PNEUMATIC
TANK GAUGING SYSTEMS
FOR
SANITARY TYPE TANKS

Contents

INSTALLATION

WELDING TYPE SENSORS

Models 200WFC, 205 WFC, and 208 WF. These models are intended for flush welding mounting in the wall of a tank.

Location
The nearer the sensor is located to the bottom of the tank the better. The lowest location results in a minimum of "dead volume". If the tank contains a *lower manhole door,* locate the sensor near the door so that it can be easily serviced. If the tank has an *upper manhole door,* locate the sensor within line of sight. If the tank has a *mechanical agitator,* locate the sensor as *far away* from the agitator as possible.

Bottom Mounting
On elevated tanks it may be possible to mount the sensor in the bottom of the vessel. While this may result in good gauging, it also may prevent accessibility for service. Unless there is bottom clearance between the tank and the floor of 18″ (460mm) or more, bottom mounting should be avoided.

Cutting the Tank
The sensor requires a 2″ diameter (50.8mm) opening which can be made with a hole saw. On insulated tanks be careful not to penetrate heating or cooling surfaces. (Figures 1 & 2)

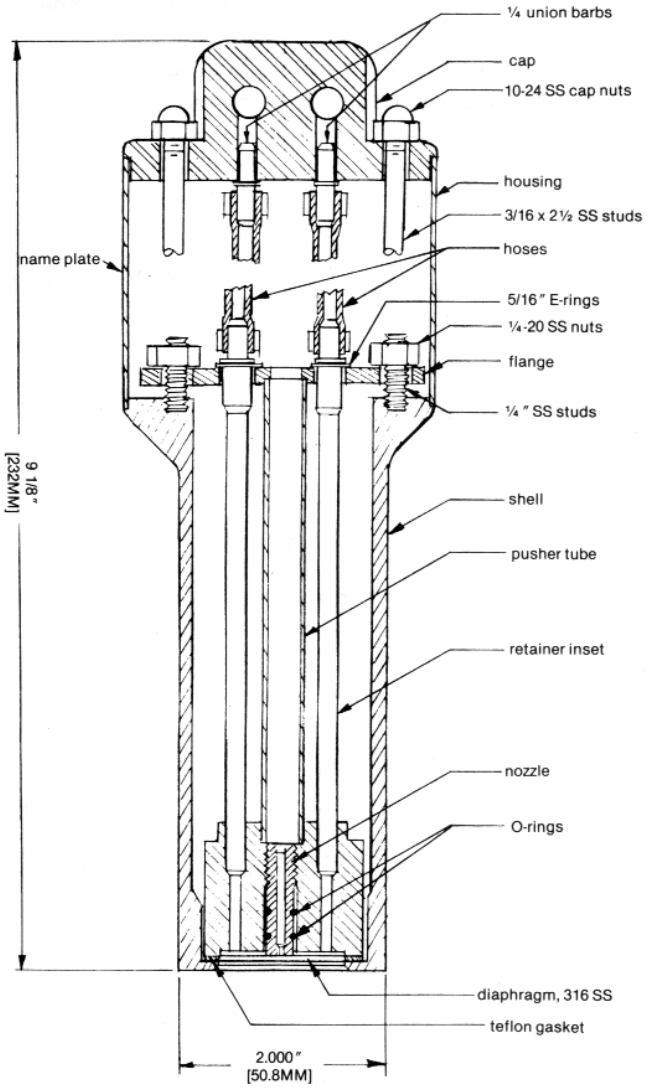


Figure 1
Model 205 WF Level Sensor

Welding

A #50-86 throwaway *welding fixture* is furnished with welding type sensors. Do *not* attempt to weld without using a welding fixture. The welding fixture protects the lip of the sensor and should be left in place until welding, grinding, and polishing has been completed.

The welding fixture includes an internal slug or heat sink which also acts as a "go" gauge. The slug has the same diameter as the sensor retainer. The slug should fit into the shell easily before welding and after welding. This verifies that the retainer will fit properly.

Instructions

1. Cut 2″ holes in tank walls at desired position of sensor.
2. Fasten welding fixture to Tank Mate shell. Pull into position and weld.
3. Do not remove welding fixture until welding, grinding, and polishing is complete. It is important that the lip of the shell is not damaged in any way.
4. Argon purge interior while making outside weld.
5. Heat sink is the same diameter as the sensor retainer. The heat sink should remove easily after welding is completed.

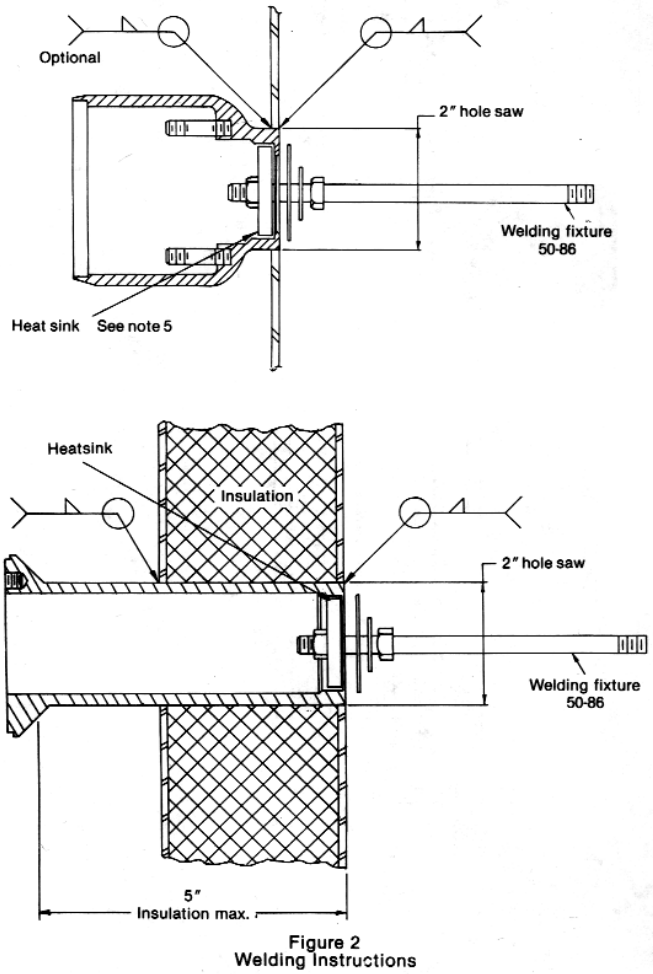


Figure 2
Welding Instructions

On *insulated tanks,* the weld to the *outer jacket* is important. A good weld is necessary in order to prevent moisture from entering the tank insulation.

MODEL 200 SENSORS (Figure 3)

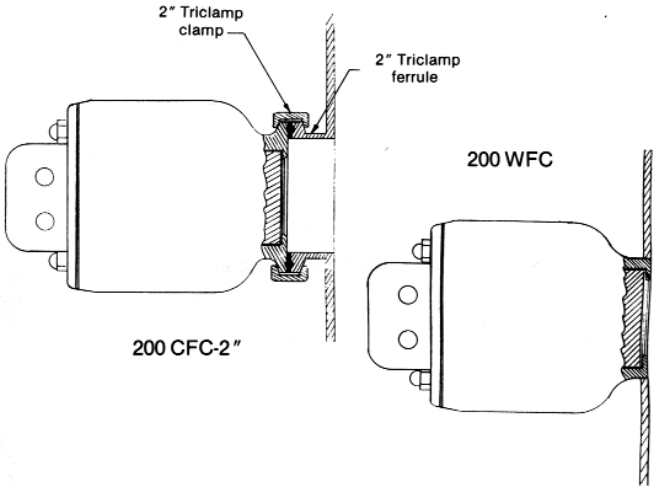


Figure 3
Model 200 Sensors

Model 200CFC-2″. This sensor requires a mating ferrule, gasket, and clamp. Use the following Ladish Tri-Clover parts, or the equivalent:

Ferrule - Ladish Tri-Clover p/n L14AM7 - 2″
Gasket - Ladish Tri-Clover p/n 40MP-U - 2″
Clamp - Ladish Tri-Clover p/n 13MHHM -2″

Due to the pocket formed with a ferrule, this type of sensor should be mounted on a vertical surface with the ferrule at a slight incline for drainage. Mount the ferrule as near to the bottom as possible on a vertical surface.

SILO TYPE TANKS (Tanks with flat, pitched bottoms.)
Locate the centerline of the sensor *half way up the pitch.* This will result in the ideal system calibration.

AIR SUPPLY (Figure 4)

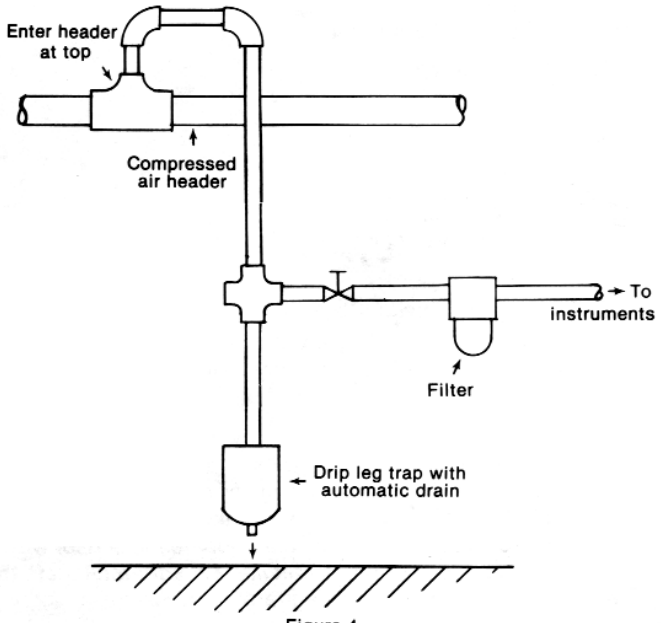


Figure 4
Recommended Compressed Air Piping

Clean, high quality compressed air is essential for proper operation of any pneumatic instrument. Oil, water, or dirt in the air will result in faulty and irregular response.

If clean instrument quality air is not available (especially if a connection is made to a general purpose compressed air system), special precautions need to be taken:

- *Never connect to the bottom of an air supply header*—always connect to the *top* of the header.
- Run the branch connection line down from the header to hand height.
- Locate a drip leg trap at the bottom of the branch line.
- Place a good air filter in the connection to the instrument air supply. (A combination filter and trap is available from some suppliers.)

Each tank gauging system requires only 1 to 3 CFH (28 to 85 liters per hour). Therefore, one filter/trap can service multiple tanks.

OUTDOOR INSTALLATIONS

If any part of a pneumatic system is located outdoors and if temperatures seasonally fall below *freezing*, it will be necessary to supply *dry* air (-40 °F dew point, -40 °C). Both chemical and thermal types of air driers are available commercially.

TUBING AND CONDUIT INSTALLATION

Generally, most installations can make use of ¼ ″ (6.35 mm) *poly tubing*. In certain cases 3/16 ″ (4.76mm) *copper tubing* is called for. These include: high temperature processing 150 °F (65 °C) and above, hazardous and corrosive atmospheres and underground installation.

The level sensor is usually supplied with a tube cable containing two tubes—red and white. The red tube is for the incoming air supply, and is to be attached to the fitting marked "IN". The white tube is the output signal and is to be attached to the fitting marked "OUT".

Conduit. If using ¼ ″ poly tubing, it is recommended that the tubing be run in conduit as illustrated in Fig. 5. Run the tubing through conduit from the tank gauge to the tank. Join the tubes with union barbs. Union barbs will fit inside of conduit with no difficulty. At the junction between the conduit and the tube cable use the loose piece of shrink tube on the tube cable. Slide half of the shrink tube over the conduit and the other half over the tube cable, and apply hot air from a heat gun until the tube is a tight fit. In sanitary work appearance is very important. Use good workmanship. Table 1 shows the number of tubes which can be run in various sizes of conduit.

CONDUIT CAPACITY	
Size	No. ¼ ″ Tubes
½ ″	2
¾ ″	3-4
1 ″	5-8
1¼ ″	9-16
1½ ″	17-22
2 ″	23-36

Table I

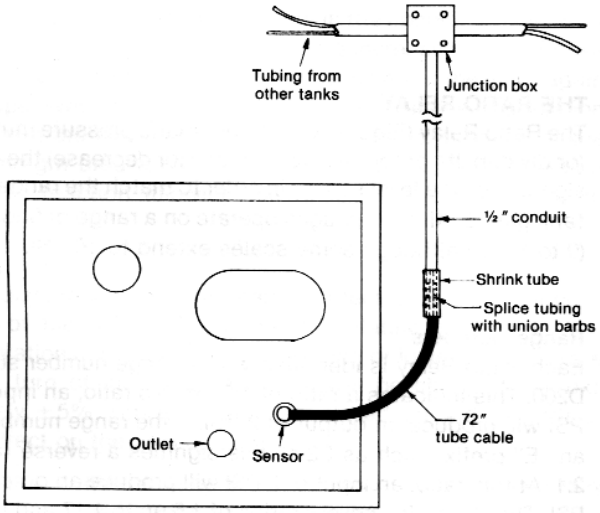


Figure 5
Typical Conduit Installation

Junction boxes. If conduit junction boxes are used, allow for *extra tubing* coiled up in the junction box. Do *not* run tubing tight. (Figure 6)

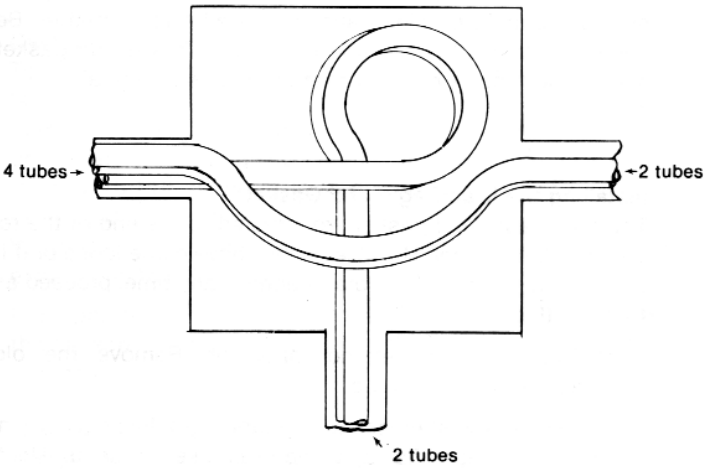


Figure 6
Conduit Box Tubing

Tagging. It is good practice to use wire markers on tubing ends. Each tube should be tagged so that it can be removed from its fitting and returned to its fitting during maintenance work. (Figure 7)

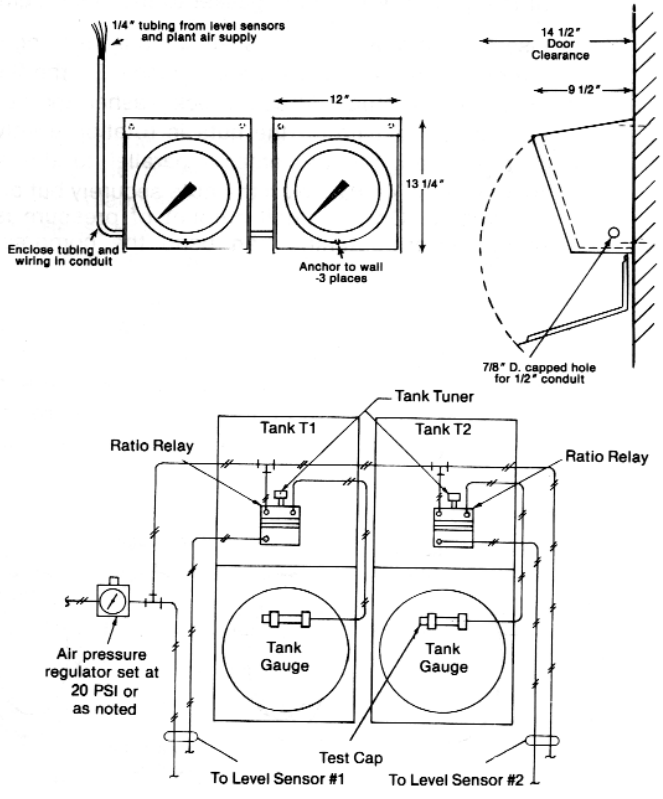


Figure 7
Gauge Cabinets
Mounting, Conduit & Tubing

ASSEMBLY AND CALIBRATION OF THE LEVEL SENSOR

Clamp type sensors (Model 200CF) are supplied completely assembled. For the welding type sensors, *Models 200WF, 205WF, and 208WF,* proceed as follows:

Clean-Up

After the welding is complete, thoroughly clean up the interior of the shell. Observe the interior with a flashlight. The surfaces should be clean and free of all foreign matter. Be certain to inspect the inside of the lip. This is the gasket seating surface. A clean gasket surface is essential.

Installing the Diaphragm and Gasket

The diaphragm and gasket are adhered to the end of the retainer at the factory. However if they have come loose or if it is necessary to replace a diaphragm at any time, proceed as follows: (Figure 8)

a) Clean up the retainer shoulder. Remove the old adhesive with a knife.

b) Take a new stainless steel diaphragm. Inspect it to insure that it is flat and free of creases or dents. Next, add a *very small* amount of adhesive to the retainer face—only enough to hold the diaphragm in place until it is in place in the shell. Use a non-toxic adhesive such as silicone sealer or a sanitary lubricant.

c) Next place a very small amount of adhesive on one side of the gasket. Adhere the gasket to the diaphragm.

d) Insert the retainer into the shell carefully, making sure the diaphragm and gasket are in place. Fit the flange onto the four studs. Attach a lock washer and nut on each stud. Take-up on the nuts in rotation evenly so that the flange plate remains parallel to the shell flange. Finally, take-up on the nuts securely but *do not overtighten.* Only a small amount of pressure is required. Over-tightening can bend the compression pipe.

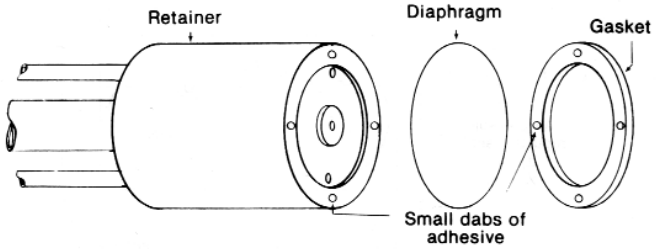


Figure 8
Diaphragm Installation

Calibration of the Sensor

The sensor is a 1:1 pressure transducer and converts a liquid pressure to an equal air pressure. The exact 1:1 ratio is obtained by adjusting the position of the exhaust nozzle. The nozzle is preset and should not be changed unless a test fixture is available as well as precision gauges or manometers. A sensor test fixture is available (Tank Mate part number 50-83).

If for any reason the nozzle must be removed and test equipment is not available, the nozzle can be positioned by aligning the nozzle with a straight edge so that it is even with the shoulders. (Figure 9)

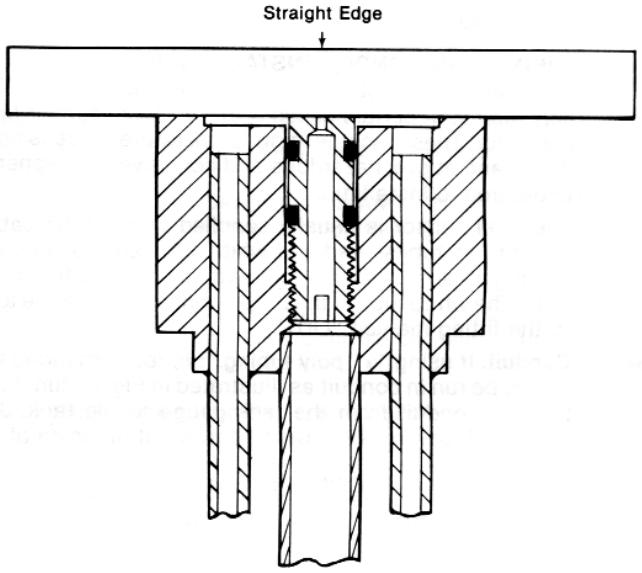


Figure 9
Alignment of Sensor Nozzle

THE RATIO RELAY

The Ratio Relay (Figure 10) is a pneumatic pressure multiplier (or divider). Its purpose is to increase (or decrease) the output signal from the level sensor in order to match the range of the tank gauge. All tank gauges operate on a range of 0 to 15 PSI (0 to 1 Bar) although some scales extend to 16 PSI.

Range Numbers

Each Ratio Relay is identified with a range number such as D200. This indicates a ratio of 1:2. At this ratio, an input of 1 PSI will produce an output of 2 PSI. If the range number has an "E" prefix, such as E200, this signifies a reverse ratio of 2:1. At this ratio, an input of 2 PSI will produce an output of 1 PSI. The "L" series covers ratios of 1:5 up to 1:17 and is used for low levels of liquid.

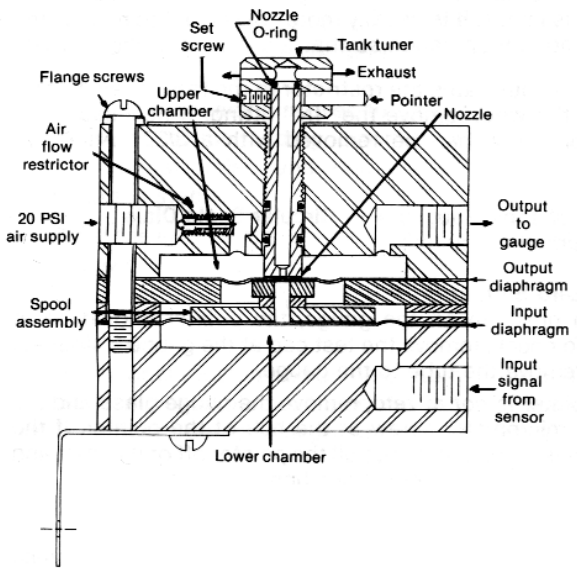


Figure 10
M51A Ratio Relay

Principle of Operation

Model M51 is shown in Figure 10. This unit includes two opposing diaphragms of differing effective areas. Figure 10 shows a D400, where the input diaphragm assembly has an area four times greater than the output diaphragm assembly. An input pressure of 1 PSI will require an opposing pressure of 4 PSI in the output chamber.

Pressure in the upper chamber is caused by a continuous flow of air introduced into the upper chamber coming from an air flow restrictor. The incoming air escapes through the opening in the nozzle and exhausts to atmosphere through the two holes in the Tank Tuner knob. The other opening in the upper chamber is connected to the tank gauge.

As the pressure in the lower chamber is increased, the force transmitted through the spool assembly closes off the nozzle exhaust. This causes the pressure in the upper chamber to increase. The pressure will continue to increase until sufficient force is created to open the nozzle and permit the air to again escape. When the spool assembly is in balance, the relation between the two pressures will be an exact function of the diaphragm area ratio. Decreasing input pressure causes a reverse reaction allowing the upper chamber pressure to decrease.

Tank Tuner

The diaphragm area ratio can be affected by the axial position of the nozzle. Therefore, by rotating the nozzle, the calibration can be affected. By raising or lowering the nozzle ± ¼ turn of the knob, the span will be changed approximately ±5%. This is a span (upscale) adjust and has little or no effect on the zero reading.

The zero output (output with zero input signal) is normally less than 1″ W.C. (2.5mm H_2O). Therefore, zero adjustment is *not* required.

The ratio relay provides a precise ratio between two pressure with high linearity and repeatability. The output capacity is limited but is sufficient to operate dead end devices such as pressure gauges, switches, recorders, and controllers. If a greater output capacity is required, a volume booster relay is recommended.

Air Supply

The air flow restrictor should be supplied with 20 PSI (1.4 bar).

Calibration

To calibrate, apply an exact pressure to the input of the Ratio Relay.The output pressure should be the input pressure multiplied by the ratio. Determine the actual ratio at 3 or 4 points of the range so that the highest output is approximately 15 PSI. If the ratio is not correct, adjust the Tank Tuner knob plus or minus and then rerun the calibration. When the output corresponds to the correct ratio, the exhaust nozzle is in its proper position.

If the pointer on the knob is *not* at ZERO on the dial, loosen the set screw, place the pointer at the ZERO position and retighten the set screw.

Setting the Nozzle

If test equipment is not available and it becomes necessary to reset the Tank Tuner to ZERO, an approximate setting can be made as follows:

1) Disassemble the Ratio Relay by removing the six flange screws.
2) Pull off the upper diaphragm.
3) Rotate the nozzle until the top of the nozzle is even with the upper housing shoulder by using a straight edge.
4) Loosen the nozzle set screw and adjust the knob so that the knob-pointer is over the ZERO mark.
5) Add some silicone sealer or other type of sealer to the shoulder of the upper housing to insure a seal between the diaphragm and the shoulder.
6) Reassemble.
7) **Note: Take care not to omit the upper nozzle O-ring.**

After the calibration or readjustment is complete, the unit can be tested for leaks. With the Ratio Relay installed and operating, cover the two exhaust holes in the knob with two fingers. This should cause the output pressure to rise. If this procedure causes the output to go to 15 PSI (1 bar) or more, (full scale on the tank gauge) the upper chamber is tight and free of leaks.

If the output pressure will not go to 15 PSI (full scale on the tank gauge):

1) There is an air leak in the upper diaphragm chamber, or
2) The upper nozzle O-ring is missing.

SYSTEM START-UP AND CALIBRATION

Air Supply

Most gauging systems will require 20 PSI (1.4 bar) air supply. Only large tanks, 30,000 gallons (114,000 liters) and larger will require more. Note: The supply pressure should always be 5 PSI (.34 bar) *greater* than the maximum liquid pressure. Typical air supply pressures are shown in Table II.

AIR SUPPLY PRESSURE

REQUIRED FOR VARIOUS LIQUID LEVELS
AT DIFFERENT SPECIFIC GRAVITIES

AIR SUPPLY PRESSURE PSI	MAXIMUM LIQUID LEVEL - FEET		
	0.90 SG	1.00 SG	1.10 SG
20	0-38	0-35	0-31
25	38-51	35-46	31-42
30	51-64	46-57	42-52
35	64-77	57-69	52-63
40	77-89	69-80	63-73

AIR SUPPLY PRESSURE BAR	MAXIMUM LIQUID LEVEL - METERS		
	0.90 SG	1.00 SG	1.10 SG
1.4	0-12	0-11	0-10
1.7	12-15	11-14	10-13
2.0	15-19	14-17	13-15
2.4	19-24	17-21	15-19
2.8	24-28	21-25	19-23

Table II

Air Flow Restrictors

Every pneumatic device requires an air flow restrictor. The restrictor acts to reduce the air pressure from the supply pressure down to the instrument working pressure. Also, the flow of air is reduced to the very small flow rate required—approximately 1-2 CFH (28-48 liters per hour).

The restrictor consists of a hollow tube with a wire inside. The clearance between the wire and the tube provides the necessary air restriction. The wire is loose, and can be removed to clean the restrictor in case of plugging caused by dirty air. Removal should permit a significant air flow which can be detected with a finger. If flow is evident, replace the wire.

Warning: The system will *not* operate properly if the wire is not replaced.

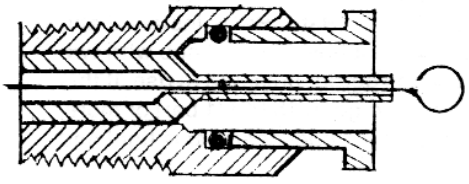


Figure 11a
The restrictor for the level sensor is attached to the cap.

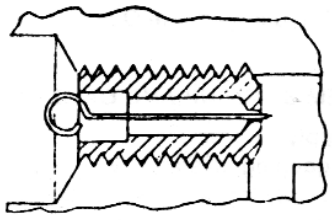


Figure 11b
The Ratio Relay restrictor.

Figure 11a illustrates the restrictor at the "IN" fitting on the cap of a level sensor. For shipping the wire is reversed so that the loop is inside. It is usually more convenient to reverse the wire for normal operation so that the loop is to the outside.

Figure 11b illustrates the restrictor in the ratio relay. For access to the wire, remove the "IN" fitting. If necessary, the restrictor screw can be removed with a 3/32″ Allen hex wrench.

Start-up of Tank Gauges with Circular Scale Dials

(All pneumatic systems)

Gauge Zero Setting

With no pressure on the gauge, the pointer should be at ZERO. To check, remove the test cap at the gauge fitting—or simply remove the tube to the gauge.

If the pointer is *not* at zero, remove the gauge glass and adjust the micrometer screw at the hub of the pointer. If the pointer has no adjustment, pull the pointer off of its shaft and then replace it at the ZERO position.

Thumb Test

This important test checks *all* components of the system. Two people must perform the test, one at the gauge and the other inside the tank. In the tank press the flat of the thumb against the center of the sensor diaphragm to close off the exhaust and cause the gauge pointer to rotate upscale.

When the pointer reads 100% of scale, release the thumb. The indicator should return to zero. If so, the system is now pressure-tight and ready to operate.

On *very high tanks* with liquid levels over 35 feet (12 meters) it will *not* be possible to exert enough thumb pressure to make the gauge pointer go full scale. This does *not* necessarily signify a leak. In this case wait until the tank is full. Then, if the reading appears to be low, soap all fittings and look for a leak.

If the pointer does *not* travel full scale, check the following:

air supply — Should be 20 PSI (1.4 bar) or more

leaks — Air leaks are the most common problem in pneumatic systems. When the system is pressurized for the Thumb Test, soap all fittings and check each one for bubbles.

Tank Tuner

The system can be calibrated upscale by means of the Tank Tuner adjustment on the Ratio Relay. This is a SPAN adjustment and will shift the calibration up to ±5%. This adjustment has no effect on the ZERO setting.

Upscale calibration can be done whenever there is a known load in the tank. This is best done, when feasible, by comparing the gauge reading to a tank truck weight or a total of several truck loads. The nearer the tank is to full, the more accurate the calibration will be.

Under the Tank Tuner knob is a scale with plus or minus graduations. The Ratio Relay is factory set at ZERO. Note that on either side of the knob are two exhaust holes. To change the original calibration, do the following:

- Place a known quantity of product in the tank.
- If the gauge reading agrees with the known quantity, make no adjustments.
- If the gauge reading is *under* the known quantity, turn the knob in the PLUS direction until the gauge reading agrees with the known quantity. At this time with the thumb and forefinger, cover the two exhaust holes in the

knob. Hold until the gauge hand begins to rise slightly, then release. This allows the nozzle to reseat. If the gauge reading has changed, readjust the knob until the reading is again correct. Repeat this procedure several times until the reading is stable.

- If the gauge reading is *over,* turn the knob in the MINUS direction until the reading is correct. As above, cover the two exhaust holes and readjust. Continue until the reading is stable.

NOTE: if the error is greater than ±5%, look for a malfunction elsewhere.

Dead Volume

If the sensor is located above the bottom of the vessel, the system has dead volume. Since the sensor cannot detect levels below its center, the gauge reading must be compensated.

First determine the amount of dead volume by calculation or preferably with a totalizing flow meter. When the dead volume has been determined:

a) Remove all pressure from the tank gauge, and

b) remove the gauge glass and adjust the pointer to read the amount of the dead volume. Reconnect the gauge.

This now will be the lowest that the gauge will read when the tank is empty. The readings will be correct above the amount of the dead volume.

PRINCIPLE OF OPERATION

The Tank Mate "F" series level sensor uses a clamped metal diaphragm to sense pressure. This type of sensor is a 1:1 repeater and converts product pressure into an equal air pressure.

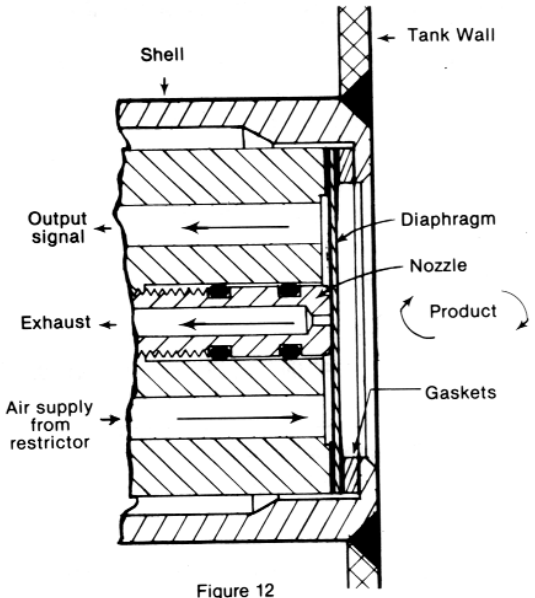


Figure 12
Principle of Operation

As shown in Figure 12, air is supplied to the underside of the diaphragm at a constant rate of flow from the air flowset. The air escapes through the center of the nozzle to atmosphere. The air pressure under the diaphragm is fed back to the measuring instrument through the opposite passage.

On an *increase* in product pressure (or level) the diaphragm will deflect inwardly a small amount and restrict the exhaust nozzle. This causes the air pressure to build up under the diaphragm. The air pressure will continue to increase until it becomes equal to the product pressure.

Decreasing pressure (or level) causes the diaphragm to deflect outwardly and allows the air to escape. In operation, the product pressure and the air pressure are essentially equal at all times.

TROUBLE SHOOTING

Symptom: READING IS TOO LOW

CAUSE	CORRECTON
• Insufficient air pressure.	• Increase air pressure to 20 PSI (1.4 bar) or more. See Pages 5 & 6.
• Restrictor plugged.	• Remove restrictor wire. Check for good air flow.
• Leaks in tubing.	• Soap all fittings when product is in tank, or use the Thumb Test. See Page 6.
• Diaphragm improperly installed.	• Install new diaphragm.
• Sensor flange nuts loose.	• Tight all four flange nuts.
• Pointer off at ZERO.	• Zero Pointer. See Page 6.
• Ratio Relay diaphragm is ruptured.	• Disassemble Ratio Relay and install new diaphragm.

Symptom: READING IS TOO HIGH

CAUSE	CORRECTION
• Pointer off at ZERO.	• Zero pointer. See Page 6.
• Tank Tuner off.	• Calibrate per Page 5.
• Sensor nozzle plugged.	• Disassemble sensor. Rod out exhaust hole in nozzle.
• Ratio Relay exhaust is plugged.	• Disassemble Ratio Relay and rod out the exhaust passages.
• Sensor exhaust nozzle misadjusted.	• Align nozzle properly. See Page 5.
• Water in tubing.	• Disconnect tubes at both ends and blow out with high pressure air.

Symptom: GAUGE POINTER REMAINS ABOVE ZERO WHEN TANK IS EMPTY

CAUSE	CORRECTION
• Gauge pointer is off at ZERO.	• Zero pointer. See Page 6.
• Cleaning wire missing from restrictor.	• Replace wire.
• Sensor nozzle plugged.	• Disassemble sensor and rod out exhaust hole in nozzle.
• Ratio Relay exhaust is plugged.	• Disassemble Ratio Relay and rod out exhaust passages.
• Gauge pointer is loose on its shaft.	• Press pointer into shaft firmly with finger. Zero pointer per Page 6.
• Water in tubing.	• Disconnect tubes at both ends and blow out with high pressure air.

Symptom: GAUGE POINTER IS LOOSE AND WILL NOT RESPOND

CAUSE	CORRECTION
• Gauge pinion gear has disengaged from sector gear. Hair spring is wound up.	• Observe tank gauge gears. Depending on the type of gauge, either remove rear cover plate or front dial plate. Return gauge to Tank Mate or to a gauge repair service.

Symptom: RATIO RELAY WILL NOT RESPOND WHEN THE TWO EXHAUST PORTS IN KNOB ARE COVERED

CAUSE	CORRECTION
• Upper diaphragm is ruptured.	• Replace upper diaphragm.
• Nozzle O-ring is missing.	• Replace O-ring.

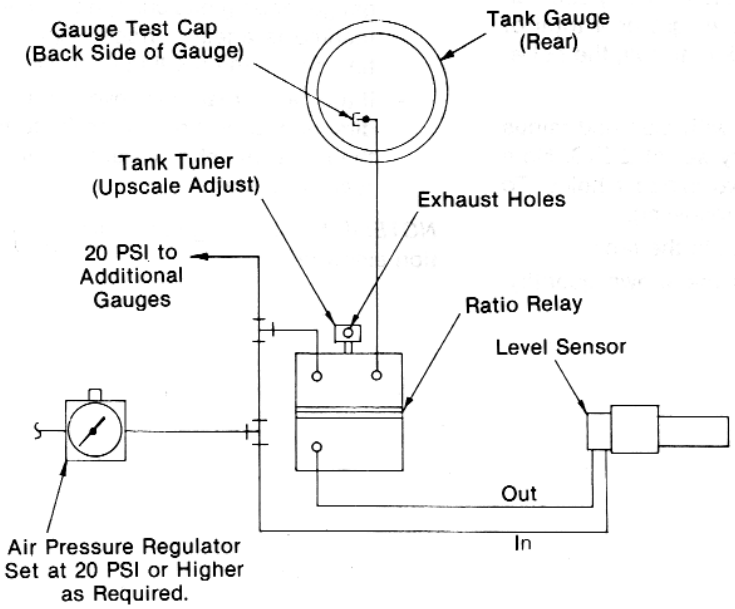
Symptom: SYSTEM WILL NOT RESPOND

CAUSE	CORRECTION
• No air supply.	• Check hook-up to plant air.
• Defective air pressure regulator.	• Remove outlet tubing and verify output air flow. Replace regulator if necessary.
• Plugged restrictors.	• Remove cleaning wires. If plug persists, replace entire restrictor.
• Impurities in the air.	• Install air filter/traps in the air supply.

Symptom: ERRATIC OPERATION

CAUSE	CORRECTION
• Water in air lines	• Blow out air lines with high pressure air.

TANK GAUGE STARTUP AND CALIBRATION



BASIC TUBING ARRANGEMENT

Note: For complete installation and start-up instructions see F112.

1. Sensor Assembly—The Models 200 WF (short) and 205 WF (long) retainers are shipped separately and are assembled on the job. The shell is either already welded into the tank or is welded on the job.

Clean out the interior of the shell. The diaphragm and gasket are adhered to the end of the retainer. If these have come loose during shipment, they can be held in place with a dab of silicone sealer or sanitary grease.

Insert the retainer into the shell and secure with four nuts and lockwashers. Take up firmly on the nuts. Next, from the interior of the tank, examine the diaphragm. This should be smooth and flat. If not, loosen the nuts and retighten. A flat diaphragm is necessary for proper operation.

The Model 200 CF with 2″ clamp end is preassembled and can be put into service immediately.

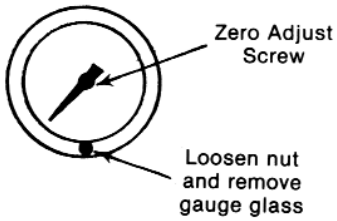
2. Air Supply—Furnish dry, filtered compressed air to the pressure regulator. Set the regulator at 20 PSI unless more is called for.

Air supplies which contain water and oil must be trapped and filtered. Do not operate with a dirty air supply.

3. Air Restrictors—Both the Ratio Relay and the Level Sensor have their own wire restrictors at the 20 PSI inlet. They normally pass 1-2 CFH at 20 PSI. If plugging should occur the wire can be removed and returned, which should open up the restricted orfice. For more details, see bulletin F112.

4. The Thumb Test—Use two people. Inside the tank press on the center of the diaphragm. The tank gauge pointer should travel full scale. If it does not, there is a leak in the system. Check all fittings for leaks.

5. Tank Gauge Zero Set—Remove the ¼″ test cap at the rear of the gauge. This releases all pressure from the gauge and the pointer should come to the zero mark. If it does not, remove the gauge glass on the front and reset the pointer to the zero mark using the micrometer screw at the center. Replace the test cap.



6. The Tank Tuner—The purpose of the Tank Tuner is to make a calibration adjustment upscale. This is a span adjustment and will shift the calibration up to ±5%. This adjustment has no effect on the zero setting.

Upscale calibration can be done whenever there is a known load in the tank. This is best done, when feasible, by comparing the gauge reading to a tank truck weight or a total of several truck loads. The nearer the tank is to full, the better will be the accuracy.

Under the Tank Tuner knob is a scale with plus and minus graduations. The Ratio Relay is factory set at ZERO. Note that on either side of the knob are two exhaust holes. To change the original calibration, do the following:

- Place a known quantity of product in the tank.
- If the gauge reading agrees with the known quantity, make no adjustments.
- If the gauge reading is *under* the known quantity, turn the knob in the PLUS direction until the gauge reading agrees with the known quantity. At this time with the thumb and forefinger cover the two exhaust holes in the knob. Hold until the gauge hand begins to rise slightly then release. This allows the nozzle to reseat. If the gauge reading has changed, readjust the knob until the reading is again correct. Repeat this process several times until the reading is stable.
- If the gauge reading is *over,* turn the knob in the MINUS direction until the reading is correct. As above, cover the two exhaust holes and readjust. Continue until the reading is stable.

NOTE: If the error is greater than ±5%, look for a malfunction elsewhere.

CHANGING TANK GAUGE DIALS

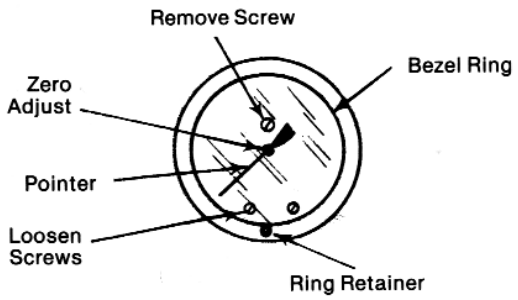


Fig. 1 Front View

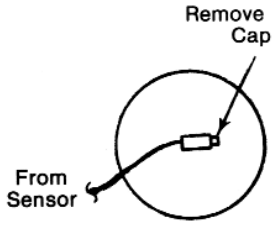


Fig. 2 Rear View

NOTE: Before handling any dial it is good practice to wash the hands in order not to smudge the dial.

To Remove Existing Dial

1. Remove bezel ring and glass by releasing the retainer screw, Fig. 1.

2. Remove the pointer by grasping at the center. Pull off gently but firmly. If the pointer fails to come off after a reasonable amount of force has been used, it will be necessary to use a special tool called a *hand jack*. Don't damage the mechanism by use of too much force.

3. Loosen the two lower screws and remove the upper dial screw.

4. Gently remove the dial.

To Replace a Dial

1. With the bezel ring and glass removed place the dial on the lower screws. Do not tighten.

2. Replace the upper screw firmly. Tighten the two lower screws.

3. **Setting Zero.** The pointer should be set at zero only when *all pressure has been released from the gauge.* This is done by removing the cap at the rear of the gauge (See Fig. 2) or by otherwise insuring that all pressure is off of the gauge.

4. Push the pointer onto the shaft at approximately the zero position. Make the final alignment with the zero adjust micrometer screw at the hub of the pointer. NOTE: Certain gauges do not have a micrometer screw adjustment. In this case carefully push the pointer onto the shaft at the exact zero position.

5. Replace the rear cap. If the tank has product in it, the pointer will rise. However if the tank is empty, the pointer may not go back to true zero. A position slightly above zero when the tank is empty is normal.

6. Replace the bezel frame and glass.

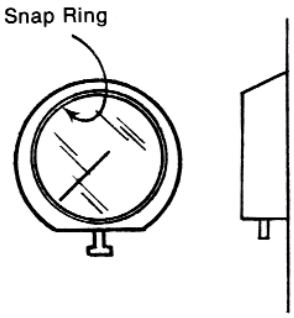


Fig. 3
Surface Mount
Tank Gauge

7. **Instructions for Surface Mount Gauges.** The glass of a surface mount gauge is held in by a snap ring.

To remove the glass, insert a screw driver blade in the snap ring slot and pry out. At the same time keep one hand on glass. When the snap ring is released, it tends to fly out. Keep one hand on the glass so that it does not drop out when the snap ring is released.

HIGH AND LOW LEVEL TANK-A-LARM and PRESSURE SWITCHES

I. TANK-A-LARM SYSTEMS

Setting high level alarm. If it is desired to change the factory setting of the high level alarm, proceed as follows:

1. Open the connection between the ratio relay and the tank gauge. The ratio relay furnishes the signal pressure which actuates the tank gauge and the pressure switch. The pressure switch acts to trip the alarm.

   The system operation can be simulated by using a temporary source of air pressure in place of the normal system signal. This can be accomplished by means of an air pressure regulator as shown in Figure 1. or a hand aspirator bulb can be used.

   CAUTION: If an air pressure regulator is used, care should be taken to never exceed 16 PSI. This is the rating of the gauge and pressure switch. Excess pressure will damage these components.

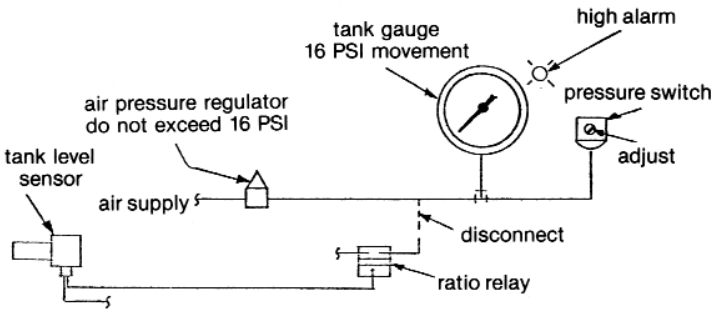


Figure 1.

2. **Before** making the connection between the regulator and the gauge, connect an air supply to the regulator. Back off the regulator all the way. Make sure that *zero pressure* is being produced.

3. Next, connect the regulator to the gauge and pressure switch as in Figure 1. Slowly increase the pressure. The gauge hand will begin to rise. Keep increasing the pressure until the alarm sounds and the lamp lights. Observe the reading on the gauge. This is the original factory setting.

4. **To change the trip point,** turn the pressure switch adjusting screw (or dial). Repeat Step 3. Continue this process until the desired alarm point is obtained.

5. Disconnect the regulator and reconnect the ratio relay to the gauge. The alarm will now activate at the final setting.

6. **Setting the low level alarm.** Repeat the process in Steps 1 through 5 except make the low level setting when the pressure is *decreasing.*

7. A pressure switch has a *differential.* That is, it makes and breaks at two slightly different pressures. So to get the exact trip point, the simulated pressure should be going in the same direction as the process. Therefore, set the low level alarm when the pressure is decreasing and the high level alarm when the pressure is increasing.

8. **Setting high and low level alarms.** Usually a high/low alarm system will employ a *dual pressure switch.* Here both high and low alarms are located on the same switch. In this case, the switch will have two adjustment screws. Each is independent of the other. Proceed as above and set each one separately.

II. INDEPENDENT PRESSURE SWITCH SYSTEMS

If there is no alarm system as above and there are pressure switches provided to obtain control functions at various levels, the control points can be determined and adjusted by use of an ordinary electrical test multimeter. Use the resistance scale which measures ohms. By connecting the multimeter to the pressure switch leads, the switching action can be observed.

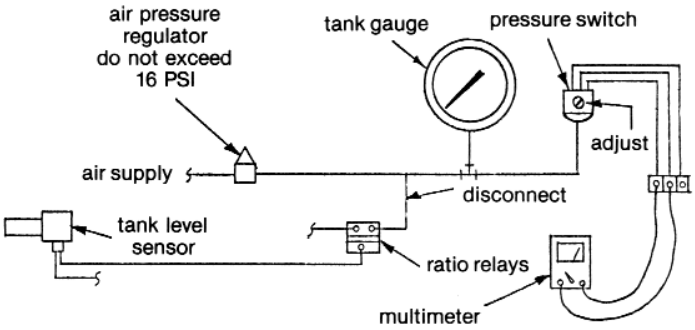


Figure 2.

9. Set up a test as in Figure 2. This is the same as Figure 1. except that a multimeter is connected to the pressure switch.

10. As before, increase and decrease the input pressure. Observe the tank gauge and the multimeter. The multimeter will read ZERO ohms. when the switch is made and INFINITE ohms. when the switch opens. Set the

switches one at a time to obtain the settings desired. Remember—the pressure should be going in the same direction as the process. See Step 7.

III. LEVEL CONTROL SYSTEMS

Some level control systems do not have any form of level indication. In this case some means must be provided to determine the product level versus the pressure switch settings. Most often controllers operate in a range of less than 100″.

The system pressure can be simulated by use of a pressure regulator or an aspirator bulb. If neither of these is available, low pressure can be obtained simply by blowing with the mouth.

To determine the product level, use a water manometer or a low pressure test gauge. NOTE: If neither of these is available, a water manometer can be devised by means of a piece of clear plastic tubing formed in the shape of a "U". The product level is equal to the difference in the heights of the two legs.

Connect a multimeter to the appropriate pressure switch leads and test as outlined in Steps 6 and 7.

11. Set up a test as in Figure 3. Disconnect the signal from the level sensor. In its place, connect a piece of tubing including a manometer or test gauge. Connect a multimeter to the pressure switch leads—the common and either the NO (normally open) or the NC (normally closed).

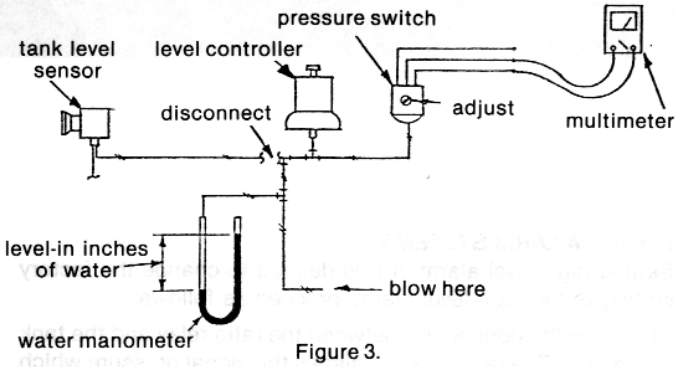


Figure 3.

12. Vary the signal pressure at the same time observing the manometer and the multimeter. Adjust the pressure switch screw to obtain the desired trip points. Remember—the pressure should go in the same direction as the process. See Step 7.

    CAUTION: Do not exceed the system rated pressure. For example, if the controller range is 16 ounces, this is equivalent to 1 PSI or 28″ of water. Therefore, do not exceed 1 PSI. Over pressure will damage the controller and the pressure switch.

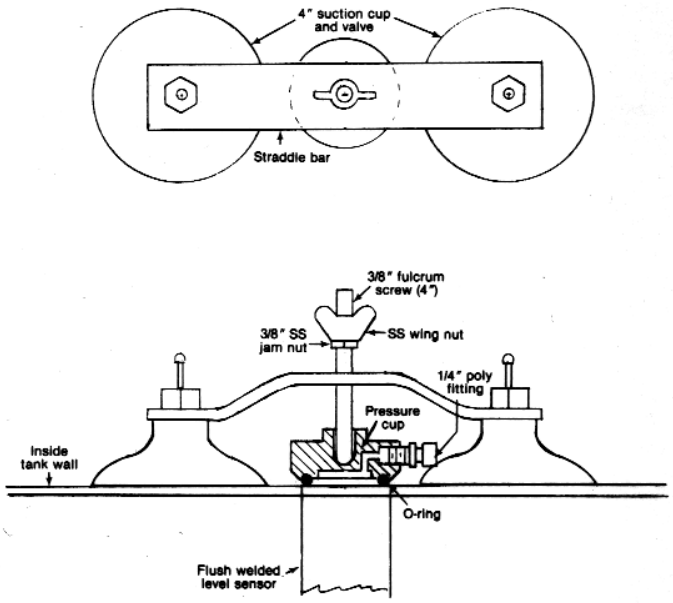
    If the controller range is 4 PSI, this is equivalent to 110″ of water. Do not exceed this pressure.

SUCTION CUP TEST PROCEDURE FOR TANK GAUGE CALIBRATION

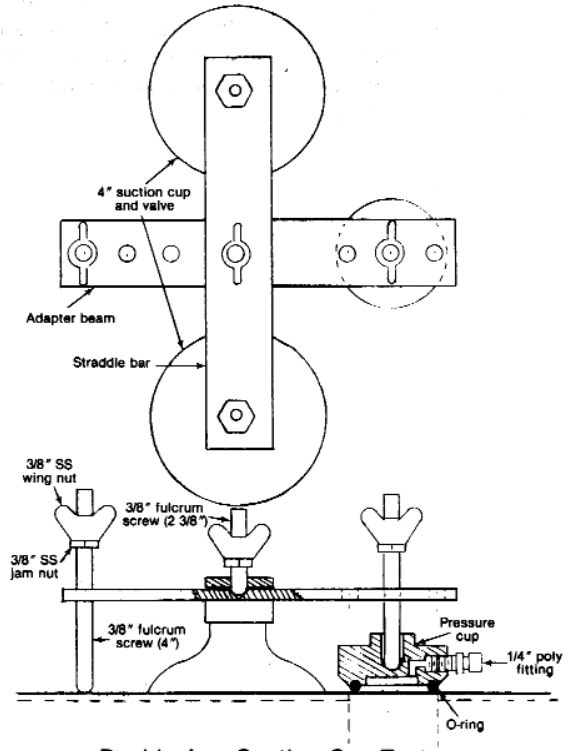
1. Inspect sensor diaphragm to insure that it is smooth and flat (if it is not, a new diaphragm should be installed).
2. Remove test gauge test cap. Upon removal of the test cap the gauge pointer should come to the zero mark. If it does not, remove the gauge glass on the front and reset the pointer to the zero mark using the micrometer screw at the center. Replace the test cap.
3. In order to check all components within the system, perform the Thumb Test: Having two people performing the test, one person should observe the gauge and the other enter the tank. Press the flat of the thumb against the center of the diaphragm. This will close off the exhaust and cause the gauge pointer to rotate upscale. When the pointer reads 100% of scale, release the thumb. The indicator should return to zero. The system is now pressure-tight and the suction cup test procedure can be performed. (Note: for more complete instructions on the Thumb Test, refer to Tank Mate Bulletin F112.)

ATTACHING THE SUCTION CUP TESTER

4. Select the appropriate suction cup tester (single or double arm) and attach it to the inside tank wall by positioning the pressure cup directly over the sensor diaphragm (as illustrated in Figures 1 and 2). Press the assembly down firmly to insure a seal between the pressure cup and the tank wall.

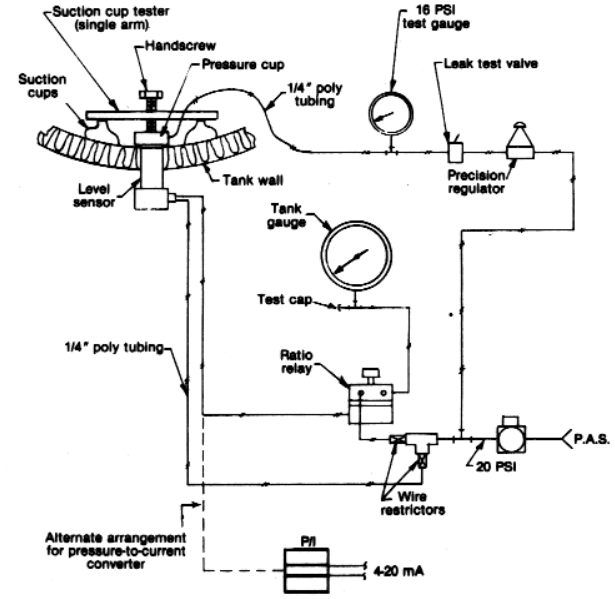


Single Arm Suction Cup Tester
Figure 1



Double Arm Suction Cup Tester
Figure 2

5. Connect ¼ " poly tubing from the pressure cup out to the test gauge, test valve and regulator as shown in Figure 3. Connect the regulator to an air supply—the air regulator output to the system may be a convenient source (see Figure 3).



Suction Cup Tester Hook-Up
Figure 3

PRESSURE SEAL

6. To determine if there is a seal between the pressure cup and the tank wall, adjust the regulator until the test gauge shows approximately 1 - 2 PSI. Next, close the leak test valve. The test gauge should hold steady. If it does not, release the air and readjust the test fixture to obtain a better seal. After a tight seal has been obtained calibration procedures can be performed.

CALIBRATION

7. At this point, it is necessary to use a copy of the calibration for the particular tank being tested. Using the tank calibration sheet, apply the pressure to the sensor shown as P1 or "Liquid Pressure". The gauge reading should correspond to the pressure being applied.

   Note: If there is a deviation between the actual reading and the true reading, adjust the Tank Tuner on the Ratio Relay and follow the directions as indicated in Tank Mate Bulletin F112.