Power Supply with 4–20 mA Loop Power Supply

⚠ Wire the APEX and APEX Sentry Radar Gauges as shown in Figure 2-20, using an 18–36 V dc main power supply. Loop power is required for the 4–20 mA/HART output. Use a 10.5–55.0 V dc secondary power supply for the 4–20 mA/HART loop output. Refer to Power Requirements on page 2-24 to determine the power supply voltage required in the control room. Make sure the main power to the gauge is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

Figure 2-20. DC Power Supply Connections with 4-wire Installation and Separate 4–20 mA Power Supply



See note regarding grounding on page 2-23.

NOTE
DC gauges can be configured as a 3 wire gauge if a jumper is used between the power supply and the loop wiring.

⚠ The power terminals are located under a sliding safety cover on the terminal blocks. This sliding cover exposes only one terminal at a time to guard against electrical shock. The safety cover must be left on while wiring the radar gauge. If the cover has been removed, the word “DANGER” appears near the terminals.

NOTE
When wiring multiple devices, run separate wire pairs to each radar gauge—do not “daisy chain” or use common return wiring configurations. In other words, while it is acceptable to multidrop gauges in the 4–20 mA loop, it is not acceptable to multidrop the power supply loops.

DC Main Power Supply Fuse Size and Type

Be sure to use the proper fuse size and type. Failure to use the appropriate fuse could result in improper operation or damage to the gauge.

The radar gauge with a dc power supply uses the following fuse size and type (Rosemount Part No. C53323-0107):

- 2 AG Fuse, 1A, 250 V, Fast Action

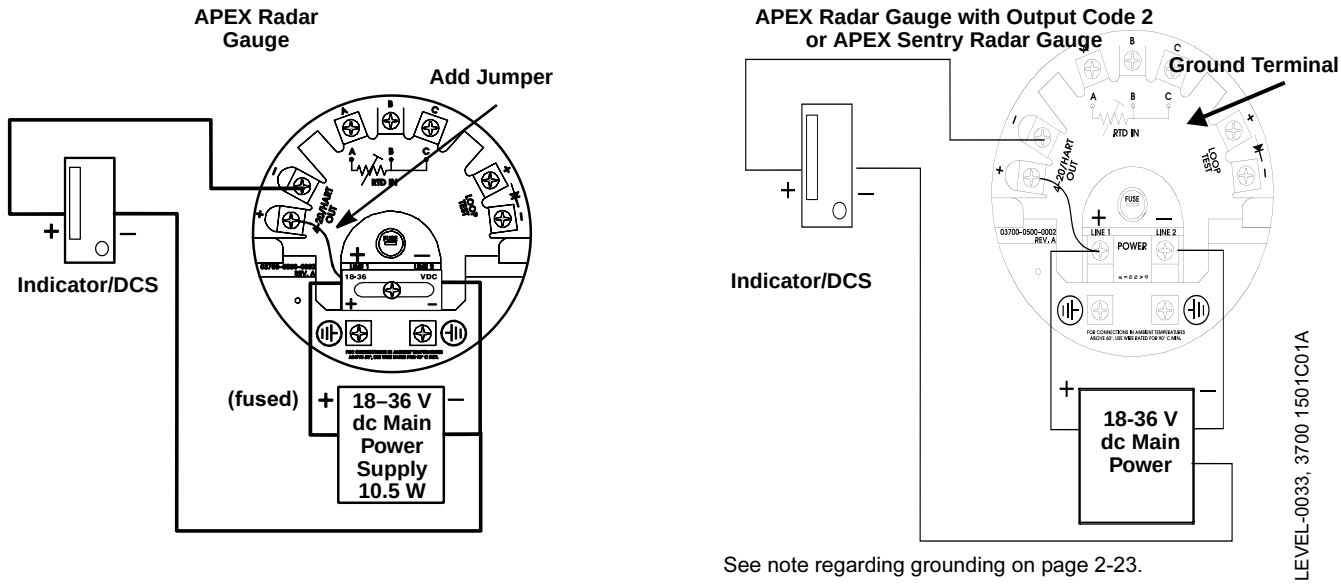
NOTE
To ensure long life for your radar gauge, and to comply with hazardous location installation requirements, tighten covers on both sides of the electronics housing to achieve metal-to-metal contact.

DC Main Power Supply with No Loop Power Supply

⚠ You can also wire the gauge as shown in Figure 2-21, using one 18–36 V dc power supply capable of supplying 8 watts. Make sure the main power to the gauge is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

NOTE
The APEX draws 1 amp at startup; it is not recommended that a DCS or channel card be used to power the gauge (the gauge has an operating draw of 0.375 amp using a 24 vdc supply).

Figure 2-21. DC Power Supply Connections with no loop power supply



See note regarding grounding on page 2-23.

⚠ The power terminals are located under a sliding safety cover on the APEX terminal block. This sliding cover exposes only one terminal at a time to guard against electrical shock. The safety cover must be left on while wiring the APEX gauge. If the cover has been removed, the word “DANGER” appears near the terminals.

NOTE
For all radar gauges with output code 2 (intrinsically safe output), the negative 4–20 mA (HART) terminal is grounded to the electronics housing. **Do not use another ground in the loop.** In installations where the intrinsically safe output (output code 2) will be used, an isolated barrier is required.

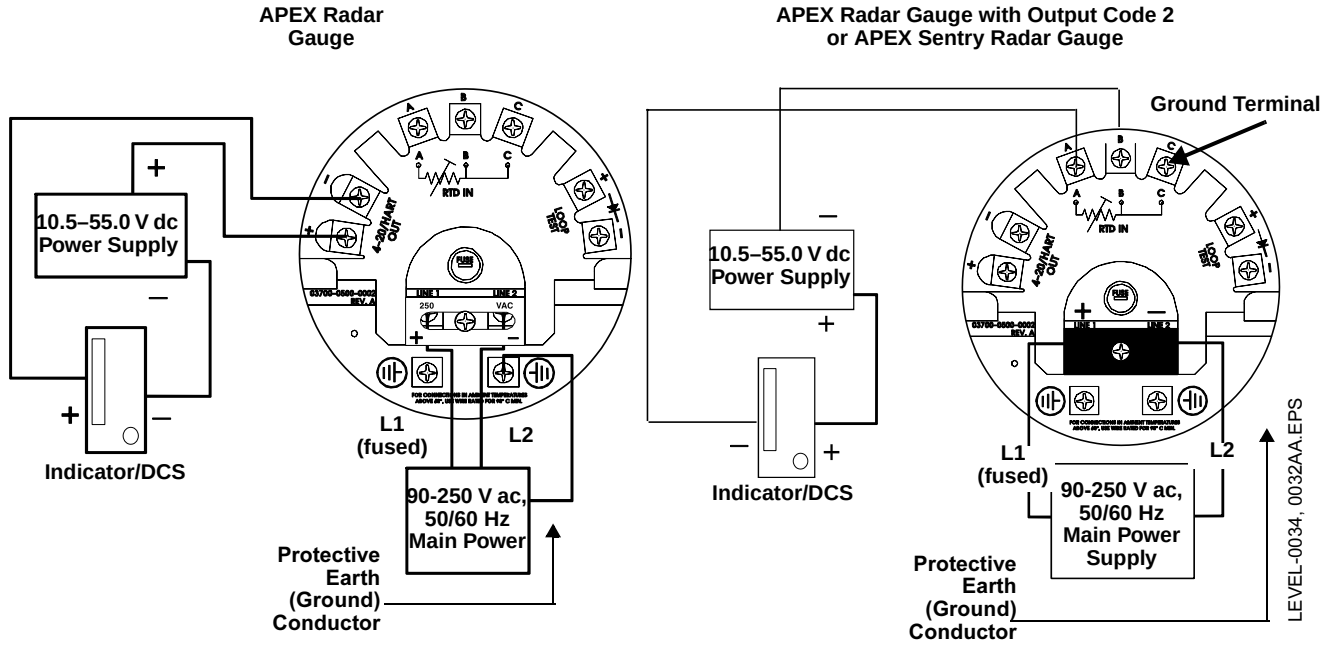
NOTE
The APEX will operate on 18–36 V dc at its power terminals. Refer to Power Requirements on page 2-24 to determine the power supply voltage required in the control room.

NOTE
To ensure long life for your radar gauge, and to comply with hazardous location installation requirements, tighten covers on both sides of the electronics housing to achieve metal-to-metal contact.

AC Main Power Supply with 4–20 mA Loop Power Supply

⚠ Wire the gauge as shown in Figure 2-22, using a 90–250 V ac, 50/60 Hz power supply. Loop power is required for the 4–20 mA/HART output. Use an additional 10.5–55.0 V dc secondary power supply for the 4–20 mA/HART loop output. Make sure the main power to the gauge is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

Figure 2-22. AC Power Supply Connections with Separate 4–20 mA Loop Power



⚠ **Refer to Safety Messages on page 2-2 for more information.**

⚠ The power terminals are located under a sliding safety cover on the terminal block. This sliding cover exposes only one terminal at a time to guard against electrical shock. The safety cover must be left on while wiring the gauge. If the cover has been removed, the word “DANGER” appears near the terminals.

NOTE
For all radar gauges with output code 2 (intrinsically safe output), the negative 4–20 mA (HART) terminal is grounded to the electronics housing. **Do not use another ground in the loop.** In installations where the intrinsically safe output (output code 2) will be used, an isolated barrier is required.

AC Main Power Supply Fuse Size and Type

Be sure to use the proper fuse size and type. Failure to use the appropriate fuse could result in improper operation or damage to the gauge.

The gauge with an ac power supply uses the following fuse size and type (Rosemount Part No. C53323-1104):

- 2 AG Fuse, 3/8 A, 250 V, Time Delay

NOTE
To ensure long life for your radar gauge, and to comply with hazardous location installation requirements, tighten covers on both sides of the electronics housing to achieve metal-to-metal contact.

WIRING OPTIONAL GAUGE DEVICES

Optional devices that can be used with the APEX and APEX Sentry Radar Gauges include the Model 751 Field Signal Indicator, a 3- or 4-wire RTD (Resistance Temperature Detector), such as the Series 58C, 68, or 78. The APEX Radar Gauge can also be used in conjunction with a model 3201 HIU to form a hybrid system.

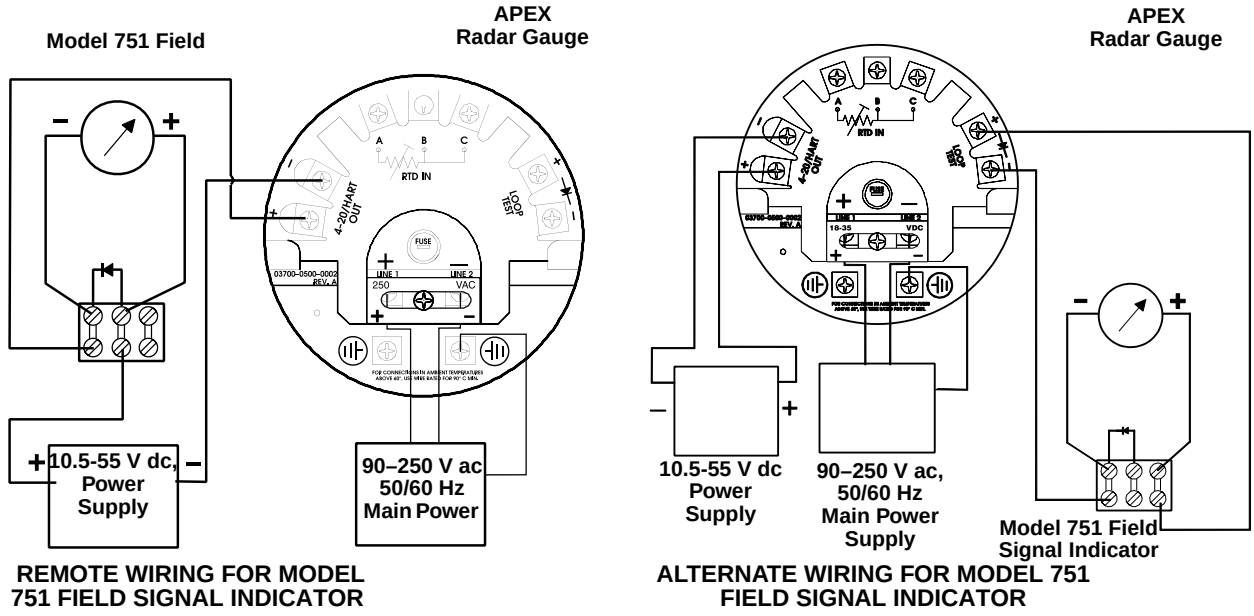
Model 751 Field Signal Indicator

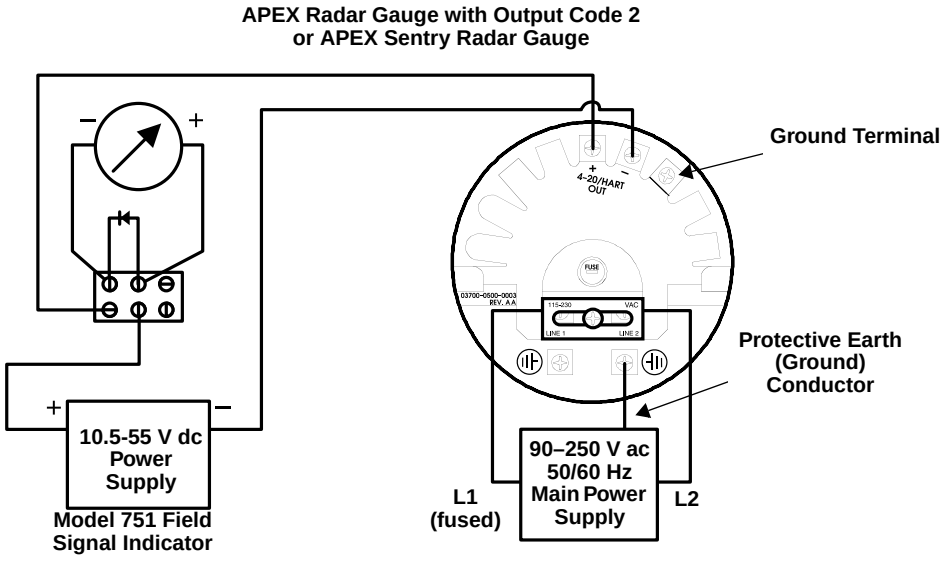
(APEX Radar Gauge and APEX Sentry Radar Gauge)

⚠ If the gauge is to be used with a Model 751 Field Signal Indicator, wire the gauge using one of the options shown in Figure 2-23.
(If necessary, refer to the Model 751 Field Signal Indicator manual, 00809-0100-4378.) Make sure the main power to the gauge is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

Refer to Safety Messages on page 2-2 for more information.

Figure 2-23. Wire Connection Options for the Model 751 Field Signal Indicator





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APEX/Hybrid System Installation (APEX Radar Gauge Only)

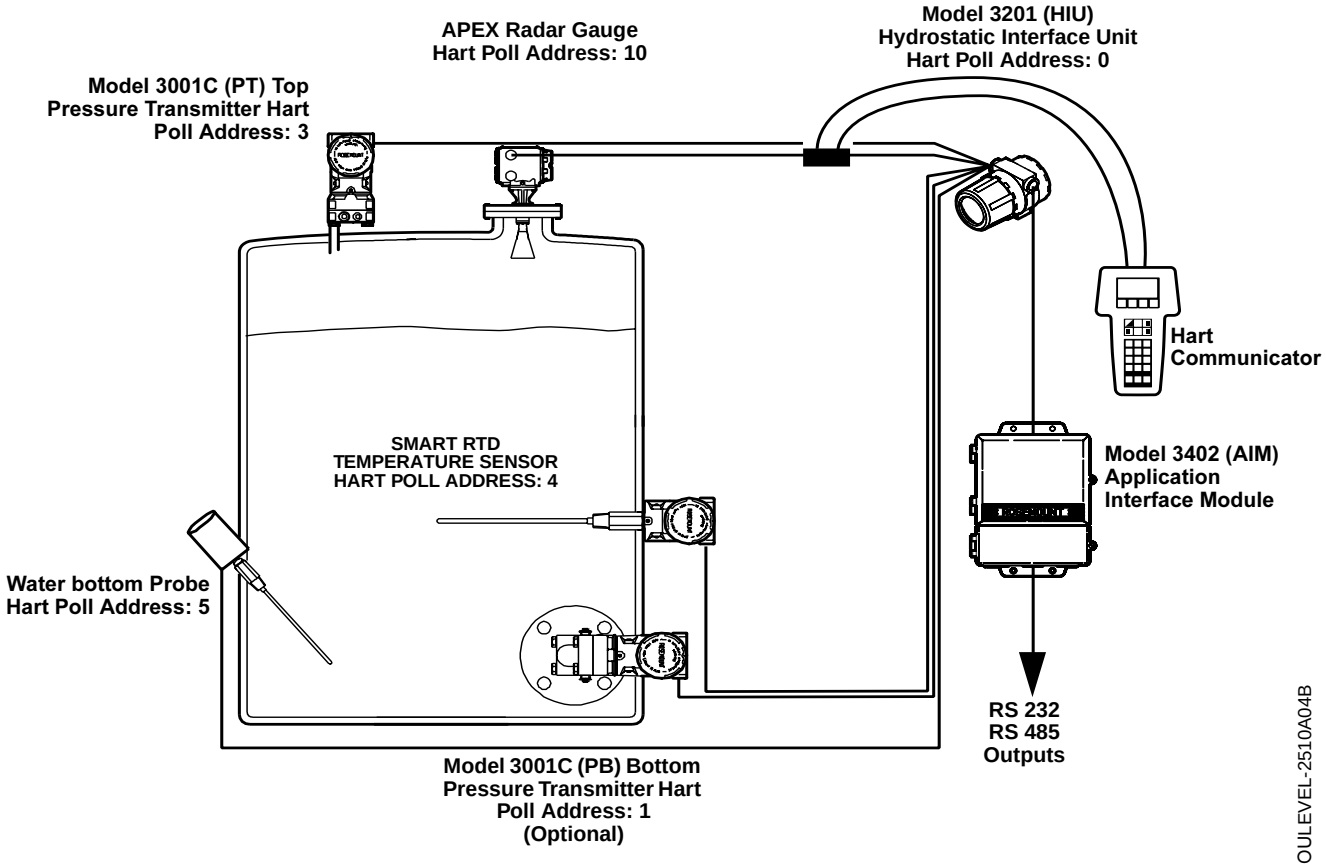
Figure 2-24 and the wiring diagrams in Figures 2-23 are provided to detail the proper methods of wiring the following tank gauging architectures:

- Figure 2-24: APEX Hybrid System (APEX interfacing with a Model 3201 HIU and Model 3402 AIM architecture)
- Figure 2-24: HART Polling addresses

Based upon the specific type of system you are installing, Figures 2-23 through 2-25 should answer your installation wiring questions. For further details regarding each component of the system, please refer to each product's individual manual.

Product	Document Number
• Model 3001C Transmitters	00809-0100-4635
• Model 3201 HIU	00809-0100-4640
• Model 3202 SAM	00809-0100-4646
• Model 3402 AIM	00809-0100-4641

Figure 2-24. APEX Hybrid Installation



3- or 4-Wire RTD (APEX Radar Gauge Only)

If your vessel is equipped with a 3- or 4-wire platinum 100 ohm RTD, wire the gauge as shown in Figure 2-25. Make a direct connection from the RTD to the gauge. The RTD may be mounted a maximum of 500 feet from the gauge.

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

⚠ 2. Connect three RTD wires directly from the temperature element to the gauge. Avoid contact with leads and terminals.

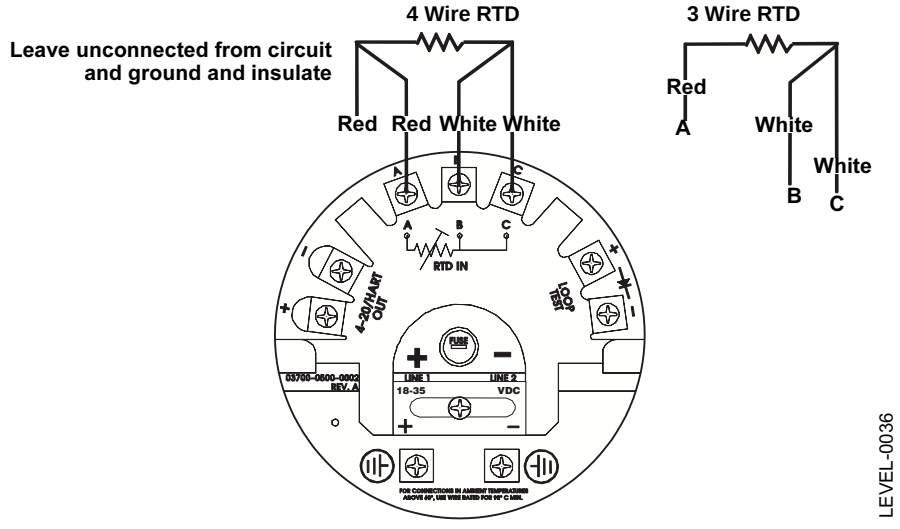
3. Wire the sensor across the gauge terminals A and B and the loop compensation across B and C.
Wires B and C are the same color code; wire A is a different color code. When using a 4-wire RTD, one wire (the same color as the wire connected to terminal A) is not used.

For more information about Rosemount RTDs, refer to Product Data Sheet No. 00813-0100-2654: Series 58C, 68, 68Q, and 78 Temperature Sensors, Assemblies, and Accessories.

NOTE
If RTD input is to be used, the gauge must have the RTD function enabled. This can be done at the factory, or it can be done in the field using a Model 275 Hart Communicator or Radar Configuration Tool (see page 3-18).

NOTE
To ensure long life for your radar gauge, and to comply with hazardous location installation requirements, tighten covers on both sides of the electronics housing to achieve metal-to-metal contact.

Figure 2-25. Wire Connections for a 3- and 4-wire RTD



⚠ **Refer to Safety Messages on page 2-2 for more information.**

POWERING UP

⚠ Be sure to make all of the APEX or APEX Sentry Radar Gauge connections before applying power to the system. Check the connections for the power to the gauge and the power supply for the 4–20 mA loop to be sure they are correct. Make sure the main power to the gauge is off and the lines to any other external power source are not powered while wiring the gauge.

Connect the gauge to either 18–36 V dc or 90–250 V ac 50/60 Hz power, depending on the model selected.

Power consumption by the gauge is approximately 8 watts.

After connecting power, configure the radar gauge using the APEX integral display (APEX Radar Gauge only), the hand-held Model 275 Hart Communicator (APEX and APEX Sentry Radar Gauges), or the Radar Configuration Tools (APEX and APEX Sentry Radar Gauges). The remainder of this section provides information about field configuration using the optional integral display.

NOTE
To ensure long life for your radar gauge, and to comply with hazardous location installation requirements, tighten covers on both sides of the electronics housing to achieve metal-to-metal contact.

⚠ **Refer to Safety Messages on page 2-2 for more information.**

Section 3 Configuration

NOTE
All information included refers to both the APEX Radar Gauge and the APEX Sentry Radar Gauge unless otherwise stated.

The HART Communicator manual provides detailed instructions on the use and features of the HART Communicator. For information on all the capabilities of the HART Communicator, refer to the HART Communicator Product Manual (document 00809-0100-4275).

SAFETY MESSAGES

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

⚠WARNING

Explosions could result in death or serious injury:

- Verify that the operating environment is consistent with the appropriate hazardous locations certifications.
- Before connecting a HART-based 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 make connections to the serial port or NiCad recharger jack in an explosive atmosphere.

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

- Make sure only qualified personnel perform these procedures.
- 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.

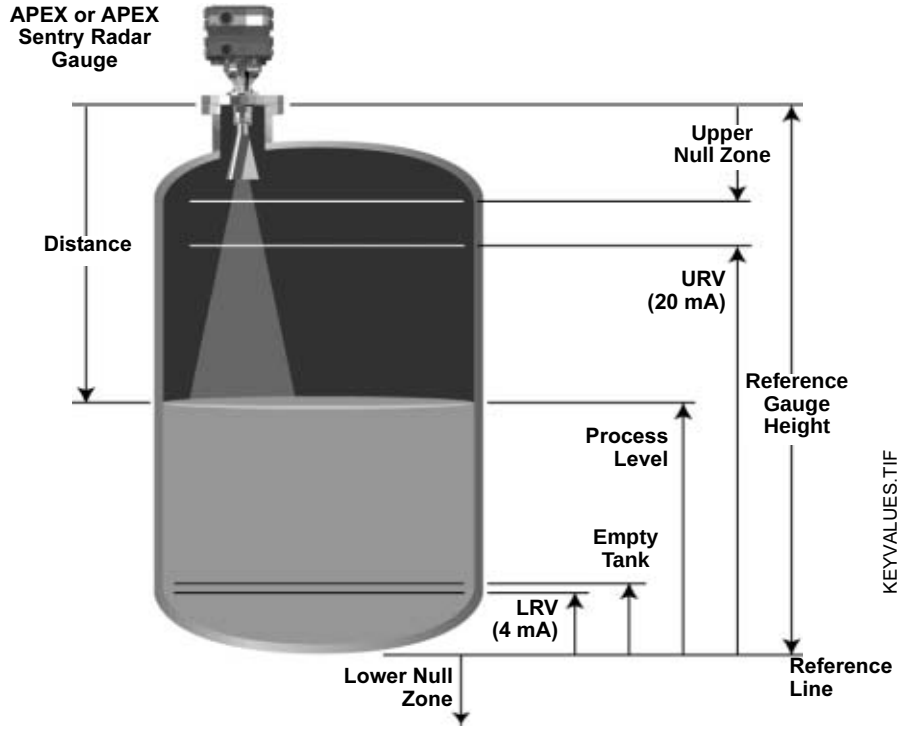
As a matter of routine, the APEX Radar Gauge and all other equipment in your tank should be shut off prior to entering the tank.

BASIC CONFIGURATION PARAMETERS

Key Measurement Values

The values given in Figure 3-1 are key factors for installing and configuring the gauge. Please take a moment to familiarize yourself with the terms used below. These terms are used throughout this manual.

Figure 3-1. Key Measurement Values



Default Values	
Upper Null Zone(1)	19.6 in (0.5 m)
Lower Null Zone(1)	-19.6 in (-0.5 m)
Minimum Value	
Span (URV-LRV)(1)	19.6 in (0.5 m)

(1) See "Null Zones" on page 3-6.

Reference Gauge Height

The *reference line* is a common point from which all level measurements are made. It is usually the bottom of the tank (see Figure 3-1). However, if there is a stationary object, such as a heat exchanger that is reflective, then that can serve as the reference line.

The *Reference Gauge Height* is the distance between the reference line and the face of the radar gauge flange, as shown in Figure 3-1. The Reference Gauge Height is the most critical setting for the radar gauge because it is the basis for all other calculations. The radar gauge measures the distance to the product surface and subtracts this value from the Reference Gauge Height to determine level. To keep level measurements within the stated accuracy specifications, the Reference Gauge Height must be within the ranges specified in Appendix A: Reference Data.

If the distance from the reference line (bottom) of the vessel to the gauge is unknown, you can do one of the following:

- Record the radar gauge level reading and compare it to another known reference level measurement, such as a hand dip.
  Enter the actual level during the configuration process (see Section 2: Installation). The actual level and distance equals the Reference Gauge Height. Use the distance reading from the gauge and the actual level measurement from some other means, add these values, and input the sum on the Reference Gauge Height.

or

- If the radar gauge is installed when the tank is empty, measure the Reference Gauge Height (see Figure 3-1) and record the value. You can determine the Reference Gauge Height in one of two ways:
  – Use the engineering drawing of the vessel to calculate the distance from the mounting flange surface to the bottom of the tank.
  – If the tank has a flat bottom, use the HART Communicator to set Distance as the secondary variable and have the radar gauge measure it. The distance reading displayed on the HART Communicator is the Reference Gauge Height.

Minimum Clearance to Product Level

The minimum clearance from the gauge flange to the expected maximum product level must be at least 19.6 inches (50 cm). The gauge cannot accurately measure levels at less than 19.6 inches (50 cm) from the flange.

Maximum Range

The maximum measuring range for stated accuracies can be found in Section A: Reference Data.

Upper Range Value (20 mA Point)

When configuring the gauge, you must provide the *Upper Range Value* (URV). The URV must be at least 19.6 inches (0.5 m) *above* the lower range value.

Lower Range Value (4 mA Point)

When configuring the gauge, the *Lower Range Value* (LRV) must be provided and must be at least 19.6 inches (0.5 m) *below* the upper range value.

Volume Parameters

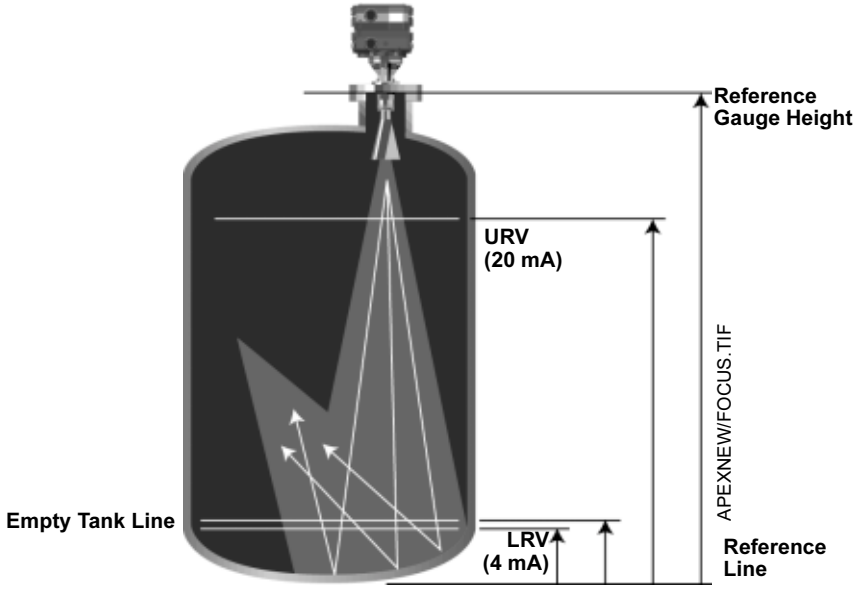
- Refer to “Set Volume Units” on page 3-19 if using a HART communicator to configure the volume parameters.
- Refer to “Setup - Volume” on page 3-32 if using RCT to configure the volume parameters.

Special Cases

Dish-bottom Tanks, Empty Tank Detection

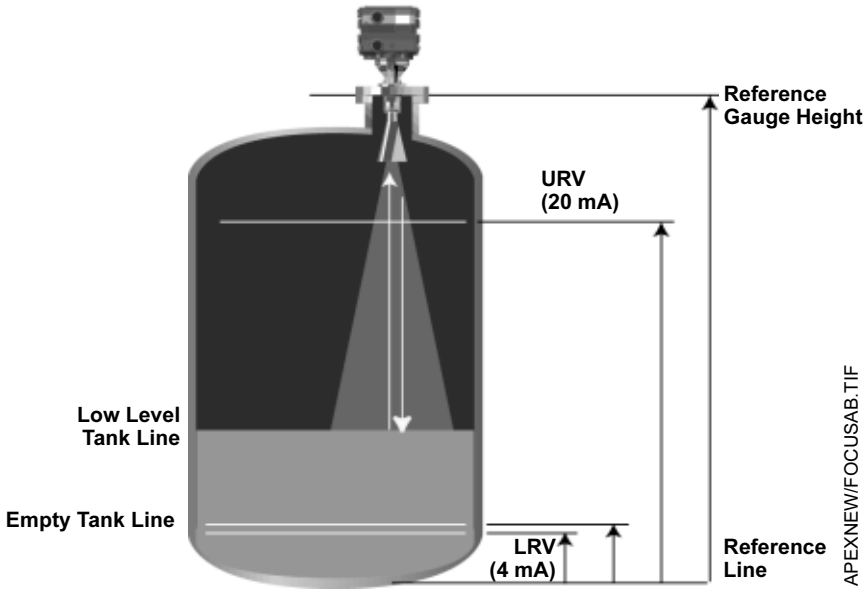
Radar gauges require a horizontal surface, such as the product surface or the bottom of the tank, to reflect the signal back up to the antenna. When a dish-bottom tank is emptied and the surface is no longer horizontal, there may not be a sufficient amount of signal reflected to get a level reading (see Figure 3-2). If this happens, the radar gauge indicates a lost signal condition unless the empty tank detection zone is configured.

Figure 3-2. Reflecting the Signal in a Dish-Bottom Tank



The gauge has an empty tank setting designed to handle this situation. To prevent the gauge from indicating “Lost Signal” in empty tank situations, the empty tank setting forces it to report “Empty Tank” if the signal is lost when the level goes below the setting.

Figure 3-3. Reflecting Signal in a Low Level Tank.



To activate the empty tank feature, use the HART Communicator and set the Empty Tank parameter to a value greater than zero, but less than 25% of the Reference Gauge Height (gauges with a serial number over 3217). If the empty tank parameter is not specified when the gauge is ordered, it will be set to approximately 10% of the Reference Gauge Height. If the signal is lost below this setting, the radar gauge will output LEVEL=0 and the mA signal corresponding to the zero level (usually 4 mA). The message will read “Empty Tank.”

If the signal is lost outside of this configured distance (that is, at higher levels in the tank), the radar gauge will go into alarm mode and indicate “Lost Signal” (see Section 5: Hardware and Software Maintenance and Troubleshooting).

Null Zones

The gauge can be programmed to ignore signals that are outside of the normal operating span of the vessel. There are two user-configurable *null zones*—one at the top of the tank and one at the bottom—that, in conjunction with the gauge height, define the measurement limits for the gauge (see Figures 3-1 and 2-3). The gauge will ignore any signals reflected outside these null zones limits.

The upper null zone is measured from the face of the flange down. The factory default setting for the upper null zone is 19.6 in. (0.5 m). This setting means that the gauge will ignore all signals within 19.6 in. (0.5 m) of the gauge flange. Typically, the upper null zone is at least the length of the gauge antenna and mounting nozzle. The nozzle length must **not** be the same as the dimension (see Figure 3-1) or the signal will not generate properly. The length of the nozzle must be set so the antenna is not even with the roof of the tank.

The lower null zone is measured from the reference line and may be either a positive or negative number. The factory default setting for the lower null zone is –19.6 in. (–0.5 m). This setting allows the gauge to read a level *below* the reference line, although it would result in a negative value.

If the lower null zone is a positive value, the gauge will not read level below that point. This may be useful if there are any obstacles near the bottom of the tank that would give a false reading. The overall level reading is still based on the reference line, however.

The null zone settings can be changed using a HART Communicator and the "Detailed Setup" procedure as outlined on Figure 3-9 on page 3-16.

FIELD CONFIGURATION USING THE INTEGRAL DISPLAY OPTION

(APEX Radar Gauge Only)

NOTE
For information on configuring the APEX Radar Gauge using a Model 275 HART Communicator, refer to page 3-18. The same parameters will need to be entered regardless of which method you use to configure the gauge.

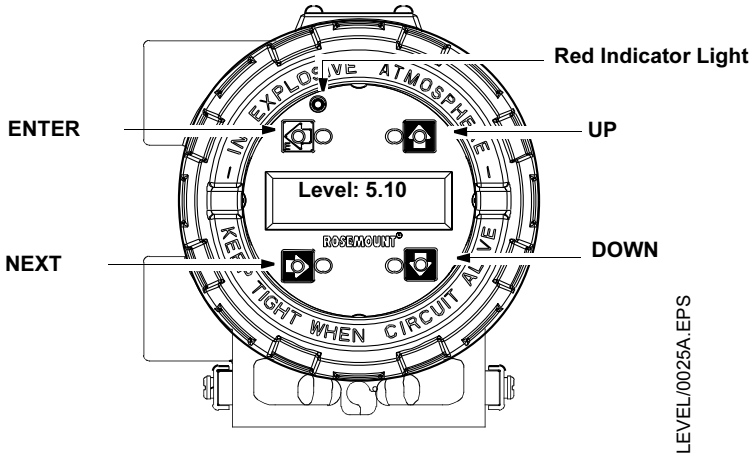
NOTE
To ensure long life for your radar gauge, and to comply with hazardous location installation requirements, tighten covers on both sides of the electronics housing to achieve metal-to-metal contact.

⚠ The gauge integral display may be used in explosion-proof areas. Verify that the operating environment of the gauge is consistent with the appropriate hazardous locations certifications. You do not need to remove the cover to operate the integral display.

To operate the integral display once it has been activated (see page 3-7), place your finger over one of the optical sensors—ENTER, NEXT, UP, or DOWN (see Figure 3-4). A light beam reflects off your finger and activates the sensor and the corresponding function. When you activate a sensor, a red light confirms that you made contact.

NOTE
An “A” displayed in the lower right corner of the display indicates that the gauge has gone into alarm mode (see Figure 3-4 for an explanation of error messages). The “A” will disappear once the unit is out of alarm mode.

Figure 3-4. Optional Integral Display and Optical Sensors



NOTE
If the red indicator light blinks constantly, try to clean the glass to see if it stops blinking.

The sensors provide the following functions:

- The ENTER sensor (left arrow) sets a variable or selects an option.
- The NEXT sensor (right arrow) moves the cursor within the displayed variable.
- The UP and DOWN sensors change the displayed value of the variable or option.

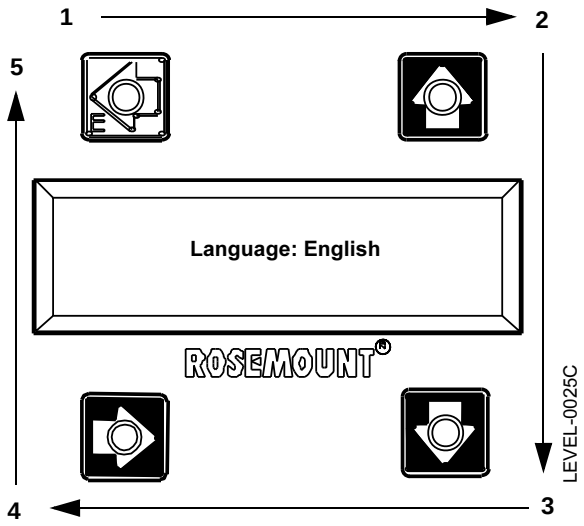
Starting the Main Menu

To start the main menu, follow these steps (refer to Figure 3-4 and Figure 3-5):

1. Press the ENTER sensor.
2. Press the UP sensor.
3. Press the DOWN sensor.
4. Press the NEXT sensor.
5. Press the ENTER sensor again to activate the main menu. The integral display shows the first variable, Language.

NOTE
If you do not activate any sensors for one minute, the display will time-out and exit the main menu without saving changes.

Figure 3-5. Main Menu Start Up Sequence



Setting Configuration Options

Once you start the main menu, you can set variables and configuration options. The integral display allows you to set the following:

- Language
- Output units
- Display units
- Reference height
- 4 mA calibration
- 20 mA calibration

The basic procedure for setting configuration options is as follows:

1. Press UP or DOWN to change the displayed value of the variable or option.
   If necessary, press NEXT to move the cursor to the digit you want to change.
2. Press ENTER to set the variable or select the option and move to the next option.Configuration changes are not saved until you exit the main menu using the “Save Changes” selection.

NOTE
When each configuration option first appears on the display, its current value is displayed below it.

The menu tree in Figure 3-6 on page 3-10 shows all of the variables and options you can configure using the integral display. Use the form on the next page to record the key pieces of information you need to configure the APEX gauge using the integral display.

Configuration Options Form

Use this form to record the five key pieces of information you need before you begin to configure the gauge using the integral display. Getting this information ahead of time will help you get your gauge set up and operating quickly and accurately.

Mark the boxes next to your choices and fill in the requested information on this form.

1.

Language (select one)

___ English ___ Francais
___ Deutsch ___ Espanol

2.

Output Units (select one)

Level	Volume
___ ft	___ m^3
___ in	___ liters
___ m	___ Imp gal
___ cm	___ US gal
___ mm	___ bbls
	___ ft^3
	___ yd^3
	___ in^3

Note: Your choice of output units determines the choices available for display units

3.

Reference Gauge Height: _____ (circle one: ft, in, cm, mm, m)

or

Known Actual Level: _____ (circle one: ft, in, cm, mm, m)

Empty Tank Setting: _____ (10% of gauge height suggested)

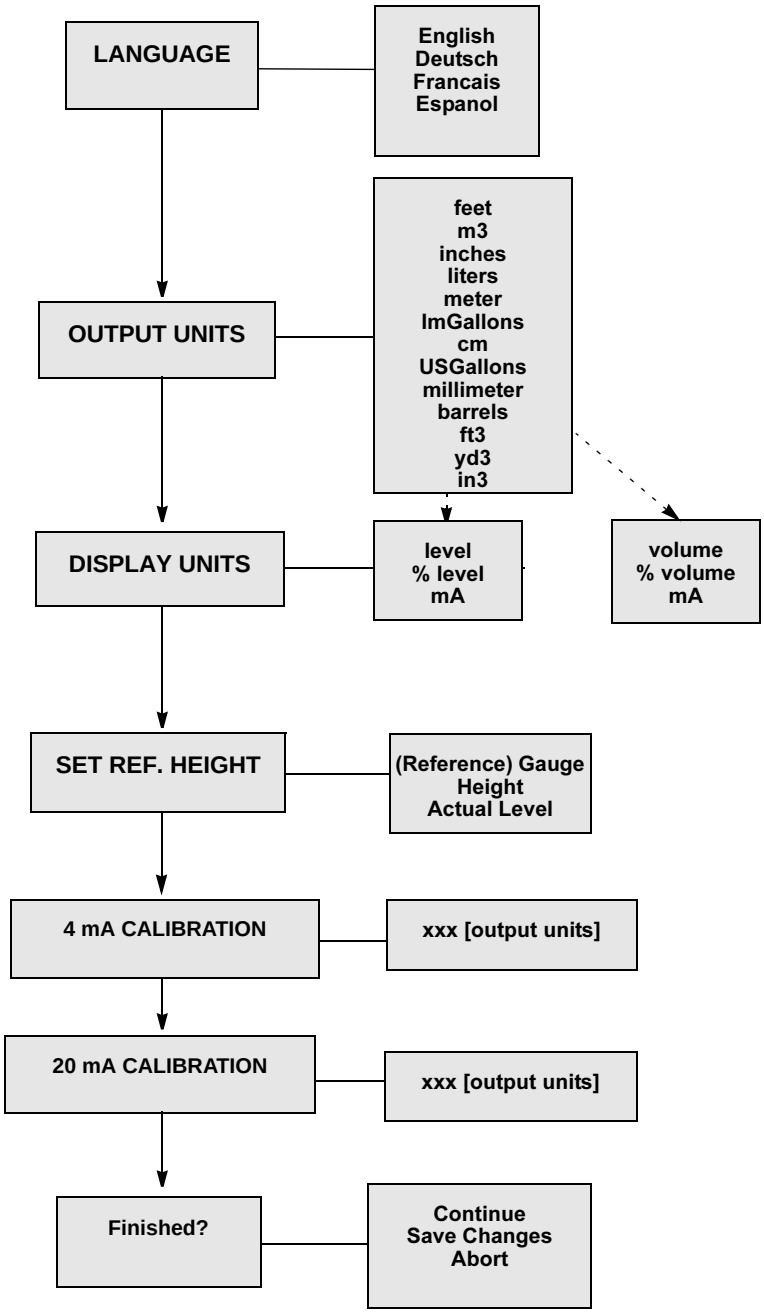
4.

4 mA Set Point: _____

5.

20 mA Set Point: _____

Figure 3-6. APEX Radar Gauge
Integral Display Menu Tree



Setting the Language

The first variable displayed is Language. Language options include English, Deutsch, Français, and Español. To set the language:

1. Press UP until the display shows the language you want to use.
2. Press ENTER to set the language.
   The menu then displays the Output Units option.

Setting the Output Units

Output unit options include level units and volume units. Level units are feet (*feet*), inches (*inches*), meters (*meter*), centimeters (*cm*), and millimeters (*millimeter*). Volume units are cubic meters (*m3*), liters (*liters*), Imperial Gallons (*ImGallons*), U. S. Gallons (*USGallons*), barrels (*barrels*), cubic feet (*ft3*), cubic yards (*yd3*), and cubic inches (*in3*).

NOTE
Volume output units should be selected only if tank type (*Tnk Typ*) Volume Geometry has been configured using the HART Communicator (refer to page 3-18). To display accurate volumetric units, the tank dimensions and volume equations or a strapping table must be configured in APEX memory using the HART Communicator.

NOTE
If volume is the desired output, the gauge must first be configured in level units (see “Setting the Reference Gauge Height” on page 3-12).

To configure the unit for volume output, refer to page 3-18.

To set the output units:

1. Press UP until the display shows the output units option you want to use.
2. Press ENTER to set the output units.
   The menu then displays the Display Units option.

Setting the Display Units

The integral display has two display lines (see Figure 3-4). The display for the upper line can be selected via the integral display itself. The lower line scrolls through a series of options. It is programmed using the HART Communicator (refer to page 3-18) or is pre-configured at the factory.

Display unit options for the upper line are *level*,*% level*, and *mA* if level units were selected for output units.

Display unit options for the upper line are *volume*,*% volume*, and *mA* if volume units were selected for output units.

To set the display units:

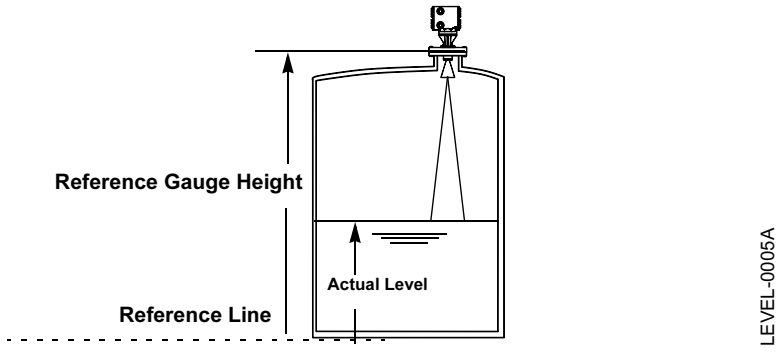
1. Press UP until the display shows the display units option you want to use.
2. Press ENTER to set the display units.
   The menu then displays the Reference Height option.

NOTE
The gauge can output up to four variables via the HART Signal.

Setting the Reference Gauge Height

The Reference Height options are Reference Gauge Height or Actual Level. The “Actual Level” option should be used only when there is a definite target for signal reflection. Flat-bottom tanks and flat, horizontal liquid surfaces reflect well. Slanted or turbulent surfaces may not provide sufficient reflection. **The Reference Gauge Height is the most critical setting for the gauge because it is the basis for all other calculations—choose it carefully!**

Figure 3-7. Reference Gauge Height



NOTE
The Reference Gauge Height must be set in level (linear) units. If you want volume output units on the integral display, you must first select level units, set the Reference Height, null zones, and empty tank settings and save the changes. You may then re-enter the menu and choose the desired volume display units.

Set the Reference Gauge Height:

NOTE
The empty tank setting must be less than or equal to 25% of the gauge height. When changing from a large gauge height to a smaller gauge height, it may be necessary to first change the empty tank setting to a smaller value using the Model 275 HART Communicator.

1. Press UP until the display shows the reference height option you want to use.
2. Press ENTER to select (reference) Gauge Height or Actual Level.
   If the dimension from the reference line (bottom) of the vessel to the gauge is unknown, do one of the following:

   • • If the tank is empty and has a flat bottom, enter “0” for the actual level.

   or

   • • Use the vessel drawing to determine the Reference Gauge Height.

   or

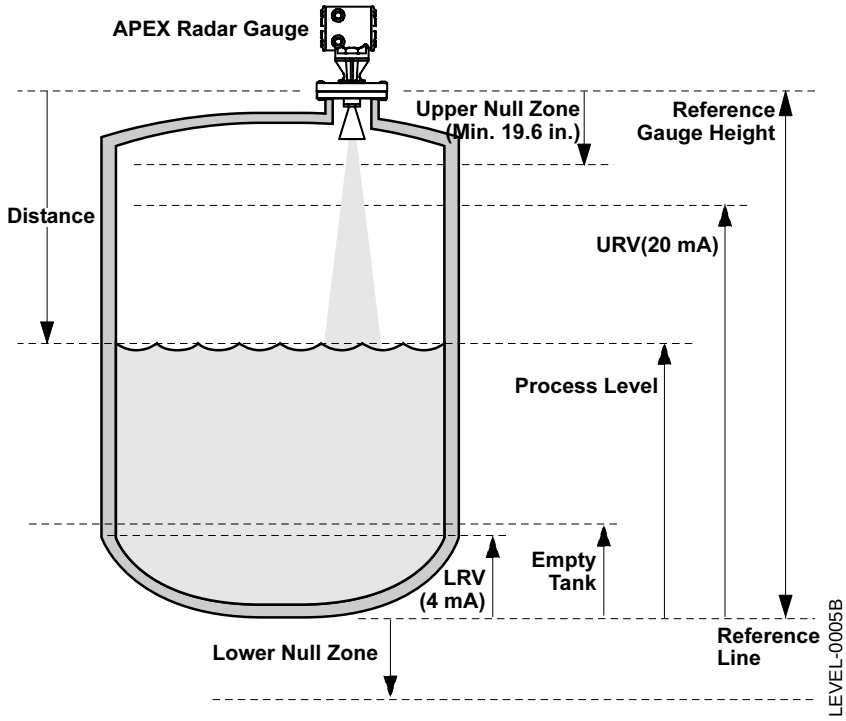
   • • Use another known reference level measurement, such as a hand dip, and enter that value for Actual Level. The gauge will then calculate its height.
3. Press NEXT to move the cursor to the digit you want to change.
4. Press UP or DOWN to change the value.
5. Repeat steps 3 and 4 for each digit.
6. When finished, press ENTER to set the value of the Reference Gauge Height or Actual Level.
   The menu will continue to the next step.

Setting the 4 mA Calibration

The 4 mA calibration variable is expressed in terms of the configured output units. To receive a 20 mA calibration on the Integral Display Option the loop must be powered. To set the 4 mA calibration:

1. Press NEXT to move the cursor to the digit you want to change.
2. Press UP or DOWN to change the value.
3. Repeat steps 1 and 2 to change the next digit.
4. When finished, press ENTER to set the desired 4 mA calibration.
   The menu then displays the 20 mA calibration variable.

Figure 3-8. Key Measurement Values



Setting the 20 mA Calibration

NOTE
When setting the 20 mA point, be sure to set it at least 19.6 in. (0.5 m) from the flange face and below the upper null zone. The gauge cannot accurately measure the product level closer than 19.6 inches.

The 20 mA calibration variable is expressed in terms of the configured output units. To receive a 20 mA calibration on the Integral Display Option the loop must be powered. To set the 20 mA calibration:

1. Press NEXT to move the cursor to the digit you want to change.
2. Press UP or DOWN to change the value.
3. Repeat steps 1 and 2 to change the next digit.
4. When finished, press ENTER to set the desired 20 mA calibration. The menu then displays the message “Finished?”

Exiting the Main Menu

To save the configuration information and exit the main menu:

1. Make sure the “Save Changes” message is displayed (press UP or DOWN if necessary).
2. Press ENTER.

To make additional changes, press UP or DOWN to display the message “Continue.”

- Press ENTER if you want to repeat the steps for changing each of the variables and configuration options.

or

- To go to a specific option, continue pressing ENTER until you reach the option you want to change.

To discard the configuration changes:

1. Press UP or DOWN to display the message “Abort.”
2. Press ENTER.

MODEL 275 HART COMMUNICATION OPTION

Commissioning on the Bench With HART

Commissioning consists of testing the transmitter and verifying transmitter configuration data. The APEX and APEX Sentry Radar Gauge can be commissioned either before or after installation. Commissioning the transmitter on the bench before installation using a Model 275 HART Communicator or AMS ensures that all transmitter components are in working order.

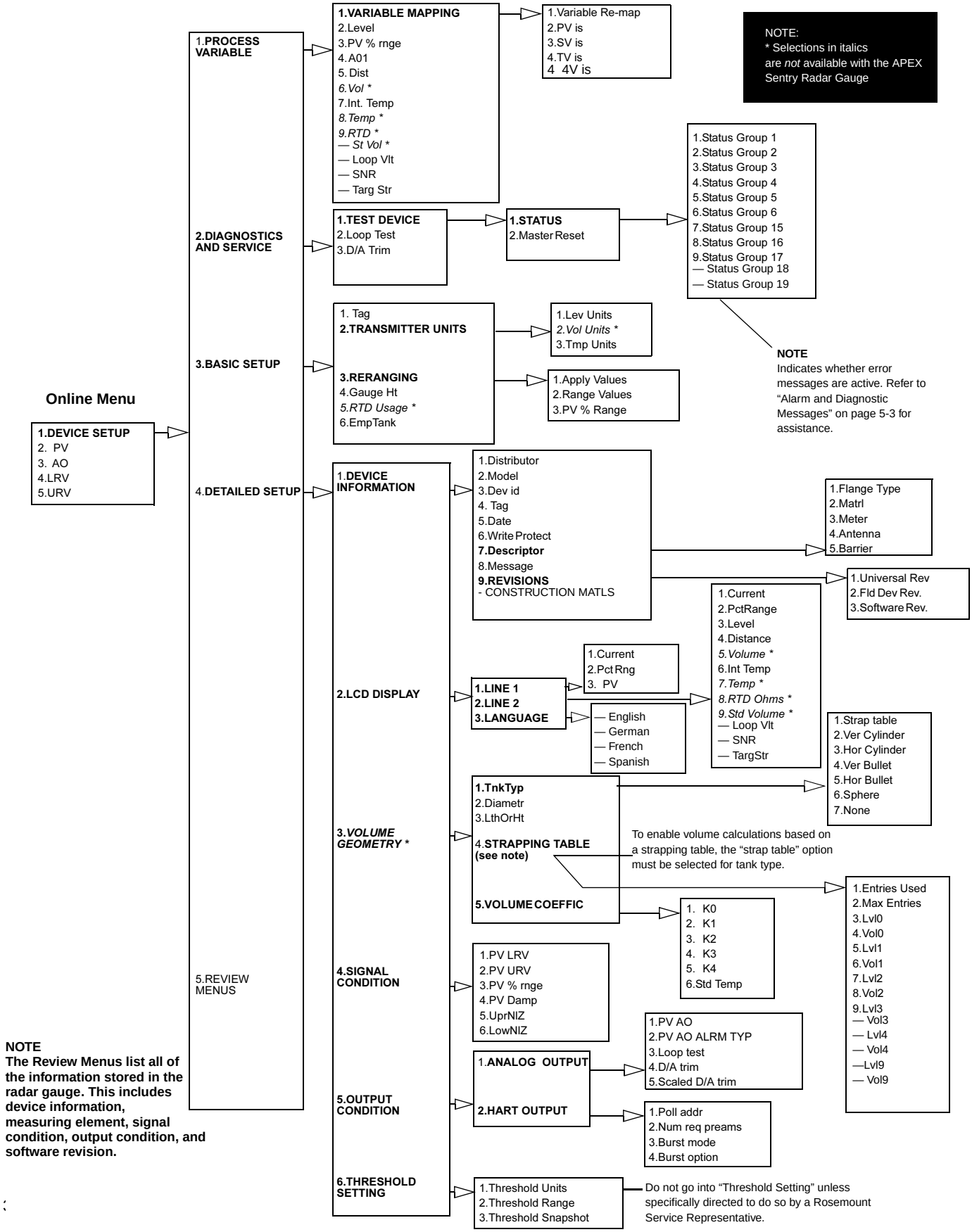
⚠ To commission on the bench, connect the transmitter and the HART Communicator. Make sure the instruments in the loop are installed according to intrinsically-safe or nonincendive field wiring practices before connecting a communication in an explosive atmosphere. Connect HART Communicator leads at any termination point in the signal loop. For convenience, connect them to the terminals labeled “COMM” on the terminal block. Connecting across the “TEST” terminals will prevent successful communication. Avoid exposing the transmitter electronics to the plant environment after installation by setting all transmitter jumpers during the commissioning stage on the bench.

For 4–20 mA transmitters, the power supply must provide 10.5 to 42.4 V dc at the transmitter, and a meter to measure output current. To enable communication, a resistance of at least 250 ohms must be present between the HART Communicator loop connection and the power supply. Do not use inductive-based transient protectors with the APEX and APEX Sentry Radar Gauge.

When using a HART Communicator, any configuration changes made must be sent to the transmitter by using the “Send” key (F2). AMS configuration changes are implemented when the “Apply” button is clicked.

For more information on the Model 275 HART Communicator see document 00275-8026-0002.

Figure 3-9. HART Communicator Menu Tree for the APEX and APEX Sentry Radar Gauges



Setting the Loop to Manual

Whenever sending or requesting data that would disrupt the loop or change the output of the transmitter, set the process application loop to manual. The HART Communicator will prompt you to set the loop to manual when necessary. Acknowledging this prompt does not set the loop to manual. The prompt is only a reminder; set the loop to manual as a separate operation.

Wiring Diagrams

Bench Hook-up

Connect the bench equipment, and turn on the HART Communicator by pressing the ON/OFF key. The HART Communicator will search for a HART-compatible device and indicate when the connection is made. If the HART Communicator fail to connect, it indicates that no device was found. If this occurs, refer to Section 5: Hardware and Software Maintenance and Troubleshooting.

Field Hook-up

Signal point may be grounded at any point or left ungrounded.

Function	HART Fast Key
Construction Materials	1, 4, 1, –
Device Information	1, 4, 1
Diameter (APEX Radar Gauge Only)	1, 4, 3, 2
Display Language	1, 4, 2, 3
Display Line 1	1, 4, 2, 1
Display Line 2	1, 4, 2, 2
Empty Tank	1, 3, 6
Length or Height (APEX Radar Gauge Only)	1, 4, 3, 3
Level Units	1, 3, 2, 1
Loop Test	1, 2, 2
Lower Null Zone	1, 4, 4, 6
Lower Range Value (LRV) (4 mA)	1, 3, 3
Master Reset	1, 2, 1, 2
Poll Address	1, 4, 5, 2, 1
Primary Variable	1, 1, 1, 1
Process Variable Damping	1, 4, 4, 4
Range Values	1, 3, 3, 2
Reference Gauge Height	1, 3, 4
Strapping Table (APEX Radar Gauge Only)	1, 4, 3, 4
Tag	1, 3, 1
Tank Type (APEX Radar Gauge Only)	1, 4, 3, 1
Temperature Units	1, 3, 2, 3
Upper Null Zone	1, 4, 4, 5
Upper Range Value (URV) (20 mA)	1, 3, 3
Variable Remapping	1, 1, 1, 1
Volume Coefficient (K Constants) (APEX Radar Gauge Only)	1, 4, 3, 5
Volume Units (APEX Radar Gauge Only)	1, 3, 2, 2

Connections and Hardware

The HART Communicator exchanges information with the APEX and APEX Sentry Radar Gauges from the control room, the instrument site, or any wiring termination point in the loop. The HART Communicator should be connected in parallel with the gauge. Use the loop connection ports on the rear panel of the HART Communicator. The connections are non-polarized.

⚠ Do not make connections to the serial port or NiCad recharger pack in an explosive atmosphere.

Using a Model 275 HART Communicator

NOTE
Remember, when using a Model 275 hand held communicator, you must **send** the data before configuration changes will take effect.

NOTE
As a matter of routine, shut off the APEX Radar Gauge and all other equipment before you enter the tank.

To configure the APEX and APEX Sentry Radar Gauges to report LEVEL (analog output is linear to level) with the gauge wired as in Figure 3-6 on page 3-10, connect the Model 275 as shown.

Set Transmitter Units

HART Comm	1, 3, 2, 1

Set transmitter units:

- ft
- m
- in
- cm
- mm

Set Reference Gauge Height

HART Comm	1, 3, 4

When setting the Reference Gauge Height, keep in mind that this value is used for all measurements performed by the APEX. (Refer to “Setting the Reference Gauge Height” on page 3-12.)

Set 4 and 20 mA Points

HART Comm	1, 3, 3

When setting the range values, it is possible to enter the values directly, or to use actual values. Keep in mind that the 20 mA point must be at least 19.6 inches below the flange face.

NOTE
The primary variable must be set to *level* (factory default).

Volume Configuration (APEX Radar Gauge Only)

To configure the gauge to report ACTUAL VOLUME (analog output is linear with volume) set transmitter units and Reference Gauge Height in level units as detailed above. The Reference Gauge Height must be set in linear units for the gauge to be able to read volume.

Set Volume Units

HART Comm	1, 3, 2, 2

You may choose one of the following:

- Gallons (gal)
- Liters (L)
- Imperial Gallons (Impgal)
- Cubic Meters (cum)
- Barrels (bbl)
- Cubic Feet (cuft)
- Cubic Inches (cuin)
- Cubic Yards (cuyd)

Set Primary Variable

HART Comm	1, 1, 1, 1

Select volume for volume measurements.

Set Range Values (4 and 20 mA points)

HART Comm	1, 3, 3

When setting the range values, it is possible to enter the values directly or to have the gauge read the values. If values are to be read by the gauge, set the desired tank type first.

Choose Tank Type

HART Comm	1, 4, 3, 1

Choose a tank with a standard shape, or select the strapping option. Standard shapes: Vertical Cylinder, Horizontal Cylinder, Vertical Bullet, Horizontal Bullet, or Sphere. (If primary variable is level, select “None”). If your tank is not one of the above, or if you have strapping table information, select “Strap Table.”

Enter Tank Dimensions

HART Comm	1, 4, 3

If a standard tank shape was chosen, enter the diameter and length (or height) for the tank.

Enter Strapping Table Information(1)

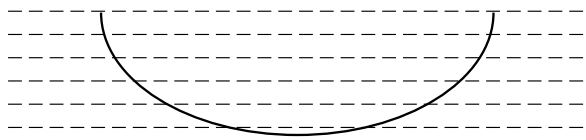
HART Comm	1, 4, 3, 4

First tell the gauge how many entries you will have; the more entries you have, the better the gauge will be able to calculate the volume. The maximum number of strapping points you can enter is 10.

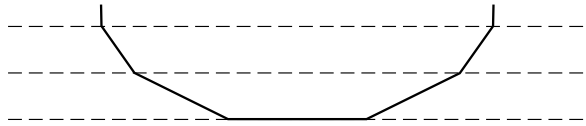
Next, input the actual level and volume points, starting at the bottom of the tank. It may be desirable to use most of the points in the areas of the tank that are the least “straight.” See Figure 3-10. Suggestion: Set first entry at zero level and zero volume to enable the gauge to track volume over the entire range.

(1) If tank type is strapping table

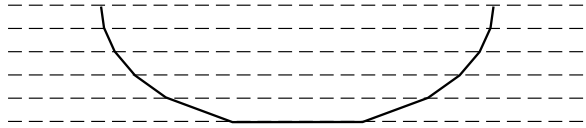
Figure 3-10. Tank Bottom Strapping Points



Actual tank bottom may look like this.



Using only 3 strapping points results in a level-to-volume profile that is more angular than the actual shape.



Using 6 of the points at the bottom of the tank yields a level-to-volume profile that is similar to the actual tank bottom.

LEVEL-APEX_05A

Standard Volume (Apex Radar Gauge Only)

If standard volume is desired, an RTD must be installed and wired to the APEX Radar Gauge. First, configure the gauge for actual volume as outlined in the previous section and configure standard volume as the secondary variable.

Enable RTD Input

Enables the radar gauge to use the RTD input.

HART Comm	1, 3, 5

Enter Volume Coefficients

Volume coefficients (K-Constants) are used to determine how temperature changes affect volume measurements. If you do not know K-Constants for your process and would like to measure standard volume, contact Rosemount Customer Central at 1-800-999-9307 for further assistance.

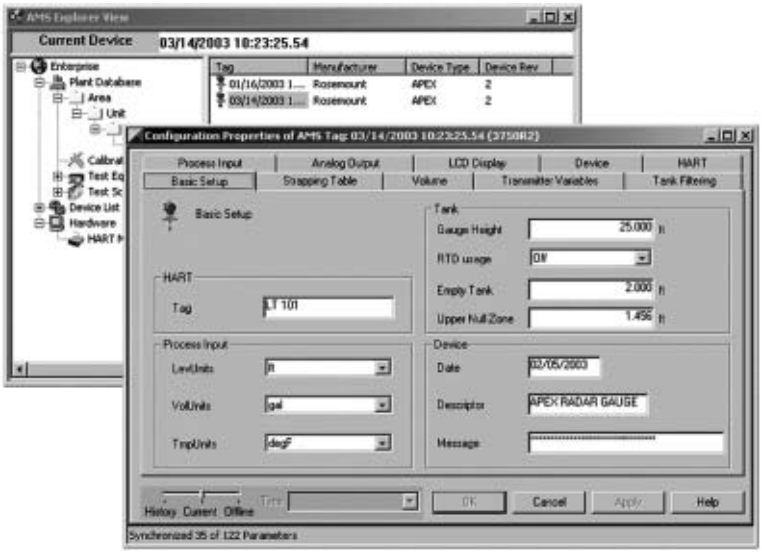
HART Comm	1, 4, 3, 4

AMS CONFIGURATION TOOL OPTION

Basic Setup

Right click on the device and select “Configuration Properties” from the menu. Select the Basic Setup tab, to enter Tank, Process Input, and Device information.

Figure 3-11. Basic Setup Example



APEX/AMS/APEX_AMS_01A.TIF

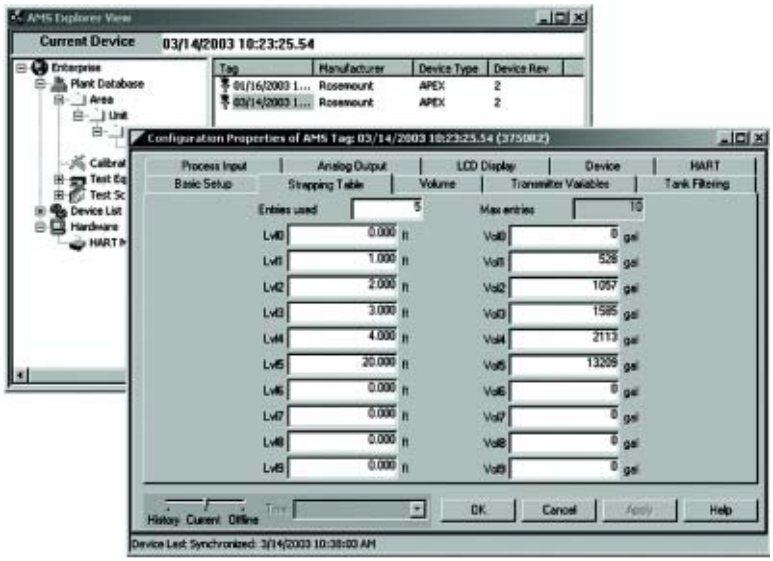
Strapping Table

Right click on the device and select “Configuration Properties” from the menu. Locate the Strapping Table tab and perform the following procedure:

First tell the gauge how many entries you will have; the more entries you have, the better the gauge will be able to calculate the volume. The maximum number of strapping points you can enter is 10.

Next, input the actual level and volume points, starting at the bottom of the tank. It may be desirable to use most of the points in the areas of the tank that are the least “straight.” Suggestion: Set first entry at zero level and zero volume to enable the gauge to track volume over the entire range.

Figure 3-12. Strapping Table Example



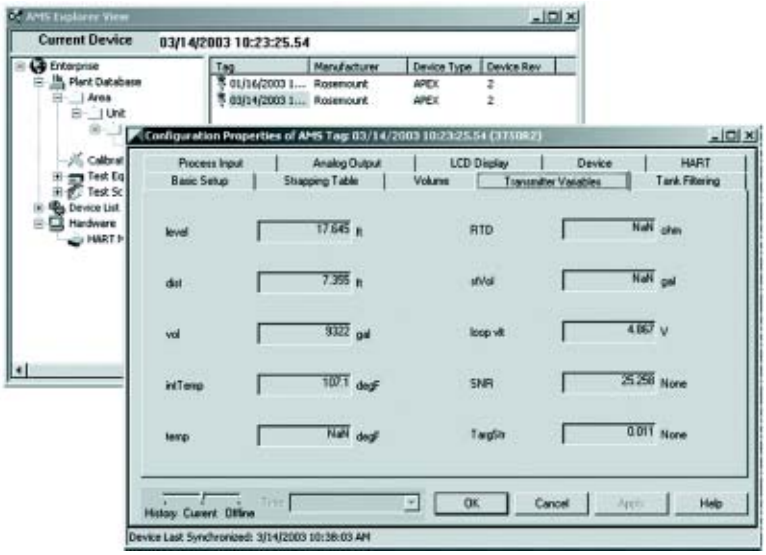
APEX/AMS/APEX_AMS_02A.TIF

Transmitter Variables

Right click on the device and select “Configuration Properties” from the menu. Locate the Transmitter Variables tab and perform the following procedure:

1. Enter the entries in the fields provided. Click **Apply**.
2. An “Apply Parameter Modification” screen appears, enter desired information and click **OK**.
3. After carefully reading the warning provided, select **OK**.

Figure 3-13. Transmitter Variables Example



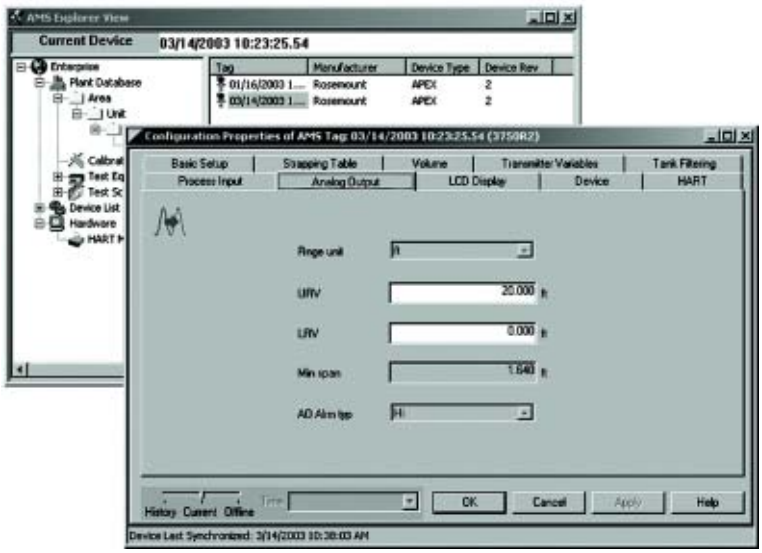
APEX/AMS/APEX_AMS_03A.TIF

Rerange

Right click on the device and select “Configuration Properties” from the menu. Locate the Analog Output tab and perform the following procedure:

1. Enter the lower range value (LRV) and the upper range value (URV) in the fields provided. Click **Apply**.
2. An “Apply Parameter Modification” screen appears, enter desired information and click **OK**.
3. After carefully reading the warning provided, select **OK**.

Figure 3-14. Analog Output Example



APEX/AMS/APEX_AMS_04A.TIF

RADAR CONFIGURATION TOOL (RCT) OPTION

The Radar Configuration Tool (RCT) is a user-friendly software tool that allows you to configure the APEX Radar gauge. You can choose either of the following two methods to configure the APEX Radar gauge:

- Start the Wizard for a guided installation if you are un-familiar with the APEX Radar Gauge (See “Using the Setup Wizard” on page 3-27).
- Use the Setup function if you are already familiar with the configuration process or if you want to change the current settings (See “Using the Setup Function” on page 3-28).

Installing the RCT Software

To install the Rosemount Configuration Tool:

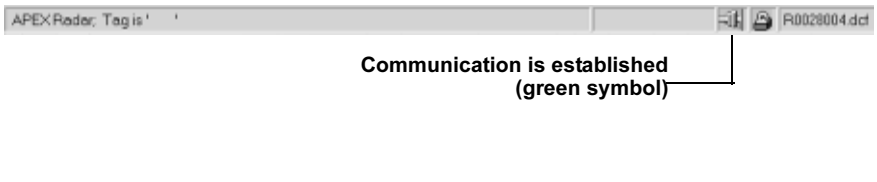
1. Insert the installation CD into your CD-Rom drive.
2. Run **Setup.exe** from the CD.
3. Follow the instructions.

NOTE
Do not use an alternate drive other then your hard drive when installing the RCT Software.

To start the RCT:

1. From the Start menu click Programs > RCT Tools > RCT.
2. In the RCT Status Bar check that RCT communicates with the radar gauge.

Figure 3-15. RCT Communication established



APEX/RCT/APEX_01AA.TIF

Figure 3-16. RCT Communication not established

APEX/RCT/APEX_01AA.TIF

Specifying the COM Port

If communication is not established, open the HART Communication Server window and verify the right COM Port is selected.

To check the current COM port settings do the following:

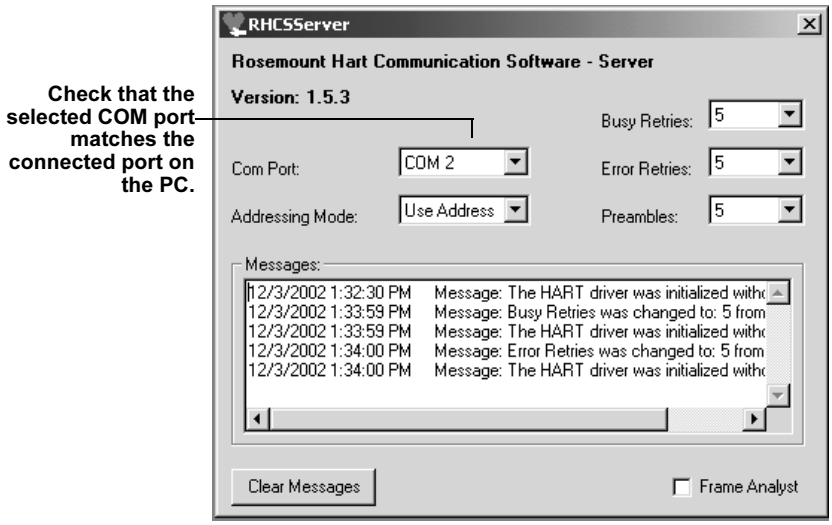
1. Locate the HART Server icon in the lower right corner of the screen.

Figure 3-17. HART Server Icon

APEX/RCT/10053_CA.TIF

2. Double-click the HART Server icon.

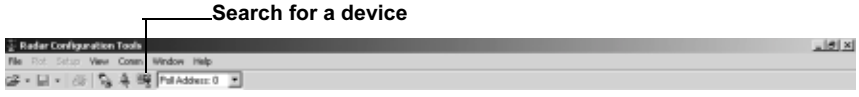
Figure 3-18. Rosemount HART Communication Software



APEX/RCT/APEX_03AA.TIF

3. Check the COM port.
4. Choose the COM Port option that matches the COM Port connected to the transmitter.
5. Click the Search for a device icon in the RCT tool bar:

Figure 3-19. RCT tool bar

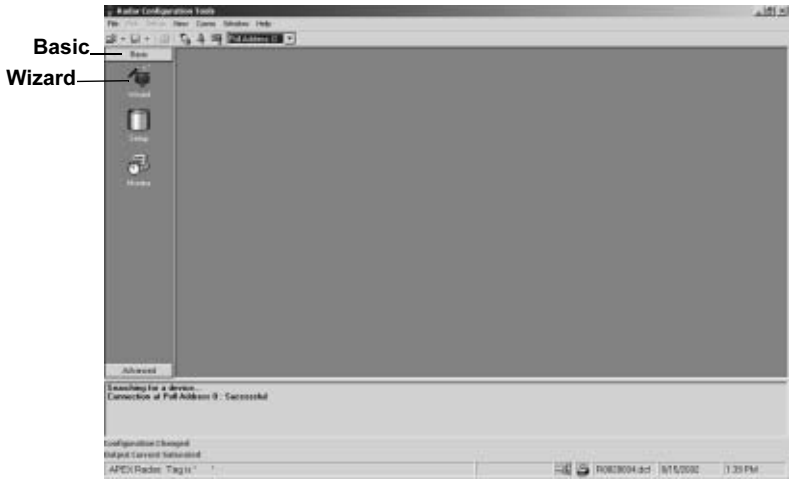


APEX/RCT/APEX_04AA.TIF

Using the Setup Wizard

To install an APEX Radar Gauge by using the installation Wizard do the following:

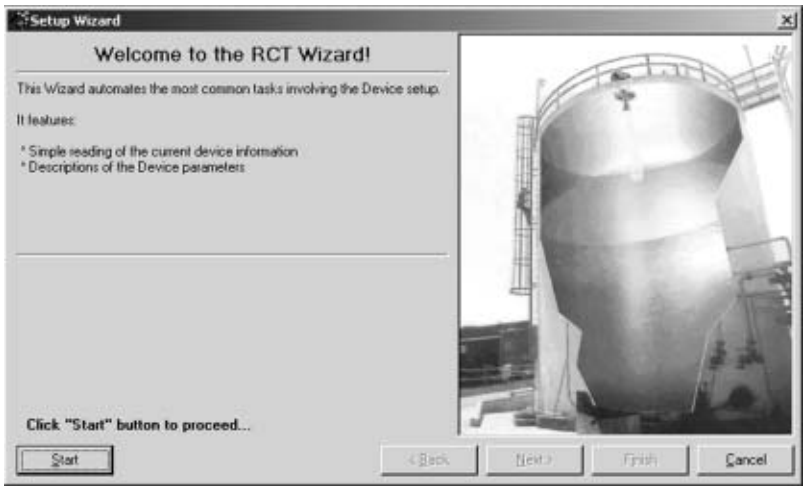
Figure 3-20. RCT workspace



APEX/RCT/APEX_05AA.TIF

1. Start the RCT software.
2. In the RCT workspace click the Wizard icon (make sure the Basic section is open), or choose the View > Wizard menu option.

Figure 3-21. RCT Wizard



APEX/RCT/APEX_06AA.TIF

3. Click the Start button and follow the instructions. Now you will be guided through a number of dialogs allowing you to configure the transmitter.

Using the Setup Function

To install the APEX Radar Gauge by using the Setup function do the following:

Figure 3-22. RCT workspace/ Setup Info

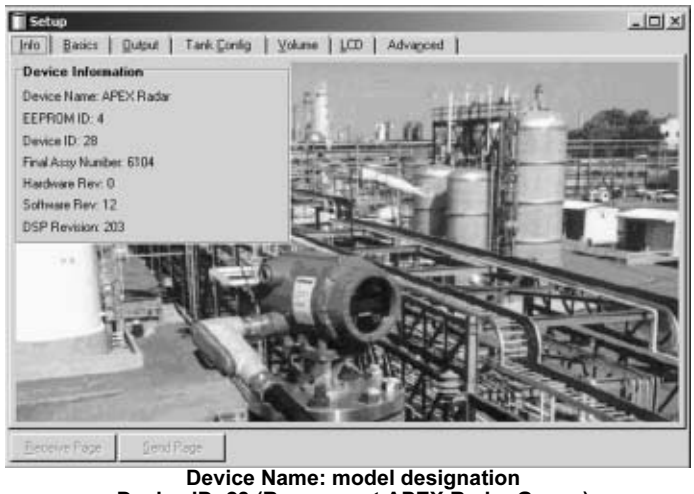
APEX/RCT/APEX_07AA.TIF

1. Start the RCT software.
2. In the RCT workspace click the Setup icon (make sure the Basic section is open)
3. Choose the appropriate tab:
   - Info: Information about the device.
   - Basics: Set measurement units.
   - Output: Variable assignment and range value settings.
   - Tank Config: Tank height and other geometry settings, null zones, and empty tank settings.
   - Volume: Specification of tank geometry for volume calculations.
   - LCD: Display panel settings.
   - Advanced: Quick pick options and their required parameter settings.

Setup - Info

The **Info** tab shows information about the connected transmitter.

Figure 3-23. Setup Info tab



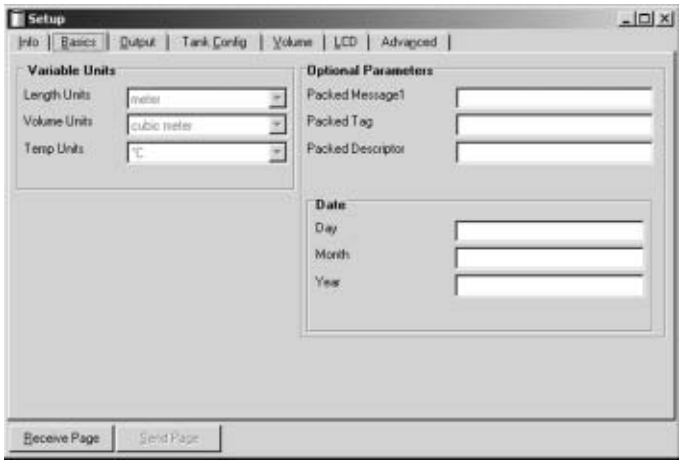
APEX/RCT/APEX_08AA.TIF

Device Name: model designation
Device ID: 28 (Rosemount APEX Radar Gauge)
Software Rev: Software version number

Setup - Basics

The **Basics** tab lets you choose Measurement Units for Length, Volume, and Temperature. These units are used wherever measurement data is presented.

Figure 3-24. Setup Basics Tab



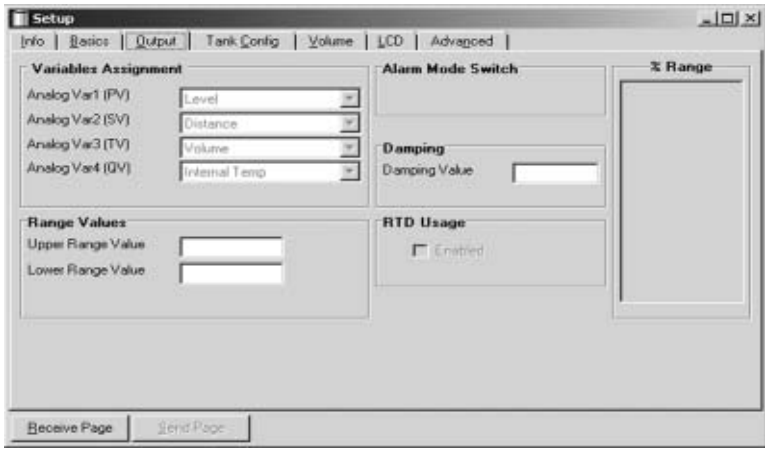
APEX/RCT/APEX_09AA.TIF

This window also allows you to enter some general information about the transmitter like Message, Tag, Descriptor, and Date. This information is not required for the operation of the transmitter and can be left out if desired.

Setup- Output

The **Output** tab lets you assign up to four transmitter variables.

Figure 3-25. Setup Output Tab



APEX/RCT/APEX_10AA.TIF

Typically, the Primary Variable (PV) is configured to be Product Level, Interface Level, or Volume.

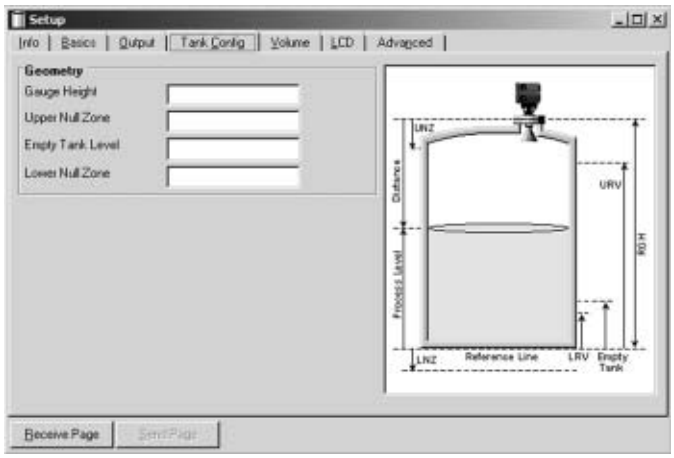
Set the Lower Range Value (4 mA) and the Upper Range Value (20 mA) to the desired values. Keep in mind the 20 mA value should be below the Upper Null Zone.

RTD Usage should be checked if an RTD is used with the gauge.

Setup - Tank Config

The **Tank Configuration** tab contains information on tank geometry.

Figure 3-26. Setup Tank Configuration Tab



APEX/RCT/APEX_11AA.TIF

Tank Geometry
The Gauge Height (RGH) is the distance from the Upper Reference Point to the bottom of the tank. When setting the Reference Gauge Height, keep in mind that this value is used for all measurements performed by the APEX Radar Gauge. The Gauge Height must be set in linear (level) units, such as feet or meters, regardless of primary variable assignment.

The Upper Null Zone (UNZ) should not be changed unless there are disturbances at the top of the tank. By increasing the Upper Null Zone value measurements in this region can be avoided. The UNZ is equal to 19.6 inches (0.5 m) in the factory configuration.

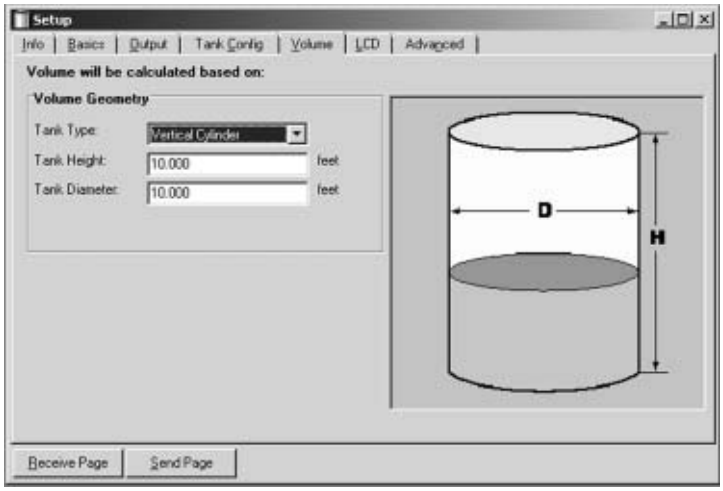
NOTE
The gauge cannot reliably read measurements too close to the antenna.

The Lower Null Zone (LNZ) should not be changed unless there are disturbances at the bottom of the tank. By increasing the Lower Null Zone value measurements in this region can be avoided. The LNZ is equal to -19.6 inches (-0.5 m) in the factory configuration.

Setup - Volume

The **Volume** tab lets you configure the transmitter for volume calculations.

Figure 3-27. Setup Tank Volume Tab



APEX/RCT/APEX_12BA.TIF

You can choose one of the standard tank shapes or the strapping option. Choose **None** if volume calculation is not used at all.

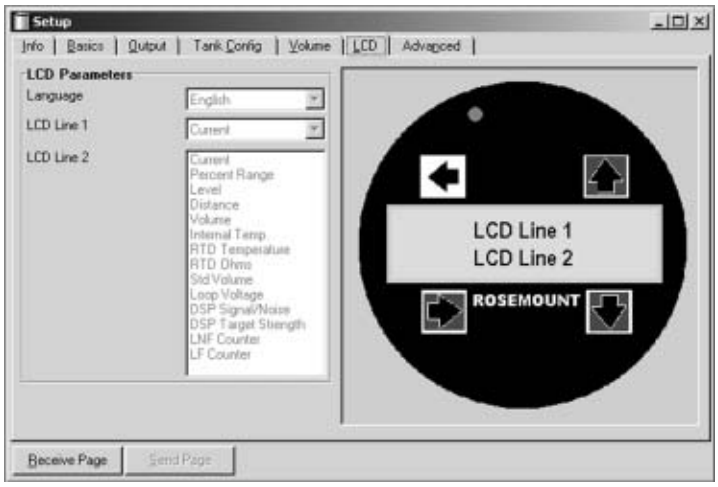
Choose one of the following options:

- None
- Strap Table
- Vertical Cylinder
- Horizontal Cylinder
- Vertical Bullet
- Horizontal Bullet
- Sphere

Setup - LCD

The **LCD** tab lets you specify which parameters to appear on the display panel.

Figure 3-28. Setup Tank LCD Tab



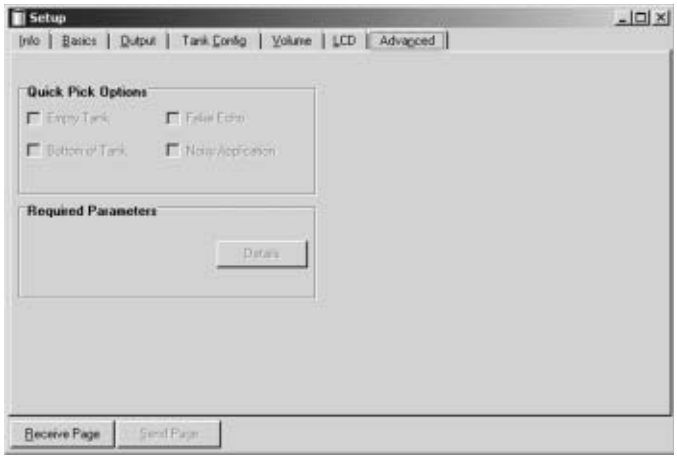
Choose one the following options:

Parameter	Description
Level	Product Level
Distance	Distance from upper reference point to product surface
Volume	Total product volume
Internal Temperature	Temperature inside the transmitter housing
RTD Temperature	Temperature report from connected RTD (optional)
RTD Ohms	Resistance report from connected RTD (optional)
Standard Volume	Product volume corrected for temperature
Loop Voltage	Voltage of loop at device terminal
DSP Signal/ Noise	An indicator of signal quality
DSP Target Strength	An indicator of signal quality
LNF Counter	A counter indicating lost targets (typically 0)
LF Counter	A counter indicating found targets (typically 8)
Percent Range	Level value in percent of total measurement range

Setup - Advanced

The Advanced tab lets you specify which quick pick option and required parameters to configure.

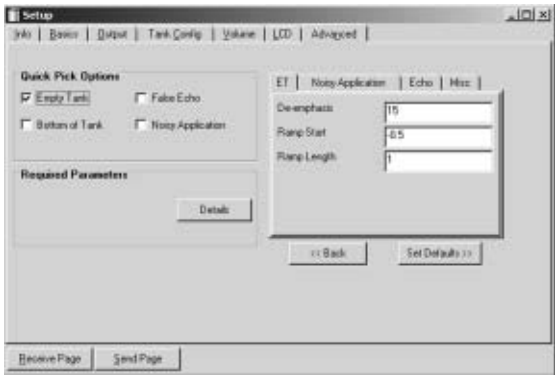
Figure 3-29. Setup Tank Advanced Tab



APEX/RCT/APEX_14AA.TIF

- **Empty Tank** - turns on when level is below the empty tank setting. The Empty Tank option controls gauge function when target is lost after level drops below the empty tank setting. This is typically used in non-flat bottom vessels. It prevents the gauge from going into full search mode when a vessel is empty. The gauge will focus its search in the area below the Empty Tank setting and wait for vessel filling to begin.

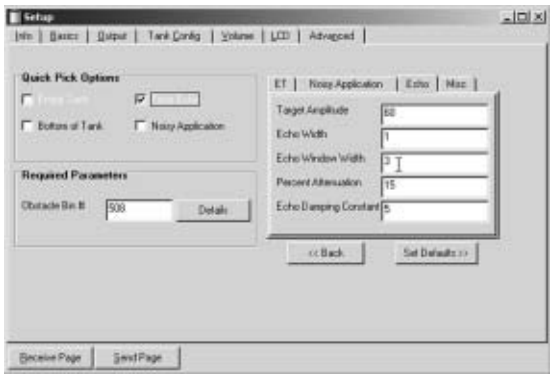
Figure 3-30. Quick Pick Option - Empty Tank



APEX/RCT/APEX_23AA.TIF

- **False Echoes** - minimizes reflection from a false target that is within the measurement range. Use this when the gauge occasionally locks on a false target when the level drops below it.
  To use this function, the false target must be identified by its bin number. To learn this, run a tank plot and spectrum (under the **Advanced Tab**) and locate the false target and associated bin number. Input this value as shown in Figure 3-31. Consult the factory for assistance.

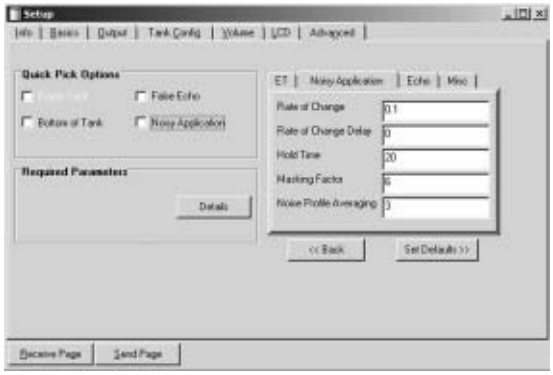
Figure 3-31. Quick Pick Option - False Echo



APEX/RCT/APEX_22AA.TIF

- **Bottom of Tank** - allows the gauge to track just beyond the LNZ without alarming. This option prevents the gauge from locking onto the tank bottom. The Bottom of Tank tab is often used in flat bottom tanks with low dielectric fluids.
- **Noisy Applications** - includes applications with high turbulence or occasional foam where the level target will disappear for short periods of time. This option increases the amount of time that gauge will look for a target within the tracking window before alarming.

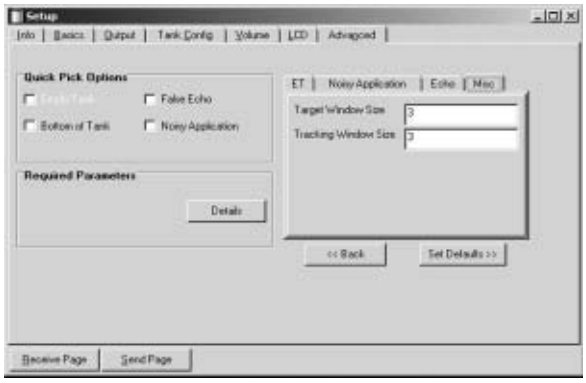
Figure 3-32. Quick Pick Option - Noisy Applications



APEX/RCT/APEX_20AA.TIF

- **Miscellaneous** - allows you to change the target window size and the tracking window size.

Figure 3-33. Quick Pick Option - Miscellaneous

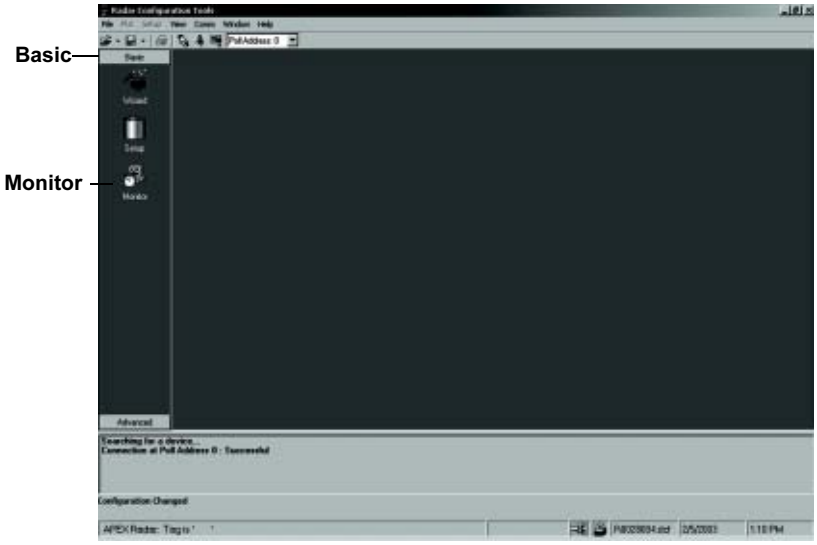


APEX/RCT/APEX_21AA.TIF

Logging Measurement Data

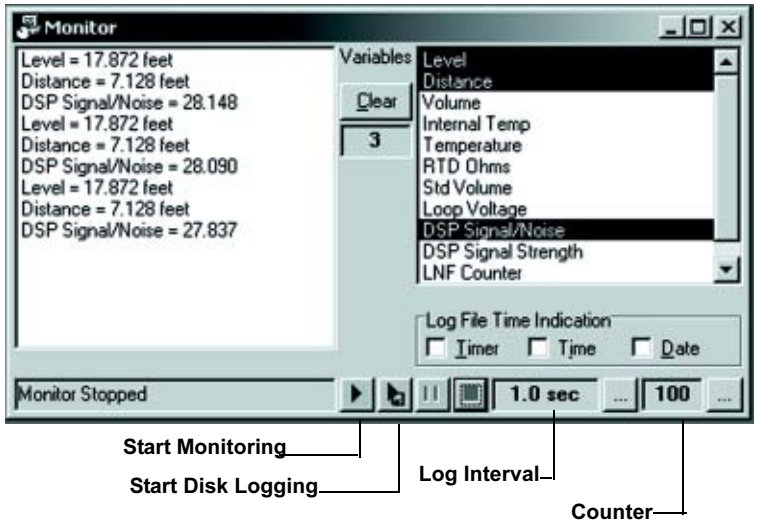
To start logging do the following:

1. Click the Monitor icon in the RCT workspace or choose the Monitor option for the View menu.



APEX/RCT/APEX_26AB.TIF

2. Choose the desired variables to be monitored. Click the Start Monitoring button.



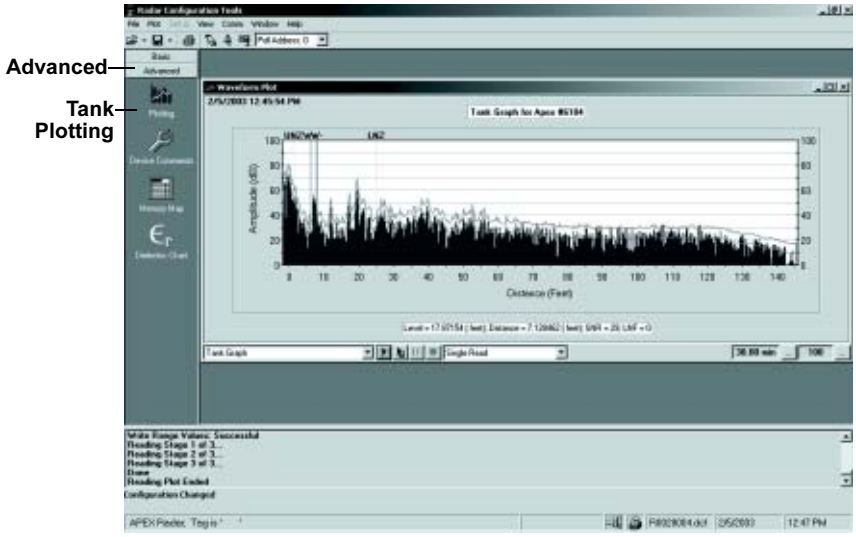
APEX/RCT/APEX_26AA.TIF

Saving the log to a disk

1. Choose the desired variables to be monitored.
2. Click the Log interval button and enter a time interval. For example, type 10 if you want data to be logged every tenth of a second.
3. Click the Counter button and enter the maximum number of files to be stored. The Counter is used to limit the amount of data stored on the hard disk. Each time the maximum number of entries in a log file is reached, the current log file is saved and a new file is created. This procedure continues up to the maximum number of files given by the Counter value. The file size is limited to 60000 entries which can easily be handled by spreadsheet programs such as MS Excel.
4. Select the desired options of Timer, Time, and Date. By selecting a check box the corresponding time indication is stored for each log entry in the log file.
5. Click the Start disk logging button.
6. Choose a destination folder and enter a file name.

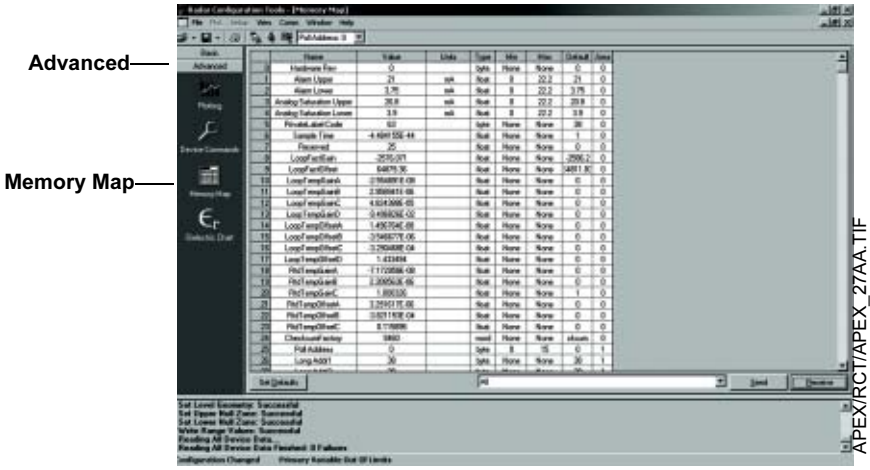
Using the Advanced Tab

Tank Plotting



Memory Map

A recording of all the memory files and a listing of standard defaults.



Section 4 Hardware and Software Maintenance and Troubleshooting

This section provides information on preventive maintenance and diagnostic and alarm messages displayed by the APEX and APEX Sentry Radar Gauges and the HART Communicator.

SAFETY MESSAGES

NOTE
All information included refers to both the APEX Radar Gauge and the APEX Sentry Radar Gauge unless otherwise stated.

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

Explosions could result in death or serious injury:

- Verify that the operating environment of the gauge is consistent with the appropriate hazardous locations certifications.
- Before connecting a HART-based 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.

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

- Make sure only qualified personnel perform these procedures.
- 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

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 APEX Radar Gauge is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

As a matter of routine, shut off the APEX Radar Gauge and all other equipment in the tank before you enter the tank.

⚠CAUTION

People who handle products exposed to a hazardous substance can avoid injury if they are informed and understand the hazard.

Return of Materials: If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned products.

PREVENTIVE MAINTENANCE

The APEX and APEX Sentry Radar Gauges have built-in diagnostics and self-tests that generate alarms if certain failures occur. In addition, there are a few basic things you may want to check periodically to prevent problems from occurring.

⚠ Use only the procedures and new parts specifically referenced in this manual to ensure specification performance and certification compliance. Unauthorized procedures or parts may affect product performance and the output signal used to control a process.

Product Buildup

If you have a process that produces condensate or is prone to coating, check the radar antenna for product buildup. If buildup appears on the inside or outside of the antenna, clean it with a solvent that will not damage the SST antenna material, flange, or PTFE/ceramic waveguide.

Splashing and Coating

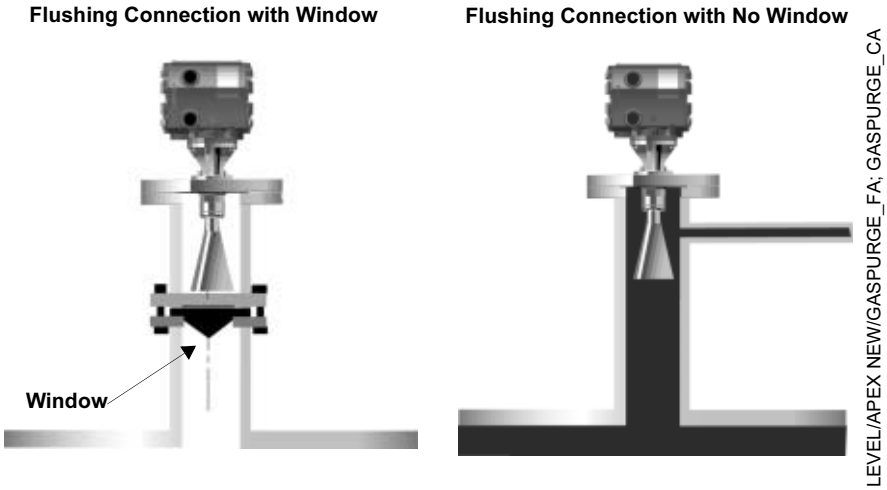
- Horn antennas can be recessed into the nozzle to protect against coating.
  - Gas purge can be used
  - Intermittent water purge can be used.
- In other cases, periodic cleaning might be required.

Flushing Connection

A flushing connection (Figure 4-1) may be installed to prevent corrosion on the radar antenna.

⚠ **Refer to "Safety Messages" on page 4-1 and for more information.**

Figure 4-1. APEX Radar Gauge with flushing connection



Performance

Check the level output from the radar gauge by comparing the gauge output with a hand dip or other means that is suitable for a level comparison.

⚠ Check the 4–20 mA output with a milliampere meter or read the signal on a current indicator. You can do this type of test by performing a loop test using the HART Communicator. Before connecting a HART-based 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.

Set the 4–20 mA current to 4 mA and measure or display the signal on the mA meter or indicator. Check the 20 mA in the same manner.

⚠ Check the ac or dc power supply that supplies operating power to the gauge to make certain it is still operating within specifications. If a separate dc power supply is used for the 4–20 mA output, check the dc power supply to make certain it is still operating within its specifications. Avoid contact with leads and terminals.

ALARM AND DIAGNOSTIC MESSAGES

Table 4-1 is a list of alarm and diagnostic messages that may be displayed on the Integral Display (if installed) or on the Model 275 HART Communicator.

Some of the messages involve the digital signal processor (DSP), which is one of the microprocessor boards. It simply indicates that this board originated the message. Also, you will see “Radar Configuration Tools (RCT)” mentioned in the “Action” column of the table.

If any of these problems persist after performing the suggested action, contact Rosemount Customer Central at 1-800-999-9307.

If you encounter any of these messages immediately after start up, wait 30 seconds to allow the gauge to “lock on” to a signal. If, after 30 seconds, these messages are still displayed, follow the course of action listed below.

⚠ **Refer to “Safety Messages” on page 4-1 and for more information.**

Table 4-1. Alarm and Diagnostic Messages

Displayed Message	Cause	Action
dspNotResponding	The DSP is not responding to a request to return the distance.	Verify that the gauge is getting enough power. See page A-7 for power requirements Verify that the APEX gauge is properly installed; the target (product) must be within 98 ft (30 m) of the flange but no closer than 19.6 in. (0.5 m). Cycle power or use a Model 275, AMS, or RCT to reset.
dspOutOfLimits	One of three conditions could cause this message: Level is returned as “Not a Number” (usually resulting from a “dspNotResponding” condition). Level is less than the lower null zone. Level is greater than (Reference Gauge Height – upper null zone).	This message most frequently appears during start-up; wait 30 seconds and if the message persists, follow steps 2 and 3. Verify that the Reference Gauge Height and null zones are set correctly. Check the Reference Gauge Height first because setting the Reference Gauge Height will cause the lower null zone to reset to its default value.
dspReportsError	The DSP has set one of its 32 error flags.	If other messages are present, follow recommended action(s) for those messages; verify configuration. Cycle power or use a 275 or RCT to reset.
dspReportWarning	The DSP has set one of its 32 warning flags.	If other messages are present, follow recommended action(s) for those messages. Some warnings, especially #5, may appear for a few seconds when the APEX gauge is being configured. If it persists, verify configuration. Cycle power or use a 275 or RCT to reset.
DSP Startup in Progress or DSP Error #6	Advisory	No action necessary; gauge is starting up.
DSP EEPROM failure or DSP Error #14	Electronics Failure	Call Rosemount Customer Central. The unit will most likely need advanced troubleshooting in the field or will need to be returned to the factory for repair.
eepromFactAreaFailure	Part of the EEPROM can be configured only at the factory. The checksum for this portion of the EEPROM does not match the contents.	Call Rosemount Customer Central for further assistance.
eepromUserChecks or eepromUserAreaFailure	Part of the EEPROM can be configured by the user, normally using a 275 or RCT. The checksum for this portion of the EEPROM does not match the contents.	Use a 275 or RCT to change some portion of the user EEPROM. (For example, change the message tag, descriptor, or date.) This causes the checksum to be updated. Verify 4-20 mA Settings, null zone configurations, Reference Gauge Height, empty tank detection zone, etc. Cycle power or use a 275 or RCT to reset.
Factory Alg Param Invalid or DSP Warning #26	Configuration Warning	Verify 4-20 mA Settings, null zone configurations, Reference Gauge Height, empty tank detection zone, etc. If error persists, call Rosemount Customer Central.
High Signal Strength or Warning: Signal too strong or DSP Warning #0	Process Condition: Return signal is stronger than expected. The radar gauge is either too close to the product or there is a failure in the gauge. or The radar gauge is in a stilling well.	The product is too close to the gauge, the nozzle is obstructed, or there is a failure in the gauge. If the message persists throughout the measurement range, the beam is unobstructed, and the level measurement is not correct, the gauge has failed. Call Rosemount Customer Central to arrange a return.
Incorrect Alg Lib Vers or DSP Error #25	Internal Software Error	Call Rosemount Customer Central. The unit will most likely need to be sent in for repair.

Table 4-1. Alarm and Diagnostic Messages

Displayed Message	Cause	Action
intTempOutOfRang or Internal PRT out of range	The APEX gauge internal temperature appears to be less than –40 °F (–40 °C) or greater than 185 °F (85 °C).	Take appropriate measures to ensure that the housing remains within the specified temperature limits. See Appendix A: Reference Data.
invalidConfigur	A background task that validates the APEX gauge configuration has found one or more discrepancies. This flag is also set if certain key items (polling address, LCD language, dynamic variable assignments, sample time) must be reset to reasonable values at start-up.	Cycle power or use a 275 or RCT to reset. Verify configuration after Master Reset; verify 4-20 mA settings, null zone configurations, Reference Gauge Height, empty tank detection zone, etc.
Invalid DSP Command or DSP Error #26	Internal Software Error	Call Rosemount Customer Central. The unit will most likely need to be sent in for repair.
INVALID TEST CMD PARAM or DSP Warning #27	Configuration Warning	Verify 4-20 mA settings, null zone configurations, Reference Gauge Height, empty tank detection zone, etc. If error persists, call Rosemount Customer Central.
DSP Error #5	Electronics Failure: Inadequate signal strength returning to gauge.	Cycle power or use a Model 275, AMS, or RCT to reset. If error does not clear, call Rosemount Customer Central for additional troubleshooting. Unit may need repair.
lowTermVoltage	The power supply for the HART communications loop has dropped below 5 V; current will be fixed at 1 mA.	Provide a proper power supply for HART communications (10.5 - 55 vdc).
Low Signal Strength or DSP Warning #1	Inadequate Return Signal	Check nozzle for obstructions/debris that could weaken the signal May occur in applications with occasional foam or in presence of low dielectric and heavy turbulence.
ramFailure	Write/read tests of RAM failed.	Cycle power or use a 275 or RCT to reset.
romChecksum or romChecksumFailure	The checksum for the ROM code does not match the contents.	Cycle power or use a 275 or RCT to reset.
rtdOutOfLimits or RTD out of sensor limits	RTD is missing, wired incorrectly, or returning invalid data.	If no RTD should be present, use a 275 or RCT to disable the RTD. Otherwise, verify that the RTD is wired and working correctly.
softwareError	A stack overflow occurred in the transmitter.	Cycle power or use a 275 or RCT to reset.
Target in null zone or DSP Warning #5	Process Condition: Target has moved into a null zone	Verify that null zones are configured correctly for your tank. (This message will only display for about one minute; the gauge will start to ignore the signal after that). Null zones may need to be adjusted; see page 3-11. After adjustment, Cycle Power or use a Model 275, AMS, or RCT to reset. This will reset the alarm condition.
Target lost or Error: lost signal or DSP Error #7	Configuration or Process Error: APEX cannot find a target in the tank.	Verify that the unit is configured correctly and that the beam has a clear shot to the target.

Table 4-1. Alarm and Diagnostic Messages

Displayed Message	Cause	Action
Empty tank or DSP Warning #7 or Warning: Empty Tank or Empty Tank mode Active	Process Condition: Target has moved into the empty tank detection zone, and the signal has been lost.	Is the tank empty? If so, the gauge is operating correctly; if not, reconfigure the empty tank detection zone (see page 3-6).
User Alg Param invalid or USR ALG PAR OUT OF RNG or DSP Warning #25	Configuration Warning: User entered parameter does not fit within suggested guidelines.	Verify 4–20 mA settings, null zone configurations, Reference Gauge Height, empty tank detection zone, etc. If error persists, call Rosemount Customer Central for further guidance.
VCO Cal Failure #X or DSP Error #16, 17, 22, or 31	Electronics Failure	Note failure number (#), and call Rosemount Customer Central. The unit will most likely need to be sent in for repair.
VCO Calibration Retry or DSP Warning #18	Internal Software Warning: This message will either go away in several seconds to be replaced by another or the unit will fail.	Cycle power; if the message does not disappear within 30 seconds, the unit has failed; call Rosemount Customer Central to arrange for repair.
volumeInputError	The level from which the volume would be computed is beyond the physical dimensions of the tank (one or more of the following): The level is less than zero. For a sphere or horizontal tank, the level is greater than twice the radius. For an upright tank, the level is greater than the height of the tank. If a strapping table is being used, an invalid number of strapping points has been defined (fewer than 2 or more than 10).	If no strapping table is being used, verify that the tank type, height, and width have been entered correctly. If a strapping table is being used, verify the following: Tank type = strapping table. Number of strapping table entries ≥ 2 and ≤ 10). All strapping entries are in ascending order. Any level to be measured is within the range of the strapping table entries.
DSP EEPROM failure or DSP Error #14	Electronics Failure	If error does not clear after power is cycled, call Rosemount Customer Central for further troubleshooting. The gauge may require service in the field.
DSP Error #3 or DSP Error #4	Hardware Failure	Cycle power; if the error does not clear, the gauge will need to be sent in for repair.
VCO Cal Failure #27 or 28 or DSP Error #27 or 28	Electronics Failure	Cycle power; if the message does not clear within three minutes, the gauge will need to be returned or serviced in the field.
VCO Cal Failure #18 or 19 or DSP Error #18 or 19	Electronics Failure	Cycle power; if the error is followed by other errors, follow instructions listed for those errors. If the error does not clear in five minutes, it will need to be returned to the factory for repair.
DSP Error #9 or 10	Electronics Failure	Cycle power; if error does not clear in a few minutes, the gauge will need to be repaired.
DSP Warning #19	Software Error	Cycle power; if error does not clear, call Rosemount Customer Central

Table 4-1. Alarm and Diagnostic Messages

Displayed Message	Cause	Action
DSP Warning #20	Advisory	The error will either clear in a few minutes or be accompanied by another error.
DSP Warning #9	Hardware Warning	This is probably an informational warning. If this message is not accompanied by any other messages, and the gauge seems to be functioning properly, this message can be ignored. If, however, it is accompanied by any other warnings, refer to these warnings.
****If you get an error message that is not listed here, it was not in use at this printing. Call Rosemount Customer Central (1-800-999-9307) for guidance.**		

LOCAL OPERATOR INTERFACE DISPLAY

If the red light is blinking constantly, it could be due to dirt over one of the optical switches. Try to clean the outside of the Local Operator Interface glass to see if the blinking stops.

HART COMMUNICATOR SOFTWARE DIAGNOSTICS

⚠ When using the HART Communicator to communicate with the APEX and APEX Sentry Radar Gauges, you may encounter software diagnostic messages. These messages may indicate problems with the equipment or mistakes made in entering data, while others act as reminders to you.

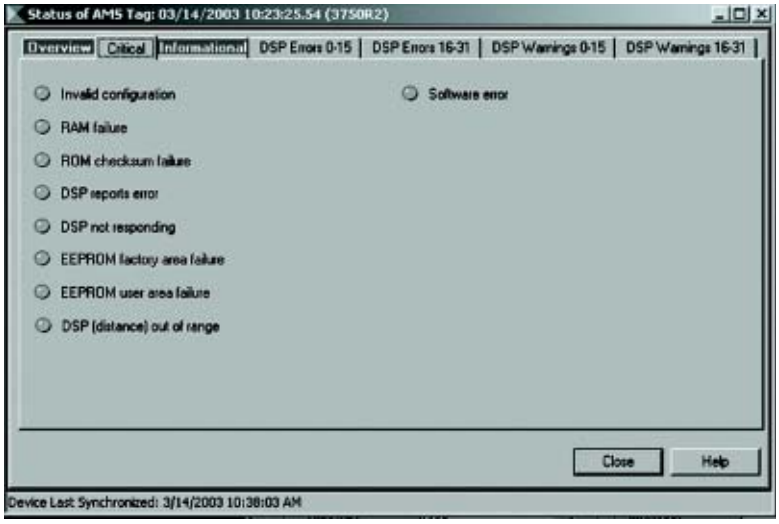
Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Section 3: Configuration describes some of the messages displayed by the HART Communicator, generally explains why they occur, and provides instructions for responding to each message.

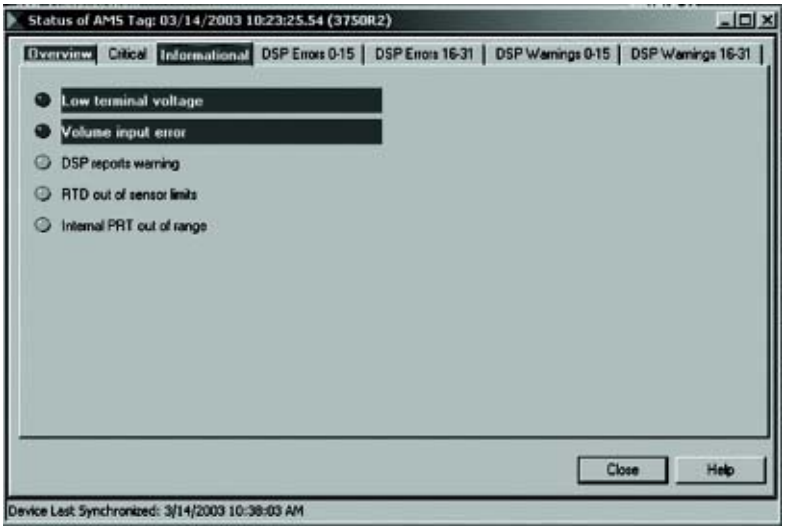
AMS CONFIGURATION SOFTWARE DIAGNOSTICS

⚠ When using AMS to communicate with the APEX and APEX Sentry Radar Gauges, you may encounter software diagnostic messages. These messages may indicate problems with the equipment or mistakes made in entering data, while others act as reminders to you.

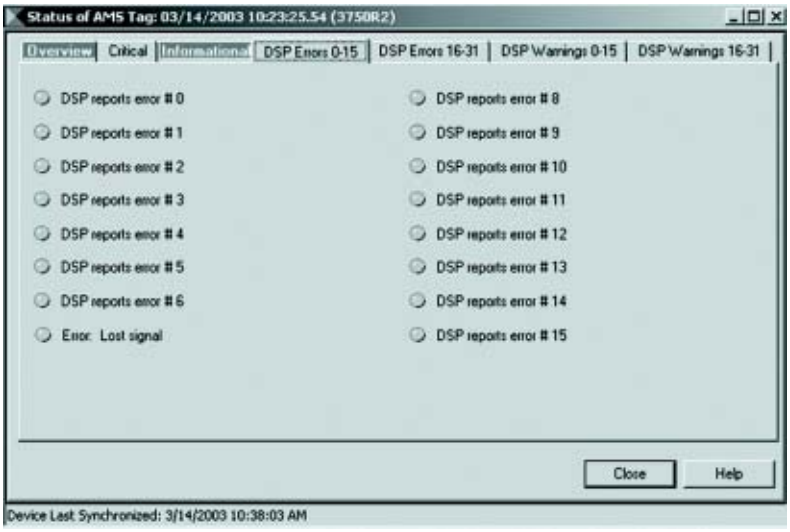
The following shows some of the error messages displayed by the AMS software.



APEX/AMS/APEX_AMS_05A.TIF



APEX/AMS/APEX_AMS_07A.TIF



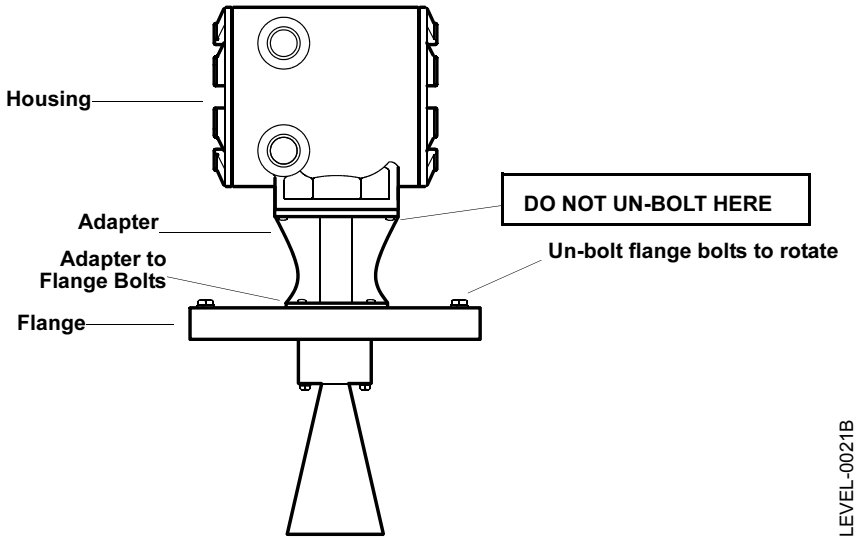
APEX/AMS/APEX_AMS_06A.TIF

REMOVING THE GAUGE HOUSING FROM THE FLANGE

⚠ If rigid conduit is used, first remove the conduit from the gauge. If you have been instructed by a Rosemount representative to remove the gauge housing from the flange, without breaking the process seal, remove the four ¼–28 UNF–2A bolts at the base of the housing adapter (Figure 4-2). Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

NOTE
If the electronics housing needs to be rotated, **do not un-bolt the adapter-to-housing bolts!** Un-bolt the flange bolts and rotate as needed. If the housing is rotated at the housing-to-adapter connection, the gauge will be irreparably damaged, and the warranty will be invalidated. Do not remove or handle the electronic components.

Figure 4-2. Removing the gauge housing from the flange



Appendix A Reference Data

ANTENNA SELECTION GUIDELINES

Selecting an antenna size can be as simple as matching the available process opening to the antenna size. However, when selecting an antenna, consider the following:

- A larger antenna will yield the strongest, most concentrated signal. Fluids with low dielectric constants, such as many hydrocarbons and solvents, only reflect a small portion of the radar signal. A more focused beam that is provided by a larger antenna will yield a stronger signal. This is especially important as the distance to the fluid surface increases.
- Ideally, the beam should not be obstructed by the sides of the vessel or any other equipment in the tank. Consult the beamwidth table to determine the size of the beam at its maximum expected distance (lowest tank level). Since beamwidth decreases as the antenna size increases, the beam from a larger antenna is least likely to encounter obstructions.
- In stilling wells and bypass assemblies, the pipe will prevent dispersion of the beam and will yield a very concentrated signal. In those situations, a smaller antenna is suitable. The use of stilling wells may impact the accuracy.
- In general, 3-in. and 4-in. antennas can be used in nozzles that have an unobstructed total length of up to 1 m (39 in.). It is recommended that 2-in. antennas be used only in nozzles where the total length is less than 0.35 m (14 in.). Consult the factory for assistance with exceptions.

TELECOM RESTRICTIONS

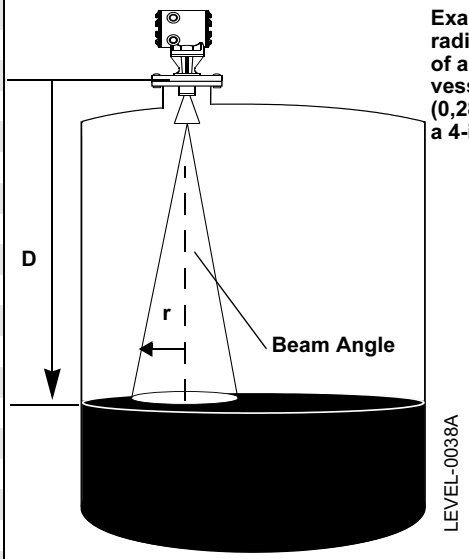
Country	Installation Restrictions	Other Comments
Argentina	Metal tanks	Average field intensity: <500μW/m at 3 meters. Peak field intensity <5000 μW/m at 3 meters
Austria		General approval
Australia	Shielded tanks	24.05-26.05 GHz, 75 nW eirp(1)
Belgium	Metal tanks	
Bolivia	Metal tanks	No license required if installed in metal tank
Brazil	Metal tanks	24.05-26.05 GHz Emission designation 2G00N0N, RF 46mW
Canada	Metal tanks	24.05-26.05 GHz, emission designation 2G00N0N, 46mW
Chad		Nothing required, no approval agency
Chile	Metal tanks	24.05-26.05 GHz Average Field Intensity: <500 μW/m at 3 meters
China		24.05-26.05 GHz, transmitting power <10mW, spurious emissions <-30dBm
Colombia		
Costa Rica	Metal tanks	Transmitting power <10mW
Croatia		Standard EN55022
Czech Republic	Metal tanks	
Denmark	Metal tanks	EN55022
Ecuador		
Egypt		
Eire/Ireland	Metal tanks	
Finland	Metal tanks	
France		
Germany	Metal tanks	
Hong Kong		
Hungary	Metal tanks	
India		24.05-26.05 GHz, 2G00N0N, <10mW
Indonesia		
Italy	Metal tanks	Electromagnetically screened environment
Jamaica	Metal tanks	Average field intensity: <500 μW/m at 3 meters. Followed FCC
Japan		
Jordan		Nothing required, no approval agency
Korea		
Kuwait	Metal tanks	
Malaysia	“In-house” and “in-building” installation required	May only be used on a non-interference radio basis, broadcasting <50mW
Mexico		
Netherlands	Metal tanks	Manual must state that use is restricted to closed or vented metal tanks
New Zealand	Metal or radio frequency shielded tanks	<75nW eirp (1)
Nicaragua	Metal tanks	
Norway	Metal tanks	24.04-26.05 GHz
Oman		Letter of no objection - “each application for use will have to be studied and if allowed earn our approval and permission to import”
Peru		
Philippines		
Poland	Metal tanks	Sit approval required for installations other than in metal tanks
Portugal	Metal tanks	24.05-26.05 GHz, 2.7 W eirp (1), 2G00N0N
Puerto Rico		
Romania		
Russia		
Saudi Arabia		No government approval needed
Singapore	Metal tanks	24.05-26.05 GHz, average field strength <500 μW/m at 3 meters, FMCW

Country	Installation Restrictions	Other Comments
South Africa	Metal tanks	<-111 dBm at a distance of 25 meters Site license required
Spain	Metal tanks	<10mW of power transmitted
Sweden	Metal tanks	
Switzerland		
Taiwan	Metal tanks	24-26 GHz
Thailand		
Trinidad & Tobago	Metal tanks	24.05-26.05 GHz, Average field strength <500 μW/m at 3 meters Peak field strength limited to 5000 μW/m at 3 meters 0.075 eirp (1)
Turkey	Metal tanks	"provided...equipment does not transmit any RF from the tank to outside and is not open to the interferences coming from out, there is not any prohibition in its use"
United Arab Emirates		No government approval required
United Kingdom	Metal tanks	2.7W eirp (1), 24.15-26.05 GHz, -20 to 55°C
United States	Metal or concrete tanks	
Venezuela	Metal tanks	500 μW/m at 3 meters 5000 μW/m at 3 meters

(1) Eirp = Equivalent Isotropically Radiated Power

TABLE 1. Beamwidth vs. Distance from Gauge

Distance (D) from Gauge	Radius (r) from Flange Centerline to Beamwidth Edge		
	2-in. Antenna	3-in. Antenna	4-in. Antenna
ft (m)	ft (m)	ft (m)	ft (m)
2 (0,6)	0.4 (0,12)	0.2 (0,07)	0.2 (0,06)
4 (1,2)	0.8 (0,25)	0.5 (0,15)	0.4 (0,11)
6 (1,8)	1.2 (0,37)	0.7 (0,22)	0.6 (0,17)
8 (2,4)	1.6 (0,49)	1.0 (0,29)	0.7 (0,22)
10 (3,0)	2.0 (0,62)	1.2 (0,37)	0.9 (0,28)
15 (4,6)	3.0 (0,93)	1.8 (0,55)	1.4 (0,42)
20 (6,1)	4.1 (1,23)	2.4 (0,73)	1.8 (0,56)
25 (7,6)	5.1 (1,54)	3.0 (0,92)	2.3 (0,70)
30 (9,1)	6.1 (1,85)	3.6 (1,10)	2.8 (0,84)
35 (10,7)	7.1 (2,16)	4.2 (1,28)	3.2 (0,98)
40 (12,2)	8.1 (2,47)	4.8 (1,46)	3.7 (1,12)
45 (13,7)	9.1 (2,78)	5.4 (1,65)	4.1 (1,26)
50 (15,2)	10.1 (3,09)	6.0 (1,83)	4.6 (1,40)
55 (16,8)	11.1 (3,40)	6.6 (2,01)	5.1 (1,54)
60 (18,3)	12.2 (3,70)	7.2 (2,20)	5.5 (1,68)
65 (19,8)	13.2 (4,01)	7.8 (2,38)	6.0 (1,82)
70 (21,3)	14.2 (4,32)	8.4 (2,56)	6.4 (1,96)
75 (22,9)	15.2 (4,63)	9.0 (2,75)	6.9 (2,10)
80 (24,4)	16.2 (4,94)	9.6 (2,93)	7.4 (2,24)
85 (25,9)	17.2 (5,25)	10.2 (3,11)	7.8 (2,38)
90 (27,4)	18.2 (5,56)	10.8 (3,30)	8.3 (2,52)
95 (29,0)	19.2 (5,86)	11.4 (3,48)	8.7 (2,66)
100 (30,5)	20.3 (6,17)	12.0 (3,66)	9.2 (2,80)



Example: The beam radius (r) at the bottom of a 10-foot (3,05 m) (D) vessel would be 0.9 ft (0,28 m) for a 4-inch antenna.

Antenna Size	Beam Angle
2-in.	22.9°
3-in.	13.7°
4-in.	10.5°

NOTE
Radar gauges should not be mounted in the top center of the tank. Off centered mounting is preferred.

EQUIPMENT DESCRIPTION

APEX and APEX Sentry

- Microprocessor-based radar level gauge with analog output, superimposed with a digital HART signal
- Small, lightweight, noncontacting design that allows for installation on the top of most pressurized or nonpressurized tanks
- Use Frequency Modulated Continuous Wave (FMCW) radar signaling technology at 24 GHz frequency

APEX Only

Measures the level of liquids, slurries, or sludges that may have a variety of severe process conditions

APEX Sentry only

Measures the level of liquids, slurries, or sludges under less severe conditions

PERFORMANCE SPECIFICATIONS

APEX and APEX Sentry

- Gauge meets the following minimum performance criteria, which are stated at Reference Conditions: free-space reflection from flat metal surface, ambient temperature 77 °F (25 °C), and atmospheric pressure conditions. The use of stilling wells may impact the accuracy.

APEX Only

- Accuracy: 1/8 in. (3mm) for distances from 1.6 to 32.8 ft (0,5 to 10 m) or ±0.03% of measured distance from 32.8 to 98.4 ft (10 to 30 m)
- Measuring range: within accuracy specifications 1.6 to 98.4 ft (0,5 to 30 m) measured from the flange face
- Repeatability: ±0.04 in. (1 mm)
- Resolution: ±0.02 in. (0,4 mm)
- Update Time: once every second

APEX Sentry Only

- Accuracy: ±0.4 in. (10 mm) for distances from 1.6 to 32.8 ft (0,5 to 10 m) or ±0.1% of measured distance from 32.8 to 65.6 ft (10 to 20 m)
- Measuring range: within accuracy specifications 1.6 to 65.6 ft (0,5 to 20 m) measured from the flange face
- Repeatability: ±0.1 in. (3 mm)
- Resolution: 0.04 in. (1 mm)
- Update Time: once every 3 seconds

ENVIRONMENTAL CONDITIONS

APEX and APEX Sentry

- Humidity: 5 to 100% relative humidity (with covers on and tightened to achieve metal-to-metal contact)
- Electronics/Housing temperature ranges:
  Standard: –40 to 158 °F (–40 to 70 °C)
  With Integral Display: –4 to 131 °F (–20 to 55 °C)
- Enclosure rating: NEMA 4X, CSA Type 4X, IP 66
- Because the frequency of the gauges is within a communication bandwidth, they must comply with telecommunication requirements. To meet most of these requirements, the APEX and APEX Sentry Radar Gauges must be installed on enclosed or vented metal tanks. However, other tank types may be approved in country of final destination. Refer to “Telecom Restrictions” on page A-2 for detailed information.

Process Conditions

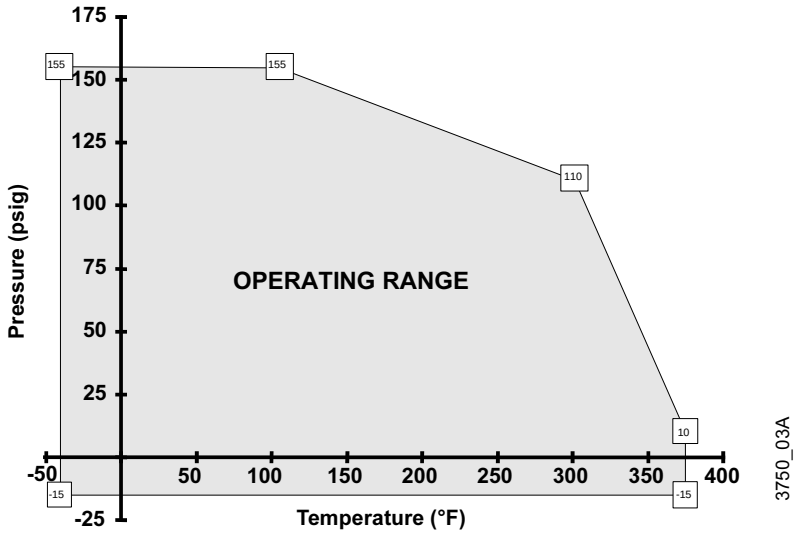
APEX and APEX Sentry

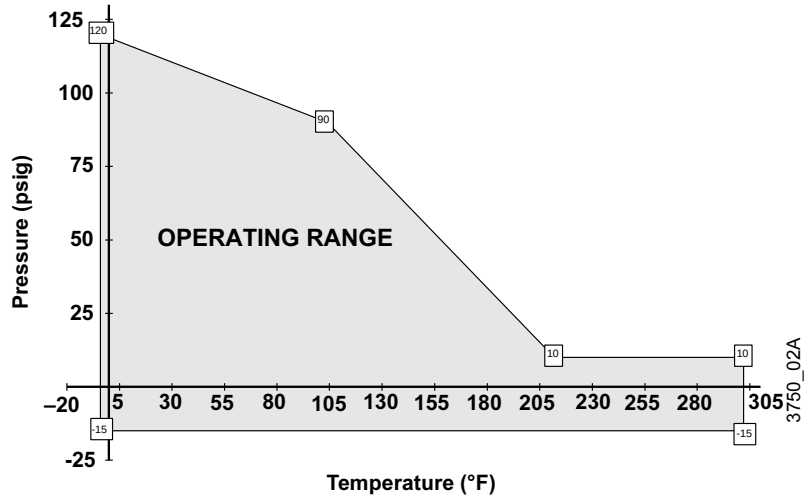
- Suitable for liquids, slurries, or sludges
- Nozzle Temperature Range: –40 to 374 °F (–40 to 190 °C) See chart on next page
- Process Pressure Range: full vacuum to 155 psi (10,69 bar) See chart on next page.

ELECTRICAL SPECIFICATIONS

APEX and APEX Sentry

- Gauge entry is ¾–14 NPT female conduit fittings
- Gauge is factory sealed; conduit seal not required to meet FM explosion-proof requirements
- Terminal block provides connections for AC or DC power (specified at time of order) and grounding
- Transient protection: APEX and APEX Sentry Radar Gauges comply with IEC standard 61000 4-5
- Connections for secondary inputs and loop testing available on APEX only

Temperature and Pressure Operating Range		
Nozzle Temperature	**Maximum Pressure**	**Pressure vs. Temperature**
–40°F to 104°F (–40°C to 40°C)	Full vacuum to 155 psig (full vacuum to 10,69 bar)	
302°F (150°C)	Full vacuum to 110 psig (full vacuum to 7,59 bar)	
374°F (190°C)	Full vacuum to 10 psig (full vacuum to 0,69 bar)	

PTFE Window Temperature and Pressure Operating Range		
Nozzle Temperature	**Maximum Pressure**	**Pressure vs. Temperature**
–4°F (–20°C)	Full vacuum to 120 psig (full vacuum to 8,2 bar)	
104°F (40°C)	Full vacuum to 90 psig (full vacuum to 6,2 bar)	
212 to 302°F (100 to 150°C)	Full vacuum to 10 psig (full vacuum to 0,69 bar)	

Power Supply

APEX and APEX Sentry

- 90 to 250 V ac ±10%, 50/60 Hz
  or
- 18 to 36 V dc

Power Consumption

- < 8 watts

Input

APEX only (Non-intrinsically safe output)

- Accepts one RTD signal (optional), as defined in the following table:

Input	Range	Accuracy
Pt 100 3- or 4-wire RTD	–40 to 400 °F (–40 to 204 °C)	±1.8°F (±1 °C)

APEX Sentry (and APEX with intrinsically safe output option code 2)

- No RTD input available

Output

APEX and APEX Sentry

- 4-20 mA analog signal (10.5 to 55.0 V dc powered), superimposed with a digital HART signal
- APEX output can be configured to provide level, volume, or standard volume
- Default analog saturation settings: minimum is 3.9 mA; maximum is 20.8 mA
- Available with optional intrinsically safe 4–20 mA output for use with galvanically isolated barriers

CALIBRATION

APEX and APEX Sentry

- Continuous frequency self-calibration ensures stated level accuracy

SOFTWARE FUNCTIONALITY

APEX and APEX Sentry

- Gauges are capable of digital communication over the 4–20 mA output loop without disruption using the HART Communications Protocol.
- All configuration data and programs are retained in non-volatile memory. Upon power interruption, all data is available when power is restored.

WEIGHT

APEX and APEX Sentry

- Less than 19 lb (9 kg) with an ASME B.16 (ANSI) 2-in. Class 150 (DN 50, PN 16) flange
- Less than 23 lb (10 kg) with an ASME B.16 (ANSI) 3-in. Class 150 (DN 80, PN 16) flange
- Less than 30 lb (14 kg) with an ASME B.16 (ANSI) 4-in. Class 150 (DN 100, PN 16) flange

MATERIALS OF CONSTRUCTION

APEX and APEX Sentry

- Electronics housing: aluminum alloy
- Finish: polyester-epoxy paint
- Antenna/flange assembly: 316L stainless steel
- Waveguide process barrier: alumina, PTFE

Mounting

Standard	Size	Rating
ASME B.16 (ANSI)	2-in., 3-in., 4-in., 6-in.	Class 150, 300
DIN	DN 50, 80, 100, 150	PN 16, 40

Size

See Table 2 below

Options

APEX and APEX Sentry

- Model 751 Field Signal Indicator
- HART Communicator
- Isolation Windows
- Guaranteed start-up at -50 °C
- NAMUR-specified analog alarm limits
- Material Traceability Certifications available
- Calibration Certification

APEX only

- Digital integral display and operator interface
- RTD temperature sensor, assemblies, and accessories
- The APEX can also be used in conjunction with a Model 3201 HIU as part of a hybrid system

APEX Sentry only

- Digital integral display

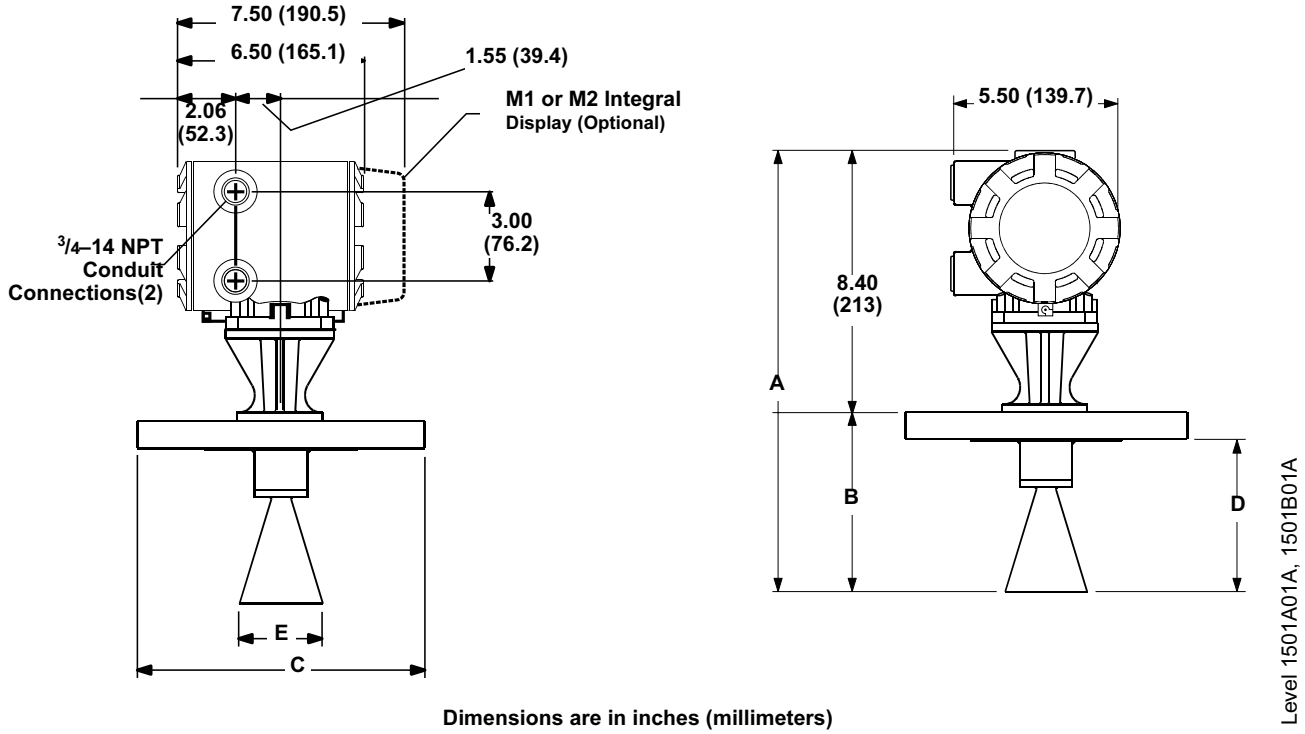
TABLE 2. Size

	Antenna	Flange Size	Flange Rating	Dimensions		
				Height	Width	Depth
Example 1(1)	2 in.	2 in.	ASME B16.5 (ANSI) Class 150	14 in (356 mm)	8 in (203 mm)	8 in (203 mm)
Example 2(1)	3 in.	3 in.	ASME B16.5 (ANSI) Class 150	16.5 in (419 mm)	8 in (203 mm)	8 in (203 mm)
Example 3(1)	4 in.	4 in.	ASME B16.5 (ANSI) Class 150	18.5 in (470 mm)	9 in (229 mm)	9 in (229 mm)

(1) Other flange sizes and ratings available. Dimensions vary. Refer to Product Data Sheet (Rosemount Document Number 00813-0100-4731)

DIMENSIONAL DRAWINGS

Figure A-1. APEX Dimensional Drawings



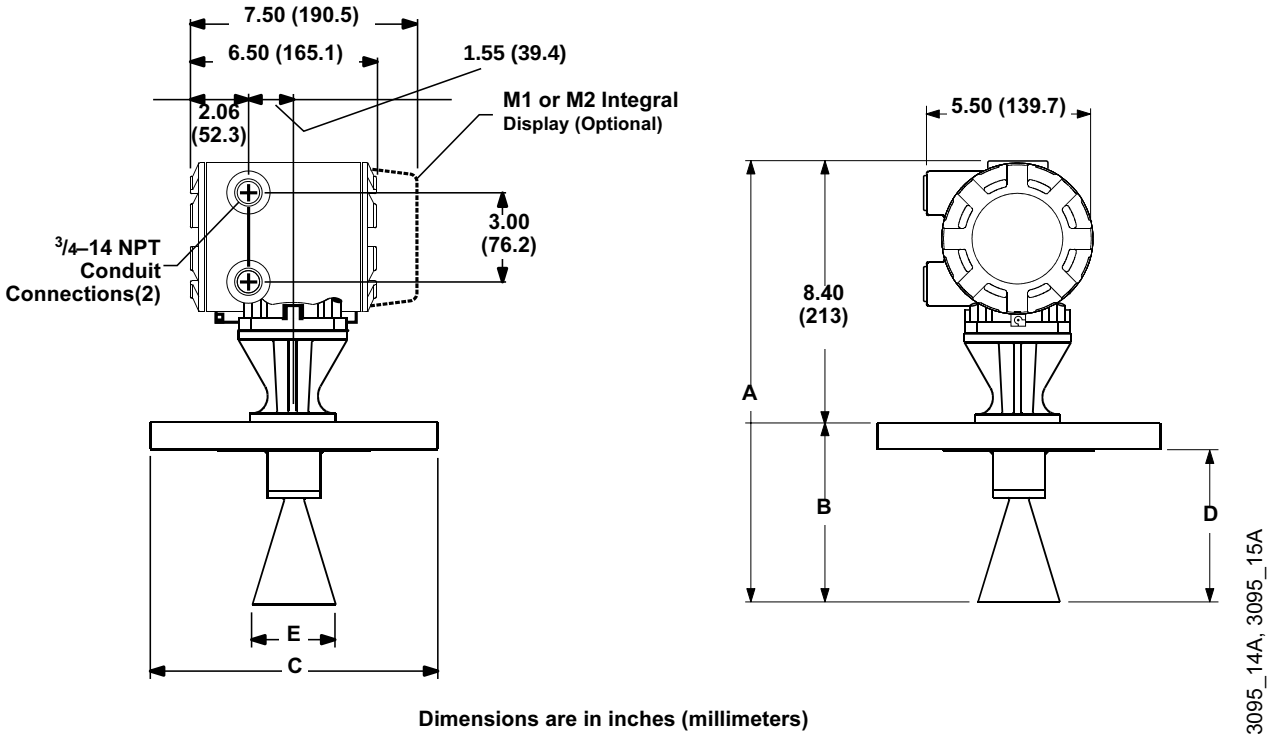
Dimensions are in inches (millimeters)

TABLE 3. Dimensions. (Table 1 of 3)

		Dimensions are in inches (millimeters)				
Flange Size	**Antenna Size**	**A**	**B**	**C**	**D**	**E**
2-inch ASME B.16 (ANSI) Class 150	2-inch	13.75 (349)	5.35 (136)	6.00 (152)	4.66 (118)	1.75 (44)
2-inch ASME B.16 (ANSI) Class 300	2-inch	13.75 (349)	5.35 (136)	6.50 (165)	4.53 (115)	1.75 (44)
3-inch ASME B.16 (ANSI) Class 150	2-inch	13.75 (349)	5.35 (136)	7.50 (191)	4.47 (114)	1.75 (44)
3-inch ASME B.16 (ANSI) Class 300	2-inch	13.75 (349)	5.35 (136)	8.25 (210)	4.29 (109)	1.75 (44)
3-inch ASME B.16 (ANSI) Class 150	3-inch (original)*	14.35 (364)	5.96 (151)	7.50 (191)	5.08 (129)	2.71 (69)
3-inch ASME B.16 (ANSI) Class 300	3-inch (original)*	14.35 (364)	5.96 (151)	8.25 (210)	4.90 (124)	2.71 (69)
3-inch ASME B.16 (ANSI) Class 150	3-inch (new)*	16.38 (416)	7.98 (203)	7.50 (191)	7.10 (180)	2.69 (68)
3-inch ASME B.16 (ANSI) Class 300	3-inch (new)*	16.38 (416)	7.98 (203)	8.25 (210)	6.92 (176)	2.69 (68)
4-inch ASME B.16 (ANSI) Class 150	2-inch	13.75 (349)	5.35 (136)	9.00 (229)	4.47 (114)	1.75 (44)
4-inch ASME B.16 (ANSI) Class 300	2-inch	13.75 (349)	5.35 (136)	10.00 (254)	4.16 (106)	1.75 (44)
4-inch ASME B.16 (ANSI) Class 150	3-inch (original)*	14.35 (364)	5.96 (151)	9.00 (229)	5.08 (129)	2.71 (69)
4-inch ASME B.16 (ANSI) Class 300	3-inch (original)*	14.35 (364)	5.96 (151)	10.00 (254)	4.77 (121)	2.71 (69)
4-inch ASME B.16 (ANSI) Class 150	3-inch (new)*	16.38 (416)	7.98 (203)	9.00 (229)	7.10 (180)	2.69 (68)
4-inch ASME B.16 (ANSI) Class 300	3-inch (new)*	16.38 (416)	7.98 (203)	10.00 (254)	6.79 (172)	2.69 (68)
4-inch ASME B.16 (ANSI) Class 150	4-inch	18.37 (467)	9.97 (253)	9.00 (229)	9.09 (231)	3.50 (89)
4-inch ASME B.16 (ANSI) Class 300	4-inch	18.37 (467)	9.97 (253)	10.00 (254)	8.78 (223)	3.50 (89)

* Gauges with 3-inch antennas and serial number 3925 or higher have the 3-inch antenna length labelled “new.”

Figure A-2. APEX Dimensional Drawings (Repeated Drawing)



Dimensions are in inches (millimeters)

TABLE 4. Dimensions (Table 2 of 3)

Flange Size	Antenna Size	Dimensions in inches (millimeters)				
		A	B	C	D	E
6-inch ASME B.16 (ANSI) Class 150	2-inch	13.75 (349)	5.35 (136)	11.00 (279)	4.41 (112)	1.75 (44)
6-inch ASME B.16 (ANSI) Class 300	2-inch	13.75 (349)	5.35 (136)	12.50 (318)	3.97 (101)	1.75 (44)
6-inch ASME B.16 (ANSI) Class 150	3-inch (original)*	14.35 (364)	5.96 (151)	11.00 (279)	5.02 128)	2.71 (69)
6-inch ASME B.16 (ANSI) Class 300	3-inch (original)*	14.35 (364)	5.96 (151)	12.50 (318)	4.58 (116)	2.71 (69)
6-inch ASME B.16 (ANSI) Class 150	3-inch (new)*	16.38 (416)	7.98 (203)	11.00 (279)	7.04 (179)	2.69 (68)
6-inch ASME B.16 (ANSI) Class 300	3-inch (new)*	16.38 (416)	7.98 (203)	12.50 (318)	6.60 (168)	2.69 (68)
6-inch ASME B.16 (ANSI) Class 150	4-inch	18.37 (467)	9.97 (253)	11.00 (279)	9.03 (229)	3.50 (89)
6-inch ASME B.16 (ANSI) Class 300	4-inch	18.37 (467)	9.97 (253)	12.50 (318)	8.59 (218)	3.50 (89)
DN 50, PN 40	2-inch	13.75 (349)	5.35 (136)	6.50 (165)	4.68 (119)	1.75 (44)
DN 80, PN 16	2-inch	13.75 (349)	5.35 (136)	7.87 (200)	4.68 (119)	1.75 (44)
DN 80, PN 40	2-inch	13.75 (349)	5.35 (136)	7.87 (200)	4.53 (115)	1.75 (44)
DN 80, PN 16	3-inch (original)*	14.35 (364)	5.96 (151)	7.87 (200)	5.29 (134)	2.71 (69)
DN 80, PN 40	3-inch (original)*	14.35 (364)	5.96 (151)	7.87 (200)	5.14 (131)	2.71 (69)
DN 80, PN 16	3-inch (new)*	16.38 (416)	7.98 (203)	7.87 (200)	7.31 (186)	2.69 (68)
DN 80, PN 40	3-inch (new)*	16.38 (416)	7.98 (203)	7.87 (200)	7.16 (182)	2.69 (68)

* Gauges with 3-inch antennas and serial number 3925 or higher have the 3-inch antenna length labelled “new.”

Figure A-3. APEX Dimensional Drawings (Repeated Drawing)

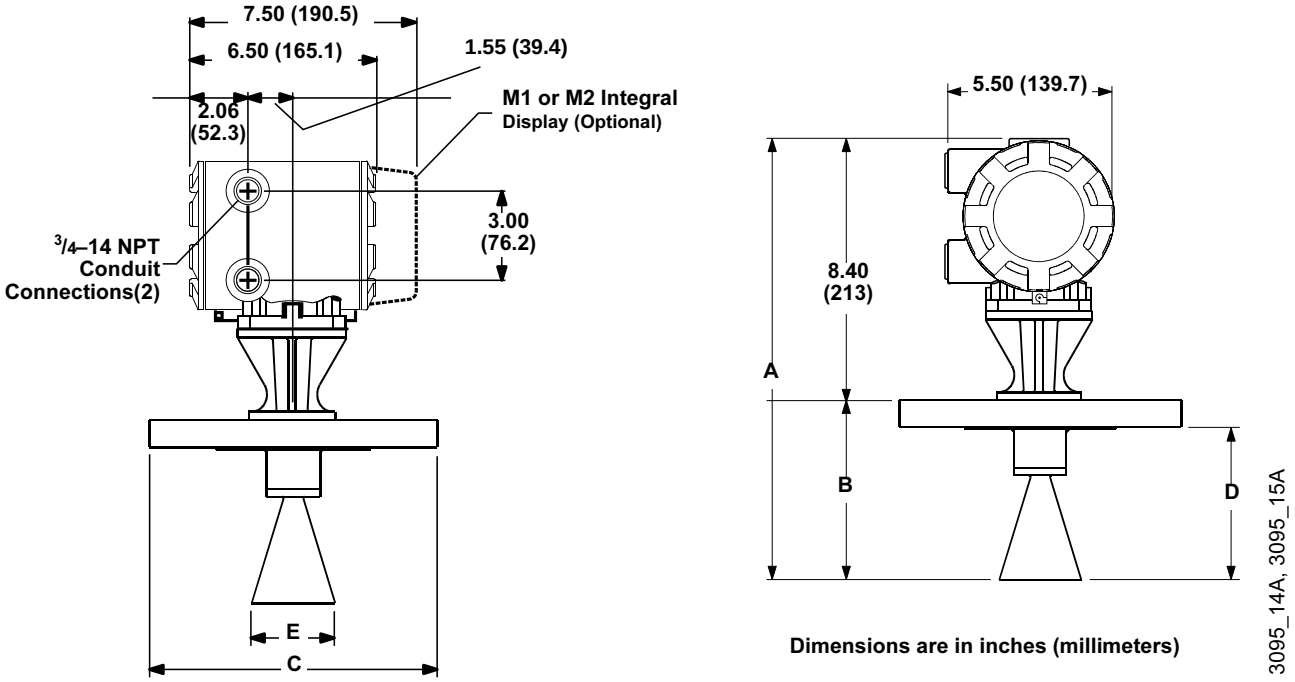


TABLE 5. Dimensions (Table 3 of 3)

		Dimensions in inches (millimeters)				
Flange Size	**Antenna Size**	**A**	**B**	**C**	**D**	**E**
DN 100, PN 40	2-inch	13.75 (349)	5.35 (136)	9.25 (235)	4.53 (115)	1.75 (44)
DN 100, PN 16	3-inch (original)*	14.35 (364)	5.96 (151)	8.66 (220)	5.29 (134)	2.71 (69)
DN 100, PN 40	3-inch (original)*	14.35 (364)	5.96 (151)	9.25 (235)	5.14 (131)	2.71 (69)
DN 100, PN 16	3-inch (new)*	16.38 (416)	7.98 (203)	8.66 (220)	7.31 (186)	2.69 (68)
DN 100, PN 40	3-inch (new)*	16.38 (416)	7.98 (203)	9.25 (235)	7.16 (182)	2.69 (68)
DN 100, PN 16	4-inch	18.37 (467)	9.97 (253)	8.66 (220)	9.30 (236)	3.50 (89)
DN 100, PN 40	4-inch	18.37 (467)	9.97 (253)	9.25 (235)	9.15 (232)	3.50 (89)
DN 150 PN 16	2-inch	13.75 (349)	5.35 (136)	11.22 (285)	4.60 (117)	1.75 (44)
DN 150 PN 40	2-inch	13.75 (349)	5.35 (136)	11.81 (300)	4.37 (111)	1.75 (44)
DN 150 PN 16	3-inch (original)*	14.35 (364)	5.96 (151)	11.22 (285)	5.21 (132)	2.71 (69)
DN 150 PN 40	3-inch (original)*	14.35 (364)	5.96 (151)	11.81 (300)	4.98 (126)	2.71 (69)
DN 150 PN 16	3-inch (new)*	16.38 (416)	7.98 (203)	11.22 (285)	7.23 (184)	2.69 (68)
DN 150 PN 40	3-inch (new)*	16.38 (416)	7.98 (203)	11.81 (300)	7.00 (178)	2.69 (68)
DN 150 PN 16	4-inch	18.37 (467)	9.97 (253)	11.22 (285)	9.22 (234)	3.50 (89)
DN 150 PN 40	4-inch	18.37 (467)	9.97 (253)	11.81 (300)	8.99 (228)	3.50 (89)

* Gauges with 3-inch antennas and serial number 3925 or higher have the 3-inch antenna length labelled “new.”

ORDERING INFORMATION

Model	Product Description	Availability
APEX	Radar Level Gauge for Tough Process Conditions	●
SENTRY	Radar Level Gauge for Less Severe Process Conditions	●
Code	**Software**	
B	Standard	●
Code	**Frequency Sweep**	
C	24 – 26 GHz	●
Code	**Outputs**	
1	4–20 mA with digital signal based on *HART*® protocol	●
2	Intrinsically Safe 4–20 mA with digital signal based on *HART* protocol (Intrinsically safe output available only with hazardous location approval, Option Codes E5, E6, or ED For hazardous locations drawings and examples of labels, see Appendix C in the reference manual (document number 00809-0100-4731). Also, the RTD connection is not available with IS Output. Must be used with Galvanically Isolated Barriers.	●
Code	**Power Supply**	
A	90 – 250 V ac	●
D	18 – 36 V dc	●
Code	**Conduit Threads**	
1	¾–14 NPT	●
2	CM20 conduit adapter	●
3	PG 13.5 conduit adapter	●
Code	**Materials of Construction: Flange/Antenna**	
S	316L stainless steel	●
Code	**Antenna Type**	
C	Cone	●
Code	**Antenna Size**	
2N	Fits 2-inch opening	●
3N	Fits 3-inch opening	●
4N	Fits 4-inch opening	●
Code	**Mounting Flange Size**	
02	2-inch ASME B 16.5 (ANSI) (DN 50) (Not available with mounting flange rating option code D2)	●
03	3-inch ASME B 16.5 (ANSI) (DN 80)	●
04	4-inch ASME B 16.5 (ANSI) (DN 100)	●
06	6-inch ASME B 16.5 (ANSI) (DN 150)	●
Code	**Mounting Flange Rating**	
A1	ASME B 16.5 (ANSI) class 150	●
A3	ASME B 16.5 (ANSI) class 300	●
D2	DIN PN 16	●
D4	DIN PN 40	●

Code	Final Destination of Product	Availability
	North America	
01	United States	●
02	Canada	●
	Europe/Middle East/Africa	
03	Spain	●
04	Germany	●
05	The Netherlands	●
06	Sweden	●
07	Finland	●
08	Poland	●
09	Czech Republic	●
10	Oman	●
11	Kuwait	●
12	Eire	●
13	South Africa	●
14	Norway	●
15	United Kingdom	●
16	Croatia	●
17	Belgium	●
18	Romania	●
19	Hungary	●
20	Portugal	●
21	Turkey	●
22	Italy	●
23	Austria	●
24	Russia	●
25	Saudi Arabia	●
26	Denmark	●
27	France	●
28	Egypt	●
29	Chad	●
30	United Arab Emirates	●
31	Jordan	●
32	Qatar	●

Code	Final Destination of Product	Availability
	Asia-Pacific	●
40	Singapore	●
41	China	●
42	India	●
43	Malaysia	●
44	South Korea	●
45	Indonesia	●
46	Taiwan	●
47	Thailand	●
48	Australia	●
49	New Zealand	●
50	Philippines	●
	Latin America	●
76	Argentina	●
77	Puerto Rico	●
78	Jamaica	●
79	Venezuela	●
80	Mexico	●
81	Chile	●
82	Brazil	●
83	Trinidad and Tobago	●
84	Bolivia	●
85	Colombia	●
86	Ecuador	●
87	Costa Rica	●
88	Nicaragua	●
89	Peru	●

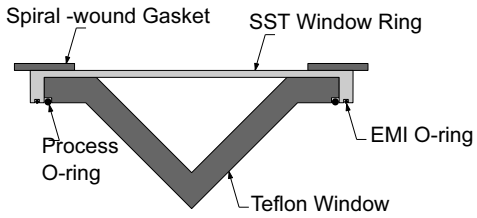
Code	Options	APEX Radar Gauge	APEX Sentry Radar Gauge
C1[1]	Factory configuration data sheet	●	●
M1	Integral display and operator interface	●	—
M2	Integral display only	—	●
E5[2]	Factory Mutual (FM) explosion proof approval	●	●
E6[2]	Canadian Standards Association (CSA) explosion proof approval	●	●
ED[2]	CENELEC (KEMA) flameproof approval	●	●
R0002	Guaranteed start-up at -50 °C	●	●
R0003	Bar code tag with tag number and purchase order number	●	●
Q4	Calibration Certificate	●	●
Q8	Material Traceability Certification per EN 10204 3.1.B (option valid for all pressure retaining parts of APEX or APEX Sentry waveguide assembly.)	●	●
C4[3]	Analog output levels compliant with NAMUR Recommendation NE43, 27-June-1996	●	●
CN[3]	Analog output levels compliant with NAMUR Recommendation NE43, 27-June-1996: alarm configuration–Low	●	●

Example Model Numbers: **APEX B C 1 A 1 S C 4N 04 A1 01 C1 M1 E5**
SENTRY B C 2 A 1 S C 3N 03 A1 04 M2 ED

(1) The Configuration Data Sheet (CDS), is included at the end of this document and is also available electronically at www.rosemount.com
(2) Option code required when ordering I.S. output Code 2
(3) NAMUR–Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field

Isolation Window Kits
(All window kits include PTFE window, process o–ring, non-wetted stainless steel ring, non-wetted EMI o–ring, and 2 spiral wound gaskets).

Cross-Section of Process Window



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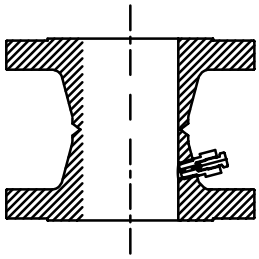
Part Number	Process O-Ring Material	Fits Flange Size	Availability
03700-0620-1100	Viton®	2-in./DN 50	●
03700-0620-1200	Buna-N	2-in./DN 50	●
03700-0620-1300	Ethylene Propylene	2-in./DN 50	●
03700-0620-1400	Fluorosilicone	2-in./DN 50	●
03700-0620-1500	Kalrez-4079®	2-in./DN 50	●
03700-0620-1550	Kalrez-6375®	2-in./DN 50	●
03700-0630-1100	Viton	3-in./DN 80	●
03700-0630-1200	Buna-N	3-in./DN 80	●
03700-0630-1300	Ethylene Propylene	3-in./ DN 80	●
03700-0630-1400	Fluorosilicone	3-in./DN 80	●
03700-0630-1500	Kalrez-4079	3-in./DN 80	●
03700-0630-1550	Kalrez-6375	3-in./DN 80	●
03700-0640-1100	Viton	4-in.	●
03700-0640-1200	Buna-N	4-in.	●
03700-0640-1300	Ethylene Propylene	4-in.	●
03700-0640-1400	Fluorosilicone	4-in.	●
03700-0640-1500	Kalrez-4079	4-in.	●
03700-0640-1550	Kalrez-6375	4-in.	●
03700-0640-1101	Viton	DN 100	●
03700-0640-1201	Buna-N	DN 100	●
03700-0640-1301	Ethylene Propylene	DN 100	●
03700-0640-1401	Fluorosilicone	DN 100	●
03700-0640-1501	Kalrez-4079	DN 100	●
03700-0640-1551	Kalrez-6375	DN 100	●

Spool Pieces
(includes spool piece only)



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Part Number	Material	Fits Flange Size	Flange Rating	Availability
03700-0263-0212	304 SST	2-in.	ASME B 16.5 (ANSI) Class 150	●
03700-0263-0213	CS Painted	2-in.	ASME B 16.5 (ANSI) Class 150	●
03700-0263-0232	304 SST	2-in.	ASME B 16.5 (ANSI) Class 300	●

Continued on Next Page

Part Number	Material	Fits Flange Size	Flange Rating	Availability
03700-0263-0233	CS Painted	2-in.	ASME B 16.5 (ANSI) Class 300	●
03700-0263-0352	304 SST	3-in.	ASME B 16.5 (ANSI) Class 150	●
03700-0263-0353	CS Painted	3-in.	ASME B 16.5 (ANSI) Class 150	●
03700-0263-0372	304 SST	3-in.	ASME B 16.5 (ANSI) Class 300	●
03700-0263-0373	CS Painted	3-in.	ASME B 16.5 (ANSI) Class 300	●
03700-0263-0412	304 SST	4-in.	ASME B 16.5 (ANSI) Class 150	●
03700-0263-0413	CS Painted	4-in.	ASME B 16.5 (ANSI) Class 150	●
03700-0263-0432	304 SST	4-in.	ASME B 16.5 (ANSI) Class 300	●
03700-0263-0433	CS Painted	4-in.	ASME B 16.5 (ANSI) Class 300	●
03700-0263-0542	304 SST	DIN DN 50	DIN PN 40	●
03700-0263-0543	CS Painted	DIN DN 50	DIN PN 40	●
03700-0263-0862	304 SST	DIN DN 80	DIN PN 16	●
03700-0263-0863	CS Painted	DIN DN 80	DIN PN 16	●
03700-0263-0882	304 SST	DIN DN 80	DIN PN 40	●
03700-0263-0883	CS Painted	DIN DN 80	DIN PN 40	●
03700-0263-1022	304 SST	DIN DN 100	DIN PN 16	●
03700-0263-1023	CS Painted	DIN DN 100	DIN PN 16	●
03700-0263-1042	304 SST	DIN DN 100	DIN PN 40	●
03700-0263-1043	CS Painted	DIN DN 100	DIN PN 40	●

Bolt Kits
(Each bolt kit includes two sets of bolts, nuts, and washers. One set connects the radar gauge to the top of the spool piece; the other connects the bottom of the spool piece to the process flange with window kit installed).

Part Number	Material	Fits Flange Size	Flange Rating	
03700-0610-0009	CS (per ASTM A193, A194)	2-in.	ASME B 16.5 (ANSI) Class 150	●
03700-0610-0010	CS (per ASTM A193, A194)	2-in.	ASME B 16.5 (ANSI) Class 300	●
03700-0610-0011	SST (per ASTM F593)	2-in.	ASME B 16.5 (ANSI) Class 150	●
03700-0610-0012	SST (per ASTM F593)	2-in.	ASME B 16.5 (ANSI) Class 300	●
03700-0610-0001	CS (per ASTM A193, A194)	3-in.	ASME B 16.5 (ANSI) Class 150	●
03700-0610-0002	CS (per ASTM A193, A194)	3-in.	ASME B 16.5 (ANSI) Class 300	●
03700-0610-0005	SST (per ASTM F593)	3-in.	ASME B 16.5 (ANSI) Class 150	●
03700-0610-0006	SST (per ASTM F593)	3-in.	ASME B 16.5 (ANSI) Class 300	●
03700-0610-0003	CS (per ASTM A193, A194)	4-in.	ASME B 16.5 (ANSI) Class 150	●
03700-0610-0004	CS (per ASTM A193, A194)	4-in.	ASME B 16.5 (ANSI) Class 300	●
03700-0610-0007	SST (per ASTM F593)	4-in.	ASME B 16.5 (ANSI) Class 150	●
03700-0610-0008	SST (per ASTM F593)	4-in.	ASME B 16.5 (ANSI) Class 300	●

Meter Kits

Part Number	Description	
03700-0670-0001	APEX meter kit (includes cover)	●
03700-0670-0003	APEX meter kit (does not include cover)	●
03700-0670-0002	APEX Sentry meter kit (includes cover)	●
03700-0670-0004	APEX Sentry meter kit (does not include cover)	●
08732-0007-0002	APEX and APEX Sentry meter cover (resists moisture, includes O-ring)	●

Configuration Data Sheet

A completed Configuration Data Sheet (CDS) gives Rosemount Inc. detailed information to verify suitability and to custom configure the radar gauge, per your specifications, at the factory so little or no field configuration is required. The CDS can be found at the end of this document and is available electronically at www.rosemount.com.

Tagging

The APEX and APEX Sentry Radar Gauges will be tagged at no charge according to customer requirements. All tags are stainless steel. The standard tag is permanently attached to the gauge. Character height is $^{1}/_{16}$-inch (1.6 mm).

Appendix B Product Certificates

Approved Manufacturing Locations

Rosemount Inc. — Chanhassen, Minnesota, USA

EUROPEAN DIRECTIVE INFORMATION

The EC declaration of conformity for all applicable European directives for this product can be found on our website at www.rosemount.com. A hard copy may be obtained by contacting our local sales office.

ATEX Directive

Rosemount Inc. complies with the ATEX Directive.

Flame-Proof enclosure Ex d protection type in accordance with EN50 018

- Radar Gage with Flame-Proof enclosure type protection shall only be opened when power is removed.
- ⚠ Closing of entries in the device must be carried out using the appropriate EE d metal cable gland and metal blanking plug.
- Do not exceed the energy level, which is stated on the approval label.

European Pressure Equipment Directive (PED) (97/23/EC)

Radar gages are SEP or Category I with Explosion-Proof protection and are outside the scope of PED and cannot be marked for compliance with PED.

Electro Magnetic Compatibility (EMC) (89/336/EEC)

EN 50081-1: 1992, EN 50082-1: 1992, ETS 300 683: 1995,

Installed signal wiring should not be run together and should not be in the same cable tray as AC power wiring.

Device must be properly grounded or earthed according to local electric codes.

To improve protection against signal interference, shielded cable is recommended.

Low Voltage Directive (93/68/EEC)

EN 61010-1: 1995

Other important guidelines

Only use new, original parts.

To prevent the process medium escaping, do not unscrew or remove process flange bolts, adapter bolts or bleed screws during operation.

Maintenance shall only be done by qualified personnel.

HAZARDOUS LOCATIONS CERTIFICATIONS

North American Certifications

Factory Mutual (FM) Approval

E5 With Output Option Code 1:
Explosion-Proof for Class I,
Division 1, Groups C and D;
Dust-ignition Proof for Class II/III,
Division 1, Groups E, F, and G; and
Non-incendive for Class I, Division 2,
Groups A, B, C, and D hazardous locations.
Temperature Code T4A. (T_{amb} = –40 to 70°C)
Factory Sealed.

E5 With Output Option Code 2:
Explosion-Proof for Class I, Division 1, Groups C and D;
Dust-ignition proof for Class II/III,
Division 1, Groups E, F, and G;
Non-incendive for Class I, Division 2,
Groups A, B, C, and D, with
Intrinsically Safe output for Class I, Division 1
Groups A, B, C, and D hazardous locations when installed in accordance with Rosemount Drawing 03700-2006
Temperature Code T4A (T_{amb} = -40° to 70 °C).
Factory Sealed.

Canadian Standards Association (CSA) Approval

E6 With Output Option Code 1:
Explosion-Proof for Class I, Division 1, Groups C and D;
Dust-ignition Proof for Class II/III, Division 1,
Groups E, F, and G;
Suitable for Class I, Division 2, Groups A, B, C, and D hazardous locations,
Temperature Code T4A (T_{amb} = 70°C).
Factory Sealed.

E6 With Output Option Code 2:
Explosion-Proof for Class I, Division 1,
Groups C and D;
Dust-ignition proof for class II/III, Division 1,
Groups E, F, and G; Suitable for Class I, Division 2,
Groups A, B, C, and D, with Intrinsically Safe output for Class I,
Division 1 Groups A, B, C, and D hazardous locations when installed in accordance with Rosemount Drawing 03700-2007
Temperature Code T4A (T_{Amb} = -40° to 70 °C).
Factory Sealed.

European Certifications

CENELEC Flame-Proof Equipment Group II, Category 1/2 G
(Category I, for Zone 0)
(Ref. European Standard EN 50284)
Certification: KEMA 97ATEX1805

ED With Output Option Code 1:
With Display: EEx d IIB+H2
T4 (T_{amb} = 55°C).
Without Display: EEx d IIB+H2
T4 (T_{amb} = 70°C)

With Output Option Code 2:
Intrinsically Safe Output
With Display:
EEx d [ia] IIB+H2 T4 (T_{amb} = 55 °C)
Without Display: EEx d [ia] IIB+H2
T4 (T_{amb} = 70 °C)

Entity Parameters:

U_O = 29.4V

I_O = Negligibly small

U_i = 30V Max

I_i = 145 mA Max

P_i = 1.6W

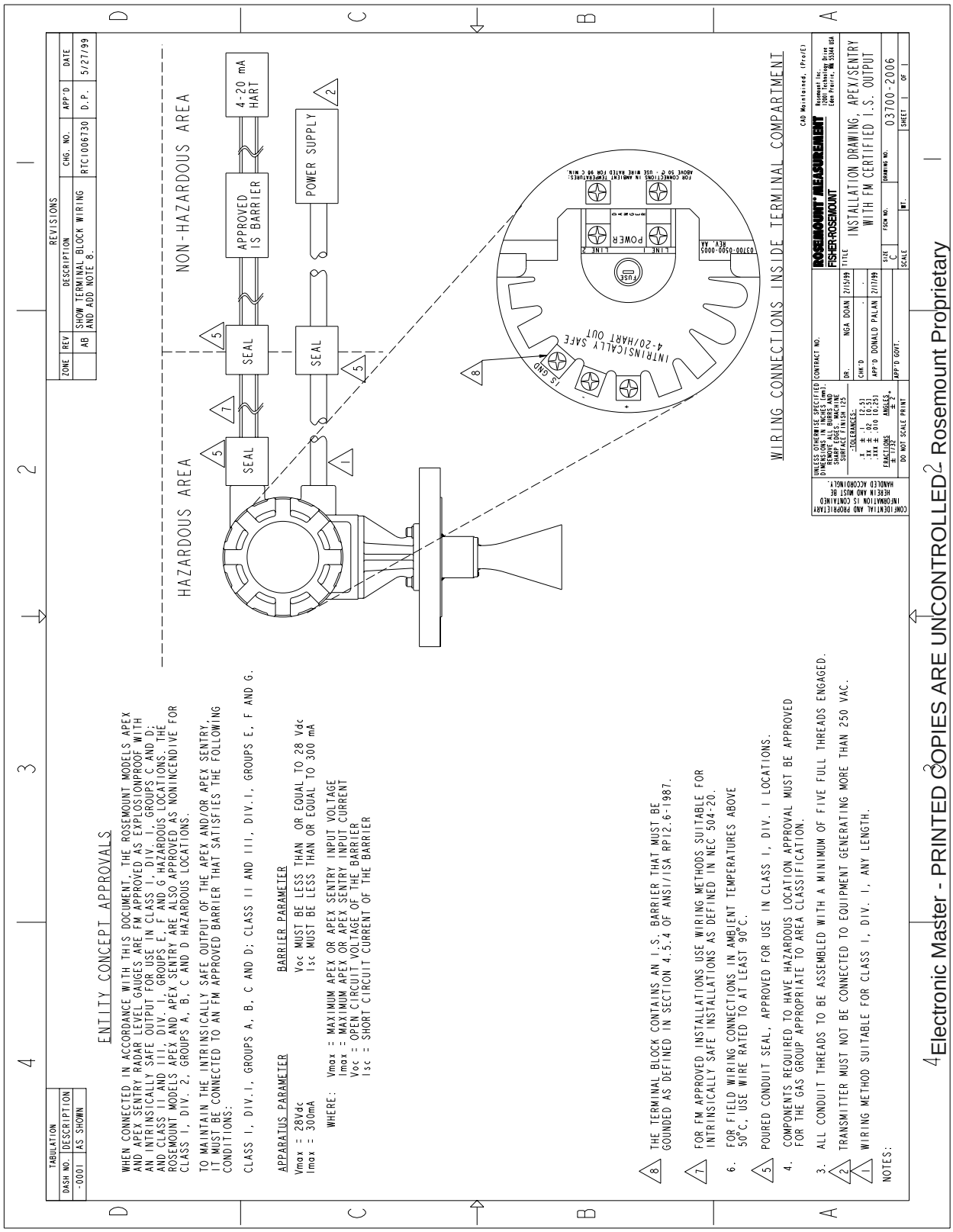
INSTALLATION INSTRUCTIONS:
The cable entry devices shall be of a certified flameproof type EEx d, suitable for the conditions of use and correctly installed.

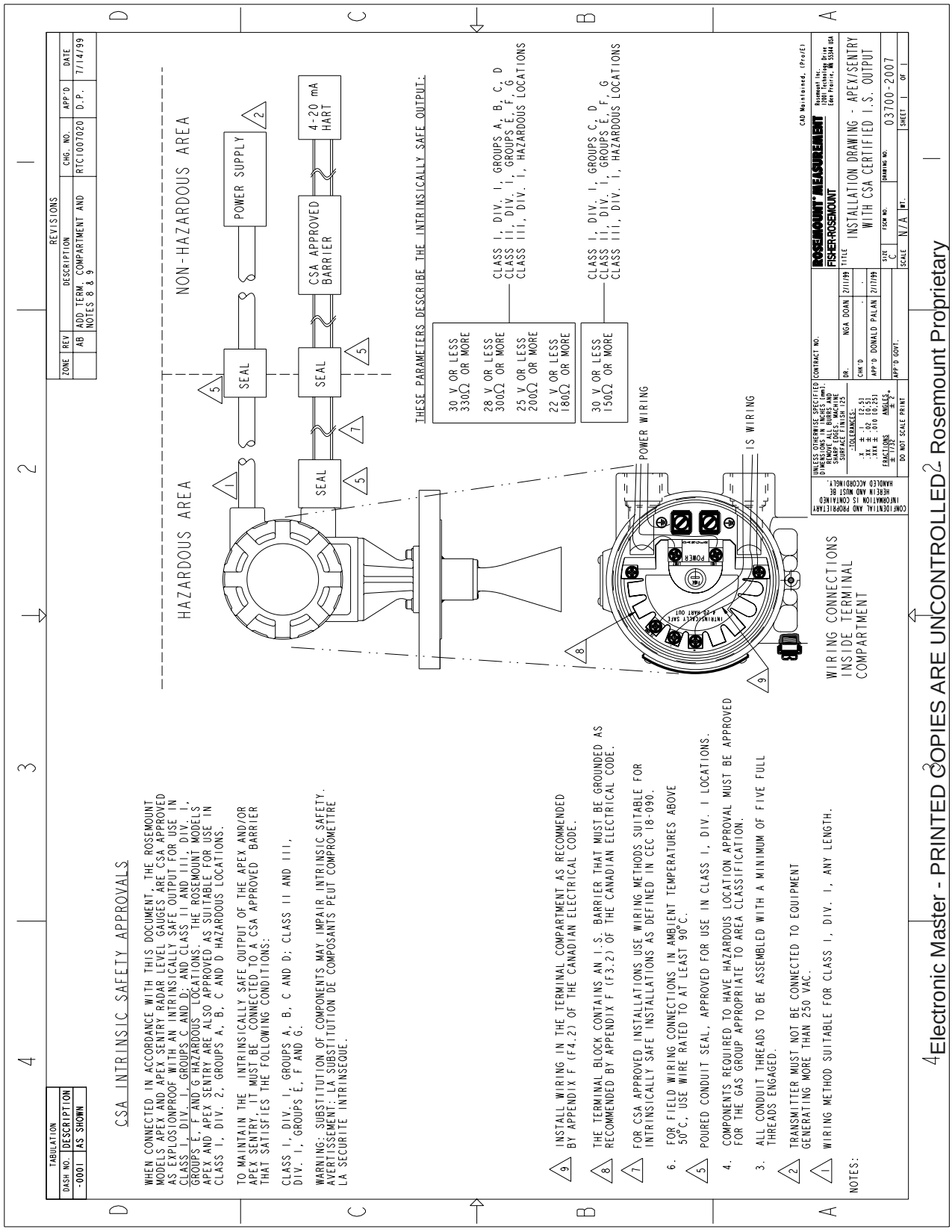
Other approvals pending for explosion-proof certifications

APPROVAL DRAWINGS

NOTE
All information included refers to both the APEX Radar Gauge and the APEX Sentry Radar Gauge unless otherwise stated.

The following contains Factory Mutual, Canadian Standards Association, and ATEX installation drawing. You must follow the installation guidelines presented in order to maintain certified ratings for installed transmitters.


ENTITY CONCEPT APPROVALS
WHEN CONNECTED IN ACCORDANCE WITH THIS DOCUMENT, THE ROSEMOUNT MODELS APEX AND APEX SENTRY RADAR LEVEL GAUGES ARE FM APPROVED AS EXPLOSIONPROOF WITH AN INTRINSICALLY SAFE OUTPUT FOR USE IN CLASS I, DIV. 1, GROUPS C AND D; AND CLASS II AND III, DIV. 1, GROUPS E, F AND G HAZARDOUS LOCATIONS. THE ROSEMOUNT MODELS APEX AND APEX SENTRY ARE ALSO APPROVED AS NONINCENDIVE FOR CLASS I, DIV. 2, GROUPS A, B, C AND D HAZARDOUS LOCATIONS.
TO MAINTAIN THE INTRINSICALLY SAFE OUTPUT OF THE APEX AND/OR APEX SENTRY, IT MUST BE CONNECTED TO AN FM APPROVED BARRIER THAT SATISFIES THE FOLLOWING CONDITIONS:
CLASS I, DIV.1, GROUPS A, B, C AND D; CLASS II AND III, DIV.1, GROUPS E, F AND G.
APPARATUS PARAMETER
Vmax = 28Vdc
Imax = 300mA
BARRIER PARAMETER
Voc MUST BE LESS THAN OR EQUAL TO 28 Vdc
Isc MUST BE LESS THAN OR EQUAL TO 300 mA
WHERE: Vmax = MAXIMUM APEX OR APEX SENTRY INPUT VOLTAGE
Imax = MAXIMUM APEX OR APEX SENTRY INPUT CURRENT
Voc = OPEN CIRCUIT VOLTAGE OF THE BARRIER
Isc = SHORT CIRCUIT CURRENT OF THE BARRIER
8 THE TERMINAL BLOCK CONTAINS AN I.S. BARRIER THAT MUST BE GOUNDED AS DEFINED IN SECTION 4.5.4 OF ANSI/ISA RP12.6-1987.
7 FOR FM APPROVED INSTALLATIONS USE WIRING METHODS SUITABLE FOR INTRINSICALLY SAFE INSTALLATIONS AS DEFINED IN NEC 504-20.
6. FOR FIELD WIRING CONNECTIONS IN AMBIENT TEMPERATURES ABOVE 50°C, USE WIRE RATED TO AT LEAST 90°C.
5 POURED CONDUIT SEAL, APPROVED FOR USE IN CLASS I, DIV. 1 LOCATIONS.
4. COMPONENTS REQUIRED TO HAVE HAZARDOUS LOCATION APPROVAL MUST BE APPROVED FOR THE GAS GROUP APPROPRIATE TO AREA CLASSIFICATION.
3. ALL CONDUIT THREADS TO BE ASSEMBLED WITH A MINIMUM OF FIVE FULL THREADS ENGAGED.
2 TRANSMITTER MUST NOT BE CONNECTED TO EQUIPMENT GENERATING MORE THAN 250 VAC.
1 WIRING METHOD SUITABLE FOR CLASS I, DIV. 1, ANY LENGTH.
NOTES:
TABULATION
DASH NO. | DESCRIPTION
-0001 | AS SHOWN
REVISIONS
ZONE | REV | DESCRIPTION | CHG. NO. | APP'D | DATE
AB | SHOW TERMINAL BLOCK WIRING AND ADD NOTE 8. | RTC1006730 | D.P. | 5/27/99
HAZARDOUS AREA
NON-HAZARDOUS AREA
SEAL
SEAL
SEAL
APPROVED I.S. BARRIER
4-20 mA HART
POWER SUPPLY
WIRING CONNECTIONS INSIDE TERMINAL COMPARTMENT
INTRINSICALLY SAFE 4-20/HART OUT
FUSE
POWER
LINE 1
LINE 2
03700-0500-0005 REV AA
FOR CONNECTIONS IN AMBIENT TEMPERATURES ABOVE 50°C, USE WIRE RATED FOR 90°C MIN
CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY.
UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm]. SHARP EDGES REMOVE SURFACE FINISH 125
TOLERANCES: .X ± .02 [0.51] .XX ± .010 [0.25]
FRACTIONS ± 1/32 ANGLES ± 2°
DO NOT SCALE PRINT
CONTRACT NO:
DR. NGA DOAN 2/15/99
CHK'D
APP'D DONALD PALAN 2/17/99
APP'D GOVT.
ROSEMOUNT® MEASUREMENT FISHER-ROSEMOUNT
Rosemount Inc. 12001 Technology Drive Eden Prairie, MN 55344 USA
CAD Maintained. (Pro/E)
TITLE
INSTALLATION DRAWING, APEX/SENTRY WITH FM CERTIFIED I.S. OUTPUT
SIZE C
FSCM NO.
DRAWING NO. 03700-2006
SCALE
WT.
SHEET 1 OF 1
4Electronic Master - PRINTED COPIES ARE UNCONTROLLED2 Rosemount Proprietary


CSA INTRINSIC SAFETY APPROVALS
WHEN CONNECTED IN ACCORDANCE WITH THIS DOCUMENT, THE ROSEMOUNT MODELS APEX AND APEX SENTRY RADAR LEVEL GAUGES ARE CSA APPROVED AS EXPLOSIONPROOF WITH AN INTRINSICALLY SAFE OUTPUT FOR USE IN CLASS I, DIV. 1, GROUPS C AND D; AND CLASS II AND III, DIV. 1, GROUPS E, F AND G HAZARDOUS LOCATIONS. THE ROSEMOUNT MODELS APEX AND APEX SENTRY ARE ALSO APPROVED AS SUITABLE FOR USE IN CLASS I, DIV. 2, GROUPS A, B, C AND D HAZARDOUS LOCATIONS.
TO MAINTAIN THE INTRINSICALLY SAFE OUTPUT OF THE APEX AND/OR APEX SENTRY, IT MUST BE CONNECTED TO A CSA APPROVED BARRIER THAT SATISFIES THE FOLLOWING CONDITIONS:
CLASS I, DIV. 1, GROUPS A, B, C AND D; CLASS II AND III, DIV. 1, GROUPS E, F AND G.
WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.
AVERTISSEMENT: LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SECURITE INTRINSEQUE.
TABULATION
DASH NO. | DESCRIPTION
-0001 | AS SHOWN
REVISIONS
ZONE | REV | DESCRIPTION | CHG. NO. | APP'D | DATE
AB | ADD TERM. COMPARTMENT AND NOTES 8 & 9 | RTC1007020 | D.P. | 7/14/99
HAZARDOUS AREA
NON-HAZARDOUS AREA
SEAL
SEAL
SEAL
POWER SUPPLY
CSA APPROVED BARRIER
4-20 mA HART
THESE PARAMETERS DESCRIBE THE INTRINSICALLY SAFE OUTPUT:
30 V OR LESS
330Ω OR MORE
28 V OR LESS
300Ω OR MORE
25 V OR LESS
200Ω OR MORE
22 V OR LESS
180Ω OR MORE
CLASS I, DIV. 1, GROUPS A, B, C, D
CLASS II, DIV. 1, GROUPS E, F, G
CLASS III, DIV. 1, HAZARDOUS LOCATIONS
30 V OR LESS
150Ω OR MORE
CLASS I, DIV. 1, GROUPS C, D
CLASS II, DIV. 1, GROUPS E, F, G
CLASS III, DIV. 1, HAZARDOUS LOCATIONS
POWER WIRING
IS WIRING
WIRING CONNECTIONS INSIDE TERMINAL COMPARTMENT
NOTES:
1. WIRING METHOD SUITABLE FOR CLASS I, DIV. 1, ANY LENGTH.
2. TRANSMITTER MUST NOT BE CONNECTED TO EQUIPMENT GENERATING MORE THAN 250 VAC.
3. ALL CONDUIT THREADS TO BE ASSEMBLED WITH A MINIMUM OF FIVE FULL THREADS ENGAGED.
4. COMPONENTS REQUIRED TO HAVE HAZARDOUS LOCATION APPROVAL MUST BE APPROVED FOR THE GAS GROUP APPROPRIATE TO AREA CLASSIFICATION.
5. POURED CONDUIT SEAL, APPROVED FOR USE IN CLASS I, DIV. 1 LOCATIONS.
6. FOR FIELD WIRING CONNECTIONS IN AMBIENT TEMPERATURES ABOVE 50°C, USE WIRE RATED TO AT LEAST 90°C.
7. FOR CSA APPROVED INSTALLATIONS USE WIRING METHODS SUITABLE FOR INTRINSICALLY SAFE INSTALLATIONS AS DEFINED IN CEC 18-090.
8. THE TERMINAL BLOCK CONTAINS AN I.S. BARRIER THAT MUST BE GROUNDED AS RECOMMENDED BY APPENDIX F (F4.2) OF THE CANADIAN ELECTRICAL CODE.
9. INSTALL WIRING IN THE TERMINAL COMPARTMENT AS RECOMMENDED BY APPENDIX F (F4.2) OF THE CANADIAN ELECTRICAL CODE.
CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125
TOLERANCES: .X ± .1 [2.5] .XX ± .02 [0.5] .XXX ± .010 [0.25] FRACTIONS ± 1/32 ANGLES ± 2°
DO NOT SCALE PRINT
CONTRACT NO.
APP'D GOVT.
DR. NGA DOAN 2/11/99
CHK'D
APP'D DONALD PALAN 2/17/99
ROSEMOUNT® MEASUREMENT
FISHER-ROSEMOUNT
Rosemount Inc. 12001 Technology Drive Eden Prairie, MN 55344 USA
TITLE INSTALLATION DRAWING - APEX/SENTRY WITH CSA CERTIFIED I.S. OUTPUT
SIZE C
FSCM NO.
DRAWING NO. 03700-2007
SCALE N/A WT.
SHEET 1 OF 1
CAD Maintained, (Pro/E)
4 Electronic Master - PRINTED COPIES ARE UNCONTROLLED - Rosemount Proprietary

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Reference Manual
00809-0100-4731, Rev FA
April 2003

APEX™ and APEX Sentry™ Radar Gauge

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