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June 1999

Rev. AB

Model 1159 Remote Diaphragm Seals Manual

With Model 1152, Model 1153 Series B, D, and F, and
Model 1154 Alphaline® Nuclear
Pressure Transmitters

Product Discontinued



ROSEMOUNT® NUCLEAR

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IMPORTANT NOTICE -- ERRATA

Model 1159 Remote Diaphragm Seal, Product Manual 00809-0100-4504, Rev AB (June 1999)

No.	Affected Pages	Description of Change	Effect. Date
1	Page i Page ii Back cover page	Replace address and phone/fax with: Rosemount Nuclear Instruments, Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA Tel: (952) 949-5210 Fax: (952) 949-5201	10/10/03

Model 1159 Remote Diaphragm Seals Manual

With Model 1152, Model 1153 Series B, D, and F, and Model 1154 Alphaline® Nuclear Pressure Transmitters

NOTICE

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

For equipment service needs outside the United States, contact the nearest Rosemount representative.

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ROSEMOUNT NUCLEAR

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

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

Rosemount Nuclear Instruments, Inc.
12001 Technology Drive
Eden Prairie, MN 55344
USA

IMPORTANT

The Rosemount Model 1159 Remote Diaphragm Seal is designed for Nuclear Class IE usage, has been tested per IEEE Std 323-1974 and IEEE Std 344-1975 as defined in the Qualification Test Report D8300151, and is manufactured to the requirements of NQA-1; 10CFR50, Appendix B quality assurance programs; and 10CFR Part 21. During qualification testing, interfaces were defined between the remote seal and its environment that are essential to meeting IEEE Std 323-1974 requirements. To ensure compliance with 10CFR Part 21, the remote seal must comply with the requirements herein throughout its installation, operation, and maintenance. It is incumbent upon the user to ensure that the Rosemount Nuclear Instruments, Inc.'s component traceability program is continued throughout the Qualified Life of the remote seal.

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

Revision Status

Changes from May 1997 to June 1999

Page (Old)	Page (New)	Changes
Title	Title	Updated copyright and phone numbers.
Warranty	Warranty	Added warranty page.
	Global Change	Removed Rosemount from left facing page header.
TOC	TOC	Updated TOC to include new sections under <i>Installation; Remote Seal Handling Considerations</i> and <i>System Installation Procedure</i> .
1-1	1-1	Reworded note.
1-1	1-1	Added one decimal place to metric measures in Figure 1-1.
2-1	2-1	Slightly reworded <i>Length of Capillary</i> section.
2-1	2-1	Slightly reworded note in <i>Static Head Effects</i> section.
3-1	3-1	Added section titled <i>Remote Seal Handling Considerations</i> .
3-1	3-2	Added note to <i>Remote Seal Installation Considerations</i> section on Model 1152 Pressure Transmitter mounting.
3-2	3-2	Added section titled <i>System Installation Procedure</i> .
3-2	3-3	Rounded newton-meter torque specifications to whole numbers in <i>Metal Seal Installation Procedure</i> .
3-3	3-4	Rounded newton-meter torque specifications to whole numbers in <i>Gasket Installation Procedure</i> .
3-3	3-4	Added metric equivalents to dimensions in <i>Mounting of Capillary Clamp</i> .
4-1	4-1	Added page reference to step 2 of <i>Gasket/Metal Seal Replacement</i> .
4-1	4-1	Slightly reworded both notes in <i>Gasket/Metal Seal Replacement</i> section.
5-1 to 5-4	5-1 to 5-4	Added metric measures to all tables in Pressure Ranges section.
	5-1 to 5-3	Added second note to Model 1152 Ordering Information table, Model 1153 Series B and D Ordering Information table, Model 1153 Series F Ordering Information table, and Model 1154 Ordering Information table.
5-3	5-3	Added special option section to Model 1159 Ordering Information table.
5-3	5-3	Footnote (3) in Model 1159 Ordering Information table rewritten.
Back Cover	Back Cover	Changed phone numbers.

NOTE

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



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Introduction

NOTE

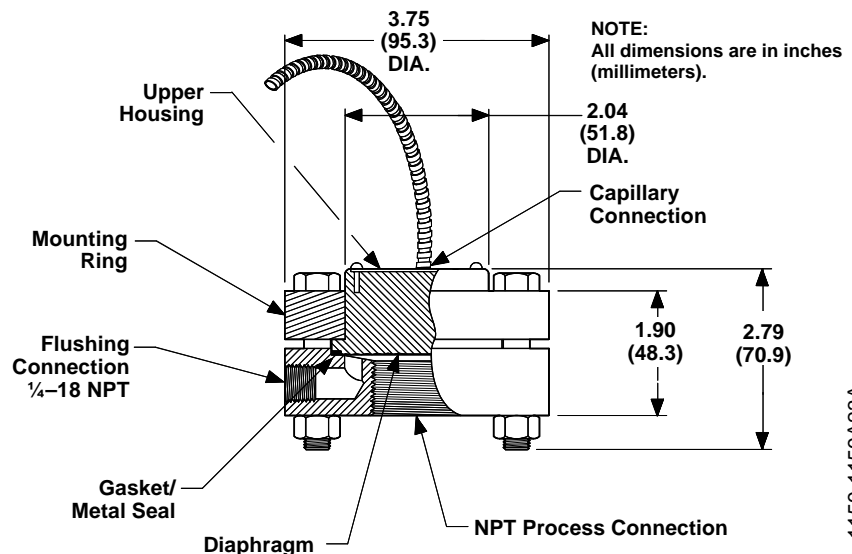
Installation, operation, maintenance, and warranty information for the Rosemount Model 1152, 1153 Series B/D/F, and 1154 Pressure Transmitters can be found in the instruction manual that corresponds to each product. This supplemental manual provides information for the use of the Model 1159 Remote Diaphragm Seals and Capillaries with the transmitters listed above. Use this manual in conjunction with the transmitter instruction manual.

The Model 1159 Remote 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 remote seal can be supplied with the following pressure transmitters:

- Model 1152
- Model 1153 Series B
- Model 1153 Series D
- Model 1153 Series F
- Model 1154

Uses for the remote seal include applications where the environment is unsuitable for instrumentation or where a wet leg reference is required. The Model 1159 Remote Seal has been tested to the following conditions: seismic qualification per IEEE Std. 344-1975 and radiation and environmental qualification per IEEE Std. 323-1974.

FIGURE 1-1. Model 1159 Diaphragm Seal.



Performance

The performance of a remote diaphragm seal is determined by how accurately it can transfer a pressure signal from the process fluid to the transmitter sensor.

The spring rate of a transmitter diaphragm is many times greater than the spring rate of a remote seal diaphragm. Therefore, the influence of the capillary and seal on transmitter linearity, hysteresis, and repeatability is usually slight. Temperature variations have the largest effect on the system's performance.

Some of the factors affected by temperature variations are:

- Length of capillary
- Quality of fill
- Static head effects

Length of Capillary

As the length of capillary increases, the volume of fill fluid also increases. Since the temperature effect will increase as the volume of fill fluid increases, it is desirable to minimize the length of capillary. During installation, the transmitter should be located as closely as possible to the diaphragm seal. It is preferable to increase the length of the loop wire rather than the length of capillary. The temperature effect can also be minimized by maintaining a constant temperature along the length of capillary. In addition to temperature effect, the length of capillary also affects time response. As the length of capillary increases, the time response increases.

Other parameters that must be considered when attempting to define the performance of a remote seal system are vibration effects, remote seal stability, and static head effects.

Quality of Fill

The presence of air in the fill fluid will cause poor performance. If fill fluid is lost due to damage to the remote seal system, it must be replaced at Rosemount.

Static Head Effects

If the diaphragm seal and transmitter are installed at different elevations, a zero error occurs due to static head effects. Rezeroing the transmitter after calibration eliminates this error. Static head effects place limits on installation. Thus, elevation of the seal *above* the transmitter is limited by the zero suppression capability of the transmitter. If the seal is located *below* the transmitter, height difference is limited not only by transmitter zero elevation capability, but also by the requirement that liquid head cannot exceed atmospheric pressure. Recommended maximum height difference to avoid this limitation is 23 ft.

NOTE

For the Model 1152 Pressure Transmitter with remote diaphragm seal, be sure to mount the transmitter at or below the lower tap to ensure proper operation.

Installation

Remote Seal Handling Considerations

When unpacking or handling a transmitter/seal system, do not lift the seal or transmitter by gripping the capillaries.

Avoid sharply bending or crimping tubing. The minimum bending radius of the capillary tubing is three inches (8 centimeters).

NOTE

Never attempt to disconnect the seals or capillaries from the transmitter. Doing so will result in loss of fluid and will void the product warranty.

The material of a diaphragm seal is designed to withstand pressure and wear from process material, but outside of process connection conditions, diaphragm seals are relatively delicate and should be handled with care.

The protective cover should remain on the seal until the moment before installation. Try to 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 transmitter/seal system.

When installing diaphragm seal systems, make sure the gasket is aligned properly on the gasket sealing surface.

Most importantly, 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

Due to infinite mounting configurations, mounting of the remote seal is the responsibility of the customer. Refer to Rosemount Report D8300151—*Qualification Report for Water Filled Remote Seal System*, for mounting details during qualification testing.

The lower housing of the remote seal has a female thread connection for attachment to a process pipe nipple. The diaphragm is welded to the upper housing, allowing the diaphragm seal to be disassembled for inspection without disturbing the fill fluid. The operating pressure of the remote seal cannot exceed that of the transmitter; i.e., if it is used with an 1152 DP, 1153 DB/DD/DF, or 1154 DP transmitter, the maximum operating pressure is 2000 psi.

The remote seal is qualified for liquid service only. The process medium should be free of solids, since these could clog the process pipe connection or accumulate 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.

Remote diaphragm seals have a ¼-in. NPT flushing connection (two flushing connections provided with socket weld option) so that the cavity under the diaphragm can be bled or flushed while the unit is in service.

Transmitters with remote diaphragm seals are frequently installed with the transmitter and seal or seals at different elevations. In installations of this type there will be a zero shift that must be corrected prior to operation. This is most easily done by rezeroing the transmitter after installation.

There are limits to the difference in elevations of seals and certain ranges of transmitters. These limits are a function of the fill fluid and its specific gravity. 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. Reference Table 3-1 below.

NOTE

For the Model 1152 Pressure Transmitter with remote diaphragm seal, be sure to mount the transmitter at or below the lower tap to ensure proper operation.

TABLE 3-1. Transmitter Upper Range Limit.

Transmitter Range Code	Height Difference Limitations
3	30 inH ₂ O
4	150 inH ₂ O
5	750 inH ₂ O
6	N/A
7	N/A
8	N/A

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

For operation at temperatures above 180 °F, apply a static pressure to the remote seal to prevent the fill fluid from boiling. Reference steam tables for appropriate pressures.

System Installation Procedure

Unbolt the seal upper and lower housing (they are factory assembled but not torqued) and thread the lower housing to the hard piping separately. When threading the lower housing to the process pipe, care should be taken not to overtighten. The applied torque should comply to ANSI B1.20.1 or applicable torque requirements for pipe connections. Bolt the upper and lower housings together following the Metal Seal or Gasket Installation procedure on page 3-3.

Whenever the upper and lower housings have been disassembled, you must replace the metal seal or gasket.

Metal Seal or Gasket Installation Procedure

Follow the appropriate installation procedure depending on whether the metal seal P/N 01159-0300-0002 or the gasket P/N 01159-0300-0001 is being used.

Metal Seal Installation Procedure**NOTE**

Use special care during the installation procedures in order to prevent possible damage to the isolating diaphragm.

1. Remove the eight remote seal bolts and nuts; retain them for reassembly.⁽¹⁾
2. Clean the mating surfaces of the upper and lower housings with a clean cloth.
3. Center the metal seal (P/N 01159-0300-0002) in position on the upper housing (see Figure 3-1), or center in the lower housing (depending on orientation).
4. Place the upper housing and metal seal against the lower housing, being careful not to shift the metal seal.
5. Slide the mounting ring over the upper housing.
6. Insert a bolt through the mounting ring and through the lower housing as shown in Figure 3-1. Place a nut on the bolt and finger tighten. Continue placement of bolts and nuts until all eight are in place and finger tight.
7. Tighten the bolts and nuts in a crossing pattern to 5 ft-lb (7 N-m).
8. Repeat to 10 ft-lb (14 N-m).
9. Repeat to 15 ft-lb (20 N-m).
10. Repeat to 17 ft-lb (23 N-m).
11. Repeat to 19 ft-lb (26 N-m).
12. Repeat to 22 ft-lb (30 N-m).
13. Repeat to 27 ft-lb (37 N-m).
14. Recheck at 27 ft-lb (37 N-m).

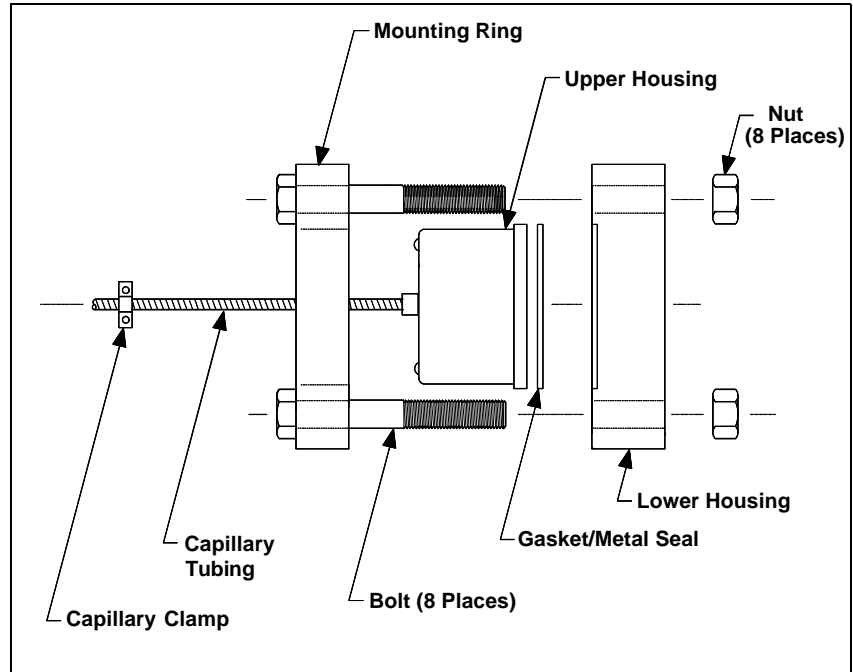
Gasket Installation Procedure**NOTE**

Use special care during the installation procedures in order to prevent possible damage to the isolating diaphragm.

1. Remove the eight remote seal bolts and nuts; retain them for reassembly.
2. Clean the mating surfaces of the upper and lower housings with a clean cloth.
3. Center the Flexitallic™ gasket (P/N 01159-0300-0001) in position on the upper housing (see Figure 3-1), or center in the lower housing (depending on orientation).

(1) If replacing Flexitallic gasket with the metal seal, the nuts and bolts provided with the metal seal kit (P/N 01159-0320-0001) must be used for initial installation.

FIGURE 3-1. Installation Diagram.



4. Place the upper housing and gasket against the lower housing, being careful not to shift the gasket.
5. Slide the mounting ring over the upper housing.
6. Insert a bolt through the mounting ring and through the lower housing as shown in Figure 3-1. Place a nut on the bolt and finger tighten. Continue placement of bolts and nuts until all eight are in place and finger tight.
7. Tighten the bolts and nuts in a crossing pattern to 10 ft-lb (14 N-m).
8. Repeat to 15 ft-lb (20 N-m).
9. Repeat to 20 ft-lb (27 N-m).
10. Recheck at 20 ft-lb (27 N-m).

Mounting of Capillary Clamps

Clamps (P/N 01159-0301-0001) should be placed approximately 18 in. (46 cm) apart to hold the capillary tubing in place, using any standard grade ¼–20 screws.

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

Maintenance

Gasket/Metal Seal Replacement

Use the following steps to replace the gasket or metal seal:

1. Remove the remote seal/transmitter unit from service.
2. Follow applicable instructions for gasket or metal seal installation (see page 3-2) after discarding the existing gasket/metal seal.

NOTE

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

For servicing other than changing out electronics boards, transmitter and remote seal system must be returned to Rosemount.

NOTE

See RETURN OF MATERIAL at the front of this manual or in the transmitter instruction manual.

MODEL 1152 ORDERING INFORMATION

Model	Product Description			
1152	AlphaLine Pressure Transmitters for Nuclear Applications			
Code	Pressure Measurement			
DP GP	Differential Pressure, 2,000 psig (13.8 MPa) Static Pressure Rating Gage Pressure			
Code	Pressure Ranges			
3	0–5 to 0–30 inH ₂ O (0–1.24 to 0–7.46 kPa)			
4	0–25 to 0–150 inH ₂ O (0–6.22 to 0–37.3 kPa)			
5	0–125 to 0–750 inH ₂ O (0–31.08 to 0–186.4 kPa)			
6	0–17 to 0–100 psi (0–0.12 to 0–0.69 MPa)			
7	0–50 to 0–300 psi (0–0.35 to 0–2.07 MPa)			
8	0–170 to 0–1,000 psi (0–1.15 to 0–6.89 MPa)			
Code	Input			
N ⁽¹⁾	4–20 mA dc with Adjustable Damping			
MATERIALS OF CONSTRUCTION				
Code	Flanges	Drain/Vent Valves	Isolating Diaphragms	Electronics Housing/ Covers
22	316 SST	316 SST	316 SST	Aluminum
92	316 SST	316 SST	316 SST	Austenitic SST
Code	T-Options			
T1808 ⁽²⁾	One Seal with one ¼ NPT/ V-D Valve			
T1809	Two Seals			
Code	Options			
PB	Panel Mounting Bracket			
PM	2-in. Pipe Mounting Bracket			
Typical Model Number: 1152 DP 4 N 22 T1808 PB				

(1) For 10–50 mA output, the “N” is replaced with “L.” For example: 1152DP5L22T1808PB. Transmitters with output code “L” have seismic qualification only.

(2) Unless otherwise noted, flange option T1808 will have the remote seal installed on the high side.

MODEL 1153 SERIES B AND D ORDERING INFORMATION

Model	Product Description
1153	Alphaline Pressure Transmitters for Nuclear Applications
Code	Pressure Measurement
D	Differential Pressure, 2000 psig Static Pressure Rating
Code	Series
B	Aluminum Housing, qualified per IEEE Std 323-1974, IEEE Std 344-1975.
D	SST Housing, qualified per IEEE Std 323-1974, IEEE Std 344-1975.
Code	Pressure Ranges
4	0–25 to 0–150 inH ₂ O (0–6.22 to 0–37.3 kPa)
5	0–125 to 0–750 inH ₂ O (0–31.08 to 0–186.4 kPa)
6	0–17 to 0–100 psi (0–0.12 to 0–0.69 MPa)
7	0–50 to 0–300 psi (0–0.35 to 0–2.07 MPa)
8	0–170 to 0–1,000 psi (0–1.15 to 0–6.89 MPa)
Code	Output
P	Standard 4–20 mA dc
R	Improved Radiation Performance 4–20 mA dc
Code	Flange Option
D ⁽²⁾	One Seal with Swagelok® and Drain/Vent Valve
E ⁽¹⁾⁽²⁾	One Seal with ¼-in. NPT and Drain/Vent Valve
F ⁽¹⁾⁽²⁾	One Seal with ¼-in. NPT/¼-in. NPT
G	Two Seals
Typical Model Number 1153 D D 4 P E	

(1) The customer assumes the responsibility for qualifying the process interface on this option.

(2) Unless otherwise noted, flange options D, E, and F will have the remote seal installed on the high side.

MODEL 1153 SERIES F ORDERING INFORMATION

Model	Description
1153	Alphaline Pressure Transmitters for Nuclear Applications
Code	Pressure Measurement
D	Differential Pressure, 2,000 psig Static Pressure Rating
Code	Series
F	Painted aluminum housing; qualified per IEEE Std. 323-1974, IEEE Std. 344-1975
Code	Pressure Ranges
4	0–25 to 0–150 inH ₂ O (0–6.22 to 0–37.3 kPa)
5	0–125 to 0–750 inH ₂ O (0–31.08 to 0–186.4 kPa)
6	0–17 to 0–100 psi (0–0.12 to 0–0.69 MPa)
7	0–50 to 0–300 psi (0–0.35 to 0–2.07 MPa)
8	0–170 to 0–1,000 psi (0–1.15 to 0–6.89 MPa)
Code	Output
T	Standard 10–50 mA
Code	Flange Option
D ⁽²⁾	One Seal with Swagelok and Drain/Vent Valve
E ⁽¹⁾⁽²⁾	One Seal with ¼-in. NPT and Drain/Vent Valve
F ⁽¹⁾⁽²⁾	One Seal with ¼-in. NPT/¼-in. NPT
G	Two Seals
Typical Model Number 1153 D F 4 T E	

(1) The customer assumes the responsibility for qualifying the process interface on this option.

(2) Unless otherwise noted, flange options D, E, and F will have the remote seal installed on the high side.

MODEL 1154 ORDERING INFORMATION

Model	Product Description
1154	Alphaline Pressure Transmitter for Nuclear Service
Code	Pressure Measurement
DP	Differential Pressure, 2000 psig Static Pressure Rating
Code	Pressure Ranges
4	0–25 to 0–150 inH ₂ O (0–6.22 to 0–37.3 kPa)
5	0–125 to 0–750 inH ₂ O (0–31.08 to 0–186.4 kPa)
6	0–17 to 0–100 psi (0–0.12 to 0–0.69 MPa)
7	0–50 to 0–300 psi (0–0.35 to 0–2.07 MPa)
8	0–170 to 0–1,000 psi (0–1.15 to 0–6.89 MPa)
Code	Output
R	Standard 4–20 mA dc
Code	Flange Option
D ⁽²⁾	One Seal with <i>Swagelok</i> and Drain/Vent Valve
E ⁽¹⁾⁽²⁾	One Seal with ¼-in. NPT and Drain/Vent Valve
F ⁽¹⁾⁽²⁾	One Seal with ¼-in. NPT/¼-in. NPT
G	Two Seals
Typical Model Number 1154 DP 4 R E	

(1) The customer assumes the responsibility for qualifying the process interface on this option.

(2) Unless otherwise noted, flange options D, E, and F will have the remote seal installed on the high side.

MODEL 1159 ORDERING INFORMATION

Model	Product Description
1159	Remote Seal Assembly
Code	Threaded Remote Seal
A	¼-in. NPT Process Connection
B	½-in. NPT Process Connection
C	1-in. NPT Process Connection
D ⁽¹⁾	1-in. NPT Socket Weld Connection
Code	Capillary ⁽²⁾
05	5 ft
10	10 ft
15	15 ft
20	20 ft
25	25 ft
30	30 ft
35	35 ft
40	40 ft
45	45 ft
50	50 ft
55	55 ft
60	60 ft
Code	Fill Fluid
A ⁽³⁾	Distilled Water
Code	Special Options
S0111	Remote Seal for Range Code 3 Transmitter (consult factory before ordering)
Typical Model Number: 1159 C 10 A	

(1) The customer assumes the responsibility for qualifying the process interface on this option.

(2) The Model 1152 Range Code 3 transmitter is limited to capillary lengths up to 25 ft.

(3) The Model 1159 is available with D.C.® 704 Silicone oil fill. It is also available with D.C. 200 Silicone oil fill, seismic qualification only. Capillary lengths of 15 ft or less are recommended for silicone oil fill. Specifications may differ with fill fluid option. Contact Rosemount Nuclear Instruments, Inc. for details.

MODEL 1159 SPARE PARTS ORDERING INFORMATION⁽¹⁾

Part Description	Part Number
Metal Seal	01159-0300-0002
Capillary Clamp	01159-0301-0001
Lower Housing	
¼-18 NPT	01153-0301-0001
½-14 NPT	01153-0301-0002
1-11-½ NPT	01153-0301-0003
Nut & Bolt Kit (8 each)	01159-0320-0001

(1) Refer to transmitter instruction manual for transmitter spare parts.

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