

Rosemount 3159 Nuclear Qualified Remote Diaphragm Seal



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Rosemount 3159 Remote Diaphragm Seal

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum performance, make sure you thoroughly understand the contents of this manual before installing, using or maintaining this product.

For Assistance:

Within the United States, contact Rosemount Nuclear Instruments, Inc. (RNII) at 1-952-949-5210.

Outside the United States, contact the nearest Rosemount representative.

Customer Feedback:

Your feedback is important to us, please send comments or suggestions to:
Chan.RNII-CustomerFeedback@Emerson.com



Rosemount Nuclear Instruments, Inc. satisfies all obligations coming from legislation to harmonize product requirements in the European Union

Rosemount Nuclear Instruments, Inc. Warranty and Limitations of Remedy

The warranty and limitations of remedy applicable to this Rosemount equipment are as stated on the reverse side of the current Rosemount quotation and customer acknowledgment forms.

RETURN OF MATERIAL

Authorization for return is required from Rosemount Nuclear Instruments, Inc. prior to shipment. Contact Rosemount Nuclear Instruments, Inc. (1-952-949-5210) for details on obtaining Return Material Authorization (RMA). **Rosemount Nuclear Instruments, Inc. will not accept any returned material without a Return Material Authorization.** Material returned without authorization is subject to return to customer.

Material returned for repair, whether in or out of warranty, should be shipped prepaid to:

Rosemount Nuclear Instruments, Inc.
8200 Market Boulevard
Chanhassen, MN 55317
USA

IMPORTANT

The Nuclear Qualified Rosemount 3159 Remote Diaphragm Seal is designed for Nuclear Class 1E usage, and has been tested to the standards shown below:

- IEEE Std 323TM-1974/1983/2003
- IEEE Std 344TM-1975/1987/2004

Rosemount 3159 Remote Diaphragm Seals are manufactured under a quality system that meets the requirements of ISO 9001, 10CFR50 Appendix B, ASME NQA-1, CSA Z299.1 and the applicable portions of IAEA-50-C-Q. During qualification testing, interfaces were defined between transmitter/remote seal system and the surrounding environment that are essential to meeting requirements of the qualification standards listed above. Specifically, to ensure compliance with 10CFR Part 21, the transmitter/remote seal system must comply with the requirements herein and in the applicable Rosemount qualification report(s) throughout its installation, operation and maintenance. It is incumbent upon the user to ensure that Rosemount Nuclear Instruments, Inc.'s component traceability program is continued throughout the life of the equipment.

In order to maintain the qualified status of the transmitter/remote seal system, the essential environmental interfaces must not be compromised. Performance of any operations on the remote seal system other than those specifically authorized in this manual has the potential for compromising an essential environmental interface. **Where the manual uses the terms requirement, mandatory, must or required, the instructions so referenced must be carefully followed.** Rosemount Nuclear Instruments, Inc. expressly disclaims all responsibility and liability for transmitter/remote seal systems for which the foregoing has not been complied with by the user.

Revision Status

Changes from October 2012 (Rev AA) to August 2017 (Rev. AB)

Page (Rev AA)	Page (Rev AB)	Changes
Cover, throughout	Cover, throughout	Document revision change from October 2012 Rev AA to August 2017 Rev AB, updated document formatting, and removed outdated information regarding the 3159 Remote Seal qualification program.
2-2	4	Updated Figure 2-2 to depict current capillary support tube.
NA	5	Added Figure 2-3.
2-3	6	Added information on Temperature Head Effects.
3-4	11	Updated Figure 3-1 to depict current capillary support tube.
3-3 – 3-4	10 – 13	Updated Remote Seal / Lower Housing Assembly Procedure to include instructions for installing Rosemount spares kit P/N 03159-5904-0003.
5-1	19	Updated Table 5-1 to include all current Rosemount Spares Kits for the 3159 Remote Seal.

NOTE

The above Revision Status list summarizes the changes made. Please refer to both manuals for complete comparison details.

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SECTION 1:

USING THIS MANUAL

Introduction

This manual is designed to assist in installing, operating, and maintaining the Rosemount 3159 Remote Diaphragm Seal. The manual contains supplemental information about the remote seal assemblies that are not covered in the corresponding transmitter manuals.

The information is organized into the following categories:

Section 2: Performance

Explains key drivers of functional performance.

Section 3: Installation

Provides mechanical installation considerations of the remote seal system.

Section 4: Maintenance

Provides basic hardware maintenance considerations for the 3159 remote seal.

Section 5: Spare Parts Ordering Information

Lists available spares kits.

The Rosemount 3159 Remote Diaphragm Seal is intended for use in nuclear power stations where stringent quality control of design and manufacturing processes is necessary to ensure high reliability over an extended service life. The 3159 remote seal can be supplied with all Rosemount 3150 Series nuclear pressure transmitters.

Uses for the remote seal include applications where the environment is unsuitable for instrumentation or where a wet leg reference is required.

NOTE

Refer to Rosemount Qualification/Test Reports and Product Data Sheets for details on testing, performance specifications and dimensional drawings.

Installation, operation, maintenance, and warranty information for Rosemount 3150 Series nuclear pressure transmitters can be found in the applicable reference manual. This supplemental manual provides information regarding the use of the Rosemount 3159 Remote Diaphragm Seal. Use this manual in conjunction with the transmitter reference manual.

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OVERVIEW

This section contains the following considerations:

- Remote Seal System
- Understanding Seal System Performance
 - Temperature Effects
 - System Time Response
 - Static Head Effects
 - Temperature Head Effects

REMOTE SEAL SYSTEM

A remote seal system consists of a pressure transmitter, a remote seal, and a capillary assembly filled with a secondary fill fluid.

During operation, the thin, flexible diaphragm and remote seal fill fluid separate the pressure sensor of the transmitter from the process medium. The capillary tubing connects the diaphragm to the transmitter.

When process pressure is applied, the diaphragm is displaced, transferring the measured pressure through the filled system, by way of the capillary tubing, to the transmitter. This transferred pressure displaces the sensing diaphragm in the pressure sensor of the transmitter. This displacement is proportional to the process pressure and is converted electronically to a 4-20 mA output signal.

Figure 2-1 Rosemount 3159 Exploded View

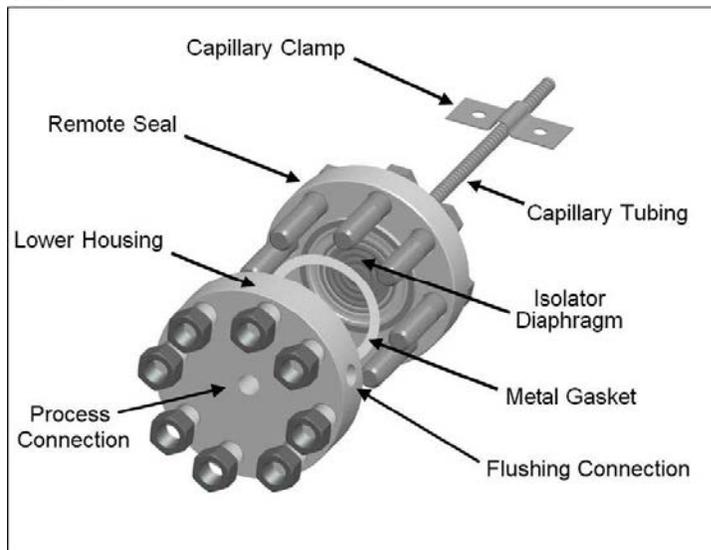
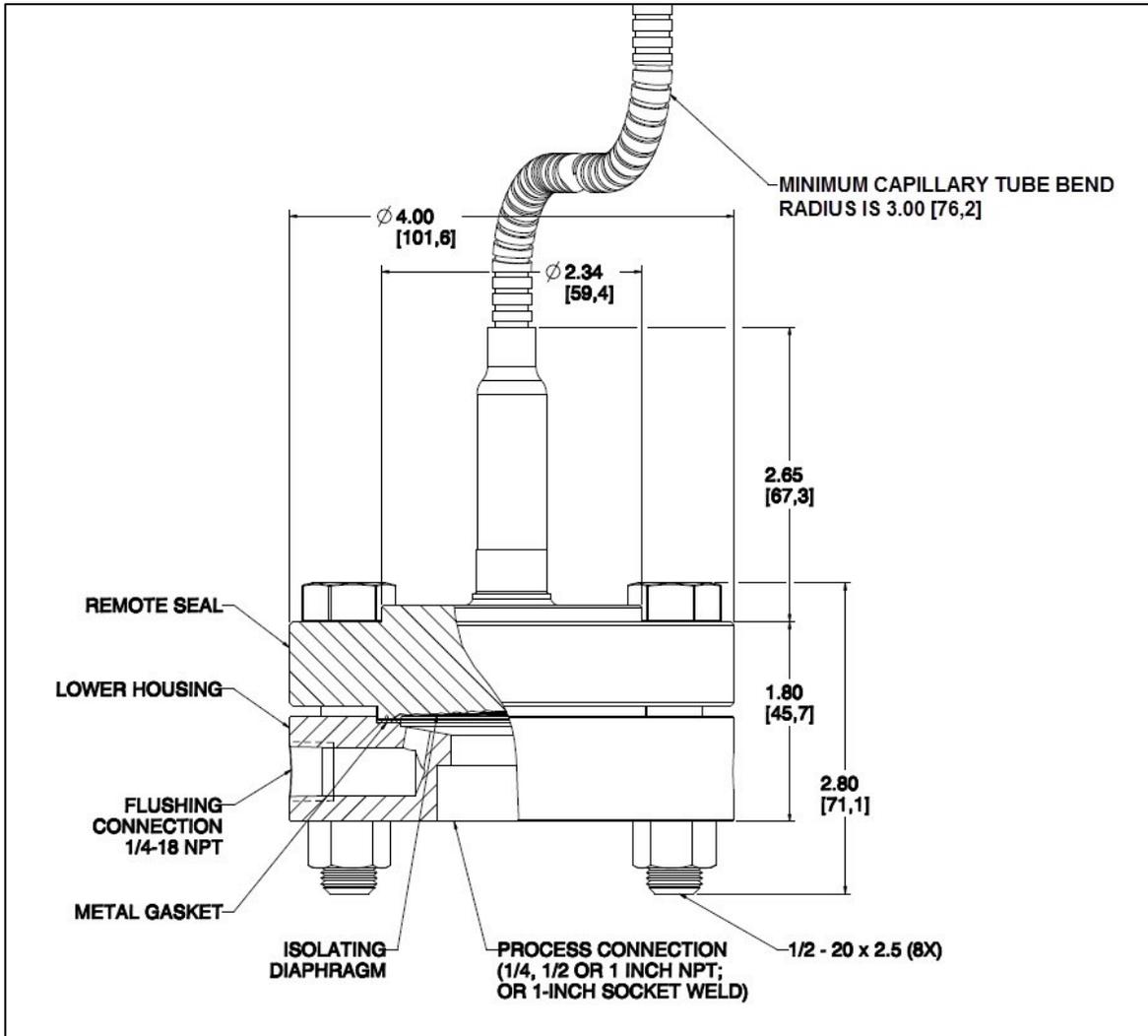
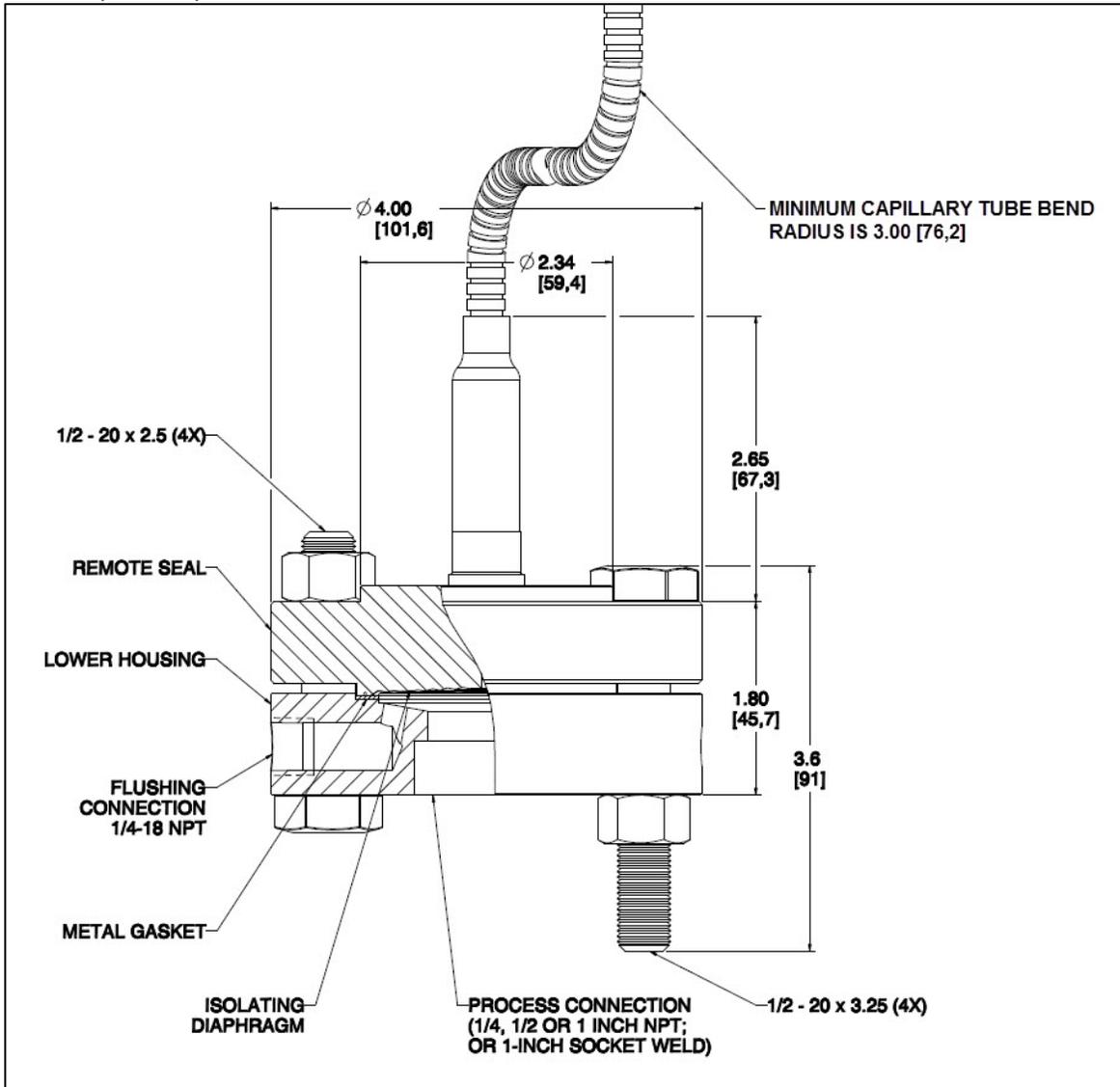


Figure 2-2 – Rosemount 3159
Remote Seal / Lower Housing
Dimensions



NOTE: All dimensions are nominal in inches (millimeters)

Figure 2-3 – Rosemount 3159
 Remote Seal / Lower Housing with
 S0201 Special Option Dimensions



NOTE: All dimensions are nominal in inches (millimeters)

UNDERSTANDING SEAL SYSTEM PERFORMANCE

The performance of a remote diaphragm seal is determined by how accurately a pressure signal is transferred from the remote seal isolator diaphragm to the transmitter sensor. Remote seal performance is characterized by:

- Temperature Effects
- System Time Response
- Static Head Effects
- Temperature Head Effects

Remote seal performance specifications are published in the Rosemount 3159 Product Data Sheet.

Temperature Effects

Changes in ambient temperature cause changes in fill fluid volume relative to the metallic capillary system. To an extent, changes in fill fluid volume are accommodated by the remote seal diaphragm, whose spring rate is much less than that of the transmitter isolator diaphragm. However, some of the temperature-induced volume change is seen as back pressure at the transmitter, which creates a shift in transmitter output. Temperature effects errors are usually smaller for symmetric systems, since the back pressure is more similar on high and low sides.

Factors that affect remote seal temperature effects performance include capillary length, fill fluid and configuration (one-sided versus two-sided).

System Time Response

The time response of a system is dependent on the transmitter model, its sensor range, the length and inner diameter (ID) of the capillary, and the viscosity of the fill fluid (which is directly affected by the process and ambient temperatures). These factors all play a role in the overall performance of any seal system.

For high viscosity fill fluids, capillary length should be kept to a minimum if system time response is an important performance requirement.

Static Head Effects

If the diaphragm seal and transmitter are installed at different elevations, a zero shift occurs due to static head effects. The zero shift can be removed by re-zeroing the transmitter after installation.

However, static head effects create restrictions on installation. When the transmitter and remote seals are installed at different heights, the limitations of the transmitter capability for zero suppression and zero elevation must be considered. The applicable 3150 Series Pressure Transmitter Product Data Sheets define the zero suppression and zero elevation capability of each pressure range. Please contact RNII for additional information.

Temperature Head Effects

Changes in ambient temperature also cause changes in the fill fluid specific gravity. Changes in fill fluid specific gravity affect the weight of the fill fluid column acting on the sensor.

At reference conditions, the weight of the fill fluid column will produce a zero shift, which can be removed by re-zeroing the transmitter (static head effect). As ambient temperature changes, the fill fluid specific gravity changes which, in turn, changes the weight of the fill fluid column. This will be seen by the transmitter as a change in pressure.

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SECTION 3: Installation

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Remote Seal Installation Considerations.....	page 9
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OVERVIEW

This section contains the following installation considerations:

- Remote Seal Handling Considerations
- Remote Seal Installation Considerations
- Remote Seal / Lower Housing Assembly Procedure
- Installation of Capillary Clamps

SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operation. Refer to the following safety messages before performing an operation preceded by this symbol: 

Warnings

 WARNING

Never attempt to disconnect the remote seal flange from the transmitter. Doing so will result in loss of fill fluid and will void the product warranty.

REMOTE SEAL HANDLING CONSIDERATIONS

Diaphragm seals are relatively delicate and should be handled with care.

Do not lift the seal or transmitter by gripping the capillaries when unpacking or handling a transmitter / remote seal system. Avoid sharply bending or crimping capillary tubing. The minimum bending radius of the capillary tubing is 3 in (8 cm).

The protective cover should remain on the seal until the moment before installation. Avoid touching the diaphragm with fingers or objects and refrain from setting the diaphragm side of the seal down on a hard surface. Even minor dents or scratches in the diaphragm material may impair the performance of the remote seal system.

When installing the remote seal system, make sure the gasket is aligned properly on the gasket sealing surface. Failure to properly install the gasket may cause process leaks, which can result in death or serious injury. In addition, make sure the gasket does not press down upon the diaphragm face. Anything pressing on the diaphragm will be read by the transmitter as pressure. A misaligned gasket may cause a false reading.



REMOTE SEAL INSTALLATION CONSIDERATIONS

Rosemount 3159 remote seal is qualified for liquid and gas service. As much as possible, the process medium should be free of solids, since these could potentially clog the process pipe connection or accumulate over time in the cavity on the process side of the diaphragm. Care should be exercised in making sure that the process fluid does not become overly viscous or freeze in the process pipe connection or seal cavity.

The maximum working pressure depends on the transmitter pressure range, pressure measurement type, and remote seal bolting option (B1 or B2). Use the applicable Rosemount 3150 Series Pressure Transmitter Product Data Sheet along with the Rosemount 3159 Remote Seal Product Data Sheet to determine maximum working pressure. Please contact RNII for additional information.

The lower housing is available with four different process connections: 1/4 inch NPT, 1/2 inch NPT, 1 inch NPT and 1 inch socket weld. The customer is responsible for making a qualified connection to the process piping. The lower housing includes one or two 1/4-18 NPT flushing connection(s) so that the cavity under the diaphragm can be bled or flushed while the unit is in service. See **Figure 2-2** or **Figure 2-3** for details.

Due to the many possible mounting configurations, Rosemount does not provide a qualified remote seal mounting bracket. Mounting of the remote seal is the responsibility of the customer. The applicable Rosemount qualification report describes the mounting configurations used during qualification testing.

Due to pressure head effects, there are limits to the allowable elevation difference between remote seals and 3150 Series pressure transmitters. These limits are a function of the remote seal fill fluid type, the fill fluid specific gravity and transmitter range code. In no case should the difference in height between a transmitter and seal or between two seals exceed the upper range limit of the transmitter. Best practice is to mount the transmitter at or below the lower process tap if possible.

If the diaphragm seal and transmitter are installed at different elevations, a zero shift occurs due to static head effects. The zero shift can be removed by re-zeroing the transmitter after installation.

Changes in process and ambient temperatures can result in changes in transmitter zero output. Temperature-induced errors can be minimized by heat tracing the capillary to ensure a constant ambient temperature.

Special precautions must be taken to prevent damage to capillary systems filled with distilled water. Distilled water should not be exposed to operating temperatures below 40°F (4.4°C); when exposed to operating temperatures above 180°F (82.2°C), application of static pressure to the remote seal is conservatively recommended to prevent the fill fluid from boiling. Refer to steam tables for required pressures.

⚠ IMPORTANT

Care must be taken under all circumstances to ensure the fill fluid vapor pressure is not exceeded.

REMOTE SEAL / LOWER HOUSING ASSEMBLY PROCEDURE

⚠ IMPORTANT

Take care during the assembly process to prevent possible damage to the isolator diaphragm or metal gasket.

Tools required for assembly of the 3159 Remote Seal / Lower Housing can be found in **Table 3-1**. If a Rosemount part number is not specified, any general brand tool that meets the specifications can be used. Please contact RNII with any questions regarding the required tools.

Table 3-1 – Tools Required for Remote Seal / Lower Housing Assembly

Description	Rosemount Part Number	Photo
3/4-inch Open-ended Wrench	Customer Supplied	
3/4-inch Socket Adjustable Torque Wrench	Customer Supplied	
Vice or holding fixture	Customer Supplied	No photo available

1. Disassemble remote seal / lower housing if necessary.

NOTE

If the metal gasket was installed between the remote seal and lower housing and bolts were torqued beyond finger tight, then a new metal gasket must be installed.

2. Gently clean the remote seal isolator diaphragm, lower housing and metal gasket with a clean cloth.
3. Center the metal gasket on the lower housing.
4. Carefully place the remote seal on top of the lower housing and metal seal, taking care to align the bolt holes.
5. Install eight bolts from the remote seal side.

NOTE

For B2 option rotate bolts to ensure the heads are “locked” against the remote seal center hub. See **Figure 3-1** for details.

NOTE

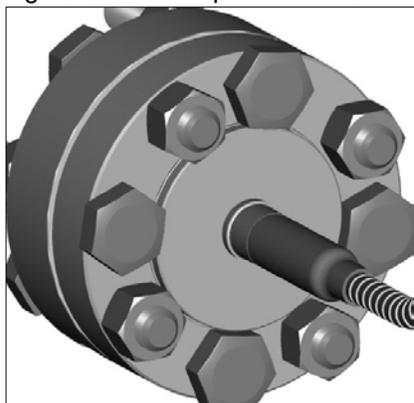
When installing bolts provided with Rosemount spare kit P/N 03159-5904-0003, insert four 3.25-inch bolts from the remote seal side and four 2.5-inch bolts from the lower housing side in an alternating pattern. See **Figure 3-2** for details.

6. Install eight nuts hand tight.
7. Tighten the eight nuts using the crossing pattern shown in **Figure 3-3** and according to the torque sequence and values shown in **Table 3-2**.

NOTE

When installing bolts provided with Rosemount spare kit P/N 03159-5904-0003, tighten the eight nuts using the crossing pattern shown in **Figure 3-4** and according to the torque sequence and values for the B2 Option shown in **Table 3-2**.

Figure 3-1 – B2 Option Bolt Detail



Rosemount 3159

Figure 3-2 – Rosemount Spares Kit
P/N 03159-5904-0003 Bolt Installation
Detail

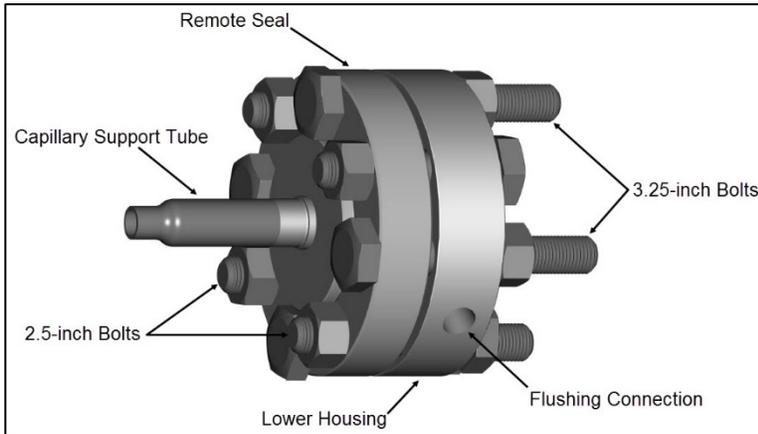


Figure 3-3 – Bolt Torqueing Pattern

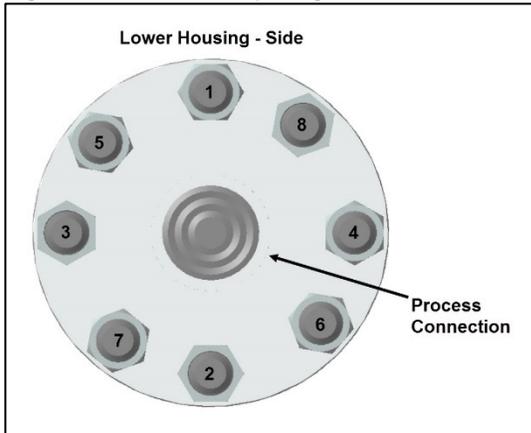


Figure 3-4 – Torqueing Pattern for
Bolts Provided with Rosemount
Spares Kit P/N 03159-5904-0003

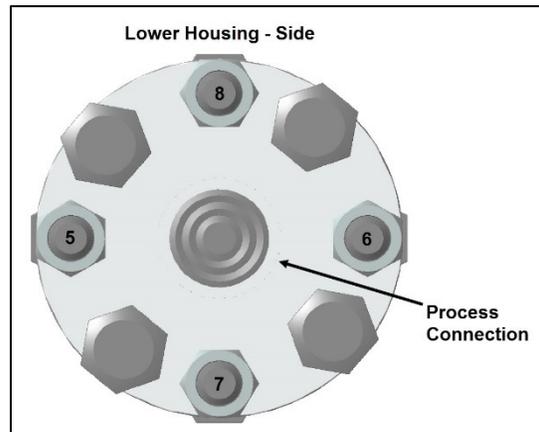
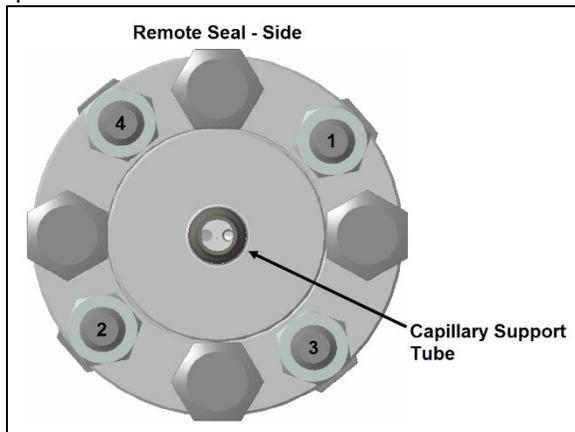


Table 3-2 – Torqueing Sequence for B1 and B2 Options

Step	Torque Value	
	B1	B2 ⁽¹⁾
1	150 in-lb (16.9 N-m)	220 in-lb (24.9 N-m)
2	300 in-lb (33.9 N-m)	440 in-lb (49.7 N-m)
3	450 in-lb (50.8 N-m)	660 in-lb (74.6 N-m)
4	600 in-lb (67.8 N-m)	875 in-lb (98.9 N-m)
5	600 in-lb (67.8 N-m)	875 in-lb (98.9 N-m) ⁽²⁾
6	600 in-lb (67.8 N-m) ⁽²⁾	--

Notes:

- (1) Use B2 torque sequence and values when installing bolts provided with Rosemount spares kit P/N 03159-5904-0003.
- (2) Torque tolerance for this step is ±5%.

**INSTALLATION OF
 CAPILLARY CLAMPS**

Clamps (Rosemount spare kit P/N 03159-5902-0001 or equivalent) should be placed approximately 18 inches (46 cm) apart to hold the capillary tubing in place, using any standard grade 1/4-20 screw.

The minimum bending radius of the capillary tubing is 3 inches (8 cm).

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SECTION 4: Maintenance

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OVERVIEW

This section contains the following maintenance considerations:

- General Considerations
- Metal Gasket Replacement

SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operation. Refer to the following safety messages before performing an operation preceded by this symbol: ⚠

Warnings

WARNING ⚠

Replacement equipment or spare parts not approved by Rosemount Nuclear Instruments, Inc. for use could reduce the performance capabilities of the remote seal system and may render the instrument dangerous or adversely impact its qualified status.

- Use only components supplied with the 3159 Remote Seal or designated by Rosemount Nuclear Instruments, Inc. as spare parts for the 3159.

WARNING ⚠

Remote seal systems are factory filled systems that cannot be refilled in the field. Do not attempt to disconnect the seals or capillaries from the transmitter. Doing so can damage the seal system assembly and voids the product warranty.

WARNING ⚠

Residual process fluid may remain after disassembly of lower housing. If this fluid is potentially contaminated, take appropriate safety measures.

WARNING ⚠

Process leaks could result in death or serious injury.

- Install and tighten all eight remote seal bolts before applying pressure
- Do not attempt to loosen or remove remote seal bolts while the remote seal is in service.

NOTE

Maintenance of traceability of any replacement parts is the responsibility of the user (see **Important Notice** at the beginning of this manual preceding Section 1).

GENERAL CONSIDERATIONS

Once installed, the Rosemount 3159 Remote Seal is generally considered to be a maintenance-free component. In cases where maintenance is required, this section provides guidance.

METAL GASKET REPLACEMENT

Use the following steps to replace the metal gasket:

1. Remove the remote seal from service.
2. Disassemble the remote seal / lower housing and discard metal gasket.
3. Follow the remote seal / lower housing assembly procedure shown in **Section 3: Installation**.

NOTE

The procedure for replacement of the metal gasket must be followed whenever the remote seal is disassembled.

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SECTION 5: Remote Seal Spare Parts

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Spare Parts Ordering Information.....	page 18

OVERVIEW

This section contains the following topics:

- Spare Parts Ordering Information

SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operation. Refer to the following safety messages before performing an operation preceded by this symbol: ⚠

WARNING ⚠
<p>Replacement equipment or spare parts not approved by Rosemount Nuclear Instruments, Inc. for use could reduce the performance capabilities of the remote seal system and may render the instrument dangerous or adversely impact its qualified status.</p> <ul style="list-style-type: none"> • Use only components supplied with the 3159 Remote Seal or designated by Rosemount Nuclear Instruments, Inc. as spare parts for the 3159.

NOTE

Maintenance of traceability of any replacement parts is the responsibility of the user (see **Important Notice** at the beginning of this manual preceding Section 1).

SPARE PARTS ORDERING INFORMATION

Table 5-1 contains part numbers used for ordering spare parts for the 3159 Remote Seal.



Table 5-1 – Rosemount 3159 Spare Parts

Rosemount Spares Kit Part Number	Description	3159 Model Code Option
03159-5901-0001	Metal Gasket (Remote Seal / Lower Housing Interface) (Qty=1)	--
03159-5902-0001	Capillary Clamp (Qty=1)	--
03159-5903-0001	Lower Housing, 1/4-inch NPT, One Flushing Connection (Qty=1)	P1
03159-5903-0002	Lower Housing, 1/2-inch NPT, One Flushing Connection (Qty=1)	P2
03159-5903-0003	Lower Housing, 1-inch NPT, One Flushing Connection (Qty=1)	P3
03159-5903-0004	Lower Housing, 1-inch Socket Weld, One Flushing Connection (Qty=1)	P4
03159-5903-0005	Lower Housing, 1/4-inch NPT, Two Flushing Connections (Qty=1)	P5
03159-5903-0006	Lower Housing, 1/2-inch NPT, Two Flushing Connections (Qty=1)	P6
03159-5903-0007	Lower Housing, 1-inch NPT, Two Flushing Connections (Qty=1)	P7
03159-5903-0008	Lower Housing, 1-inch Socket Weld, Two Flushing Connections (Qty=1)	P8
03159-5904-0001	Nut & Bolt, 2.5-inch, Standard Head (Qty=8)	B1
03159-5904-0002	Nut & Bolt, 2.5-inch, Heavy Hex Head (Qty=8)	B2
03159-5904-0003	Nut & Bolt, 2.5-inch & 3.25-inch, Heavy Hex Head (Qty=4 ea.)	--

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