

# Ultrasonic Level Switch

## User Guide

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Revision A.6



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# Ultrasonic Level Switch User Manual

Thank you for purchasing an ABM Ultrasonic Level Switch. Your Ultrasonic Level Switch is adaptable to your tank environment. This guide will help you understand the operation and setup of your Ultrasonic Level Switch. In this guide the Ultrasonic Level Switch will be referred to as “Level Switch”, “Switch” or “Sensor”.

## 1.0 Ultrasonic Level Switch Wiring

The Switch housing has 3 wiring cables as shown in Figure 1. The power and communication wire cable is #24 AWG. The relay cable is a three conductor #18 AWG capable of carrying higher currents. The wires are colour coded as shown in Figure 1. The Level Switch requires an input voltage between 12 and 30 volts DC. The third cable (#24 AWG) connects the ultrasonic controller to the transducer.

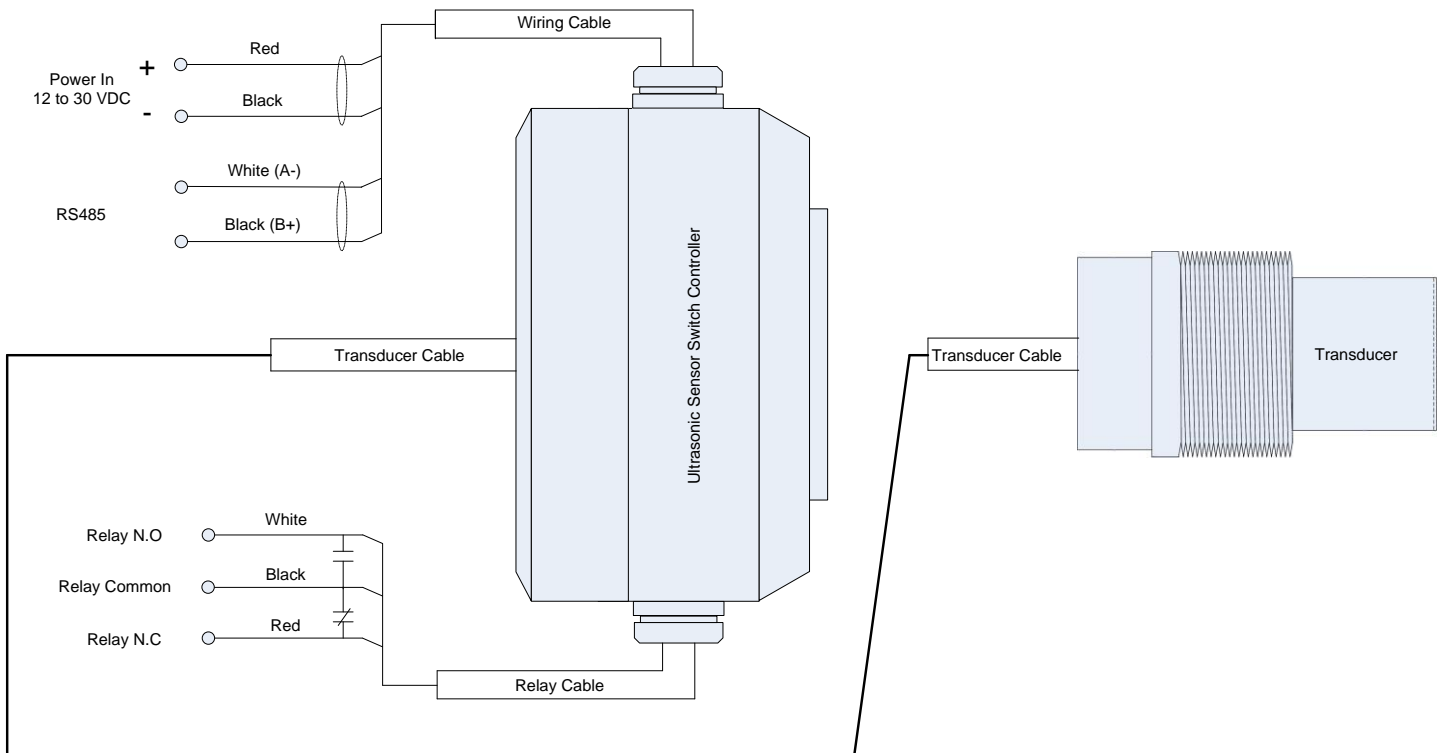


Figure 1 The Ultrasonic Level Switch has 2 wiring cables, one for power and communication and one for the relay.

## 2.0 Basic Switch Operation

Your Ultrasonic Level Switch emits a short burst of ultrasonic energy. The energy is coupled through a rubber membrane to the tank causing the tank to vibrate. The tank vibrations are detected and analysed by the Switch. Based on the vibration patterns the Switch is able to detect the presence or absence of liquid inside the tank, and directly opposite the Level Switch.

When the liquid inside the tank is below the switch point of the Switch (see Figure 2) the Switch’s relay will be in the energized state referred to as the Normally Open (N.O) state (connecting the relay common to the relay normally open connector see Figure 1 for wiring). When the liquid inside the tank is above the detection zone of the Switch (see Figure 3) the relay will be in the non-energized state referred to as the Normally Closed (N.C) state (connecting the relay common to the relay normally close connector see Figure 1 for wiring).

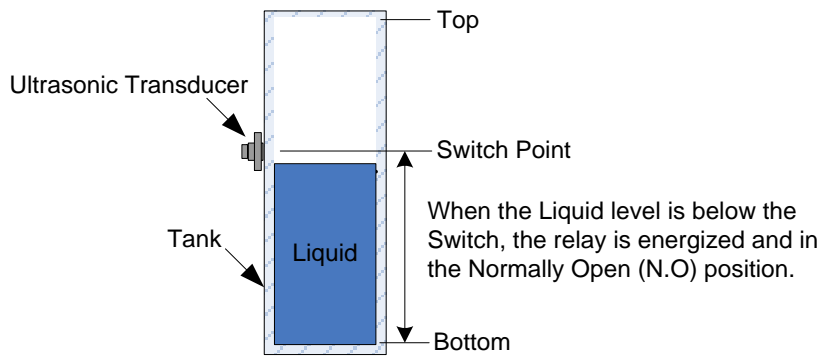


Figure 2 The Switch's relay will be in the Normally Open (N.O) position when the liquid in the tank is below the Switch.

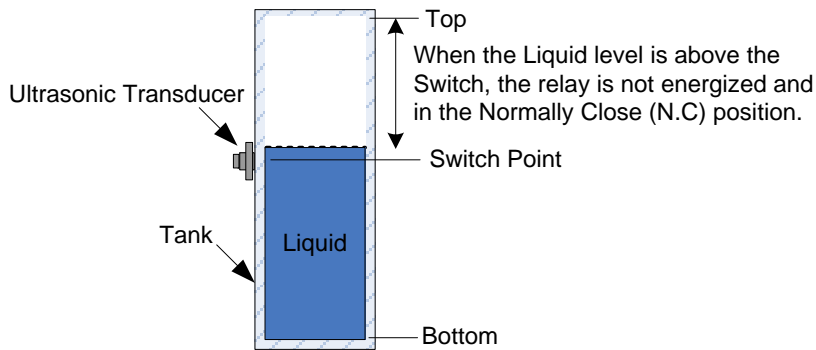


Figure 3 The Switch's relay will be in the Normally Closed (N.C) position when the liquid in the tank is above the Switch.

### Hysteresis Zone - Preventing Relay Clatter.

When the liquid in the tank crosses the switch point, the relay will change to energized or non-energized. To prevent the relay from changing state a small hysteresis zone is created around the switch point see Figure 4. The relay cannot change state until the liquid level in the tank increases or decreases beyond the hysteresis zone.

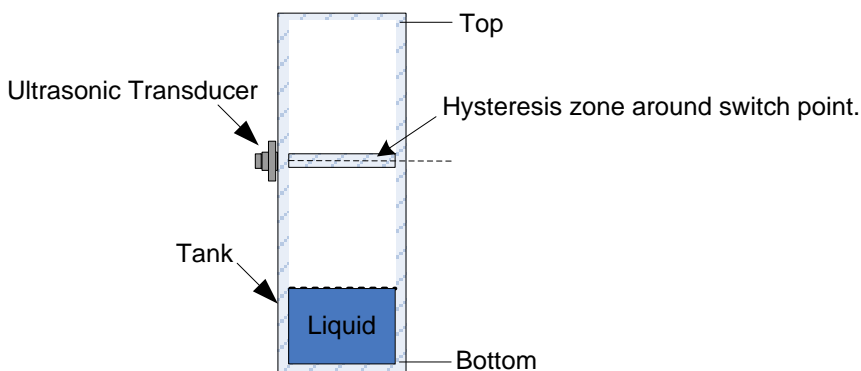


Figure 4 The hysteresis zone prevents the relay from toggling states when the liquid level is at the switch point.

### **3.0 Tank Wall Thickness (Definitions)**

The Ultrasonic Level Switch has two modes of operation “thin walled tank” and “thick walled tank”.

#### **Thin Walled Tanks**

Thin walled tanks are defined as plastic tanks of any thickness and metal tanks with a wall thickness of 0.5 mm or 0.016”.

#### **Thick Wall Tanks**

Thick walled tanks are defined as metal tanks with a wall thickness greater than 0.5 mm or 0.016”.

## 4.0 Calibrating Your Level Switch

After your Switch has been installed a simple 2 step calibration process must be performed using the calibration button on the Switch. Your Switch must be calibrated to the dynamics and characteristics of your tank when the liquid level is above and below the Switch. The calibration process and liquid level requirements are different for thick walled tanks and thin walled tanks.

### Level Switch Calibration Button and LED Color

Your Switch is equipped with a calibration button that can be used to calibrate your Switch to match your tanks characteristics. The button can also be used to change from Thick Walled Tank Mode (flashing green LED) to Thin Walled Tank mode (Solid Green LED). To access the calibration button on the Switch remove the Switch's lid by unscrewing it. To activate the calibration mode using the button, power must be supplied to the Switch and the button must be pressed for the time specified in Table 1. Press the calibration button until the LED turns the desired color and then release the button.

**Table 1 Calibration Button Timing and LED Color**

Button Timing of the Ultrasonic Level Switch.		
Seconds Pressed	LED Color	Description
< 5	Off	If the button is pressed for less than 5 seconds it is ignored and no action is taken.
> 5	Yellow	<b>Thin Tank Calibration</b> - Releasing the button while the LED is yellow indicates that the tank liquid is below the Switch and calibrates the Switch for "liquid below" Switch tank characteristics.  <b>Thick Tank Calibration</b> – Releasing the button while the LED is yellow starts Thick Tank calibration mode.
> 10	Red	<b>Thin Tank Calibration</b> - Releasing the button while the LED is red indicates that the tank liquid is above the Switch and calibrates the Switch for "liquid above" Switch tank characteristics  <b>Thick Tank Calibration</b> – Releasing the button while the LED is red ends Thick Tank calibration mode. After releasing the button wait to see if the LED blinks green or red. Blinking <u>only</u> green indicates that the calibration was successful. Blinking red 10 times indicates that the calibration failed.
> 15	Off	If the button is pressed for greater than 15 seconds the sensor toggles between the Thick Walled Tank algorithm and the Thin Walled Tank Algorithm.  The sensor LED indicates the sensor's mode. Thick Walled Tank Mode (flashing green LED) Thin Walled Tank mode (Solid Green LED)

Where: < means less than and > means greater than.

## Calibration - Liquid Level Below the Ultrasonic Switch (Thin Walled Tank)

The Switch must be in Thin Wall mode before starting. In Thin Wall mode the LED is solid green (does not blink on and off). If the LED is blinking on and off you must change the sensor to Thin Wall mode by pressing the sensor's button for more than 15 seconds as describe in section [Level Switch Calibration Button and LED Color](#).

For this step the liquid level must be a minimum of 2 inches (5 centimeters) below the Switch as shown in Figure 5. With the Switch powered on the LED should be green. Press and hold the calibration button. The LED will turn off, 5 seconds later it will turn yellow. Release the button when the LED turns yellow. The LED will blink green for 10 seconds while the sensor is calibrating. When the calibration cycle is finished the LED will stop blinking and remain green.

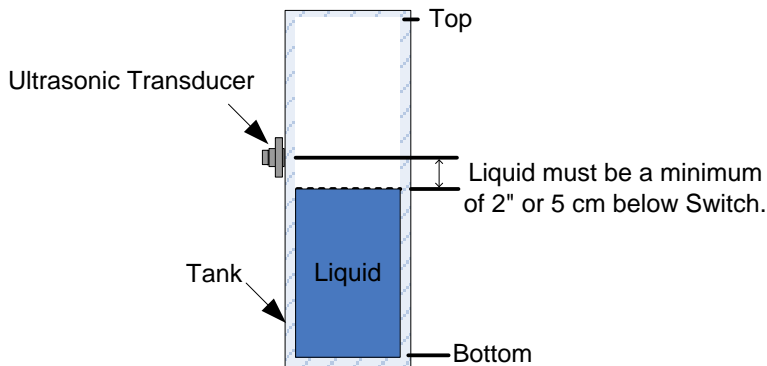


Figure 5 Calibrating the Switch when the liquid level is below the Switch. (Thin walled tank)

## Calibration - Liquid Level Above the Ultrasonic Switch (Thin Walled Tank)

For this step the liquid level must be a minimum of 2 inches (5 centimeters) above the Switch as shown in Figure 6. With the Switch powered ON the LED should be green. Press and hold the calibration button. The LED will turn off, after 5 seconds the LED will turn yellow, after another 5 seconds the LED will turn red. Release the button when the LED turns red. The LED will blink green for 10 seconds while the sensor is calibrating. When the calibration cycle is finished the LED will stop blinking and remain green.

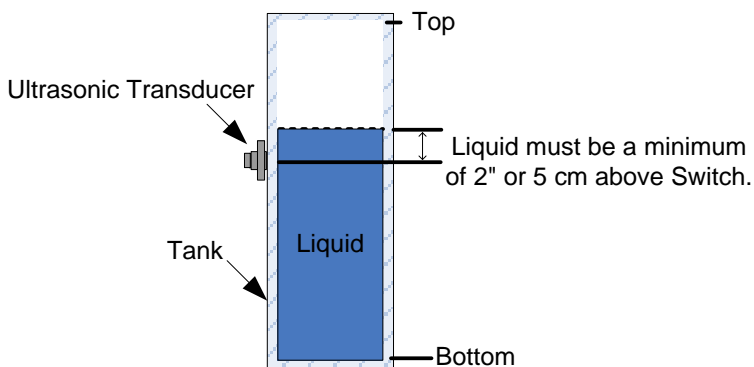


Figure 6 Calibrating the Switch when the liquid level is above the Switch. (Thin walled tank)

## Calibrating the Level Switch - Thick Walled Tank

The Switch must be in Thick Wall mode before starting. In Thick Wall mode the LED blinks on and off. If the LED is not blinking on and off you must change the sensor to Thick Wall mode by pressing the sensor's button for more than 15 seconds as describe in section [Level Switch Calibration Button and LED Color](#).

### Step 1 – Tank Setup

For tanks with thick walls, the sensor monitors the tank echoes while it is filling from empty to full. To calibrate the sensor for thick walled tanks we recommend using your normal filling process. If possible start with an empty tank. If it is not possible to start with an empty tank then start with the liquid at a minimum of 2 inches (5 centimeters) below the sensor as shown in Figure 7.

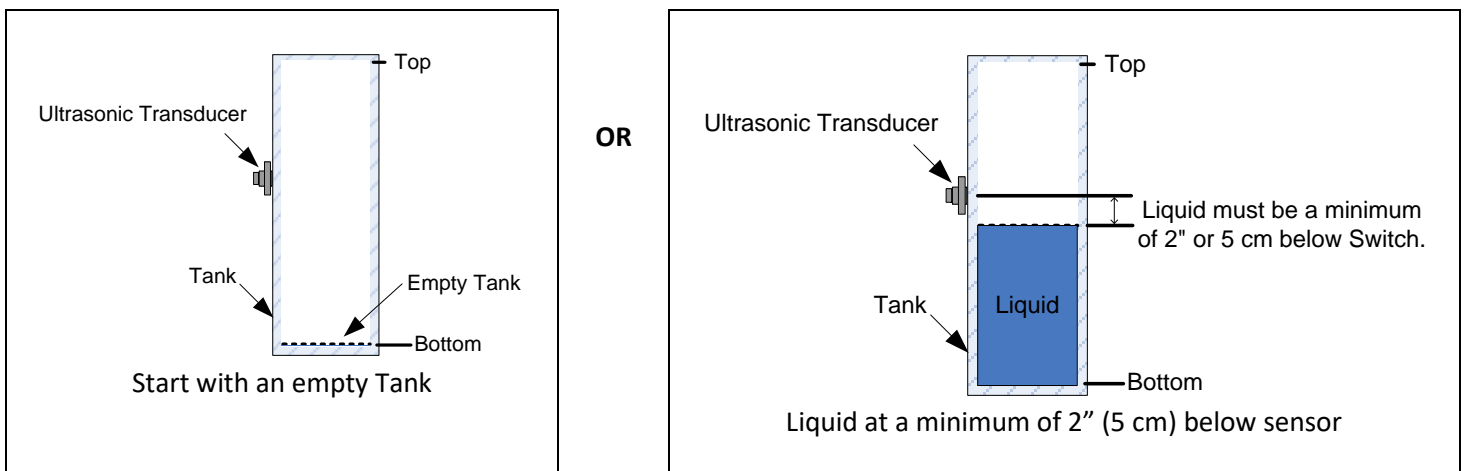


Figure 7 Before starting Thick Walled Tank calibration the tank should be empty or the liquid level should be at least 2" or 5 cm below the sensor.

### Step 2 – Put Sensor in Calibration Mode

With the Switch powered on the LED should be green. Press and hold the calibration button. The LED will turn off and then 5 seconds later it will turn yellow. Release the button when the LED turns yellow. **The sensor is now in calibration mode.**

### Step 3 – Fill the Tank

Start filling the tank using your normal filling process. Fill the tank to the normal full level. If the tank cannot be filled completely, it must be filled to at least 2" or 5 cm above the sensor as shown in Figure 8.



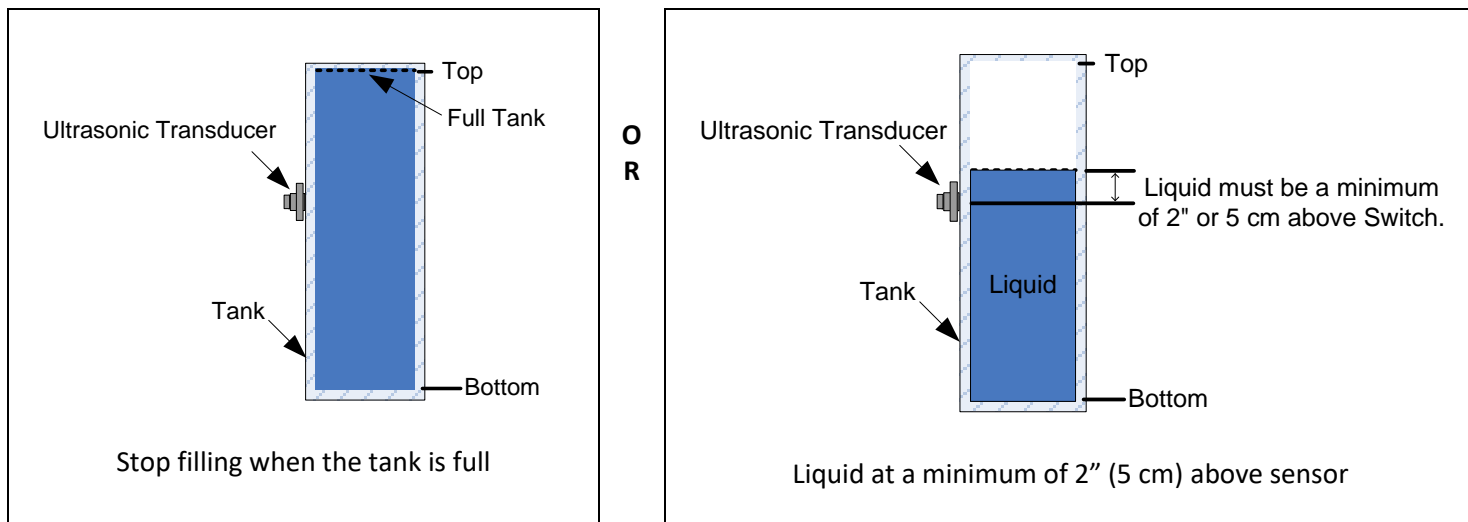


Figure 8 Fill the tank until full or at a minimum of 2" or 5 cm above the Level Switch.

#### Step 4 – Complete the Calibration.

Press and hold the calibration button. The LED will turn off, after 5 seconds the LED will turn yellow, after another 5 seconds the LED will turn red. Release the button when the LED turns red. The LED will blink green. Calibration is now complete and the LED color will indicate if the calibration was successful (see step 5).

#### Step 5 – Determine Calibration Results

If the calibration was successful, the LED will only blink green. If the calibration process failed, the LED will blink red 10 times. If the calibration failed the sensor will load the previous calibration from the sensor's EEPROM.

#### Cause of Calibration Failure

During thick tank calibration the sensor records the echo characteristics of the tank as it fills. A minimum range of echoes are required to calibrate the Switch to the tank. If the minimum range of echoes is not collected during calibration the calibration will fail and the LED will blink red 10 times to indicate the failure.

To fix the problem the calibration will need to be performed again. Ensure the tank is empty or that the liquid level is a minimum of 2" (5 cm) below the center of the sensor before starting the calibration process. Once calibration is started the liquid in the tank should be filled to a minimum of 2" (5 cm) above the center of the sensor before completing the calibration process. The tank should be filled using the normal filling process.

#### Step 6 – Test New Calibration

The sensor uses the calibration process described in steps 1 to 5 to automatically detect your tanks characteristics. If the sensor detected a wide range of echoes during the calibration process the sensor will calculate a switch point for the tank. Many factors influence the calibration including the tank shape, size, wall thickness, mounting, welded seams and the interior shape and design of the tank. The calibration must always be tested and may need to be repeated or fine-tuned using the free ABM Switch Gateway software available on ABM Sensor website.

## Switch Point

When the sensor has been calibrated the switch point will be located near the center of the transducer face as shown in Figure 9. The thickness of the tank walls may cause the switch point to shift. It may be necessary to adjust the sensor location on thick tanks or use the Gateway software to adjust the switch point.

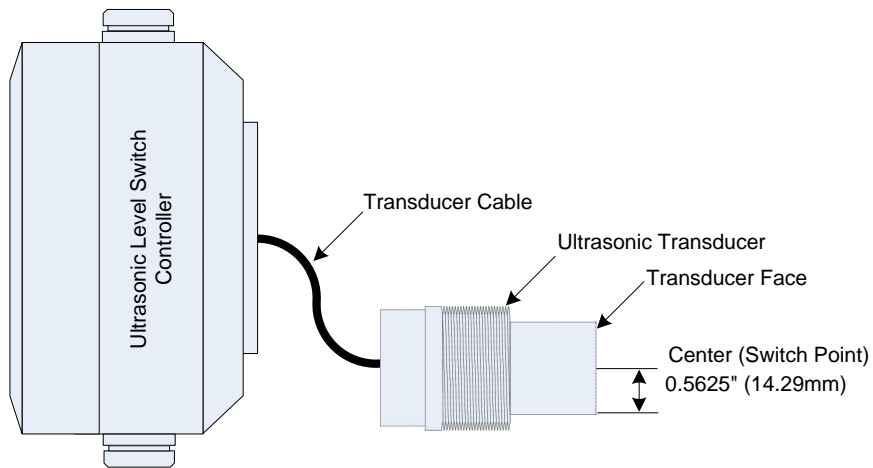


Figure 9. The switch point of a calibrated Sensor is near the center of the transducer face. Tank thickness can cause the switch point to shift.

## Easy Mounting Option for Round Tanks

The Ultrasonic Level Switch can be installed quickly and easily on round tanks using the ABM Level Switch mounting flange system (see Figure 10 and Figure 11). For other tank shapes please contact [ABM Sensor Technology](http://www.abmsensor.com) for different mounting options. A 1 inch (2.5 cm) ratchet strap is wrapped around the tank and connected to both side of the mounting flange. Once the mounting flag is in place the strap is tightened using the ratchet lever. The strap must be tightened enough to ensure that transducer face is pressed tightly against the tank wall and cannot move. Ratchet straps come in lengths up to 100 feet or 30 meters.

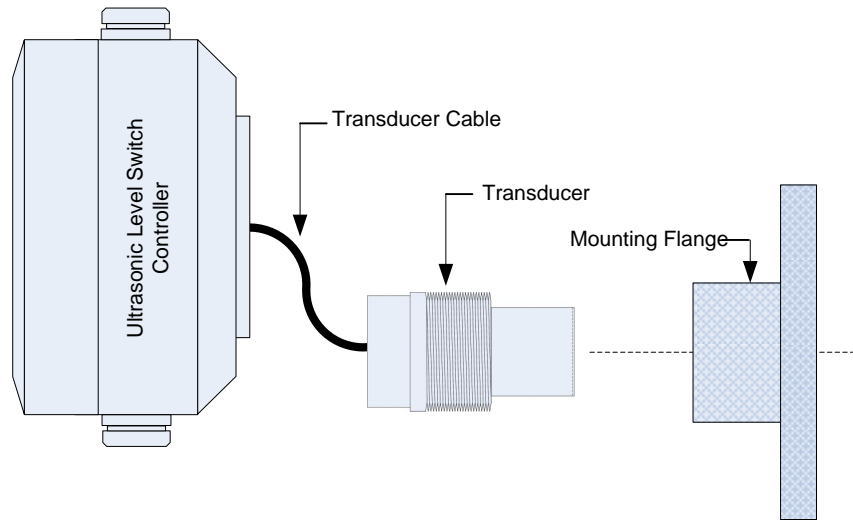


Figure 10 The transducer nozzle screws through the mounting flange allowing the nozzle to extend 1/4" (6.35mm) beyond the flange.

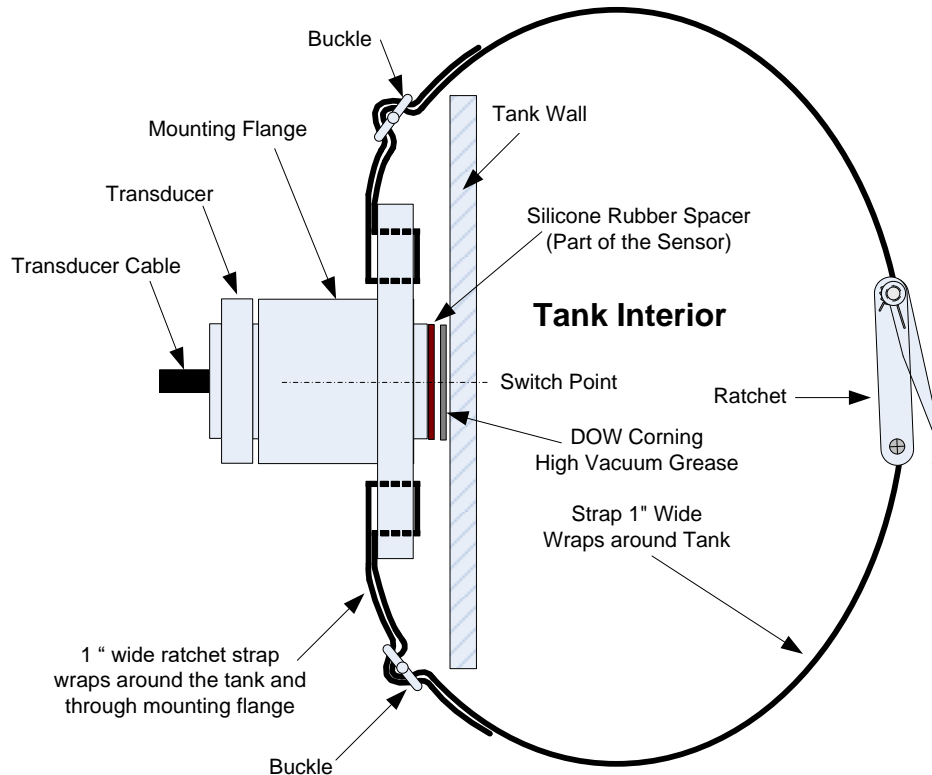


Figure 11 A ratchet strap is attached to the mounting flange and wraps around the tank.

## Level Switch Installation Procedure

The Switch is installed against an outside vertical tank wall. Refer to Figure 12 and Figure 13 during the installation process. As described in step 6 below, when installing the Level Switch a generous amount of High Vacuum Grease should be applied to the rubber spacer as shown in Figure 12. The grease should cover the entire rubber spacer. The grease provides an “air free” connection between the rubber spacer and the tank wall. For proper operation it is important that enough grease be used and carefully spread to prevent air bubbles being trapped between the rubber spacer and the tank wall.

1. Identify and mark the location where the sensor is to be installed on the tank.
2. Hold the ratchet in place and run the 1” strap around the tank to each side of the mounting flange.
3. Thread the 1” strap through each side of the mounting flange.
4. Hold the flange in place and tighten the 1” strap, so that the flange pressure on tank is at least 1 bar or higher.
5. Use the provided buckles to prevent the straps from loosening.
6. Spread the high vacuum silicone grease on the transducer’s rubber spacer. This is a critical step. The grease must cover the entire rubber spacer. There should be no air bubbles in or under the grease. Air bubbles will strongly reduce coupling between the sensor and the tank. The grease provides a medium that matches the transducer to the tank. **Without the grease the Level Switch will not work.**
7. Insert the transducer into the flange and thread it all the way into the flange while holding the flange away from the tank.
8. Once the transducer has been threaded all the way into the flange, unscrew the transducer one complete turn.
9. Gently let the transducer move towards and rest against the tank and tighten the ratchet.
10. Tighten the transducer the remaining one turn.
11. The transducer should now be completely threaded into the flange and the transducer’s rubber spacer with grease should be pressed firmly against the tank.

You should remove the transducer from the flange and repeat steps 4 to 10 if any of the following are true:

- a. There is a space between the transducer’s rubber spacer and the tank.
- b. The transducer’s rubber spacer is not firmly pressed against the tank.
- c. The transducer has not been completely threaded through the flange.
- d. The ratchet straps have not been tightened sufficiently.

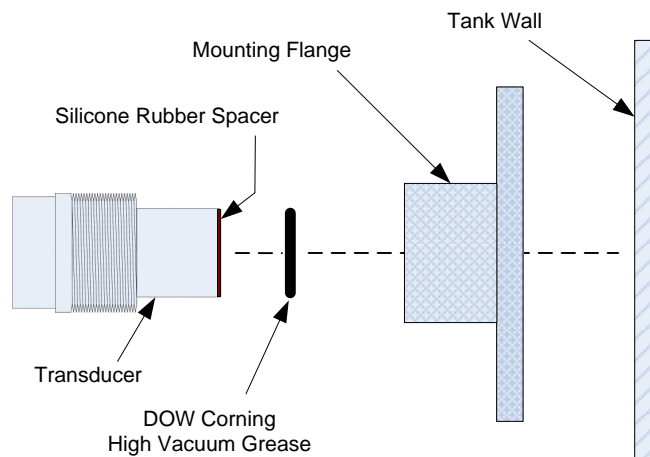


Figure 12 The transducer rubber spacer must be coated with grease before the transducer is inserted into the mounting flange.

The Switch must be securely pressed against the tank wall to prevent the Switch from tilting or moving. Figure 13 shows a correctly mounted Switch.

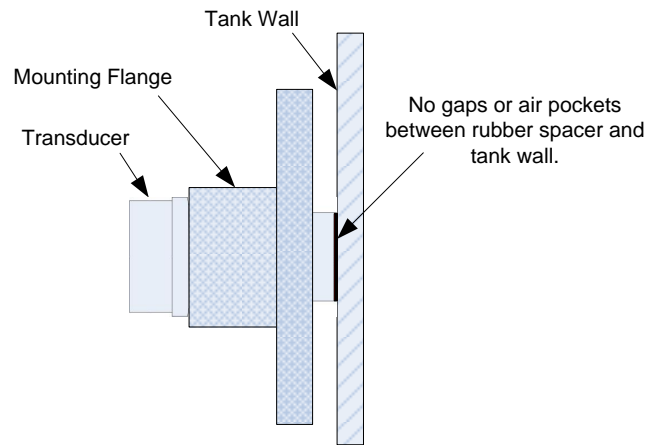


Figure 13 A correctly installed Level Switch with no gaps or air pockets between the rubber spacer and the tank wall.