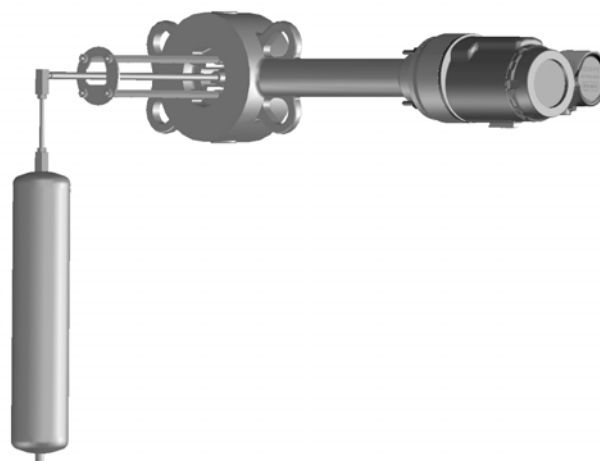


# Fisher™ 249VS Cageless Displacer Sensor

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Figure 1. Fisher 249VS Sensor with FIELDVUE™  
DLC3010/DLC3020f Digital Level Controller



W9355-1

## Introduction

### Scope of Manual

This instruction manual includes maintenance and parts ordering information for the cageless Fisher 249VS sensor.

Although a 249VS sensor is usually shipped with an attached controller or transmitter, this manual does not include operation, installation, calibration, maintenance, or parts ordering information for the controller/transmitter or for the complete unit. For this information, refer to the appropriate controller/ transmitter instruction manual.

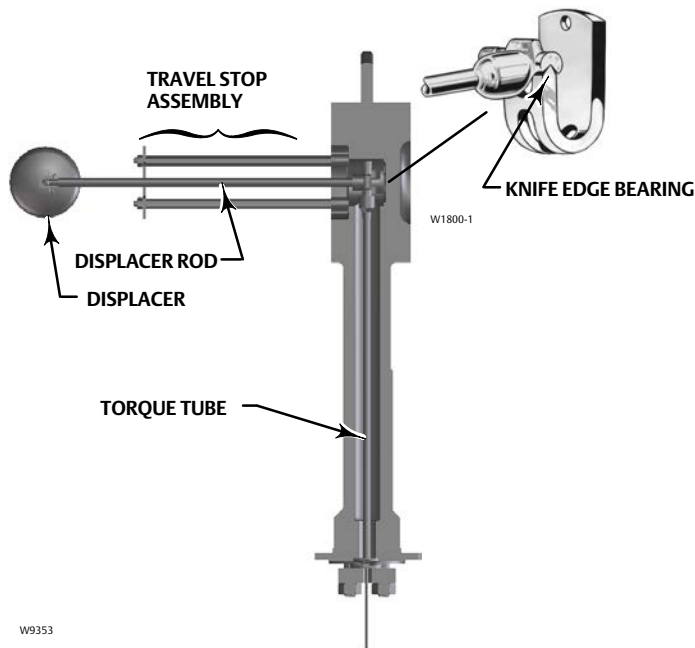
Do not install, operate, or maintain a 249VS sensor without being fully trained and qualified in valve, actuator, and accessory installation, operation, and maintenance. To avoid personal injury or property damage, it is important to carefully read, understand, and follow all of the contents of this manual, including all safety cautions and warnings. If you have any questions about these instructions contact your [Emerson sales office](#) or Local Business Partner before proceeding.

### Description

The 249VS sensor is designed to measure liquid level, interface level, or density/specific gravity inside a process vessel.

A torque tube assembly (figure 2) and displacer provide an indication of liquid level, interface level, or density/specific gravity. The torque tube assembly consists of a hollow torque tube with a shaft welded inside it at one end and protruding from it at the other end.

Figure 2. Side-Mounted Cageless Wafer-Style Sensor Assembly



The unconnected end of the tube is sealed by a gasket and clamped rigidly to the torque tube arm, permitting the protruding end of the shaft to twist and therefore transmit rotary motion. This allows the interior of the torque tube to remain at atmospheric pressure, thus eliminating packing and the disadvantages of packing friction.

The displacer always exerts a downward force on one end of the displacer rod. The other end of the displacer rod rests on the knife-edge of the driver bearing. A keyed shaft on the bearing end of the displacer rod fits into a socket on the outside of the welded end of the torque tube assembly.

A change in liquid level, interface level, or density/specific gravity buoys up the displacer by a force equal to the weight of the liquid displaced. Corresponding vertical movement of the displacer results in angular movement of the displacer rod around the knife edge. Since the torque tube assembly is a torsional spring which supports the displacer and determines the amount of movement of the displacer rod for a given displacement change, it will twist a specific amount for each increment of buoyancy change. This rotation is brought through the torque tube arm by the protruding rotary shaft. A controller or transmitter attached to the end of the rotary shaft converts the rotary motion into varying pneumatic or electric signals. Figure 3 shows how the controller or transmitter mounts on the torque tube arm.

The 249VS wafer-style sensor mates with cast iron CL125 flat face and CL250 raised face flanges, and CL150, 300, 600, 900, and 1500 raised face steel flanges. The 249VS is also available with CL600, 900, 1500, and 2500 butt weld end process connections.

Unless otherwise noted, all NACE references are to NACE MR0175-2002.

The Parts List section shows some standard 249VS displacer lengths and materials. Table 1 contains displacer and torque tube materials. However, 249VS parts are available in a wide variety of materials of construction, part dimensions, and other specifications. Contact your [Emerson sales office](#) or Local Business Partner for assistance in selection of specific materials, dimensions, and specifications.

Figure 3. Torque Tube Arm Exploded View Showing Controller or Transmitter Mounting

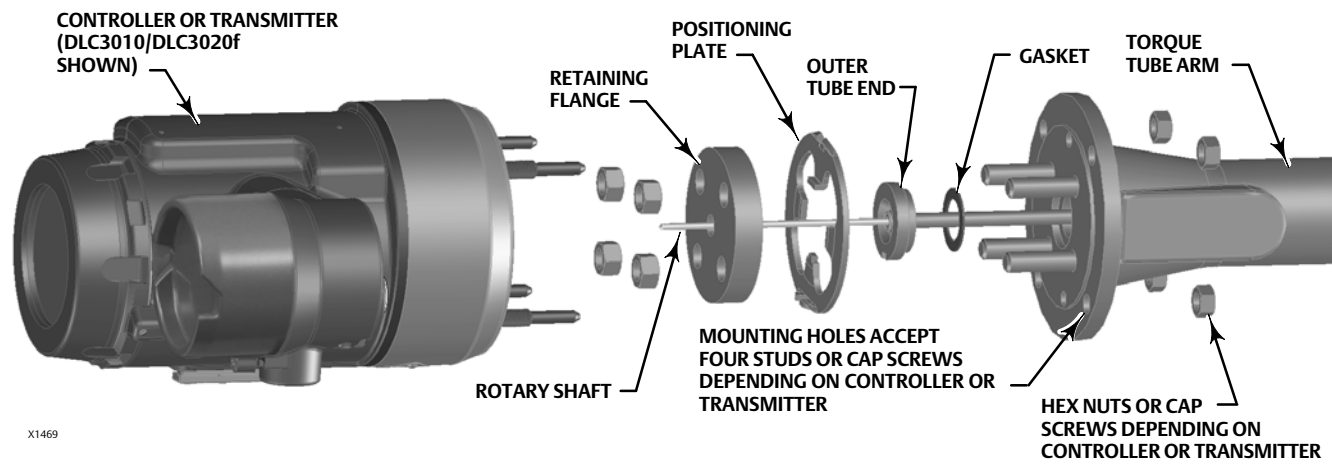


Table 1. Displacer and Torque Tube Materials

Part	Standard Material	Other Materials
Displacer	304 Stainless Steel	316 Stainless Steel, N10276, N04400, Plastic, and Special Alloys
Displacer Stem, Driver Bearing, Displacer Rod and Driver	316 Stainless Steel	N10276, N04400, other Austenitic Stainless Steels, and Special Alloys
Torque Tube	N05500 <sup>(1)</sup>	316 Stainless Steel, N06600, N10276

1. N05500 is not recommended for spring applications above 232°C (450°F). Contact your Emerson sales office or application engineer if temperatures exceeding this limit are required.

## Educational Services

For information on available courses for 249VS sensors, as well as a variety of other products, contact:

Emerson Automation Solutions  
 Educational Services - Registration  
 Phone: 1-641-754-3771 or 1-800-338-8158  
 E-mail: education@emerson.com  
<http://www.emerson.com/en-us/automation/services-consulting/educational-services>



## Installation

### ⚠ WARNING

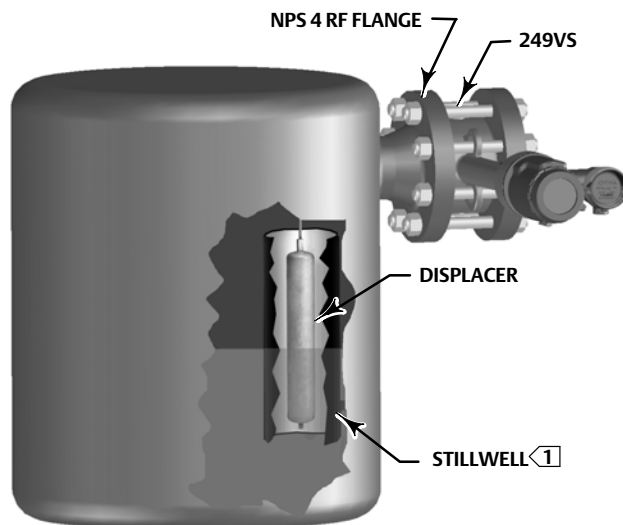
To avoid personal injury or property damage resulting from the sudden release of pressure:

- Always wear protective clothing, gloves, and eyewear when performing any installation operations.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.
- If installing into an existing application, also refer to the WARNING at the beginning of the Maintenance section of this instruction manual.

The 249VS is installed directly on the vessel as shown in figure 4. The sensor mounts on the side of the vessel using an NPS 4 flat face or raised face flange.

Because the displacer hangs inside the vessel, provide a stillwell around the displacer if the fluid is in a state of constant agitation to avoid excessive turbulence around the displacer. For interface or fluid level applications, install a gauge glass on the vessel.

Figure 4. Fisher 249VS Sensor Side Mounted on Vessel



NOTE:  
 1 STILLWELL REQUIRED AROUND DISPLACER IF THE FLUID IS IN A STATE OF CONTINUOUS AGITATION  
 W9356-1

## Mounting the Sensor on the Process Vessel

### CAUTION

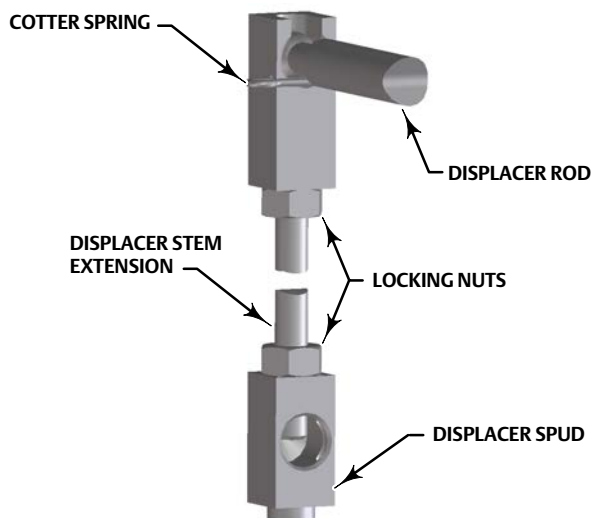
**If inserting the displacer into the vessel before attaching it to the displacer rod, provide a means of supporting the displacer to prevent it from dropping into the vessel and being damaged.**

Install the sensor wafer body on the vessel using the following procedure.

Attach the displacer to the displacer rod (see figure 5) before installing the sensor on the vessel.

1. Place a connecting flange gasket on the sensor assembly.
2. Install four line flange studs and nuts in the connecting flange at locations that correspond to the sensor mounting lug locations.

Figure 5. Displacer and Displacer Rod Connections



3. Insert the displacer and the 249VS sensor into the process connection/vessel.
4. Place a blind flange on the back of the sensor and lightly secure (tightening nuts enough to hold wafer body and gasket in place) using four line flange bolt nuts, centering the connecting flange gasket and sensor on the vessel connecting flange.
5. Install the remaining line flange bolts and nuts.
6. Tighten all nuts in a crisscross fashion.

## Maintenance

Sensor parts are subject to normal wear and must be inspected regularly and replaced as necessary. The frequency of inspection and replacement depends upon the severity of service conditions.

### **⚠ WARNING**

Always wear protective clothing, gloves, and eyewear when performing any maintenance operations to avoid personal injury.

Avoid personal injury or property damage resulting from the sudden release of pressure. Before performing any maintenance procedure:

- Relieve any process pressure in the process vessel where the 249VS sensor is installed.
- Drain the process liquid from the process vessel.
- Shut off any electrical or pneumatic input to the controller or transmitter attached to the 249VS sensor and vent any pneumatic supply pressure.
- Use caution when loosening flange bolting.
- Remove the controller or transmitter from the torque tube arm (key 1).

Before performing any maintenance procedure requiring the handling of the displacer, inspect the displacer (key 9) to make sure process pressure or liquids have not penetrated the displacer.

The displacer in this unit is a sealed container. If penetrated by process pressure or liquid, the displacer may hold pressure or hazardous liquid for an extended period. A displacer that has been penetrated by process pressure or liquid may contain:

- pressure as a result of being in a pressurized vessel.
- liquid that becomes pressurized due to a change in temperature.
- liquid that is flammable, hazardous, or corrosive.

Sudden release of pressure, contact with hazardous liquid, fire, or explosion, which might result in personal injury or property damage, can occur if a displacer that is retaining pressure or process liquid is punctured, subjected to heat, or repaired.

Handle the displacer with care. Damage to the displacer will decrease its ability to withstand process pressure.

Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

---

#### Note

Except for gaskets (key 7), trouble symptoms peculiar to specific parts are discussed in the following sections. Each section is specific to these parts. Gasket failure is indicated by leakage in the gasket area. Every time a gasket is removed, replace it with a new one upon reassembly.

---

Refer to figure 8 or 9 for key number locations.

## Removing the Displacer and Stem

The displacer (key 9) is a sealed container. If the displacer has been penetrated by process pressure or liquid, it may hold pressure or hazardous liquid for an extended period.

Process residue buildup on the displacer and stem (key 19) may change displacer weight or displacement. A bent stem or a dented or corroded displacer can impair performance.

If the displacer rests against the travel stop, appears to be overweight, or causes output drift or other output inaccuracies, it may have been penetrated by process pressure or liquid. Such a displacer may contain pressure because it was in a pressurized vessel, may contain process liquid that becomes pressurized due to a change in temperature, and may contain process liquid that is flammable, hazardous, or corrosive.

### **▲ WARNING**

**Sudden release of pressure, contact with hazardous liquid, fire, or explosion, which may result in personal injury or property damage, can occur if a displacer that is retaining pressure or process liquid is punctured, subjected to heat, or repaired.**

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Handle the displacer with care.

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#### Note

On a 249VS with travel stop, the displacer must come out with the torque tube arm (key 1) before being completely disconnected from the displacer rod assembly (key 14). If separating the displacer and displacer rod, remove the cotter spring (key 8).

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**CAUTION**

Be careful not to let the displacer slip and drop into the bottom of the process vessel, as displacer damage could result.

When removing a sensor assembly from a process vessel, the displacer may remain attached to the displacer rod and removed with the sensor assembly.

If the displacer is removed with the sensor assembly, be careful not to damage the displacer or bend the displacer stem when setting the sensor assembly down.

If separating the displacer and displacer stem during the removal of the sensor assembly from the process vessel, remove the cotter spring (key 8) and separate the displacer/displacer stem from the sensor assembly.

Be careful not to let the displacer slip and drop into the bottom of the process vessel, as displacer damage could result.

1. Before starting any maintenance procedure, be sure the following safety actions are completed.
  - Relieve process pressure in the process vessel where the 249VS sensor is installed.
  - Drain the process liquid from the process vessel.
  - Shut off any electrical or pneumatic input to the controller or transmitter attached to the 249 sensor and vent any pneumatic supply pressure. Remove the controller or transmitter from the torque tube arm.
  - Use caution when loosening flange bolting or pipe plugs.
  - Be sure process pressure or liquids have not penetrated the displacer.

2. Carefully remove the torque tube arm.

3. On the 249VS, the travel stop plate can be located in one of four positions, as shown in figure 6.

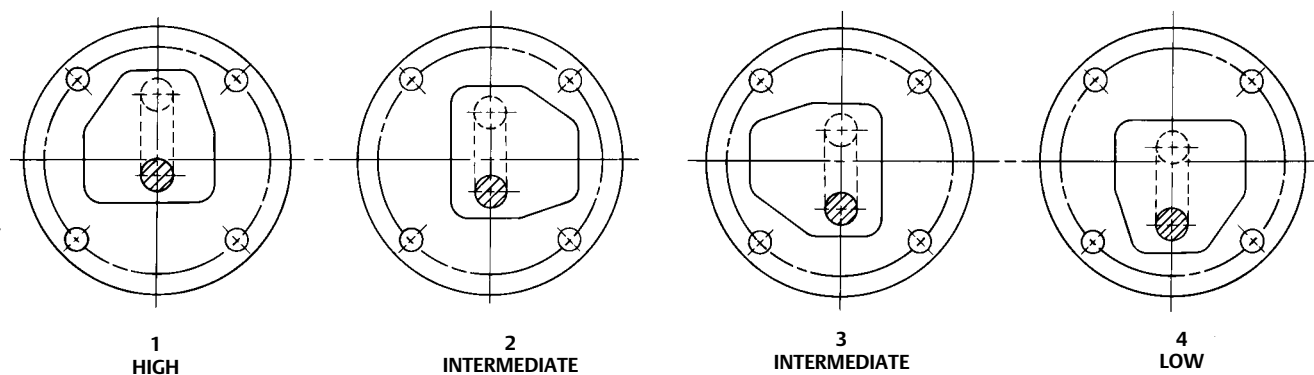
For proper operation in the target application, the displacer rod must not touch either plate over the expected range of process conditions.

- When the displacer is completely submerged in the upper fluid, the net load of weight minus buoyancy must be low enough to allow the displacer rod to be above the lower plate.
- When the displacer is completely submerged in the lower fluid, the net load of weight minus buoyancy must be high enough to keep the displacer rod from hitting the upper plate.

If necessary, remove the plate and choose a position where the rod will not touch the plate.

4. Follow the procedure for replacing the displacer, displacer rod assembly, cotter spring, stem end piece, and displacer spud as necessary.

Figure 6. Fisher 249VS Travel Stop Plate Positions



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## Replacing the Displacer, Cotter Spring, Stem End Piece, and Displacer Spud

The cotter spring (key 8), the ball on the displacer rod/driver assembly (key 14), and the stem end piece or displacer stem connector (key 18) may be either too worn for a secure connection or so clogged or corroded that the displacer does not pivot properly. Replace these parts, as necessary.

### CAUTION

**If the displacer is to be disconnected from the displacer rod/driver assembly before being removed from the process vessel, provide a suitable means of supporting the displacer to prevent it from dropping into the process vessel and being damaged.**

1. After following the proper procedure to remove the torque tube arm assembly and the displacer from the process vessel, move the sensor assembly to a suitable maintenance area. Support the assembly to avoid damage to the displacer, displacer stem, displacer rod assembly, and associated parts.
2. Reach the cotter spring, displacer spud, ball end of the displacer rod/driver assembly, stem end piece, or displacer stem connector as follows:  

Remove the process vessel bolting and pull out the torque tube arm assembly (key 1). The inside of the process vessel wall will cause the displacer to swing up so it can be pulled out through the vessel opening.
3. Remove the cotter spring to free the displacer or stem end piece from the ball end of the displacer rod/driver assembly. Lift the displacer or stem end piece from the ball.
4. Replace worn or damaged parts as necessary. Return the displacer or stem end piece to the displacer rod/driver assembly. Install the cotter spring.
5. Install the controller/transmitter. Calibrate the controller/transmitter following the procedures given in the controller/transmitter instruction manual.

## Replacing the Displacer Rod/Driver Assembly

The ball on the displacer rod/driver assembly (key 14) may be either too worn for a secure connection or so corroded that the displacer does not pivot properly. Replace the displacer rod/driver assembly, if necessary.

### CAUTION

**If the displacer is to be disconnected from the displacer rod before being removed from the process vessel, provide a suitable means of supporting the displacer to prevent it from dropping into the process vessel and being damaged.**

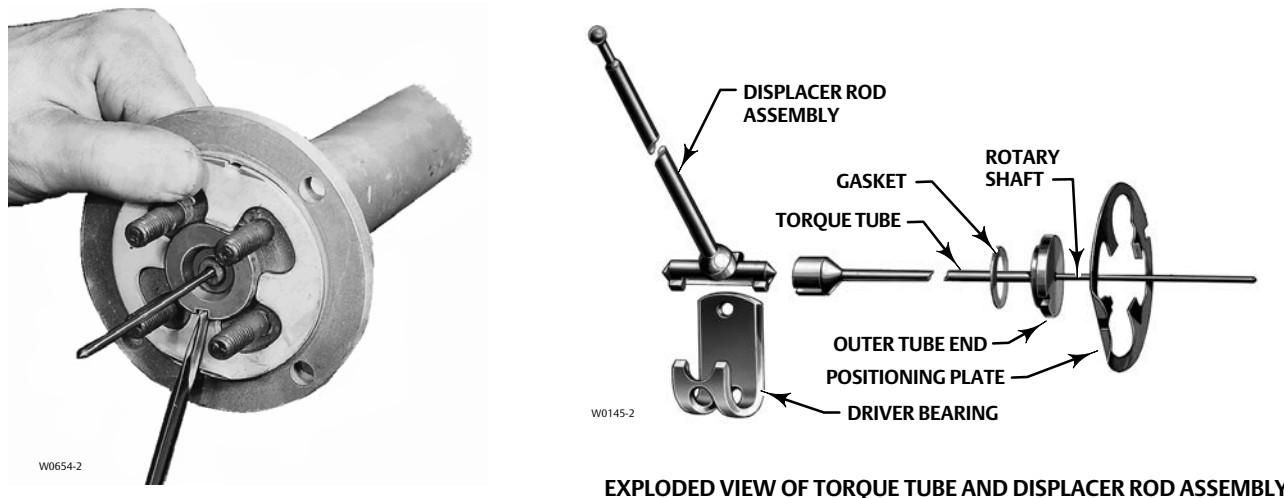
1. After following the proper procedure to remove the torque tube arm assembly and the displacer from the process vessel, move the sensor assembly to a suitable maintenance area. Support the assembly to avoid damage to the displacer, displacer stem, displacer rod assembly, and associated parts.
2. Remove the controller/transmitter and displacer (key 9).
3. Remove the nuts (key 13) and retaining flange (key 12) at the end of the torque tube arm.
4. Remove the positioning plate (key 21) by freeing its two lugs.

The vertical lug fits into a hole in the flange of the torque tube arm (top of figure 7, left). The horizontal lug (hidden behind the screwdriver at the bottom of figure 7, left) fits into a slot in the outer tube end of the torque tube assembly (the figure 7 exploded view shows this lug to the right of the outer tube end).



Place a screwdriver blade in the slots of the positioning plate and outer tube end as shown in figure 7. Slowly turn the positioning plate to release its lug from the torque tube arm. Then carefully turn the plate back to allow the displacer to come to rest, and slip the other lug of the plate from its slot in the outer tube end.

Figure 7. Torque Tube and Displacer Rod Assemblies



**REMOVAL OR INSTALLATION OF POSITIONING PLATE**

5. Pull the torque tube assembly out of the torque tube arm. Remove the tube end gasket (key 17) and discard (a new gasket will be installed in step 9). Clean and inspect the gasket mating surfaces.
6. Using the proper tool, loosen and then remove the upper bearing driver bolt (key 4). Lift the displacer rod/driver assembly from the knife edge of the driver bearing (key 3).
7. Visually inspect the bearing driver for corrosion or wear. If replacement is necessary, remove the bearing driver by removing the lower bearing driver bolt. Install a new bearing driver and the lower bearing driver bolt.
8. Install the new displacer rod/driver assembly on the knife edge of the bearing driver. Install the upper bearing driver bolt (key 4), but do not tighten.
9. Insert new tube end gasket into recess in torque tube arm.
10. Insert the torque tube assembly and rotate until its socket mates with the displacer rod assembly and so that the outer tube flange rests against the gasket.
11. With a thumb on the upper portion of the positioning plate and a screwdriver in the slots as shown in figure 7, rotate the plate and press the lug on the plate into the hole in the torque tube arm (this will preload the torque tube).
12. Install the retaining flange and secure it with four nuts (key 13), being sure to tighten all nuts evenly.
13. Tighten the upper bearing driver bolt (key 4). It will be necessary to put slight pressure on the displacer rod/driver assembly to access the upper bearing driver bolt.
14. Install the controller/transmitter. Calibrate the controller/transmitter following the procedures given in the controller/transmitter instruction manual.

## Replacing the Torque Tube

Corrosion or leakage through the outer end of the torque tube is evidence of deterioration in the torque tube assembly (key 10) or torque tube end gasket (key 17). Erratic or nonexistent rotary shaft output may occur if the socket on the inner end of the torque tube assembly does not engage the bearing end of the displacer rod assembly (key 14).

**CAUTION**

**Support the sensor assembly to avoid damage to the displacer, displacer stem, displacer rod assembly, and associated parts.**

1. After following the proper procedure to remove the sensor assembly from the process vessel, move the sensor assembly to a suitable maintenance area.
2. Remove the controller/transmitter and displacer (key 9).
3. Remove the nuts (key 13) and retaining flange (key 12) holding the positioning plate (key 21) at the end of the torque tube arm.

**CAUTION**

**If the displacer is still attached to the displacer rod at this point, be careful not to let the torque tube assembly slip when using the screwdriver leverage procedure in steps 4 and 6. Sudden release of the displacer would cause damage.**

4. Remove the positioning plate (key 21) by freeing its two lugs.

The vertical lug fits into a hole in the flange of the torque tube arm (top of figure 7). The horizontal lug (hidden behind the screwdriver at the bottom of figure 7) fits into a slot in the outer tube end of the torque tube assembly (the figure 7 exploded view shows this lug to the right of the outer tube end).

The positioning plate may be pried away from the torque tube arm and outer tube end if the displacer already has been disconnected from the displacer rod. However, if the displacer is still connected to the displacer rod, place a screwdriver blade in the slots of the positioning plate and outer tube end as shown in figure 7. Slowly turn the positioning plate to release its lug from the torque tube arm. Then, carefully turn the plate back to allow the displacer to come to rest and slip the other lug of the plate from its slot in the outer tube end.

5. Pull the torque tube assembly and tube end gasket out of the torque tube arm. Remove the tube end gasket (key 17) and discard (a new gasket will be installed in step 6). Clean and inspect the gasket mating surfaces.
6. Install a new tube end gasket into recess in torque tube arm.
7. Insert the torque tube assembly into the torque tube arm as shown in figure 7. Rotate the torque tube assembly until its socket mates with the driver member on the displacer rod assembly and so the outer tube flange rests against the gasket. With a thumb on the upper portion of the positioning plate and a screwdriver in the slots as shown in figure 7, rotate the plate and press the lug on the plate into the hole in the torque tube arm (this will preload the torque tube).
8. Install the retaining flange and secure it with four nuts (key 13), being sure to tighten all nuts evenly.
9. Install the sensor head and controller/transmitter. Calibrate the controller/transmitter following the procedures given in the controller/transmitter instruction manual.

## Replacing the Torque Tube Arm and Changing the Mounting Position

Looseness of the driver bearing (key 3), wear on its knife-edged surface, or a bent, worn, or corroded displacer rod assembly (key 14) may impair performance. Be especially sure to check the ball on the displacer rod.

**CAUTION**

**Support the sensor assembly to avoid damage to the displacer, displacer stem, displacer rod assembly, and associated parts.**

1. After following the proper procedure to remove the sensor assembly and the displacer from the process vessel, move the sensor assembly to a suitable maintenance area.
2. Remove the controller/transmitter and displacer/displacer stem (key 9).
3. Follow the proper procedure to remove the torque tube assembly (key 10).
4. Remove the bearing bolts (key 4), displacer rod assembly, and driver bearing.

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**Note**

Be sure to install the driver bearing so its knife edge is pointing up when the torque tube arm is mounted in the desired orientation. Since changing the mounting position of the torque tube arm by 180° will change controller or transmitter action from direct to reverse or vice versa, controller/transmitter action must be reversed from what it was before the mounting method was changed.

---

5. Install the bearing driver and the lower bearing bolt into the torque tube arm. Place the rod/driver assembly on the knife-edged surface of the driver bearing. Install the bolt and tighten both the top and the bottom bearing bolts.
6. Install a new tube end gasket (key 17) and torque tube into the torque tube arm. Install the controller/transmitter and attach the displacer/displacer stem to the rod/driver assembly.
7. Install the sensor assembly to the process vessel and calibrate the controller/transmitter following the procedures given in the controller/transmitter instruction manual.
8. Calibration of the controller/transmitter can be done prior to installing of the sensor assembly to the process vessel using the simulation of process conditions method.

## Simulation of Process Conditions for Calibration of Fisher Level Controllers and Transmitters

Contact your Emerson sales office or Local Business Partner for information on obtaining the Supplement to 249 Sensor Instruction Manuals—Simulation of Process Conditions for Calibration of Fisher Level Controllers and Transmitters ([D103066X012](#)), or visit our website at [Fisher.com](#).

## Parts Ordering

When corresponding with your Emerson sales office or Local Business Partner about this equipment, always refer to the sensor serial number. Each sensor is assigned a serial number which is stamped on a nameplate (key 54, not shown) attached to the torque tube arm. This same number also appears on the controller/ transmitter nameplate when a complete controller/ transmitter-sensor unit is shipped from the factory.

### **⚠ WARNING**

**Use only genuine Fisher replacement parts. Components that are not supplied by Emerson Automation Solutions should not, under any circumstances, be used in any Fisher instrument. Use of components not supplied by Emerson Automation Solutions may void your warranty, might adversely affect the performance of the instrument, and could cause personal injury or property damage.**

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## Parts Kits

Description	Part Number
Sensor Part Kit Kit contains keys 8, 10, 17	R249VSX0012

## Parts List

### Note

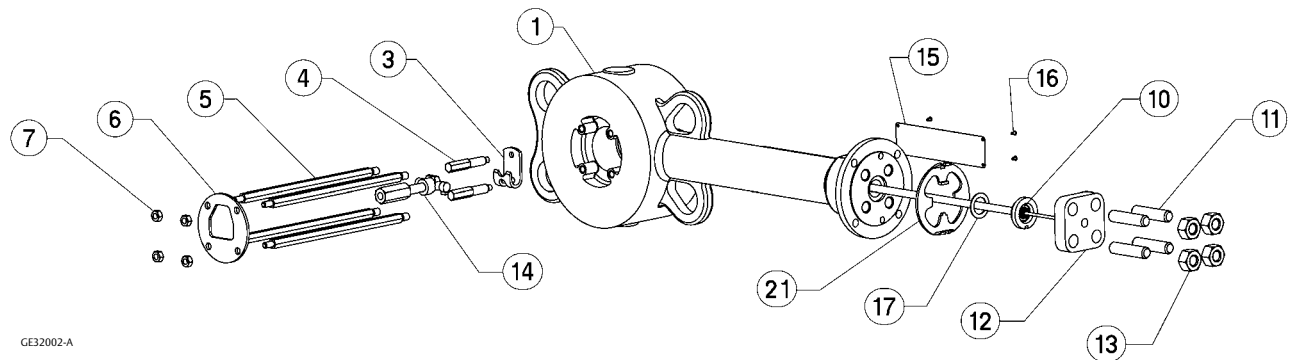
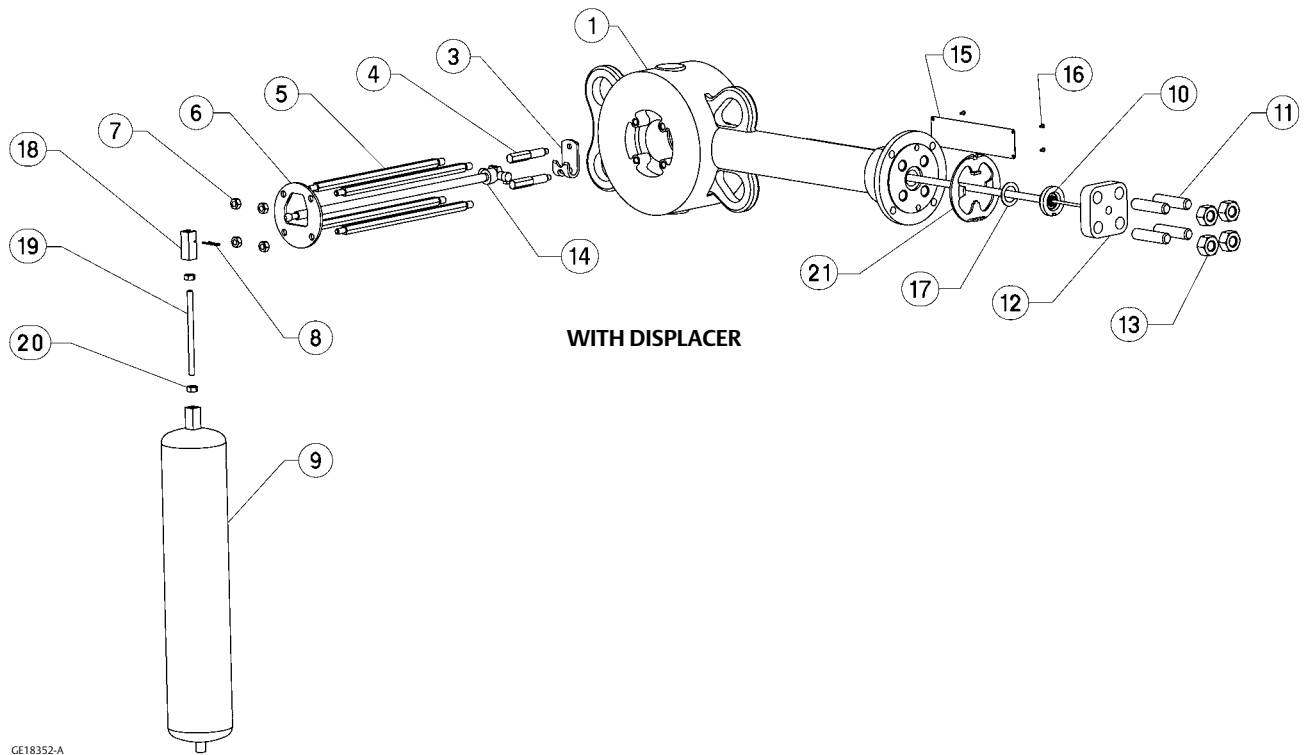
Contact your [Emerson sales office](#) or Local Business Partner for Part Ordering information.

Key Description

## Sensor Parts

Key	Description	Part Number
5	Travel Stop Post (4 req'd) 410 / 416 SST, annealed 316 SST, annealed	
6	Travel Stop Carbon Steel 316 SST, annealed	
7	Nut (4 req'd) Carbon Steel S31600	
8*	Cotter Spring N04400 N10276	
9*	Displacer 3 inch x 10 inches (1600 psi), S30400 (vertical or horizontal mounting) 3 inch x 10 inches (1600 psi), S31603 (NACE) (vertical or horizontal mounting) 3 inch x 14 inches (1600 psi), S30400 3 inch x 14 inches (1600 psi), S31600 3 inch x 14 inches (1500 psi), S31603 (NACE) 2 inch x 32 inches (1500 psi), S30400 2 inch x 32 inches (1500 psi), S31600 2 inch x 32 inches (1500 psi), S31603 (NACE) 1.375 inch x 48 inches (1800 psi), S30400 1.5 inch x 60 inches (1800 psi), S30400	
10*	Torque Tube Assembly Standard Wall N05500 (NACE) N10276 N06600 S31600 Thin Wall N05500 (NACE) N06600 S31600	
11	Stud Bolt (4 req'd) SA193 Grade B7 / NCF2 SA193 Grade B7M / NCF2 B8M Class 2	
12	Retaining Flange, carbon steel	
13	Hex Nut (4 req'd) SA194-2H / NCF2 (NACE) SA194-2HM / NCF2 (NACE) SA194 Grade 8M	
14	Rod & Driver ,w/vertical displacer 316 SST (NACE) N04400 N10276  Spud & Driver, w/vertical displacer or no displacer, 316 SST (NACE)  Rod, w/vertical displacer 316 SST, annealed (NACE)  Rod & Driver horizontal mounting 316 SST (NACE)	
1	Torque Tube Arm CL125, CL150 FF, CL150 through1500 RF WCC LCC CF8M (316 SST) CL600, 900, 1500, 2500, Butt Weld End WCC LCC CF8M (316 SST)	
3	Driver Bearing Use <b>with</b> displacer stem and standard displacer for vertical mounting S31600 ASME SA-240 (NACE) N04400 N10276 Use <b>without</b> displacer stem with displacers for vertical / horizontal mounting S31600 ASME SA-240 (NACE)	
4	Driver Bearing Bolt (2 req'd) Use <b>with</b> displacer stem and standard displacer for vertical mounting 316 SST, annealed (NACE) N04400 N10276 Use <b>without</b> displacer stem with displacers for vertical / horizontal mounting 316 SST, annealed (NACE)	

**Figure 8. Fisher 249VS Sensor Construction; Flanged Connections**

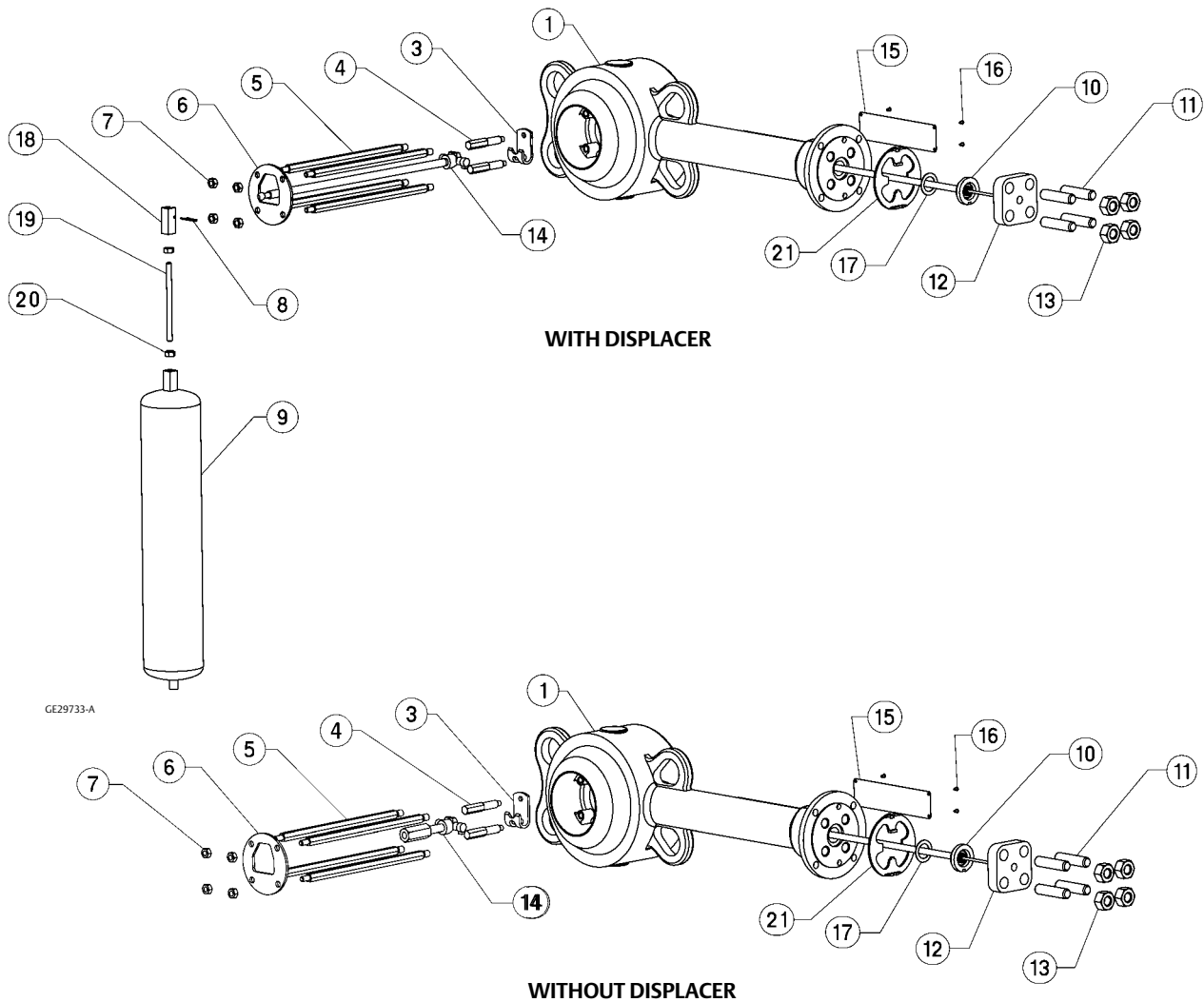


Key	Description
15	Nameplate
16	Drive Screw (4 req'd), 18-8 SST
17*	Tube End Gasket N04400/PTFE Flexible Graphite

Key	Description
18	Stem End Piece use with displacer stem and standard displacer for vertical mounting 316 SST, annealed (NACE) N04400 N10276
	Rod Connector use <i>without</i> displacer stem with standard displacers for vertical mounting 316 SST, annealed (NACE)

\*Recommended spare parts

Figure 9. Fisher 249VS Sensor Construction; Butt Weld End



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Key	Description
19	Displacer Stem
20	Hex Nut (2 req'd) use with displacer stem and standard displacer for vertical mounting S31600 (NACE) N04400 N10276

Key	Description
21	Positioning Plate, zn pl steel
22	Tag, NACE (not shown)
23	Seal Wire (not shown)



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