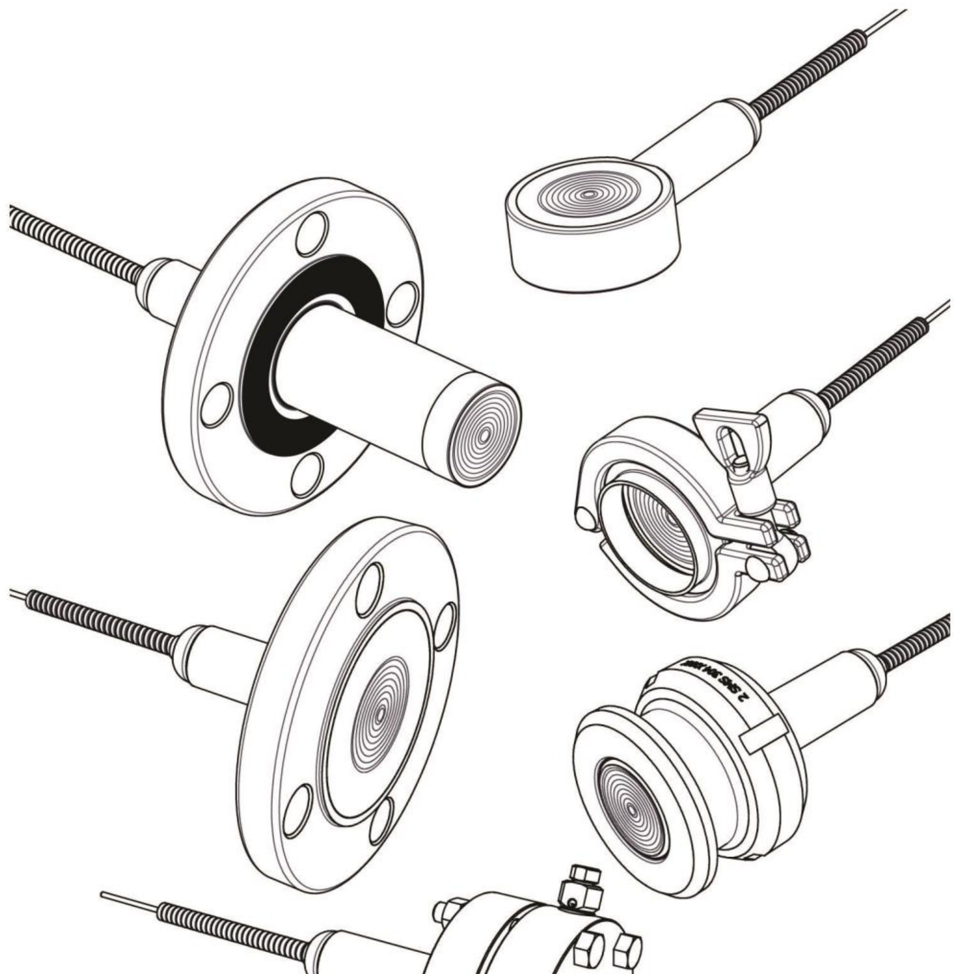
smar - SR301

OPERATION & MAINTENANCE INSTRUCTIONS MANUAL

REMOTE SEAL



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INTRODUCTION

The **SR301** is a Remote Seal that allows the pressure transmitter to make measures in situations where the immediate contact of the transmitter diaphragm with the process fluid it is not allowed.

The remote seal is made up by one connection with the diaphragm and one capillary connection with filling fluid. The filling fluid transfers the pressure measured in the process fluid to the transmitter sensor. The capillary connection links the seal diaphragm to the transmitter.

The remote seals available in the **SR301** series are: Flanged “T” Type (SR301T), Threaded (SR301R), Pancake (SR301P) both models having an optional flush connection, Sanitary (SR301S), and Flanged with Extension (SR301E).

The SR301 is assembled with gauge and differential pressure transmitters. When used in food applications the connections are sanitary type. Level models are also available.

SR301

The typical applications of the remote seal on the transmitter are:

- For corrosive process fluid;
- For viscous process fluid or with solids in suspension;
- The process fluid may freeze, crystallize or solidify;
- Processes that require easy cleaning and others.

The choice of the remote seal must be based on the recommendations of this manual.

The quality of measurement is important, because there is a growing demand for better electronic accuracy and stability on transmitters.

Some remote seal characteristics influence measurement, as capillary length, work temperature, response time, correct seal model and type of installation.

For example, regarding the **remote seal model**, it is common practice to standardize the seal type and the capillary length in the longest extension offered by supplier, aiming to guarantee interchangeability in the entire plant without considering the application characteristics for each point of measurement.

As for the **installation**, not always the device life span is taken into consideration, as it suffers various mechanical aggressions as line and tank vibration, high agitation, or turbulence of the process fluid, free or inadequately supported capillaries.
There are problems also in relation to mechanical assembly, inadequate installation of gaskets, plug point centralization and alignment, excessive squeeze, or bad distribution of the holding bolts.

Thus, in choosing the seal size these factors must be considered according to each case to guarantee excellent performance and long-life span.

This manual was made to help install, operate, and maintain the SR301. It contains information about transmitter/seal assembly, organized in the following categories:

- Installation;
- Selection;
- Operation;
- Maintenance;
- Examples;
- Types of Seal and Ordering Code.

Read these instructions carefully to get the most out of the **SR301**.

Waiver of responsibility

The contents of this manual abides by the hardware and software used on the current equipment version. Eventually there may occur divergencies between this manual and the equipment. The information from this document are periodically reviewed and the necessary or identified corrections will be included in the following editions. Suggestions for their improvement are welcome.

Warning

For more objectivity and clarity, this manual does not contain all the detailed information on the product and, in addition, it does not cover every possible mounting, operation or maintenance cases.

Before installing and utilizing the equipment, check if the model of the acquired equipment complies with the technical requirements for the application. This checking is the user's responsibility.

If the user needs more information, or on the event of specific problems not specified or treated in this manual, the information should be sought from Smar. Furthermore, the user recognizes that the contents of this manual by no means modify past or present agreements, confirmation or judicial relationship, in whole or in part.

All of Smar's obligation result from the purchasing agreement signed between the parties, which includes the complete and sole valid warranty term. Contractual clauses related to the warranty are not limited nor extended by virtue of the technical information contained in this manual.

Only qualified personnel are allowed to participate in the activities of mounting, electrical connection, startup and maintenance of the equipment. Qualified personnel are understood to be the persons familiar with the mounting, electrical connection, startup and operation of the equipment or other similar apparatus that are technically fit for their work. Smar provides specific training to instruct and qualify such professionals. However, each country must comply with the local safety procedures, legal provisions and regulations for the mounting and operation of electrical installations, as well as with the laws and regulations on classified areas, such as intrinsic safety, explosion proof, increased safety and instrumented safety systems, among others.

The user is responsible for the incorrect or inadequate handling of equipments run with pneumatic or hydraulic pressure or, still, subject to corrosive, aggressive or combustible products, since their utilization may cause severe bodily harm and/or material damages.

The field equipment referred to in this manual, when acquired for classified or hazardous areas, has its certification void when having its parts replaced or interchanged without functional and approval tests by Smar or any of Smar authorized dealers, which are the competent companies for certifying that the equipment in its entirety meets the applicable standards and regulations. The same is true when converting the equipment of a communication protocol to another. In this case, it is necessary sending the equipment to Smar or any of its authorized dealer. Moreover, the certificates are different and the user is responsible for their correct use.

Always respect the instructions provided in the Manual. Smar is not responsible for any losses and/or damages resulting from the inadequate use of its equipments. It is the user's responsibility to know and apply the safety practices in his country.

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Chapter 1

INSTALLATION

Application

The SMAR Remote Seals must be used when:

- ✓ The process fluid is corrosive, and the transmitter must be protected from this;
- ✓ The process fluid contains solids in suspension or is viscous enough to block the transmitter connections;
- ✓ The process fluid may freeze, crystallize or solidify inside the transmitter;
- ✓ It is necessary to maintain aseptic or sanitary conditions, as well as cleaning ease; and
- ✓ The process temperature is higher than 100°C.

The LD301 transmitter series manufactured by SMAR and used with remote seal keeps the characteristics of the insulated transmitters, such as external zero and span adjustments or via programmer, facilitating the device installation, functioning and maintenance.

General Recommendations for Remote Seal Use

The seals require a special construction for pressure below atmosphere (vacuum). Therefore, Datasheet must inform when they will be used in this condition.

The temperature variation may cause unacceptable errors in transmitter reading. To minimize this effect, see the necessary recommendations in Chapter 2 - "Temperature Error Presented by Seal".

For applications in corrosive environments, select materials compatible for contact with the process fluid. However, also consider materials not in contact with the process but subject to corrosive atmospheres or the spatter of fluids from the corrosion process.

The capillary length, the diaphragm sensitivity and the characteristics of the fill fluid (the coefficient of thermic expansion and the density) present error in the measurement making impracticable the application of the remote seal for ranges below to 0-625 mmH2O.

Should it be possible to empty the fill fluid due to puncture of the insulator diaphragm, verifies if its volume (less than 5 ml) may contaminate the process of inadmissible form. If this happens requests a seal with fill fluid compatible with the process.

Choose the fill fluid that does not evaporate at the pressure and process temperature conditions.

Type of Remote Seal

The types of remote seal, as well as the dimensions available are presented in the Chapter 6 of this Manual - "Type of Seal and Ordering Code".

Receiving and Handling

- Verify if the data plate is according to the order;
- The transmitter and the remote seal, with its respective capillary, must be in the package until installation to prevent possible damages;
- The set must not be handled by the capillary;
- The sealed bolts must not be handled. If this is done, the remote seal can be permanently damaged and lose the manufacturer’s warranty.

Mounting of Transmitter with Remote Seal

In the Transmitter Manual see the suggested mounting positions. The Transmitter and the Remote Seal can be mounted according to the Figure 2.1 of Chapter 2 of this Manual.

The Remote Seals must be installed so that the process fluid wets all its surface. Installations that can provoke the deposition of any incrustation on the diaphragm must be avoided.

Choose a place free from mechanical shocks (seal and transmitter) that facilitates access to the measuring points. The ambient temperature must be within the limits allowed by the Transmitter Manual.

Use a valve in the process connection, before the seal, as this facilitates the transmitter calibration and the seal maintenance.

The maximum upper or lower height allowed for the transmitter on the remote seal, depends on the density of the seal fill fluid and the pressure on it. If this height is exceeded, it may cause saturation in the transmitter due to difference of the hydrostatic columns in both sides.

The correct heights of the transmitter, in relation to the seal, are shown in Table 2.3 of Chapter 2 of this Manual.

The capillaries must be held firm to avoid oscillations in the reading.

Choose an installation site lowly sensitive to temperature variation or, instead, keep the temperature equal in both sides of the seal.

The minimum radius of the capillary bending is 70mm. To prevent damages, avoid twisting and folding the capillary.

The connections for the lower "L" side and higher "H" side are indicated in the transmitter by letters "L" and "H".

In the seals horizontally mounted, the gasket must be centralized and not be in contact with the diaphragm. Hold the set in the counterflange by applying equal torques in the bolts.

ATTENTION
In hot environment, the transmitter and the seals must be installed in a way to prevent the exposition to the sun, as much as possible. Also avoid the installation closed with lines and vases subject to high temperatures. The use of sun protector or heat shield to protect both devices from external heat source is recommended. The temperature increase, due to direct exposition to the sun, can cause a zero deviation, mainly if one of the sides will be exposed. The seal, due to its metal construction, can have an increase of 60ºC in the temperature when exposed to the sun. For example, a transmitter with a remote seal of 2", calibrated in 1000 mmH2O, with capillary of 1m, exposed to 20ºC of variation will have an error of 49 mmH20 (4.9%). Check Chapter 2 for more information about temperature effect.

Chapter 2

SELECTION

Procedure for Remote Seal Specification

Tables 2.1 and 2.2 show, respectively, the steps that must be followed for the ideal Remote Seal specification and the recommendations to improve its performance.

STEP	PROCEDURE	PAGE
1	Type of assembly and calculation of the transmitter range	2.2
	Transmitter Range	2.3
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2	Maximum Seal temperature variation in relation to calibration temperature	2.8
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Table 2.1 – Steps for Remote Seal Selection

OBJECTIVE / ACTION	Reduce the Error due to Temperature	Reduce the Response Time	Improve the Accuracy
Choose the oil with lesser coefficient of volumetric expansion (see Table 2.5)	☺	😐	😐
Choose the oil with lesser viscosity (see Table 2.5)	😐	☺	😐
Increase the seal diaphragm diameter	☺	😐	😐
Decrease the capillary length	☺	☺	😐
Specify the equal capillary lengths of both sides	☺	☹	😐
Install the equipment preferably where lesser variation of temperature occurs	☺	😐	😐
Choose the transmitter in the upper limit of the range (1:1)	😐	😐	☺

Table 2.2 – Recomendations to Improve the Remote Seal Performance

Legend: ☺ - Positive Action / 😐 - Neutral Action / ☹ - Negative Action

Choosing the Ideal Assembly for Application

Figure 2.1 shows the most common types of remote seal assembly and its applications.

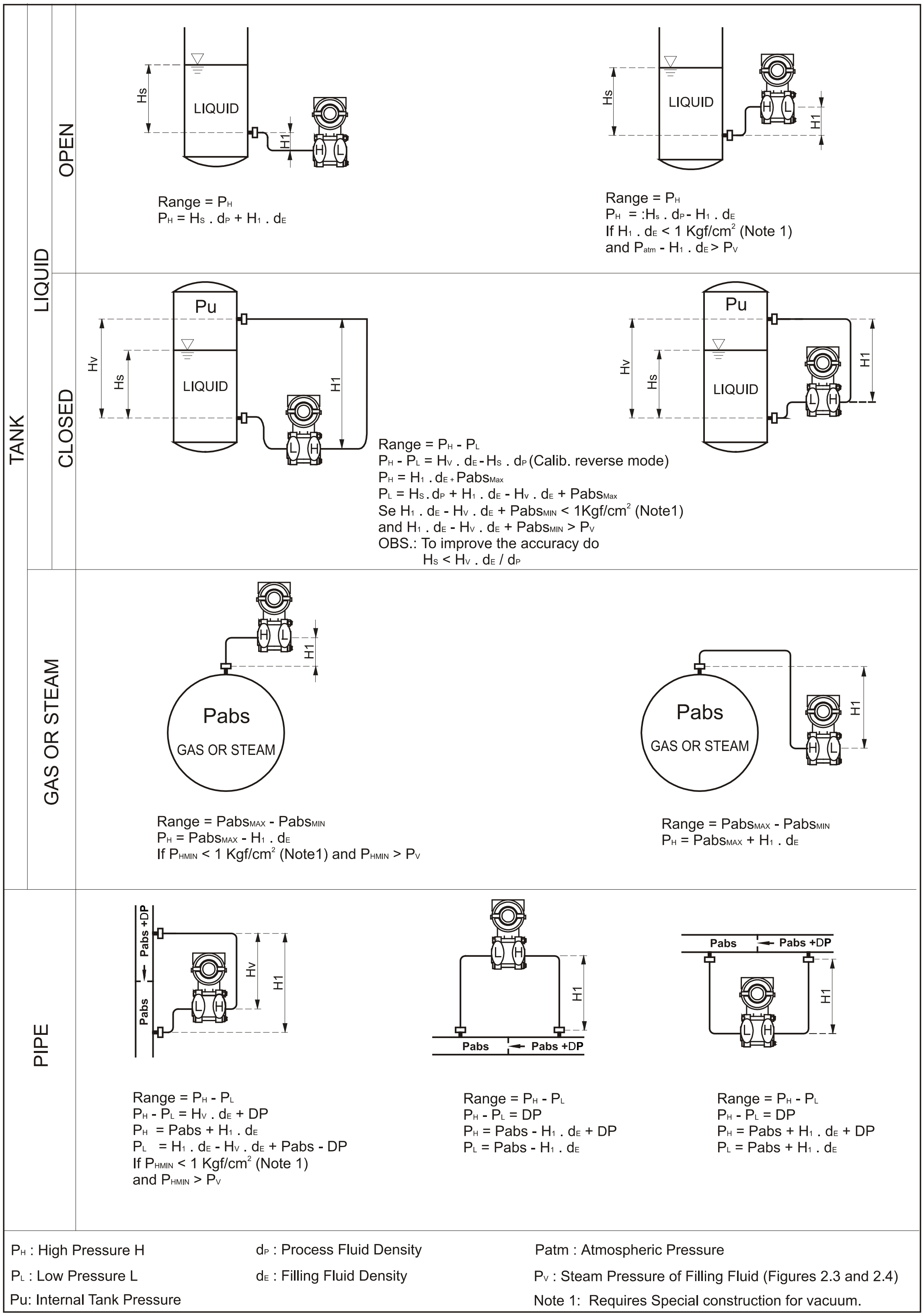


Figure 2.1 – Types of Remote Seal Assembly and Applications

Transmitters Range for Remote Seal Application

Verify in Table 2.3 the transmitter range, the pressure and overpressure limit and the applicable static pressure.

After calculating the ranges according to the type of installation, always try to work with the upper limits of each transmitter range to achieve the best equipment accuracy.

TRANSMITTER	LIMITS	TRANSMITTER RANGE (-URL TO URL) (1)				
		Range 2	Range 3	Range 4	Range 5	Range 6
LD30XD	Pressure	-50 to 50 kPa	-250 to 250 kPa	-2500 to 2500 kPa	----	----
	Overpressure and Static Pressure	160 bar	160 bar	160 bar	----	----
LD30XH	Pressure	-50 to 50 kPa	-250 to 250 kPa	-2500 to 2500 kPa	-25 to 25 MPa	----
	Overpressure and Static Pressure	320 bar	320 bar	320 bar	320 bar	----
LD30XM	Pressure	-50 to 50 kPa	-100 to 250 kPa	-100 to 2500 kPa	-0.1 to 25 MPa	-0.1 to 40 MPa
	Overpressure and Static Pressure	160 bar	160 bar	160 bar	400 bar	520 bar
LD30XA	Pressure	0 to 50 kPa	0 to 250 kPa	0 to 2500 kPa	0 to 25 MPa	0 to 40 MPa
	Overpressure and Static Pressure	160 bar	160 bar	160 bar	320 bar	520 bar
LD30XL / LD30XS	Pressure	-50 to 50 kPa	-250 to 250 kPa	-2500 to 2500 kPa	-25 to 25 MPa	----
	Overpressure and Static Pressure	(2)	(2)	(2)	(2)	----

(1) The calibration maximum limit of the remote seal or level/sanitary transmitter should be smallest value between the connection/flange pressure limit (Tables 1 to 6, chapter 6) and the upper range limit of the transmitter (URL).
(2) According to flange/connection pressure limit. See Tables 1, 2, 3, 5 and 6 – Chapter 6.

Table 2.3 – Transmitter Pressure Range, Overpressure Limits and Static Pressure

Where:
LD30XD: Differential Pressure Transmitter (Family 301, 302 and 303)
LD30XH: Differential Pressure Transmitter – High Static Pressure (Family 301, 302 and 303)
LD30XM: Gage Pressure Transmitter (Family 301, 302 and 303)
LD30XA: Absolute Pressure Transmitter (Family 301, 302 and 303)
LD30XL: Level Transmitter (Family 301, 302 and 303)
LD30XS: Sanitary Transmitter (Family 301, 302 and 303)

For more information, consult SMAR Pressure Transmitters Catalogs and Manuals.

NOTE
The overpressure shown in Table 2.3 above, does not damage the transmitter, although it will be necessary to recalibrate the transmitter.

Figure 2.2 below shows the Transmitter Operation Range, where the work range can be located in many positions within range.

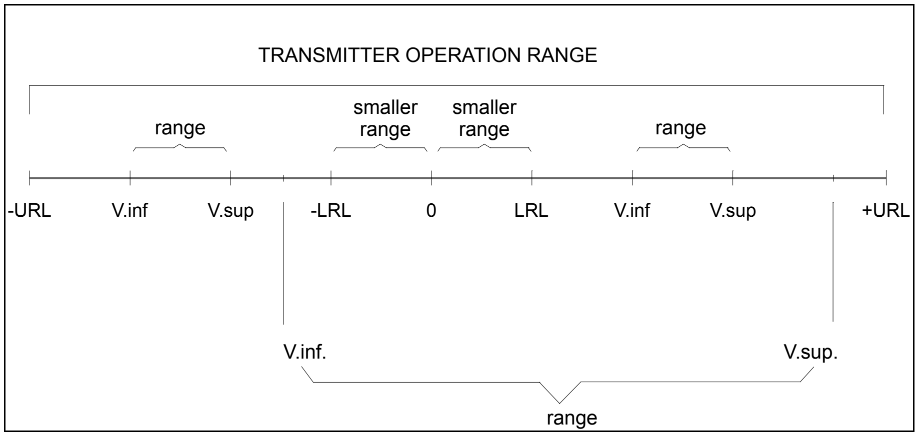


Figure 2.2 –Transmitter Operation Range

Where:
URL –Transmitter Range Upper Limit
LRL –Transmitter Range Lower Limit
V. sup. –Work Range Upper Value
V. inf – Work Range Lower Value

Diaphragm Material

The diaphragm material should be selected considering its chemical resistance to external agents, process fluid and temperature involved.

For more information about materials corrosion, consult the Smar's Application Engineer.

Filling Fluids

Filling fluids must be selected considering its physical properties at extreme conditions of temperature, pressure, chemical compatibility with the process fluid and its contamination in a unacceptable way.

Table 2.4 shows the filling fluids used by Smar with some physical properties and types of application. On Figures 2.3 and 2.4 the Steam Pressure curves (mmHg) are shown against the Temperature (°C) of these fluids.

Fluid	Limit of °C Temperature (°F) to Pabs < 1 atm (Vacuum) (3)	Limit of °C Temperature (°F) to Pabs > 1 atm	Viscosity (cSt) at 25°C	Density (g/cm3) at 25°C	Volumetric Expansion Coefficient 1/ºC (1/ºF)	Types of Application
Sillicone DC200	-40 to 100 (-40 to 212) (3)	-40 to 170 (-40 to 338)	20	0.950	0.001070 (0.000594)	General (Atoxicity, not irritating, odorless, Food Processing)
Sillicone DC704	0 to 200 (+32 to 392) (3)	0 to 315 (+32 to 599)	39	1.070	0.000950 (0.000528)	General (High Temperatures and Vacuum)
Fluorolube MO-10	N.A. (2)	-20 to 100 (-4 to 212)	50	1.910	0.000874 (0.000486)	Oxygen, Chlorine, Nitric Acid
Syltherm 800	N.A. (2)	-40 to 350 (-40 to 662)	10	0.934	0.001500 (0.000833)	General (High Temperatures)
Neobee M20 (1)	-15 to 120 (+5 to 248) (3)	-15 to 225 (+5 to 437)	9.5	0.920	0.001008 (0.000560)	Foods, Beverage and Pharmaceuticals
Glycerin (50%) and Water (50%)	N.A. (2)	-15 to 93 (+5 to 199.4)	12.5	1.130	0.000500 (0.000280)	Foods
Fomblim	-20 to 100 (-4 to 212) (3)	-20 to 200 (-4 to 392)	48	1.87	0.000900 (0.000500)	Low toxicity, excellent compatibility with metals, plastics and elastomers, excellent performance in high vacuum
Krytox	-40 to 100 (-40 to 212) (3)	-40 to 120 (-40 to 248)	42	1.88	0.000900 (0.000500)	Inert, nontoxic, biologically inert, nonexplosive, nonreactive to all elastomers, plastics and metals, excellent performance in high vacuum
Halocarbon	-45 to 80 (-49 to 176) (3)	-45 to 130 (-49 to 266)	5.6	1.85	0.001199 (0.000667)	Inert, low odor, low toxicity, noncorrosive. Standard for manufacturers of oxygen and reactive liquids

Table 2.4 – Filling Fluid Characteristics

Legend: (1) Propylene Glycol Diester of Octanoato / Decanoato; (2) N.A. – Nonapplicable; (3) Consult graphs in the Figures 2.3 and 2.4 below when the vacuum pressure is known.

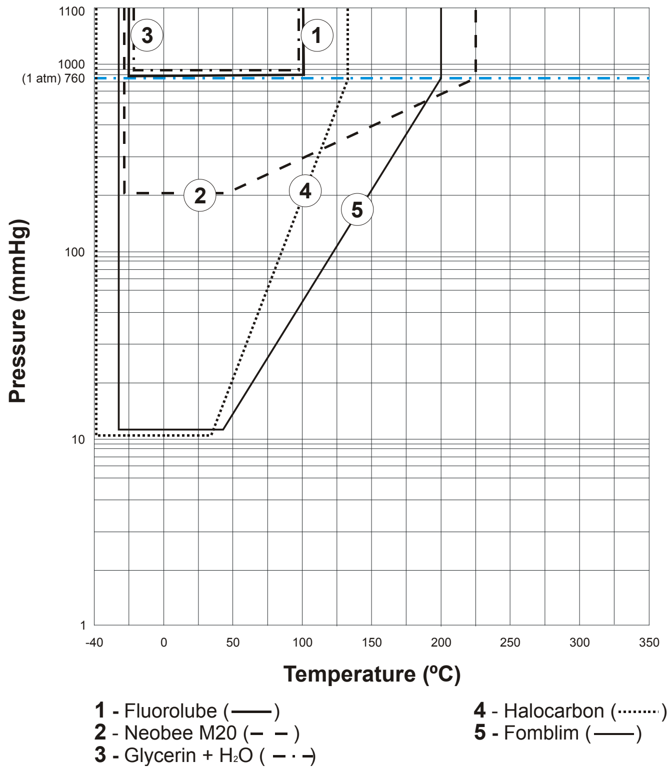


Figure 2.3 – Pressure x Temperature Curve (1)

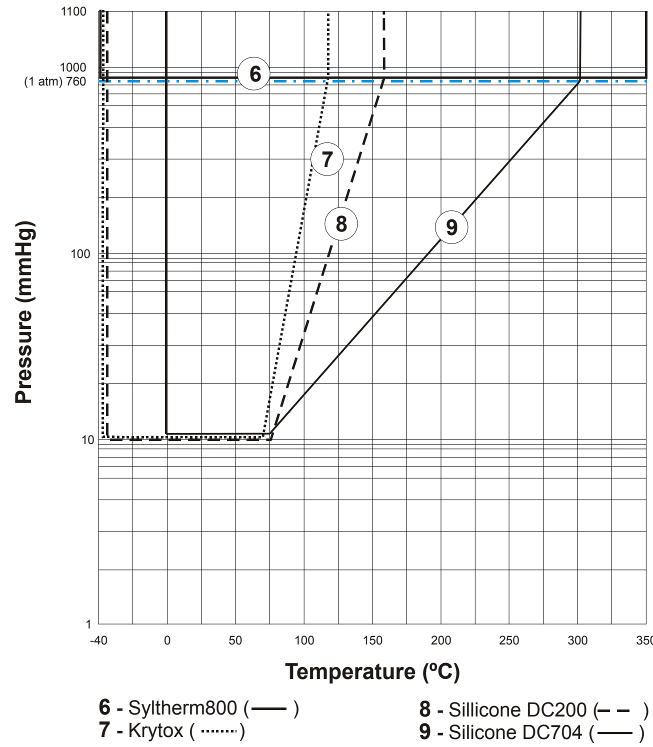


Figure 2.4 – Pressure x Temperature Curve (2)

Temperature Error Presented by Seal

With the variation of ambient or process temperature, the filling fluid, which fills the internal cavity of the remote seal and capillaries, its volume also varies. The volume variation provokes a displacement of the seal diaphragm. To absorb this volume variation, the diaphragm, due to its characteristic of rigidity, reacts with a change in pressure that it exerts on the filling fluid. This change causes a deviation in relation to the process pressure, which is the error caused by the temperature variation.

This error can be minimized if some important cautions are taken when choosing the remote seal model, the capillary length and the conditions of temperature and process ambient.

The seal model also counts, as the bigger is the diaphragm diameter of the remote seal, the less rigidity it presents, achieving more absorbing capability of volume variations without causing too many errors in the transmitter.

The capillary length has a direct effect, namely, the longer its length, the greater the volume of the filling fluid, causing higher volume variation with the temperature.

The influence of the temperature conditions can be reduced through the installation of the seal in places less susceptible to it. If possible choose a transmitter with identical seals in the two sides of the pressure plug, and that possess similar conditions of temperature variation and length, so that the two sides suffer the same temperature conditions. Thus the errors tend to minimize.

With basis on these information, it was developed a process of simplified calculation that takes into account the internal volumes of the remote seal, the capillary lengths, the rigidity of the sensing diaphragms and the coefficient of volume expansion of the filling fluid, thus supplying the approximate error calculation caused by the temperature variation.

Calculation of Temperature Errors

Remote seal temperature errors are due to the volume variation of the filling fluid in the transmitter body, extension, capillary and remote seal. Following, the necessary information for the error calculation are described.

Equations

To obtain a volume variation for each leg of the remote seal, the temperature variation in the seal, in the capillary and in the transmitter body must be known and then insert the value in the equations below.

$$\Delta T_{seal} = T_{seal} - Tref \qquad (2.1)$$

$$\Delta T_{cap} = T_{cap} - Tref \qquad (2.2)$$

$$\Delta T_{body} = T_{body} - Tref \qquad (2.3)$$

$$\Delta V_{rdf} = V_{rdf} . \Delta T_{seal} . \gamma_{oil} \qquad (2.4)$$

$$\Delta V_{ext} = (0.012 + 0.9 \cdot L_{ext}) . \Delta T_{seal} \cdot \gamma_{oil} \qquad (2.5)$$

$$\Delta V_{cap} = (0.9 \cdot L_{cap}) . \Delta T_{cap} \cdot \gamma_{oil} \qquad (2.6)^{*}$$

$$\Delta V_{body} = (1.154) . \Delta T_{body} \cdot \gamma_{oil} \qquad (2.7)$$

$$\Delta V_{Total} = \Delta V_{rdf} + \Delta V_{ext} + \Delta V_{cap} + \Delta V_{body} \qquad (2.8)$$

$$V_{Total} = \Delta V_{total} \text{ , (diaphragm initial volume is zero)} \qquad (2.9)$$

$$Error = Error\,(Graphic) . Fm \qquad (2.10)$$

$$Error\,\% = \frac{Error}{Calibrated\ Span} \cdot 100 \qquad (2.11)$$

Where:

ΔT_{seal} : Variation in the seal temperature in relation to the calibration temperature (°C)
ΔT_{cap} : Variation in the capillary temperature in relation to the calibration temperature (°C)
ΔT_{body} : Variation in the body temperature in relation to the calibration temperature (°C)
T_{seal} : Seal Temperature (°C)
T_{cap} : Capillary temperature (°C)
T_{body} : Transmitter body temperature (ºC)
T_{ref} : Reference Temperature equal to 25°C
V_{rdf} : Volume of the diaphragm reservoir (cm^3)
ΔV_{rdf}: Variation in the reservoir volume (cm^3)
ΔV_{ext}: Variation in the extension volume (cm^3)
ΔV_{cap}: Variation in the capillary volume (cm^3)
ΔV_{body}: Variation in the body volume (cm^3)
ΔV_{total}: Volume variation in the capillary, extension and seal set (cm^3)
V_{total}: Total diaphragm volume after contraction or expansion effect
γoil: Volume expansion coefficient of the oil presented in the Table 2.5 (1/ ºC)
L_{cap}: Capillary length (meters). For the LD30XL consider L = 0.5m
L_{ext}: Extension length (meters)
Error: Error (mmH_2O @ 4 ºC)
Error(Graphic): Error Removed from Figures 2.6, 2.7 and 2.8 in terms of the V_{total}, for diaphragm of 0.05 mm, 0.075 mm and 0.1mm respectively.
Error%: Error Percentage relative to Transmitter Calibration

Calibrated Span: Transmitter Calibration (mmH_2O @ 4 ºC)
Fm: Diaphragm Material Factor
*Only for capillary standard diameter (≈1.0 mm)

ATTENTION
The temperature of reference for adjustment is 25 ºC. The Errors in terms of the temperature occur with the deviation of the temperature beyond 25 °C.

Determination of the Seal/Level Error for High (H) or Low (L) Sides

a) Upper Variation of Temperature

In this case adopt the temperature variation above zero line.

b) Lower Variation of Temperature

In this case adopt the temperature variation below zero line.

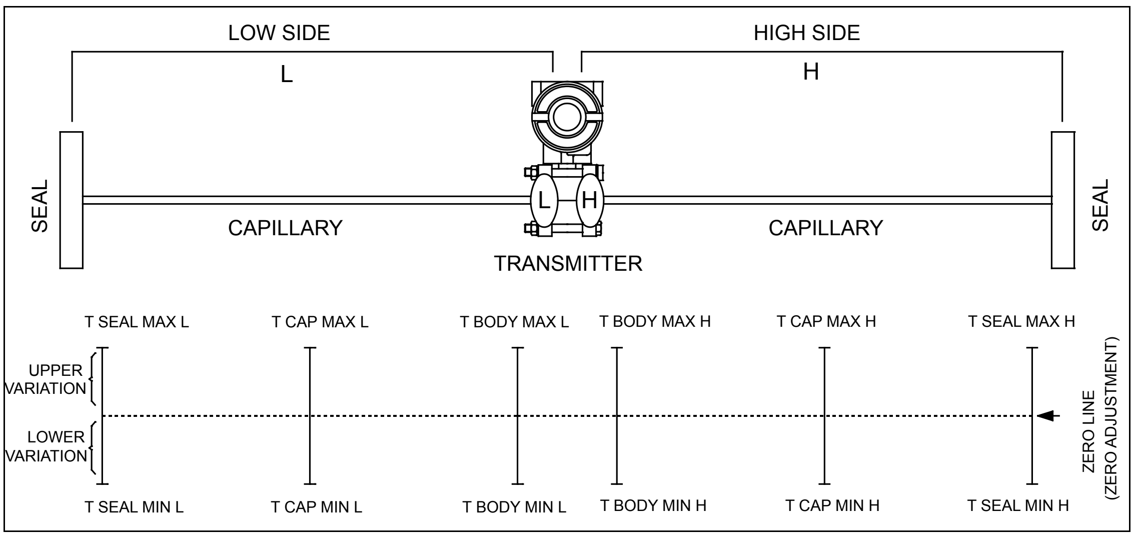


Figure 2.5 – Transmitter/Seal Set Temperatures

Where:
T seal max H: Maximum Temperature on the seal high Side (ºC)
T seal min H: Minimum Temperature on the seal high Side (ºC)
T cap max H: Maximum Temperature on the capillary high Side (ºC)
T cap min H: Minimum Temperature on the capillary high Side (ºC)
T body max H: Maximum Temperature on the body high Side (ºC)
T body min H: Minimum Temperature on the body high Side (ºC)
T seal max L: Maximum Temperature on the seal low Side (ºC)
T seal min L: Minimum Temperature on the seal low Side (ºC)
T cap max L: Maximum Temperature on the capillary low Side (ºC)
T cap min L: Minimum Temperature on the capillary low Side (ºC)
T body max L: Maximum Temperature on the body low Side (ºC)
T body min L: Minimum Temperature on the body low Side (ºC)

Error for Two Seals Influenced by Temperature Symmetry

If the transmitter has a remote seal, the error is directly obtained using Figures 2.6, 2.7 and 2.8. In case the transmitter has two remote seals, it will be necessary to know the thermal symmetry in the seals.

We can say that a Set of Seals/Level and Transmitter has thermal symmetry when the temperatures applied on the High side (H) are equal to the temperatures applied on the Low side (L). When they are different there is a Thermal Asymmetry.

After determining the thermal symmetry, the error for each one of the seals must be found independently (see Figures 2.6, 2.7 and 2.8). Then, substitute these values in equations 2.12 or 2.13.

Thermal Symmetry: $$Es = \sqrt{(E_H)^2 + (E_L)^2} \times \left(\frac{1}{\sqrt{6}} \right) \quad (2.12)$$

Thermal Asymmetry: $$Es = \sqrt{(E_H)^2 + (E_L)^2} \quad (2.13)$$

Where:

Es : Total error of both remote seals due to temperature variation (mmH2O @ 4ºC)

E_L : Error on the remote seal L side (mmH_2O @ 4ºC)

E_H : Error on the remote seal H side (mmH_2O @ 4ºC)

ATTENTION
The effects caused by geometric variations, as the increase of the capillary length or diameter are considered in the calculations of diaphragm errors in terms of the diaphragm families. Therefore, when calculating the errors of the High or Low sides, the differences between capillaries diameters and length are already taken into account.

Table 2.5 below shows the diaphragm family in terms of the transmitter/seal model.

Model / Diaphragm Family	LD301L (WITHOUT /EXT)	LD301L (WITH/ EXT)	SR301T	SR301E	LD/SR 301 S (WITHOUT/ EXT)	LD/SR 301 S (WITH/ EXT)	SR301 R	SR301P
0	—	—	1" DN25	—	1.1/2" (SMS;RJT *;IDF *;TC)	DN25	—	—
1	—	1.1/2" DN40	—	1.1/2" DN40	—	DN40 DN50 2" (SMS;RJT;IDF;TC) 1.1/2" (SMS;RJT;IDF;TC) *	—	—
2	—	2" DN50	—	2" DN50	DN40 DN50 2" (SMS;RJT;IDF; TC)	—	—	—
3	1.1/2" DN40	—	1.1/2" DN40	—	—	—	—	1.1/2" DN40
4	2" DN50	—	2" DN50	—	—	—	SR301R	2" DN50
5	—	—	—	—	—	—	—	—
6	—	—	—	—	—	DN 80 3" (SMS;RJT;IDF;TC)	—	—
7	3" DN80	3" DN80	3" DN80	3" DN80	DN 80 3" (SMS *;RJT *;IDF *;TC)	—	—	3” DN80
8	4" DN100	4" DN100	4" DN100	4" DN100	—	—	—	4” DN100

* Projects in process.

Legend: SR301T – “T” Type Flanged; SR301R – Threaded; SR301S – Sanitary; SR301E – Flanged with Extension; SR301P – Pancake; LD301L – LD Level; LD301S – Sanitary;.

Table 2.5 – Diaphragm Family

The Table 2.6 below shows the value of the diaphragm reservoir volume (Vrdf) for each family.

Diaphragm Family	Vrdf ($\times 10^{-2} cm^3$)
0	18.1
1	20.4
2	24.8
3	29.2
4	38.4
5	47.7
6	82.8
7	105.6
8	274.2

Table 2.6 – Diaphragm Volume

The Table 2.7 below shows the value of the material factor (Fm) in function of the diaphragm material.

Diaphragm Material	Fm
316/316L SST	1.00
Hastelloy	1.08
Monel	0.96
Tantalum	0.99
Titanium	0.56
304/304L SST	1.00
Duplex	1.01
Super Duplex	1.05

Table 2.7 – Materials Factor

The Table 2.8 below shows the crescent classification (better to worst) of the diaphragms in relation to performance and mechanical resistance.

Diaphragm Material	Performance	Mechanical Resistance
316L SST	4	6
Hastelloy	7	4
Monel	2	5
Tantalum	3	7
Titanium	1	2
304L SST	4	8
Duplex	5	3
Super Duplex	6	1

Table 2.8 – Comparative

The Figure 2.6 shows the error of the remote seal in terms of the diaphragm total volume (V_{total}) for diaphragms of 0.05mm thick in 25°C.

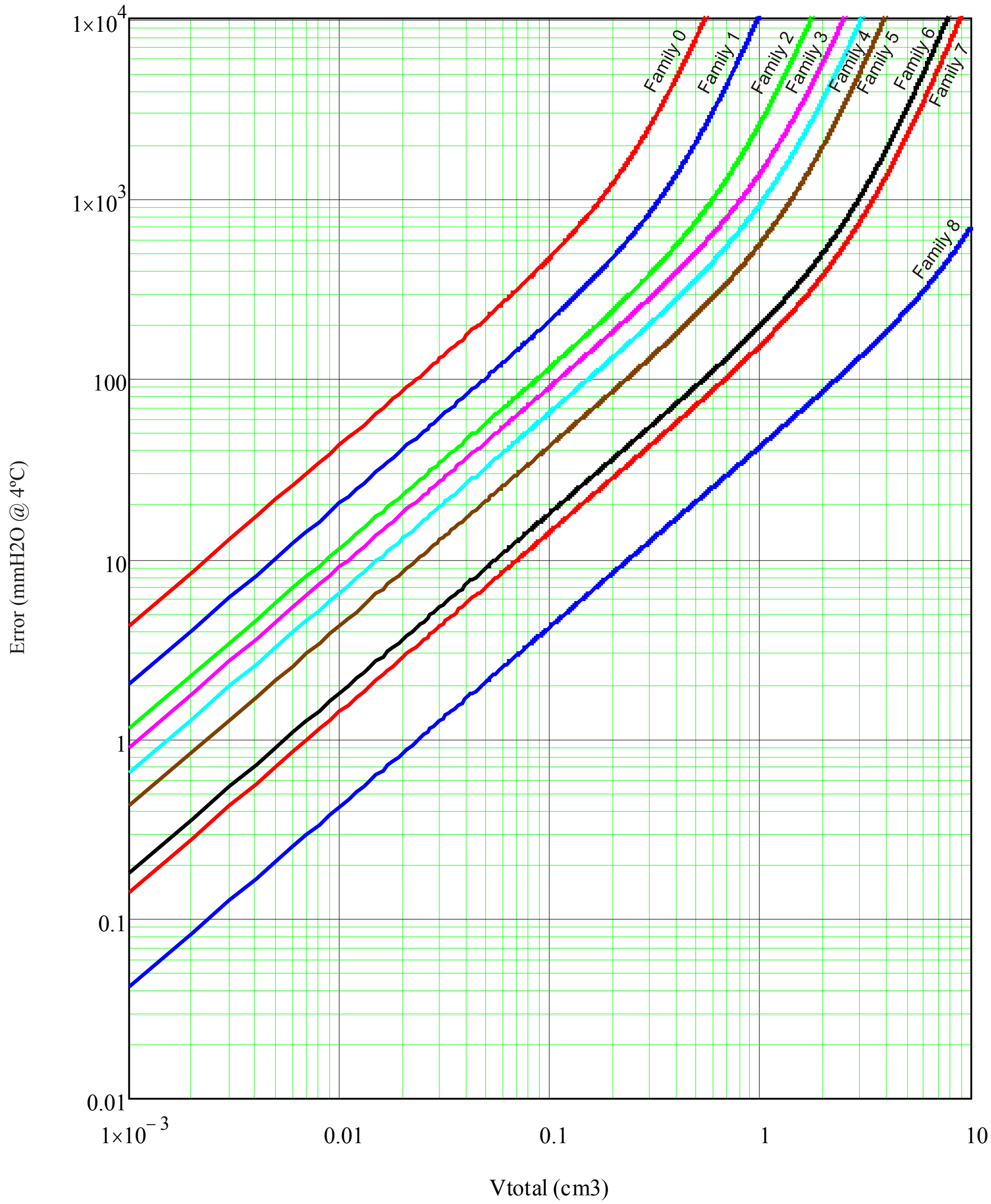


Figure 2.6 – Error for Diaphragms with 0.05mm thickness

The Figure 2.7 shows an error of the remote seal in terms of the diaphragm total volume (V_{total}) for diaphragms of 0.075mm thick in 25°C.

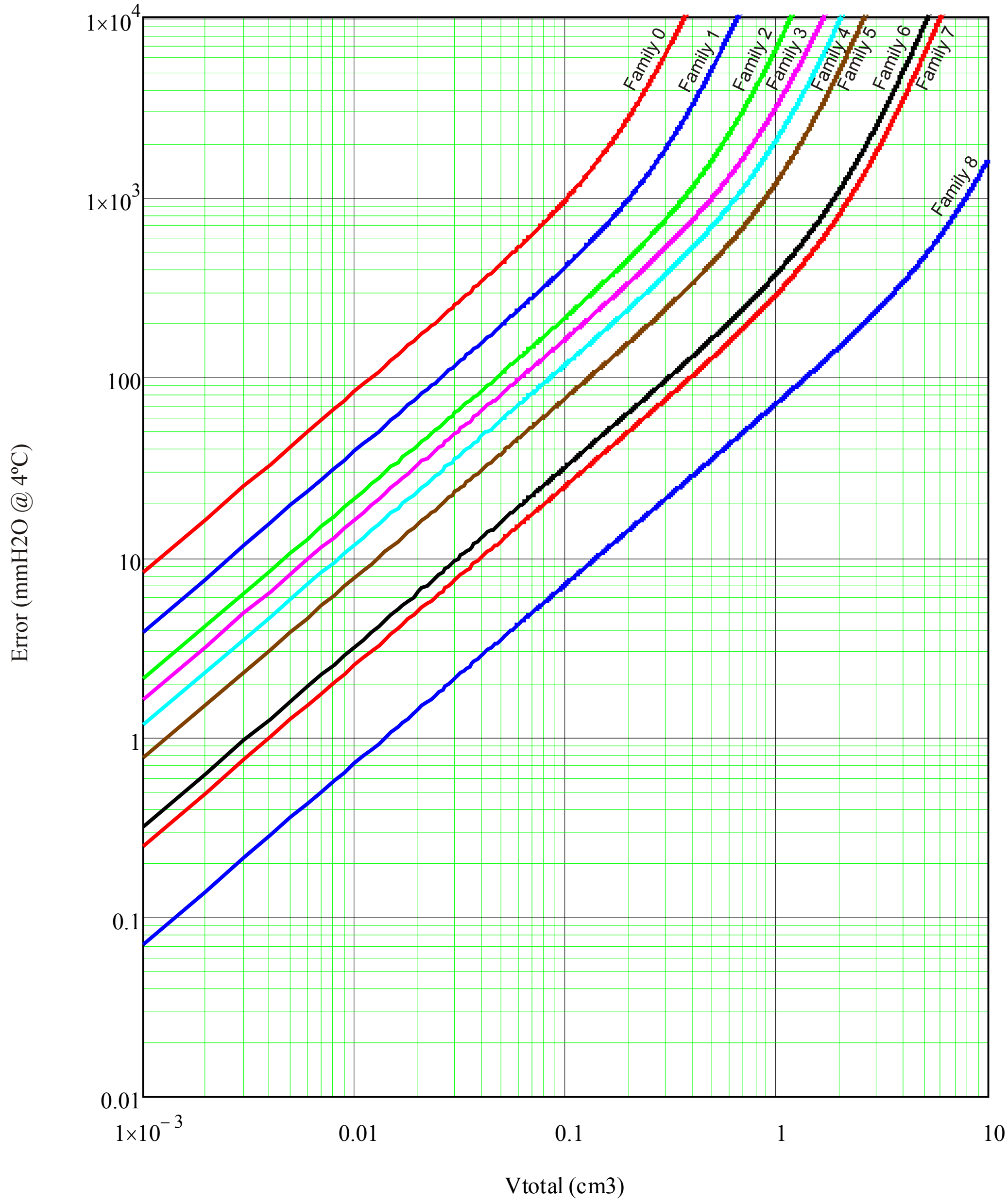


Figure 2.7 – Error for Diaphragms with 0.075mm thickness

The Figure 2.8 shows an error of the remote seal in terms of the diaphragm total volume (V_{total}) for diaphragms of 0.1mm thick in 25°C

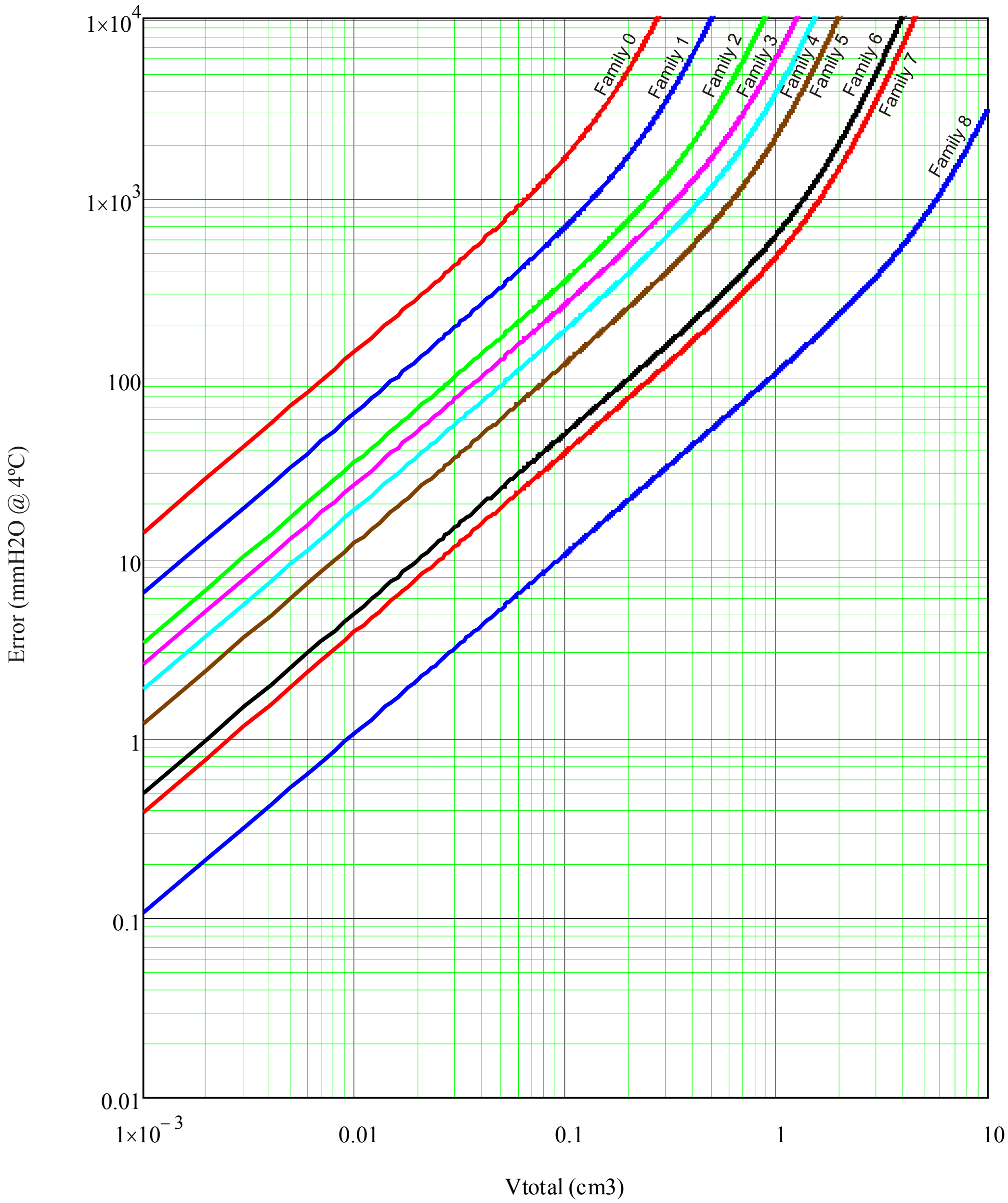


Figure 2.8 – Error for Diaphragms with 0.1mm thickness

Assembly Accuracy

The transmitter accuracy is not significantly modified by the addition of seals/level. However, the error of resulting measurement of the combination significantly increases due to geometric and physical parameters in terms of the temperature variation.

Total Probable Assembly Error

The Total Probable Error (TPE) of the transmitter and seal/level assembly is a measure that involves all the probable error sources in this measurement, such as: transmitter accuracy, ambient temperature, static pressure, vibration and changes in the transmitter power supply.

To know the TPE of the transmitter and remote seal assembly, use the method of the square root addition for each error as shown in equation 2.14:

$$ETP = \sqrt{(E_S)^2 + (E_T)^2} \qquad (2.14)$$

ETP : Total Probable Error of the transmitter and remote seal assembly (mmH_2O)

E_S : Total Error of both remote seals due to temperature variation (mmH_2O)

E_T : Pressure Transmitter Error (mmH_2O) – See the Transmitter Manual

Remote Seal Response Time

The response time of a measurement system having a remote seal with capillary and a transmitter is defined as the time the transmitter pressure takes to read 63% of the pressure variation value applied on a 10% to 90% range of the measured pressure, as in Figure 2.9.

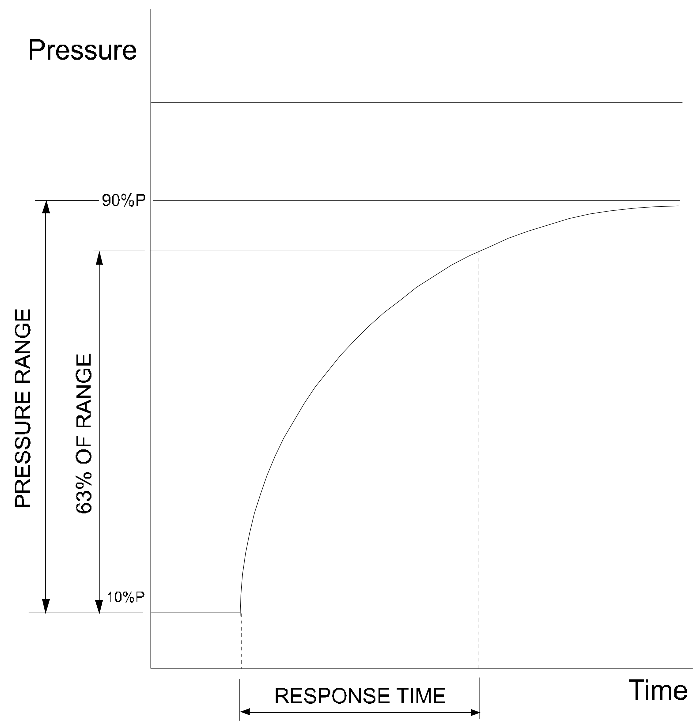


Figure 2.9 – Response Time

The response time is the result of the resistance of the oil displacement in the capillary, so that, the bigger the capillary and the oil viscosity are, the longer will be the response time. The transmitter range influences the response time due to the rigidity of the sensor diaphragm, so that the wider the range, the quickest the response time.

The response time is also influenced by the viscosity of the filling fluid, which varies with the temperature. The higher the temperature, the lesser the viscosity of the filling fluid, which, consequently, reduces the response time.

Calculation of Remote Seal Response Time

The response time is obtained through the equation 2.15, below:

$$TR_S = TR_{listed} \cdot L \qquad (2.15)$$

Where:

TR_S : Remote seal response time (seconds)

TR_{listed} : Response Time through the capillary length (seconds/meters) – See Table 2.10

L : Capillaty length (meters)

NOTE
The values obtained for the seal response time do not consider the response time of the transmitter. Therefore, the response time of the seal and transmitter set will be the addition of both.

NOTE
Capillary lengths whose difference of response time between H and L sides exceeds 0.5s must be avoided. This measure prevents wrong measurements.

TRANSMITTER RANGE	CAPILLARY TEMPERATURE(°C)	Response Time in seconds/meter of capillary (s/m)(6)								
		DC 200	DC 704	FLUOROLUBE	SYLTHERM 800	NEOBEE M20	Glycerin 50% + Water 50%	FOMBLIM	KYTROX	HALOCARBOM
	100(4)	2.69E-01	3.99E-01	1.72E-01	1.09E-01	5.59E-02	2.16E-02	2.66E-01	3.08E-01	8.37E-02
	75	3.38E-01	5.75E-01	2.84E-01	1.52E-01	8.89E-02	4.32E-02	4.46E-01	4.83E-01	1.19E-01
	50	4.55E-01	9.29E-01	7.86E-01	2.23E-01	1.57E-01	1.19E-01	1.00E+00	9.85E-01	1.88E-01
	25	6.98E-01	1.72E+00	3.78E+00	3.47E-01	3.15E-01	5.32E-01	3.41E+00	2.90E+00	3.80E-01
2	10	9.87E-01	2.69E+00	1.28E+01	4.67E-01	5.09E-01	2.01E+00	9.03E+00	6.92E+00	6.90E-01
	0	1.30E+00	3.74E+00	3.26E+01	5.77E-01	7.21E-01	6.20E+00	1.94E+01	1.37E+01	1.13E+00
	-10	1.78E+00	N.A.	9.18E+01	7.21E-01	1.04E+00	N.A.	4.62E+01	2.99E+01	1.99E+00
	-20	2.56E+00	N.A.	2.86E+02	9.12E-01	N.A.	N.A.	1.22E+02	7.19E+01	3.86E+00
	-40	6.10E+00	N.A.	N.A.	1.51E+00	N.A.	N.A.	N.A.	5.76E+02	1.98E+01
	100(4)	5.39E-02	7.97E-02	3.45E-02	2.18E-02	1.12E-02	4.32E-03	5.32E-02	6.17E-02	1.67E-02
	75	6.75E-02	1.15E-01	5.68E-02	3.03E-02	1.78E-02	8.65E-03	8.91E-02	9.67E-02	2.38E-02
	50	9.09E-02	1.86E-01	1.57E-01	4.45E-02	3.15E-02	2.38E-02	2.01E-01	1.97E-01	3.76E-02
	25	1.40E-01	3.45E-01	7.56E-01	6.94E-02	6.30E-02	1.06E-01	6.81E-01	5.80E-01	7.60E-02
3	10	1.97E-01	5.38E-01	2.56E+00	9.34E-02	1.02E-01	4.02E-01	1.81E+00	1.38E+00	1.38E-01
	0	2.60E-01	7.48E-01	6.53E+00	1.15E-01	1.44E-01	1.24E+00	3.88E+00	2.75E+00	2.25E-01
	-10	3.57E-01	N.A.	1.84E+01	1.44E-01	2.09E-01	N.A.	9.24E+00	5.98E+00	3.98E-01
	-20	5.12E-01	N.A.	5.72E+01	1.82E-01	N.A.	N.A.	2.45E+01	1.44E+01	7.73E-01
	-40	1.22E+00	N.A.	N.A.	3.03E-01	N.A.	N.A.	N.A.	1.15E+02	3.96E+00
	100(4)	4.86E-03	7.19E-03	3.11E-03	1.97E-03	1.01E-03	3.90E-04	4.80E-03	5.56E-03	1.51E-03
	75	6.09E-03	1.04E-02	5.13E-03	2.74E-03	1.60E-03	7.80E-04	8.04E-03	8.72E-03	2.14E-03
	50	8.20E-03	1.68E-02	1.42E-02	4.02E-03	2.84E-03	2.15E-03	1.81E-02	1.78E-02	3.39E-03
	25	1.26E-02	3.11E-02	6.82E-02	6.26E-03	5.68E-03	9.60E-03	6.15E-02	5.24E-02	6.86E-03
4	10	1.78E-02	4.85E-02	2.31E-01	8.42E-03	9.18E-03	3.62E-02	1.63E-01	1.25E-01	1.25E-02
	0	2.35E-02	6.75E-02	5.89E-01	1.04E-02	1.30E-02	1.12E-01	3.50E-01	2.48E-01	2.03E-02
	-10	3.22E-02	N.A.	1.66E+00	1.30E-02	1.89E-02	N.A.	8.33E-01	5.39E-01	3.59E-02
	-20	4.61E-02	N.A.	5.16E+00	1.65E-02	N.A.	N.A.	2.21E+00	1.30E+00	6.97E-02
	-40	1.10E-01	N.A.	N.A.	2.73E-02	N.A.	N.A.	N.A.	1.04E+01	3.57E-01
	100(4)	2.11E-04	3.13E-04	1.35E-04	8.54E-05	4.38E-05	1.69E-05	2.09E-04	2.42E-04	6.56E-05
	75	2.65E-04	4.50E-04	2.23E-04	1.19E-04	6.96E-05	3.39E-05	3.49E-04	3.79E-04	9.31E-05
	50	3.56E-04	7.28E-04	6.16E-04	1.75E-04	1.23E-04	9.32E-05	7.87E-04	7.72E-04	1.47E-04
	25	5.47E-04	1.35E-03	2.96E-03	2.72E-04	2.47E-04	4.17E-04	2.67E-03	2.27E-03	2.98E-04
5	10	7.74E-04	2.11E-03	1.00E-02	3.66E-04	3.99E-04	1.57E-03	7.08E-03	5.42E-03	5.41E-04
	0	1.02E-03	2.93E-03	2.56E-02	4.52E-04	5.65E-04	4.86E-03	1.52E-02	1.08E-02	8.82E-04
	-10	1.40E-03	N.A.	7.20E-02	5.65E-04	8.19E-04	N.A.	3.62E-02	2.34E-02	1.56E-03
	-20	2.00E-03	N.A.	2.24E-01	7.15E-04	N.A.	N.A.	9.59E-02	5.64E-02	3.03E-03
	-40	4.78E-03	N.A.	N.A.	1.19E-03	N.A.	N.A.	N.A.	4.52E-01	1.55E-02
	100(4)	1.66E-04	2.46E-04	1.06E-04	6.71E-05	3.44E-05	1.33E-05	1.64E-04	1.90E-04	5.16E-05
	75	2.08E-04	3.54E-04	1.75E-04	9.34E-05	5.48E-05	2.66E-05	2.75E-04	2.98E-04	7.32E-05
	50	2.80E-04	5.73E-04	4.84E-04	1.37E-04	9.70E-05	7.33E-05	6.19E-04	6.07E-04	1.16E-04
	25	4.30E-04	1.06E-03	2.33E-03	2.14E-04	1.94E-04	3.28E-04	2.10E-03	1.79E-03	2.34E-04
6	10	6.08E-04	1.66E-03	7.89E-03	2.88E-04	3.13E-04	1.24E-03	5.56E-03	4.26E-03	4.25E-04
	0	8.01E-04	2.31E-03	2.01E-02	3.56E-04	4.44E-04	3.82E-03	1.20E-02	8.46E-03	6.93E-04
	-10	1.10E-03	N.A.	5.66E-02	4.44E-04	6.44E-04	N.A.	2.85E-02	1.84E-02	1.23E-03
	-20	1.58E-03	N.A.	1.76E-01	5.62E-04	N.A.	N.A.	7.54E-02	4.43E-02	2.38E-03
	-40	3.76E-03	N.A.	N.A.	9.33E-04	N.A.	N.A.	N.A.	3.55E-01	1.22E-02

Table 2.9 – Remote Seal Response Time

Notes:

(1) The response time is defined as the time that the indication of the instrument pressure takes to show 63% of the pressure variation value applied in the 10% to 90% range of the measured pressure.
(2) If the transmitter has two capillaries add their lengths to calculate the response time.
(3) N.A: No applicable due to temperature limit.
(4) The temperature limit for (Water 50% + Glycerin 50%) is 93°C.
(5) The user will have to analyze the total response time to the related application.
(6) Without the transmitter response time.
(7) The table above is only for capillary standard diameter (≈1.0 mm)

Capillary Length

The capillary length is a variable defined in terms of the application need, as for example, the tank height or distance of the remote point to be measured.

To evaluate the maximum capillary length, three conditions must be fulfilled:

1) To check if the expanded or contracted volume relative to the initial volume of the corrugated is within Lower and Upper limits (VC_{min} and VC_{max});

$$VC_{\min} \leq V_{total} \leq VC_{\max} \tag{2.16}$$

Where:

V_{total} : Total diaphragm volume after expansion or contraction effect (defined in this Chapter)

$VC_{\min}$: Minimum Critical Volume of the Seal

$VC_{\max}$: Maximum Critical Volume of the Seal

To obtain the $VC_{\max}$ value, use Tables 2.10 to 2.17, where the maximum critical volume for different materials and diaphragm thickness in function of temperature is presented

To obtain the $VC_{\min}$ value use the Table 2.18, where the minimum critical volume for the transmitter range and applied process pressure is presented.

$$\%VC_{\min} = \frac{MVP}{URL} \times 100 \tag{2.17}$$

Where:

$\%VC_{\min}$: Percentage of $VC_{\min}$ regarding URL

MVP : The higher value between $|V.\sup|$ and $|V.\inf|$

2) Verify if the response time is compatible with the process variables and there will be enough time so that the pressure transmission guarantees the application control limits.

3) Verify if the assembly global error is within client expectations.

After these three analysis, the maximum remote seal capillary length needed is acceptable.

Tp (ºC)	VCmax (10^{-2} x cm^3) for 316L Stainless Steel Diaphragm																	
	# 0.05mm									# 0.1mm								
	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8
-25 to 35	9.6	15.9	24.3	29.8	36.6	47.9	86.6	100.6	248.9	8.1	13.4	21.2	26.7	32.6	42.2	76.6	88.4	231.4
75	9.0	14.8	22.6	27.6	34.0	44.5	80.5	93.7	230.5	7.6	12.6	19.8	24.7	30.5	39.5	71.8	82.9	215.7
125	8.2	13.6	20.7	25.2	31.0	40.8	73.7	85.9	210.0	7.0	11.6	18.2	22.9	28.0	36.4	66.2	76.7	198.0
175	7.6	12.5	19.0	23.1	28.5	37.5	67.9	79.2	192.6	6.4	10.8	16.9	21.1	25.9	33.7	61.4	71.2	182.8
225	7.1	11.7	17.7	21.4	26.5	34.9	63.0	73.6	178.5	6.0	10.1	15.7	19.6	24.1	31.5	57.4	66.6	170.1
275	6.7	11.0	16.6	20.1	24.9	32.8	59.3	69.3	167.7	5.7	9.5	14.9	18.5	22.7	29.8	54.2	63.0	160.4
325	6.4	10.5	15.9	19.2	23.8	31.4	56.8	66.4	160.2	5.5	9.1	14.3	17.7	21.8	28.6	52.1	60.5	153.6
375	6.2	10.3	15.5	18.8	23.2	30.7	55.4	64.8	156.2	5.3	8.9	13.9	17.3	21.3	27.9	50.9	59.2	150.0

***Table 2.10 – Maximum Critical Volume for 316L Stainless Steel Diaphragm** (See Note - page 2.20)*

Tp (ºC)	VCmax (10^{-2} x cm^3) for Hastelloy Diaphragm																	
	# 0.05mm									# 0.1mm								
	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8
-25 to 35	14.0	23.0	35.9	45.0	54.9	70.8	128.0	147.5	379.8	11.5	18.9	30.2	39.0	47.0	59.8	108.2	123.7	336.0
75	13.5	22.1	34.4	43.1	52.6	68.0	122.9	141.8	363.1	11.1	18.3	29.1	37.5	45.2	57.7	104.2	119.5	323.2
125	12.8	21.1	32.7	40.8	49.9	64.6	116.7	134.9	343.3	10.6	17.5	27.8	35.7	43.1	55.2	99.8	114.4	307.8
175	12.2	20.1	31.1	38.6	47.3	61.4	110.7	128.3	324.7	10.1	16.7	26.5	33.9	41.1	52.7	95.4	109.5	293.2
225	11.6	19.1	29.5	36.6	44.8	58.3	105.4	122.0	307.3	9.7	16.0	25.3	32.3	39.2	50.4	91.3	104.8	279.3
275	11.1	18.2	28.1	34.7	42.6	55.5	100.3	116.2	291.2	9.2	15.3	24.2	30.8	37.4	48.2	87.3	100.4	266.3
325	10.6	17.4	26.8	33.0	40.5	52.9	95.6	110.9	276.6	8.8	14.7	23.2	29.4	35.8	46.1	83.7	96.3	254.4
375	10.1	16.7	25.6	31.5	38.7	50.5	91.3	106.1	263.5	8.5	14.1	22.2	28.4	34.3	44.3	80.4	92.6	243.6

***Table 2.11 – Maximum Critical Volume for Hastelloy Diaphragm** (See Note - page 2.20)*

Tp (ºC)	VCmax (10^{-2} x cm^3) for Monel Diaphragm																	
	# 0.05mm									# 0.1mm								
	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8
-25 to 35	10.0	16.5	25.4	31.2	38.3	50.1	90.5	105.1	260.8	8.4	13.9	22.0	27.9	34.0	43.9	79.7	91.8	241.3
75	9.4	15.6	23.8	29.2	35.9	47.0	85.0	98.8	244.0	7.9	13.2	20.8	26.2	32.0	41.5	75.3	86.9	227.2
125	8.8	14.5	22.2	27.1	33.4	43.8	79.1	92.1	226.2	7.4	12.4	19.5	24.5	29.9	38.8	70.6	81.6	212.0
175	8.3	13.7	20.9	25.4	31.4	41.2	74.4	86.7	212.0	7.0	11.7	18.4	23.1	28.2	36.7	66.8	77.3	199.7
225	7.9	13.1	19.9	24.2	29.8	39.2	70.9	82.7	201.7	6.7	11.2	17.6	22.0	27.0	35.1	63.9	74.0	190.7
275	7.7	12.7	19.3	23.4	28.9	38.0	68.7	80.2	195.2	6.5	10.9	17.1	21.3	26.2	34.1	62.1	72.0	185.0
325	7.6	12.5	19.0	23.1	28.5	37.6	67.9	79.2	192.7	6.4	10.8	16.9	21.1	25.9	33.7	61.4	71.2	182.8
375	7.5	12.4	18.8	22.7	28.2	37.2	67.7	78.2	190.0	6.3	10.6	16.7	21.0	25.4	33.0	60.5	70.8	180.5

***Table 2.12 – Maximum Critical Volume for Monel Diaphragm** (See Note - page 2.20)*

Tp (ºC)	VCmax (10^{-2} x cm^3) for Tantalum Diaphragm																	
	# 0.05mm									# 0.1mm								
	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8
-25 to 35	8.5	13.9	21.3	25.9	32.0	42.0	75.8	88.3	216.4	7.1	11.9	18.7	23.5	28.7	37.3	67.9	78.5	203.5
75	7.1	11.7	17.8	21.5	26.6	35.0	63.8	74.0	179.4	6.0	10.1	15.8	19.7	24.2	31.6	56.6	66.8	170.9
125	5.6	9.2	13.9	16.8	20.8	27.4	49.6	58.0	139.4	4.8	8.0	12.5	15.5	19.1	25.1	45.8	53.3	134.5
175	4.3	7.2	10.7	12.9	16.0	21.2	38.3	44.9	107.1	3.7	6.3	9.7	12.0	14.8	19.6	35.8	41.8	104.2
225	3.4	5.6	8.4	10.0	12.4	16.5	29.3	35.0	83.1	2.9	4.9	7.6	9.3	11.6	15.3	28.0	32.8	81.3
275	2.8	4.6	6.8	8.1	10.1	13.4	24.3	28.5	67.6	2.4	4.0	6.2	7.6	9.4	12.5	22.9	26.9	66.3
325	2.5	4.1	6.1	7.3	9.1	12.1	21.8	25.6	60.8	2.1	3.6	5.6	6.9	8.5	11.3	20.6	24.2	59.6
375	2.2	3.8	5.7	7.0	8.3	11.2	19.7	22.4	58.7	1.9	3.1	4.8	6.0	7.9	10.7	18.6	22.8	55.8

Table 2.13 – Maximum Critical Volume for** Tantalum **Diaphragm (See Note - page 2.20)

Tp (ºC)	VCmax (10^{-2} x cm^3) for Titanium Diaphragm																	
	# 0.05mm									# 0.1mm								
	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8
-25 to 35	18.2	29.9	47.5	61.0	73.6	93.8	169.5	194.0	519.6	14.7	24.0	38.8	50.9	60.8	76.5	137.8	156.6	438.1
75	16.7	27.4	43.4	55.3	67.0	85.7	154.9	177.7	469.6	13.6	22.2	35.8	46.7	55.9	70.6	127.5	145.1	402.3
125	14.9	24.5	38.5	48.6	59.1	76.0	137.4	158.1	410.9	12.2	20.0	32.1	41.6	50.1	63.6	114.9	131.1	359.1
175	13.3	21.8	34.0	42.5	51.9	67.1	121.3	140.0	358.1	10.9	18.0	28.7	36.9	44.6	56.9	103.0	117.9	319.1
225	11.8	19.4	30.0	37.2	45.6	59.3	107.1	124.0	312.9	9.8	16.1	25.7	32.8	39.8	51.0	92.4	106.1	283.6
275	10.6	17.4	26.8	33.0	40.5	52.9	95.6	110.9	276.8	8.8	14.6	23.1	29.4	35.7	46.1	83.6	96.2	254.3
325	9.7	15.9	24.4	30.0	36.9	48.2	87.2	101.3	250.9	8.1	13.5	21.3	26.9	32.8	42.4	77.0	88.8	232.8
375	9.2	15.1	23.1	28.2	34.8	45.6	82.4	95.8	236.2	7.7	12.8	20.2	25.4	31.1	40.2	73.2	84.5	220.4

Table 2.14 – Maximum Critical Volume for** Titanium **Diaphragm (See Note - page 2.20)

Tp (ºC)	VCmax (10^{-2} x cm^3) for 304L Stainless Steel Diaphragm																	
	# 0.05mm									# 0.1mm								
	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8
-25 to 35	8.1	13.4	20.4	24.9	30.7	40.3	72.9	84.9	207.5	6.9	11.5	18.0	22.6	27.7	36.0	65.6	75.9	195.8
75	7.6	12.5	19.0	23.0	28.4	37.4	67.6	78.9	191.9	6.4	10.7	16.8	21.0	25.8	33.6	61.2	71.0	182.1
125	6.9	11.4	17.3	21.0	25.9	34.2	61.8	72.1	174.7	5.9	9.9	15.4	19.2	23.6	30.9	56.3	65.4	166.8
175	6.4	10.5	15.9	19.2	23.8	31.4	56.8	66.4	160.2	5.5	9.1	14.3	17.7	21.8	28.6	52.1	60.5	153.6
225	5.9	9.8	14.8	17.8	22.1	29.2	52.7	61.6	148.3	5.1	8.5	13.3	16.5	20.3	26.6	48.5	56.5	142.8
275	5.6	9.2	13.9	16.7	20.7	27.2	49.5	58.0	139.2	4.8	8.0	12.5	15.5	19.1	25.1	45.8	53.3	134.4
325	5.3	8.8	13.3	16.0	19.8	26.2	47.4	55.0	133.0	4.6	7.7	12.0	14.8	18.3	24.0	43.9	51.1	128.5
375	5.2	8.6	12.9	15.6	19.3	25.5	46.2	54.0	129.5	4.5	7.5	11.7	14.4	17.8	23.5	42.8	49.9	125.3

***Table 2.15 – Maximum Critical Volume for 304L Stainless Steel Diaphragm** (See Note - page 2.20)*

Tp (ºC)	VCmax (10^{-2} x cm^3) for Duplex Diaphragm																	
	# 0.05mm									# 0.1mm								
	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8
-25 to 35	16.9	27.7	43.8	55.8	67.5	86.3	156.0	179.0	473.2	13.7	22.5	36.1	47.1	56.4	71.2	128.5	146.2	405.3
75	15.9	26.1	41.2	52.2	63.3	81.2	146.8	168.7	442.2	13.0	21.3	34.2	44.4	53.4	67.5	121.9	138.9	382.7
125	14.8	24.4	38.2	48.2	58.6	75.4	136.3	156.8	407.0	12.2	20.0	32.0	41.4	49.8	63.2	114.3	130.4	356.6
175	13.9	22.8	35.6	44.6	54.4	70.2	126.9	146.4	376.3	11.4	18.8	30.0	38.7	46.6	59.2	107.3	122.8	333.4
225	13.1	21.5	33.4	41.7	50.9	65.9	119.1	137.5	350.8	10.8	17.8	28.3	36.4	43.9	56.1	101.6	116.3	313.7
275	12.4	20.4	31.7	39.4	48.2	62.5	112.9	130.5	331.0	10.3	17.0	27.0	34.5	41.8	53.5	97.0	111.2	298.2
315	12.0	19.8	30.6	38.0	46.2	61.1	109.3	126.4	319.5	10.0	16.5	26.2	33.5	40.6	52.0	94.2	108.1	289.1

Table 2.16 – Maximum Critical Volume for Duplex Diaphragm (See Note - page 2.20)

Tp (ºC)	VCmax (10^{-2} x cm^3) for Super Duplex Diaphragm																	
	# 0.05mm									# 0.1mm								
	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8	Family 0	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	Family 8
-25 to 35	18.7	30.7	48.9	62.9	75.8	96.4	174.2	199.3	535.5	15.1	24.7	39.9	52.3	62.5	78.5	141.4	160.5	449.9
75	17.8	29.2	46.3	59.3	71.7	91.4	165.2	189.2	504.5	14.4	23.6	38.0	49.8	59.5	74.9	135.0	153.5	427.9
125	16.8	27.5	43.5	55.3	67.0	85.7	155.0	177.8	469.6	13.6	22.3	35.9	46.8	56.1	70.8	127.7	145.4	402.7
175	15.9	26.0	41.0	51.9	63.0	80.8	146.1	167.8	439.6	12.9	21.2	34.0	44.2	53.1	67.2	121.4	138.3	380.8
225	15.1	24.8	38.9	49.1	59.7	76.8	138.8	159.6	415.3	12.4	20.3	32.5	42.1	50.6	64.3	116.1	132.4	362.8
275	14.5	23.9	37.4	47.0	57.2	73.7	133.3	153.5	397.1	11.9	19.6	31.3	40.5	48.8	62.0	112.1	128.0	349.1
300	14.3	23.5	36.8	46.3	56.3	72.6	131.3	151.2	390.5	11.8	19.4	30.9	39.9	48.1	61.2	110.6	125.6	344.1

Table 2.17 – Maximum Critical Volume for Super Duplex Diaphragm (See Note - page 2.20)

Note - Tables 2.10 to 2.17
The tables 2.10 to 2.17 are Theoretical. For the VcMax values in diaphragm with 0.075 mm of thickness, interpolate the listed values. All the thickness and listed materials are not available. In case of doubt it consults our representatives.

See below the Table 2.18 of Minimum Critical Volume.

VCmin (10^{-2} x cm^3)												
% VCmin / Transmitter Range	120%	110%	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%
2	7.02	6.44	5.85	5.27	4.68	4.10	3.51	2.93	2.34	1.76	1.17	0.59
3	7.02	6.44	5.85	5.27	4.68	4.10	3.51	2.93	2.34	1.76	1.17	0.59
4	6.34	5.81	5.28	4.75	4.22	3.70	3.17	2.64	2.11	1.58	1.06	0.53
5	2.75	2.52	2.29	2.06	1.83	1.60	1.37	1.15	0.92	0.69	0.46	0.23
6	3.46	3.17	2.88	2.59	2.30	2.02	1.73	1.44	1.15	0.86	0.58	0.29

Table 2.18 – Minimum Critical Volume

Error Guide Trend for Transmitter Assembled with Remote Seal

There are factors that influence the remote seal response, like process temperature, ambient temperature, seal diameter and capillary length.

To better understand the influence of these parameters, a Total Probable Error behavior guide for the transmitter and the remote seal assembly was devised.

This guide is valid only for the assembly of the Remote Seal SR301T and the Smar pressure transmitter LD30X with the following conditions:

- Stainless Steel # 0.05mm diaphragm;
- Filling Fluid DC200;
- Stability for 12 months;
- Static pressure variation up to 10 bar (only for LD30XD);
- Reference Temperature of 25°C;
- Thermal simmetry for two seals assembly;
- Transmitter Calibration with Rangeability 1:1 for cases 1,2,3.

  Therefore, the transmitter calibrations are the following:

  Range 2 : 0 to 50 Kpa;
  Range 3 : 0 to 250 Kpa;
  Range 4 : 0 to 2500 Kpa;
  Range 5 : 0 to 25000 Kpa;
  Range 6 : 0 to 40000 Kpa.

- Transmitter Calibration with Rangeability 10:1 for cases 4,5,6.

  Therefore, the transmitter calibrations are the following:

  Range 2 : 0 to 5 Kpa;
  Range 3 : 0 to 25 Kpa;
  Range 4 : 0 to 250 Kpa;
  Range 5 : 0 to 2500 Kpa;
  Range 6 : 0 to 4000 Kpa.

The Guide is divided in six cases that must be chosen according to the process temperature and ambient temperature. Through these six cases it is possible to observe some factors that influence measuring:

- Ambient and Process Temperature: This is the most important factor and can turn the remote seal use unfeasible. Note that by comparing the six tables (cases 1, 2 and 3; cases 4, 5 and 6), as the temperatures increase, the errors also increase. Cases 3 and 6, where temperatures are higher, present more specifications where the remote seal is not applicable (N.A.).

- Capillary Length: In cases with high temperatures (cases 2 and 3; cases 5 and 6), the shorter the capillary length, the smaller the seal response time and the better the assembly Total Probable Error (TPE).

- Remote Seal Diameter: In cases with high temperatures (cases 2 and 3; cases 5 and 6), the bigger the seal diameter, the better the the assembly Total Probable Error (TPE).

For cases 1 to 6, are:

- N.A.: Nonapplicable by outdatet mechanical limits;
- Error %: TPE lesser or equal to Error % of the calibrated span;
- Δtp: Variation of Temperature in the process;
- Δta: Variation of Temperature in the capillary and pressure transmitter;
- Obs.: For median capillary lengths, use the higher listed value.

Case 1 – TPE % of the Span with Calibration in Rangeability (1:1)

Process Temperature: 40 ºC ± 0 ºC -> Δtp = + 15ºC
Ambient Temperature: 25 ºC ± 0 ºC -> Δta = 0ºC

Capillary	Range	LD30XM (2 to 6)						LD30XD (2 to 4)					
		1 Seal SR301T						2 Seals SR301T(equal)					
		Tr (s)	1"	1.1/2"	2"	3"	4"	Tr (s)	1"	1.1/2"	2"	3"	4"
0.5 m	2	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	3	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	4	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	5	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
1.5 m	2	1.15	0.25%	0.25%	0.25%	0.25%	0.25%	2.20	0.25%	0.25%	0.25%	0.25%	0.25%
	3	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	4	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	5	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
3 m	2	2.20	0.25%	0.25%	0.25%	0.25%	0.25%	4.30	0.25%	0.25%	0.25%	0.25%	0.25%
	3	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	4	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	5	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
5 m	2	3.60	0.25%	0.25%	0.25%	0.25%	0.25%	7.10	0.25%	0.25%	0.25%	0.25%	0.25%
	3	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	1.50	0.25%	0.25%	0.25%	0.25%	0.25%
	4	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	5	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
8 m	2	5.70	0.25%	0.25%	0.25%	0.25%	0.25%	11.27	0.25%	0.25%	0.25%	0.25%	0.25%
	3	1.22	0.25%	0.25%	0.25%	0.25%	0.25%	2.35	0.25%	0.25%	0.25%	0.25%	0.25%
	4	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	5	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
10 m	2	7.10	0.25%	0.25%	0.25%	0.25%	0.25%	14.10	0.25%	0.25%	0.25%	0.25%	0.25%
	3	1.50	0.25%	0.25%	0.25%	0.25%	0.25%	2.90	0.25%	0.25%	0.25%	0.25%	0.25%
	4	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	5	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.

Table 2.19 – TPE (Case 1)

Case 2 – TPE % of the Span with Calibration in Rangeability (1:1)

Process Temperature: 100 ºC ± 0 ºC -> Δtp = + 75ºC
Ambient Temperature: 40 ºC ± 0 ºC -> Δta = + 15ºC

Capillary	Range	LD30XM (2 to 6)						LD30XD (2 to 4)					
		1 Seal SR301T						2 Seals SR301T(equal)					
		Tr (s)	1"	1.1/2"	2"	3"	4"	Tr (s)	1"	1.1/2"	2"	3"	4"
0.5 m	**2**	**< 1**	3.50%	1.00%	1.00%	0.25%	0.25%	**< 1**	2.00%	0.50%	0.50%	0.25%	0.25%
	3	**< 1**	1.00%	0.25%	0.25%	0.25%	0.25%	**< 1**	0.50%	0.25%	0.25%	0.25%	0.25%
	4	**< 1**	0.25%	0.25%	0.25%	0.25%	0.25%	**< 1**	0.25%	0.25%	0.25%	0.25%	0.25%
	5	**< 1**	0.25%	0.25%	0.25%	0.25%	0.25%	**- - -**	N.A.	N.A.	N.A.	N.A.	N.A.
	6	**< 1**	0.25%	0.25%	0.25%	0.25%	0.25%	**- - -**	N.A.	N.A.	N.A.	N.A.	N.A.
1.5 m	**2**	**< 1**	5.00%	1.50%	1.00%	0.50%	0.25%	**1.70**	3.00%	1.00%	0.50%	0.25%	0.25%
	3	**< 1**	1.00%	0.25%	0.25%	0.25%	0.25%	**< 1**	1.00%	0.25%	0.25%	0.25%	0.25%
	4	**< 1**	0.25%	0.25%	0.25%	0.25%	0.25%	**< 1**	0.25%	0.25%	0.25%	0.25%	0.25%
	5	**< 1**	0.25%	0.25%	0.25%	0.25%	0.25%	**- - -**	N.A.	N.A.	N.A.	N.A.	N.A.
	6	**< 1**	0.25%	0.25%	0.25%	0.25%	0.25%	**- - -**	N.A.	N.A.	N.A.	N.A.	N.A.
3 m	**2**	**1.70**	7.00%	1.50%	1.50%	0.50%	0.25%	**3.28**	4.00%	1.00%	1.00%	0.25%	0.25%
	3	**< 1**	1.50%	0.50%	0.50%	0.25%	0.25%	**< 1**	1.00%	0.25%	0.25%	0.25%	0.25%
	4	**< 1**	0.25%	0.25%	0.25%	0.25%	0.25%	**< 1**	0.25%	0.25%	0.25%	0.25%	0.25%
	5	**< 1**	0.25%	0.25%	0.25%	0.25%	0.25%	**- - -**	N.A.	N.A.	N.A.	N.A.	N.A.
	6	**< 1**	0.25%	0.25%	0.25%	0.25%	0.25%	**- - -**	N.A.	N.A.	N.A.	N.A.	N.A.
5 m	**2**	**2.75**	N.A.	1.50%	1.50%	0.50%	0.25%	**5.40**	N.A.	1.50%	1.00%	0.50%	0.25%
	3	**< 1**	N.A.	0.50%	0.50%	0.25%	0.25%	**1.16**	N.A.	0.25%	0.25%	0.25%	0.25%
	4	**< 1**	N.A.	0.25%	0.25%	0.25%	0.25%	**< 1**	N.A.	0.25%	0.25%	0.25%	0.25%
	5	**< 1**	N.A.	0.25%	0.25%	0.25%	0.25%	**- - -**	N.A.	N.A.	N.A.	N.A.	N.A.
	6	**< 1**	N.A.	0.25%	0.25%	0.25%	0.25%	**- - -**	N.A.	N.A.	N.A.	N.A.	N.A.
8 m	**2**	**4.35**	N.A.	3.00%	2.50%	1.00%	0.25%	**8.57**	N.A.	2.00%	1.50%	0.50%	0.50%
	3	**< 1**	N.A.	1.00%	0.50%	0.25%	0.25%	**1.80**	N.A.	0.50%	0.50%	0.25%	0.25%
	4	**< 1**	N.A.	0.25%	0.25%	0.25%	0.25%	**< 1**	N.A.	0.25%	0.25%	0.25%	0.25%
	5	**< 1**	N.A.	0.25%	0.25%	0.25%	0.25%	**- - -**	N.A.	N.A.	N.A.	N.A.	N.A.
	6	**< 1**	N.A.	0.25%	0.25%	0.25%	0.25%	**- - -**	N.A.	N.A.	N.A.	N.A.	N.A.
10 m	**2**	**5.40**	N.A.	3.50%	2.50%	1.00%	0.50%	**10.68**	N.A.	2.00%	1.50%	0.50%	0.25%
	3	**1.16**	N.A.	1.00%	0.50%	0.25%	0.25%	**2.22**	N.A.	0.50%	0.50%	0.25%	0.25%
	4	**< 1**	N.A.	0.25%	0.25%	0.25%	0.25%	**< 1**	N.A.	0.25%	0.25%	0.25%	0.25%
	5	**< 1**	N.A.	0.25%	0.25%	0.25%	0.25%	**- - -**	N.A.	N.A.	N.A.	N.A.	N.A.
	6	**< 1**	N.A.	0.25%	0.25%	0.25%	0.25%	**- - -**	N.A.	N.A.	N.A.	N.A.	N.A.

Table 2.20 – TPE (Case 2)

Case 3 – TPE % of the Span with Calibration in Rangeability (1:1)

Process Temperature: 170 ºC ± 0 ºC -> Δtp = + 145ºC
Ambient Temperature: 60 ºC ± 0 ºC -> Δta = + 35ºC

Capillary	Range	LD30XM (2 to 6) 1 Seal SR301T						LD30XD (2 to 4) 2 Seals SR301T(equal)					
		Tr (s)	1"	1.1/2"	2"	3"	4"	Tr (s)	1"	1.1/2"	2"	3"	4"
0.5 m	2	< 1	N.A.	2.00%	2.00%	0.50%	0.50%	< 1	N.A.	1.50%	1.00%	0.50%	0.50%
	3	< 1	N.A.	0.50%	0.50%	0.25%	0.25%	< 1	N.A.	0.50%	0.50%	0.25%	0.25%
	4	< 1	N.A.	0.25%	0.25%	0.25%	0.25%	< 1	N.A.	0.25%	0.25%	0.25%	0.25%
	5	< 1	N.A.	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	N.A.	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
1.5 m	2	< 1	N.A.	2.50%	2.00%	0.50%	0.50%	1.29	N.A.	1.50%	1.50%	0.50%	0.25%
	3	< 1	N.A.	1.00%	0.50%	0.25%	0.25%	< 1	N.A.	0.50%	0.50%	0.25%	0.25%
	4	< 1	N.A.	0.25%	0.25%	0.25%	0.25%	< 1	N.A.	0.25%	0.25%	0.25%	0.25%
	5	< 1	N.A.	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	N.A.	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
3 m	2	1.30	N.A.	3.50%	3.00%	0.50%	0.50%	2.49	N.A.	2.00%	2.00%	0.50%	0.50%
	3	< 1	N.A.	1.00%	1.00%	0.25%	0.25%	< 1	N.A.	0.50%	0.50%	0.25%	0.25%
	4	< 1	N.A.	0.25%	0.25%	0.25%	0.25%	< 1	N.A.	0.25%	0.25%	0.25%	0.25%
	5	< 1	N.A.	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	N.A.	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
5 m	2	2.00	N.A.	N.A.	4.00%	1.00%	0.50%	4.08	N.A.	N.A.	2.00%	1.00%	0.50%
	3	< 1	N.A.	N.A.	1.00%	0.50%	0.25%	< 1	N.A.	N.A.	0.50%	0.25%	0.25%
	4	< 1	N.A.	N.A.	0.25%	0.25%	0.25%	< 1	N.A.	N.A.	0.25%	0.25%	0.25%
	5	< 1	N.A.	N.A.	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	N.A.	N.A.	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
8 m	2	3.28	N.A.	N.A.	N.A.	1.50%	0.50%	6.45	N.A.	N.A.	N.A.	1.00%	0.50%
	3	< 1	N.A.	N.A.	N.A.	0.50%	0.25%	1.37	N.A.	N.A.	N.A.	0.25%	0.25%
	4	< 1	N.A.	N.A.	N.A.	0.25%	0.25%	< 1	N.A.	N.A.	N.A.	0.25%	0.25%
	5	< 1	N.A.	N.A.	N.A.	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	N.A.	N.A.	N.A.	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
10 m	2	4.08	N.A.	N.A.	N.A.	2.00%	0.50%	8.16	N.A.	N.A.	N.A.	1.00%	0.50%
	3	< 1	N.A.	N.A.	N.A.	0.50%	0.50%	1.70	N.A.	N.A.	N.A.	0.25%	0.25%
	4	< 1	N.A.	N.A.	N.A.	0.25%	0.25%	< 1	N.A.	N.A.	N.A.	0.25%	0.25%
	5	< 1	N.A.	N.A.	N.A.	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	N.A.	N.A.	N.A.	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.

Table 2.21 – TPE (Case 3)

Case 4 – TPE % of the Span with Calibration in Rangeability (10:1)

Process Temperature: 40 ºC ± 0 ºC -> Δtp = + 15ºC
Ambient Temperature: 25 ºC ± 0 ºC -> Δta = 0ºC

Capillary	Range	LD30XM (2 to 6)						LD30XD (2 to 4)					
		1 Seal SR301T						2 Seals SR301T(equal)					
		Tr (s)	1"	1.1/2"	2"	3"	4"	Tr (s)	1"	1.1/2"	2"	3"	4"
0.5 m	2	< 1	2.50%	1.00%	1.00%	0.50%	0.50%	< 1	1.50%	0.50%	0.50%	0.50%	0.25%
	3	< 1	0.50%	0.25%	0.25%	0.25%	0.25%	< 1	0.50%	0.25%	0.25%	0.25%	0.25%
	4	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	5	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
1.5 m	2	1.15	2.50%	1.00%	1.00%	0.50%	0.50%	2.20	1.50%	0.50%	0.50%	0.50%	0.25%
	3	< 1	0.50%	0.25%	0.25%	0.25%	0.25%	< 1	0.50%	0.25%	0.25%	0.25%	0.25%
	4	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	5	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
3 m	2	2.20	2.50%	1.00%	1.00%	0.50%	0.50%	4.30	1.50%	0.50%	0.50%	0.50%	0.25%
	3	< 1	0.50%	0.25%	0.25%	0.25%	0.25%	< 1	0.50%	0.25%	0.25%	0.25%	0.25%
	4	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	5	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
5 m	2	3.60	2.50%	1.00%	1.00%	0.50%	0.50%	7.10	1.50%	0.50%	0.50%	0.50%	0.25%
	3	< 1	0.50%	0.25%	0.25%	0.25%	0.25%	1.50	0.50%	0.25%	0.25%	0.25%	0.25%
	4	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	5	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
8 m	2	5.70	2.50%	1.00%	1.00%	0.50%	0.50%	11.27	1.50%	0.50%	0.50%	0.50%	0.25%
	3	1.22	0.50%	0.25%	0.25%	0.25%	0.25%	2.35	0.50%	0.25%	0.25%	0.25%	0.25%
	4	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	5	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
10 m	2	7.10	2.50%	1.00%	1.00%	0.50%	0.50%	14.10	1.50%	0.50%	0.50%	0.50%	0.25%
	3	1.50	0.50%	0.25%	0.25%	0.25%	0.25%	2.90	0.50%	0.25%	0.25%	0.25%	0.25%
	4	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	< 1	0.25%	0.25%	0.25%	0.25%	0.25%
	5	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.

Table 2.22 – TPE (Case 4)

Case 5 – TPE % of the Span with Calibration in Rangeability (10:1)

Process Temperature: 100 ºC ± 0 ºC -> Δtp = + 75ºC
Ambient Temperature: 40 ºC ± 0 ºC -> Δta = + 15ºC

Capillary	Range	LD30XM (2 to 6)						LD30XD (2 to 4)					
		1 Seal SR301T						2 Seals SR301T(equal)					
		Tr (s)	1"	1.1/2"	2"	3"	4"	Tr (s)	1"	1.1/2"	2"	3"	4"
0.5 m	2	< 1	N.A.	N.A.	N.A.	3.00%	2.00%	< 1	N.A.	N.A.	N.A.	2.00%	1.50%
	3	< 1	N.A.	2.00%	1.50%	1.00%	0.50%	< 1	N.A.	1.50%	1.00%	0.50%	0.50%
	4	< 1	1.00%	0.50%	0.50%	0.25%	0.25%	< 1	0.50%	0.25%	0.25%	0.25%	0.25%
	5	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
1.5 m	2	< 1	N.A.	N.A.	N.A.	3.50%	2.50%	1.70	N.A.	N.A.	N.A.	2.00%	1.50%
	3	< 1	N.A.	2.50%	2.00%	1.00%	0.50%	< 1	N.A.	1.50%	1.00%	0.50%	0.50%
	4	< 1	1.00%	0.50%	0.50%	0.25%	0.25%	< 1	1.00%	0.50%	0.25%	0.25%	0.25%
	5	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
3 m	2	1.70	N.A.	N.A.	N.A.	4.00%	2.50%	3.28	N.A.	N.A.	N.A.	2.50%	1.50%
	3	< 1	N.A.	3.00%	2.50%	1.00%	1.00%	< 1	N.A.	2.00%	1.50%	0.50%	0.50%
	4	< 1	1.50%	0.50%	0.50%	0.25%	0.25%	< 1	1.00%	0.50%	0.50%	0.25%	0.25%
	5	< 1	0.50%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	0.25%	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
5 m	2	2.75	N.A.	N.A.	N.A.	5.00%	3.00%	5.40	N.A.	N.A.	N.A.	N.A.	1.50%
	3	< 1	N.A.	4.00%	3.50%	1.00%	1.00%	1.16	N.A.	2.50%	2.00%	1.00%	0.50%
	4	< 1	N.A.	0.50%	0.50%	0.25%	0.25%	< 1	N.A.	0.50%	0.50%	0.25%	0.25%
	5	< 1	N.A.	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	N.A.	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
8 m	2	4.35	N.A.	N.A.	N.A.	6.00%	3.00%	8.57	N.A.	N.A.	N.A.	N.A.	2.00%
	3	< 1	N.A.	6.00%	4.50%	1.50%	1.00%	1.80	N.A.	3.50%	2.50%	1.00%	0.50%
	4	< 1	N.A.	1.00%	0.50%	0.25%	0.25%	< 1	N.A.	0.50%	0.50%	0.25%	0.25%
	5	< 1	N.A.	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	N.A.	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
10 m	2	5.40	N.A.	N.A.	N.A.	7.00%	3.50%	10.68	N.A.	N.A.	N.A.	N.A.	2.00%
	3	1.16	N.A.	7.00%	5.00%	1.50%	1.00%	2.22	N.A.	4.00%	3.00%	1.00%	0.50%
	4	< 1	N.A.	1.00%	1.00%	0.25%	0.25%	< 1	N.A.	0.50%	0.50%	0.25%	0.25%
	5	< 1	N.A.	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	N.A.	0.25%	0.25%	0.25%	0.25%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.

Table 2.23 – TPE (Case 5)

Case 6 – TPE % of the Span with Calibration in Rangeability (10:1)

Process Temperature: 170 ºC ± 0 ºC -> Δtp = + 145ºC
Ambient Temperature: 60 ºC ± 0 ºC -> Δta = + 35ºC

Capillary	Range	LD30XM (2 to 6)						LD30XD (2 to 4)					
		1 Seal SR301T						2 Seals SR301T(equal)					
		Tr (s)	1"	1.1/2"	2"	3"	4"	Tr (s)	1"	1.1/2"	2"	3"	4"
0.5 m	2	< 1	N.A.	N.A.	N.A.	N.A.	4.00%	< 1	N.A.	N.A.	N.A.	4.00%	2.50%
	3	< 1	N.A.	4.00%	3.00%	1.50%	1.00%	< 1	N.A.	2.50%	2.00%	1.00%	1.00%
	4	< 1	N.A.	1.00%	1.00%	0.50%	0.50%	< 1	N.A.	1.00%	1.00%	0.50%	0.50%
	5	< 1	N.A.	0.50%	0.50%	0.50%	0.50%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	N.A.	0.50%	0.50%	0.50%	0.50%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
1.5 m	2	< 1	N.A.	N.A.	N.A.	N.A.	4.50%	1.29	N.A.	N.A.	N.A.	4.50%	2.50%
	3	< 1	N.A.	5.00%	4.00%	1.50%	1.00%	< 1	N.A.	3.00%	2.50%	1.00%	1.00%
	4	< 1	N.A.	1.00%	1.00%	1.00%	0.50%	< 1	N.A.	1.00%	1.00%	0.50%	0.50%
	5	< 1	N.A.	0.50%	0.50%	0.50%	0.50%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	N.A.	0.50%	0.50%	0.50%	0.50%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
3 m	2	1.30	N.A.	N.A.	N.A.	N.A.	5.00%	2.49	N.A.	N.A.	N.A.	5.00%	3.00%
	3	< 1	N.A.	7.00%	5.50%	2.00%	1.00%	< 1	N.A.	4.00%	3.00%	1.50%	1.00%
	4	< 1	N.A.	1.00%	1.00%	1.00%	0.50%	< 1	N.A.	1.00%	1.00%	0.50%	0.50%
	5	< 1	N.A.	0.50%	0.50%	0.50%	0.50%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	N.A.	0.50%	0.50%	0.50%	0.50%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
5 m	2	2.00	N.A.	N.A.	N.A.	N.A.	5.50%	4.08	N.A.	N.A.	N.A.	6.00%	3.00%
	3	< 1	N.A.	N.A.	7.00%	2.50%	1.50%	< 1	N.A.	N.A.	5.00%	1.50%	1.00%
	4	< 1	N.A.	N.A.	1.00%	1.00%	0.50%	< 1	N.A.	N.A.	1.00%	0.50%	0.50%
	5	< 1	N.A.	N.A.	0.50%	0.50%	0.50%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	N.A.	N.A.	0.50%	0.50%	0.50%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
8 m	2	3.28	N.A.	N.A.	N.A.	N.A.	6.00%	6.45	N.A.	N.A.	N.A.	8.00%	3.50%
	3	< 1	N.A.	N.A.	N.A.	3.00%	1.50%	1.37	N.A.	N.A.	N.A.	2.00%	1.00%
	4	< 1	N.A.	N.A.	N.A.	1.00%	0.50%	< 1	N.A.	N.A.	N.A.	0.50%	0.50%
	5	< 1	N.A.	N.A.	N.A.	0.50%	0.50%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	N.A.	N.A.	N.A.	0.50%	0.50%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
10 m	2	4.08	N.A.	N.A.	N.A.	N.A.	7.00%	8.16	N.A.	N.A.	N.A.	N.A.	4.00%
	3	< 1	N.A.	N.A.	N.A.	3.50%	1.50%	1.70	N.A.	N.A.	N.A.	2.00%	1.00%
	4	< 1	N.A.	N.A.	N.A.	1.00%	0.50%	< 1	N.A.	N.A.	N.A.	0.50%	0.50%
	5	< 1	N.A.	N.A.	N.A.	0.50%	0.50%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.
	6	< 1	N.A.	N.A.	N.A.	0.50%	0.50%	- - -	N.A.	N.A.	N.A.	N.A.	N.A.

Table 2.24 – TPE (Case 6)

Chapter 3

OPERATION

Operation of the Remote Seal Sensor

In the remote seal transmitter, the remote insulator diaphragm plus transmission capillary set is connected to the transmitter chamber.

The internal spaces of the capillary pipe diaphragm and the sensor chamber are filled with the application proper fluid, according to the pressure and the of the process operation temperature.

The process pressure displaces the insulator diaphragm of the seal causing the filling fluid to transmit through the capillary the pressure to the sensor, generating a difference of capacitance between the sensor diaphragm and each plate on the capacitive cell. This differential capacitance is electrically converted into a signal of 4 to 20 mA transmitted by the two-wire system.

Operation Start Up

To start operating the remote seal transmitter see the Transmitter Operation and Maintenance Instructions Manual.

The transmitter is supplied in compliance with the data list and calibrated according to the range requested by the client.

Should you need to change the range (see the Transmitter Operation Manual) make new calculations and adjust the transmitter in accordance with these calculations.

The output signal adjustment on zero, in accordance with the "Test and Output Signal Adjustment" item is available on any transmitter, except to the absolute pressure transmitter.

Calibration

Output Signal Test and Setting

While testing and adjusting the transmitter, the ambient temperature should not change.

It is possible to test and to adjust the output signal without disassembling the remote seal for a pressure value (Px) known, if this remains constant.

Adjust the corresponding pressure at the beginning of the range for value (Pi), and similarly adjust the pressure on the end of the range (Ps). See Figures 3.1 or to 3.2 according to the type of curve (ascendant or descendant).

To determine the "Ix" current value when the current curve in terms of the ascendant (Figure 3.1) or descendant pressure (Figure 3.2), use the equation 3.1 below.

$$Ix = 4 + 16 \cdot \frac{Px - Pi}{Ps - Pi} \tag{3.1}$$

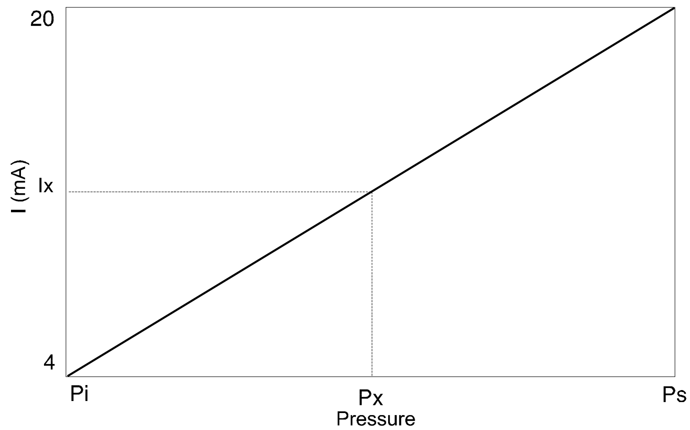


Figure 3.1 – Ascendant Curve of the Ix Output Signal in Terms of the Pressure

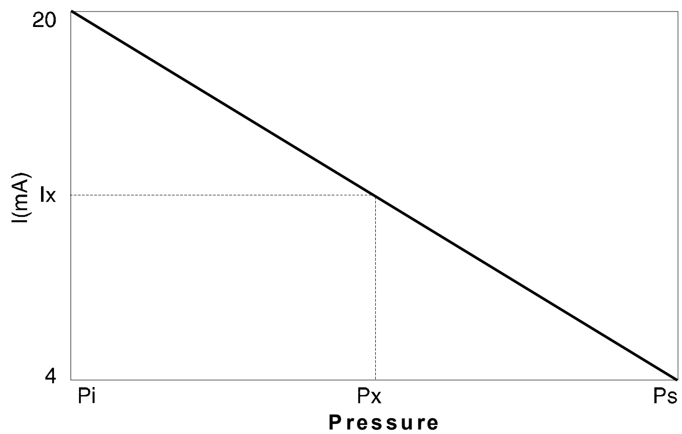


Figure 3. 2 - Descendant Curve of the Ix Output Signal in Terms of the Pressure (Reverse Mode)

If the seal needs a final adjustment, bring it to a laboratory and do the following:

- Put the pressure generator with adapter to the leaking test, in the side (H) of the seal and keep the low side (L) in the same height as the high side, leaving it opens to the atmosphere. If the beginning of the range is below the atmospheric pressure, simulate the depression setting an equivalent pressure value in the low side of the seal (this requires special equipments for vacuum calibration). In this case the high side will be submitted to the atmospheric pressure.

- Always maintain the two seals on the same height.

- Compensate the hydrostatic pressure of the capillary filling fluid in accordance with the seal assembling. See the calculation of the Pf pressure according to the "Influence of Filling Fluids on the Capillaries" item.

Range Beginning Change

This change is possible only for the transmitters installed on field when there is an input signal that corresponds to the range start with due accuracy. Otherwise, disassemble the transmitter, remove it to the laboratory and make the change in accordance with the "Span Change" item.

Make the adjustments in accordance with the transmitter operation manual.

Span Change on Differential and Flow Pressure Transmitters

In general, this work can be done only at the laboratory and with the two seals on the same height.

- Apply on the (H) side the pressure you want to calibrate.
- Make the adjustments according to the transmitter operation manual.

Level Transmitter Span Change

Proceed as for differential and flow transmitters. The span is given in Table 3.1.

OUTPUT	ZERO	SPAN
Ascendant	Pi = Hi . ∗p	Ps = Hs . ∗p
Descendant	Pi = Hs . ∗p	Ps = Hi . ∗p

Table 3.1 – Ascendant and Descendant Curves Span

Where:

Hs = Maximum level measured

Hi = Minimum level measured

∗p = Density of the process fluid

Capillaries Filling Fluid Effect

The effect of the hydrostatic pressure of the capillary filling fluid must be compensated during measuring (see item Calibration).

The hydrostatic pressure is given by:

Pf = Hv . ∗e (3.2)

Where:

Pf = Hydrostatic Pressure

Hv = Level Difference between the two seals

∗e = Density of the Filling Fluid (see Table 2.6)

The Hv distance between the two seals is limited by the capillary length and the maximum H1 difference allowed between the transmitter and the seal. See the "Mounting of Transmitter with Remote Seal" – Chapter 1.

Chapter 4

MAINTENANCE

Before working with transmitter verifies the characteristics of the fill fluid in the piping and observes all safety standards.

Remote Seal Cleaning

The interval between the cleaning of the seals depends on the service conditions and the chemical and physical characteristics of the materials. This period depends on the concentration of dirt incrustations in the seal and in the tap that connects the seal to the main piping or tank.

When it is necessary to clean the seal and this piping, be careful not to damage it, because it is very delicate. If there are incrustations it can cause damages when disassembling the diaphragm, such as hardened bitumen between the diaphragm and the flange of the tank. To prevent this, this incrustation must be eliminated through the heating of this section of the piping or by using solvent before disassembling. Use a paintbrush to remove it.

Disassembling and Packing the Remote Seal Transmitter

Instructions:

a) Disable the transmitter;
b) Switch off the power supply;
c) Remove the counterflange seal;
d) Clean the seal carefully because the diaphragm is very delicate;
e) Set the protection cover over the diaphragm and fix it with adhesive tape;
f) Release the transmitter;
g) Roll the capillary without twisting it, leaving a 150mm or greater radius;
h) Do not loose the sealed bolts;
i) The transmitter package must protect it from mechanical shocks and must be like the original (See Figure 4.1) when returning materials.

Figure 4.1- Remote Seal Package

Component Replacement

The seal, the capillary and the cell form an only set in which is sealed the fill fluid. For eventual replacements the set must be considered.

Return of Materials

If it becomes necessary to return the transmitter and/or configurator to Smar, simply contact our office, informing the defective instrument's serial number, and return it to our factory. To speed up analysis and solution of the problem, the defective item should be returned with the Service Request Form (SRF – Appendix A) properly filled with a description of the failure observed and with as much details as possible. Other information concerning to the instrument operation, such as service and process conditions, is also helpful.

Remote Seal Spare Parts

Sanitary Model

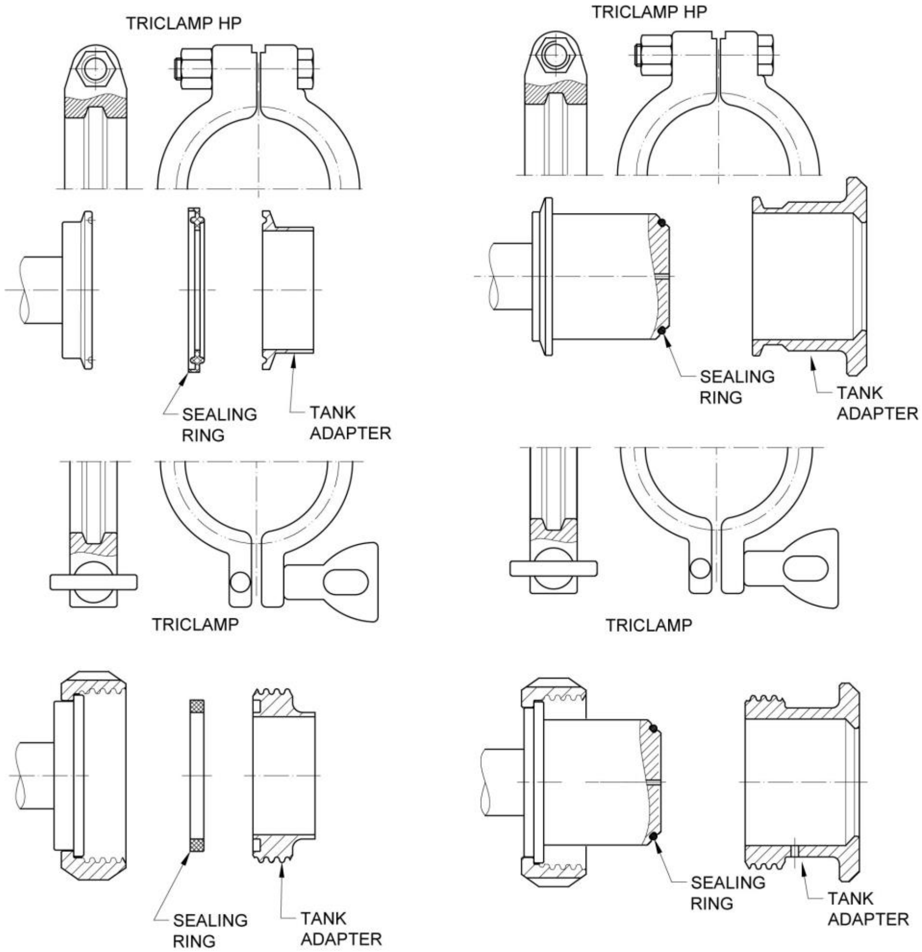


Figure 4.2 – Sectional view SR301S

400-1331	SANITARY SEALING RING

Option	Mounting
0	Without Extension
1	With Extension

Option	Nominal Diameter	Option	Nominal Diameter
0	DN25	4	DN40
1	1 ½"	5	DN50
2	2"	6	DN80
3	3"		

Option	Connection
0	O´Ring (Connection with Extension)
1	Tri-clamp
2	SMS
3	RJT
4	IDF
5	DIN

Option	Material
B	Buna N
T	Teflon
V	Viton

400-1331	0	2	2	B

400-1332	SANITARY TANK ADAPTER

Option	Mounting
0	Without Extension
1	With Extension

Option	Nominal Diameter	Option	Nominal Diameter
0	DN25	4	DN40
1	1 ½”	5	DN50
2	2”	6	DN80
3	3”		

Option	Connection
1	Tri-clamp
2	SMS
3	RJT
4	IDF
5	DIN

400-1331	0	2	2

400-1333	TRI-CLAMP

Option	Diameter
1	1 ½”
2	2”
3	3”

Option	Pressure
H	HP (High pressure)
N	Standard

400-1333	2	N

Flanged "T" Type and Pancake Models

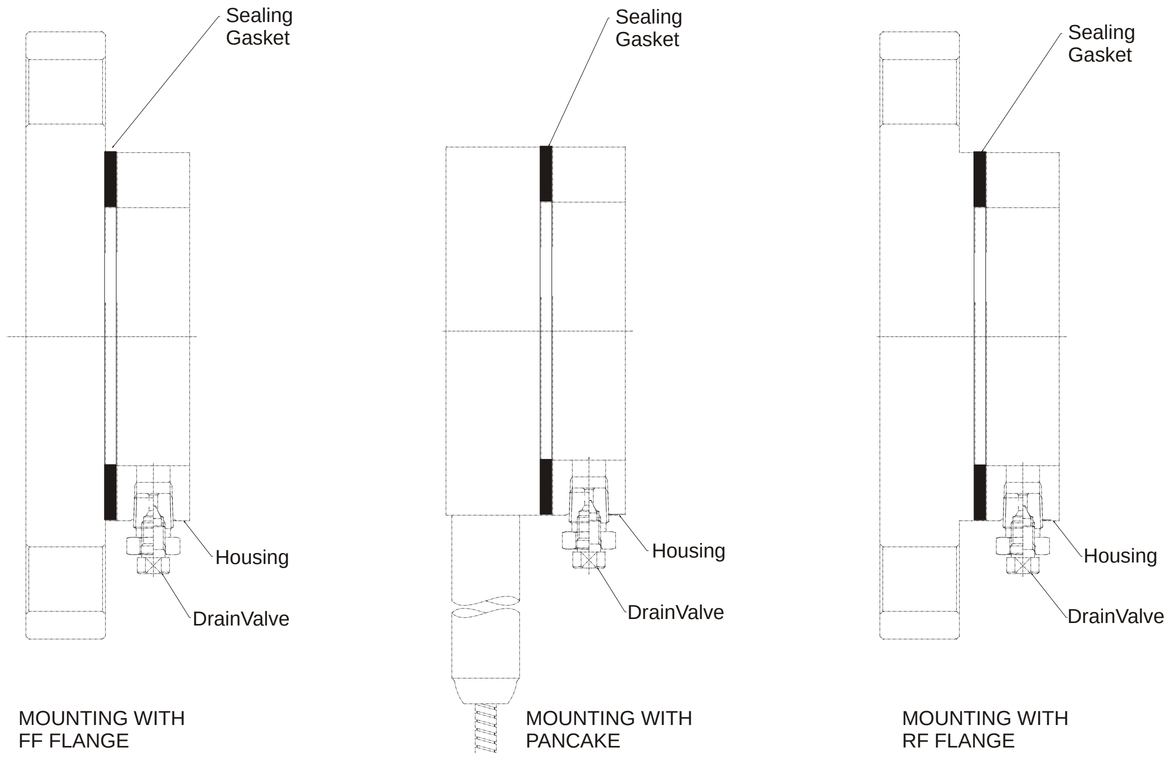


Figure 4.3 – Sectional View - Mounting with Gasket and Drain Valve

400-1337	SEALING GASKET FOR FLANGE ASME/DIN – FACE RF-FF (PACKAGE WITH 10 UNITS);		
Option	**Diameter**		
1	1" (ASME)	**6**	DN25 (DIN)
2	1 1/2" (ASME)	**7**	DN40 (DIN)
3	2" (ASME)	**8**	DN50 (DIN)
4	3" (ASME)	**9**	DN80 (DIN)
5	4" (ASME)	**A**	DN100 (DIN)

Option	Material
G	Grafoil
T	Teflon

400-1337	**3**	**T**

RTJ SPARE PARTS: LD300L (without Extension) / SR301T / SR301E					
ØN	CLASS	STANDARD	RING	METALLIC RING	DRAIN VALVE
				STAINLESS STEEL 316L	STAINLESS STEEL 316L
1”	150	ASME B 16.20 RTJ	R15	400-0887	400-0792
	300		R16	400-0888	
	600		R16	400-0888	
	1500		R16	400-0888	
	2500		R18	400-0889	
1.1/2”	150		R19	400-0890	
	300		R20	400-0891	
	600		R20	400-0891	
	1500		R20	400-0891	
	2500		R23	400-0893	
2”	150		R22	400-0892	
	300		R23	400-0893	
	600		R23	400-0893	
	1500		R24	400-0894	
	2500		R26	400-0895	
3”	150		R29	400-0896	
	300		R31	400-0897	
	600		R31	400-0897	
4”	150		R36	400-0900	
	300		R37	400-0901	
	600		R37	400-0901	

Table 4.1 – LD300L (without extension) / SR301T / SR301E Spare Parts

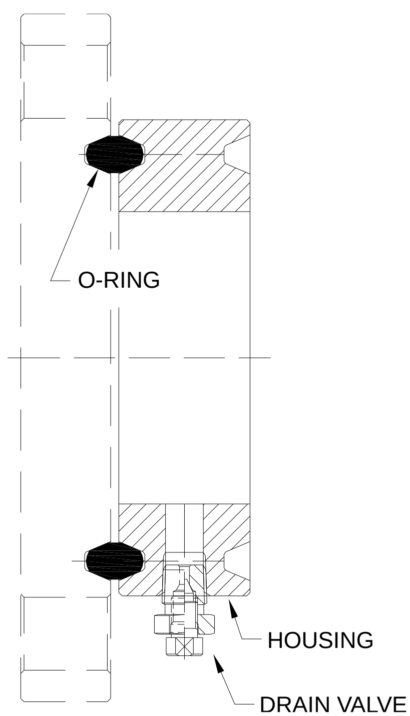


Figure 4.4 – Sectional View of LD300L (without extension) SR301T / SR301E

Threaded Model

SR301R SPARE PARTS			
NPT THREAD	SEALING GASKET		DRAIN VALVE
	TEFLON	GRAFOIL	STAINLESS STEEL 316L
1/4"	201-0120	400-0459	400-0792
3/8"			
1/2"			
3/4"			
1"			
1.1/2"			

Table 4.2 – SR301R Spare Parts

NOTE
The gasket is common for the 138 bar and 400 bar versions.

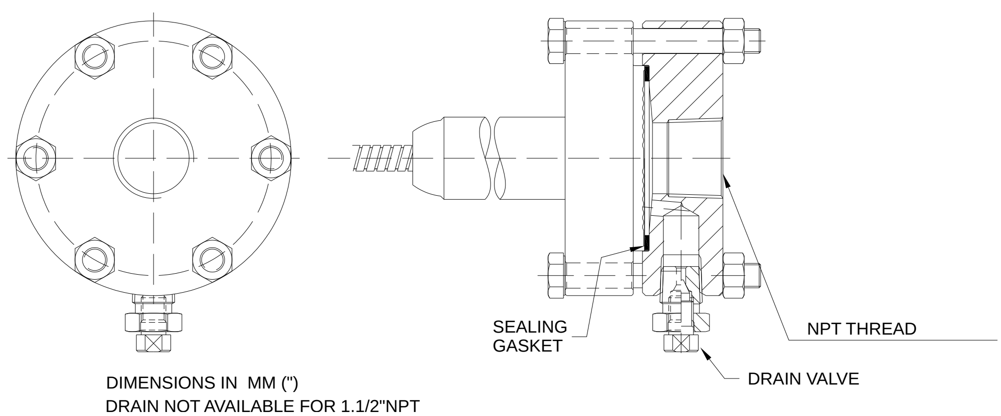


Figure 4.8 – SR301R Sectional View

Chapter 5

EXAMPLES

NOTE
For the examples on this Chapter, consider the calibrated seal at temperature of 25°C.

Example 1

Considering a Two-Seal Transmitter.

A – TRANSMITTER DATA	RESPONSE
1. Type of Transmitter (Absolute, Gauge, Differential)	Differential
2. Range Superior Value / (V.sup.) (mmH2O @ 4 ºC)	2400
3. Range Inferior Value / (V. inf.) (mmH2O @ 4 ºC)	-1000
4. Transmitter Calibration (mmH2O @ 4 ºC)	3400
5. Transmitter Range (2,3,4,5)	2
6. Diaphragm Material/Fill Oil	316 SST/Sillicone
7. Maximum Ambient Temperature T Max. (ºC)	60
8. Minimum Ambient Temperature T Min. (ºC)	-15
9. Static Pressure Variation (Bar)	3
10. Pressure Transmitter Error to T Max. (Calibration percent)	0.175
11. Pressure Transmitter Error to T Min. (Calibration percent)	0.195
12. Transmitter Accuracy (Transmitter Calibration percent)	0.075
13. Stability/Time (Transmitter Calibration percent / months)	0.225 / 60
14. Transmitter Response Time (seconds)	0.1

Table 5.1 – Transmitter Data (Example 1)

B – SEAL/LEVEL DATA	RESPONSE
1. Type of Connection (One Seal, Two Seals, One Level, Level/Seal)	Two Seals
2. Capillary Filling Fluid (Table 2.4)	Dc 200
3. Geometric Symmetry (Symmetric, Assymetric)	Assymetric
4. Thermic Symmetry (Symmetric, Assymetric)	Assymetric
5. Diaphragm Material (Steel, Hasteloy, Monel, Titanium, Tantalum and other)	Steel
6. Diaphragm Thickness	0.05 mm
B.1 – H Side	
1. H Side Model (SR301T, SR301E, SR301R, SR301S, SR301P, LD30XL, LD30XS)	SR301E
2. Side H Diameter Seal (N Inch, DN (mm))	3 Pol.
3. H Side Diaphragm Family (Table 2.5)	7
4. Diaphragm Reservoir Volume – Vrdf (cm3) (Table 2.6)	105.6E-2
5. H Side Capillary Length (meters)	2.5
6. H Side Extension Length (meters)	0.10
B.2 – L Side	
1. L Side Model (SR301T, SR301E, SR301R, SR301S, SR301P, LD30XL, LD30XS)	SR301E
2. Side L Diameter Seal (N Inch, DN (mm))	3 Pol.
3. L Side Diaphragm Family (Table 2.5)	7
4. Diaphragm Reservoir Volume – Vrdf (cm3) (Table 2.6)	105.6E-2
5. L Side Capillary Length (meters, N.A. - Non Applicable)	4.5
6. L Side Extension Length (meters)	0.10

Table 5.2 – Level/Seal Data (Example 1)

C – ASSEMBLY SCHEME

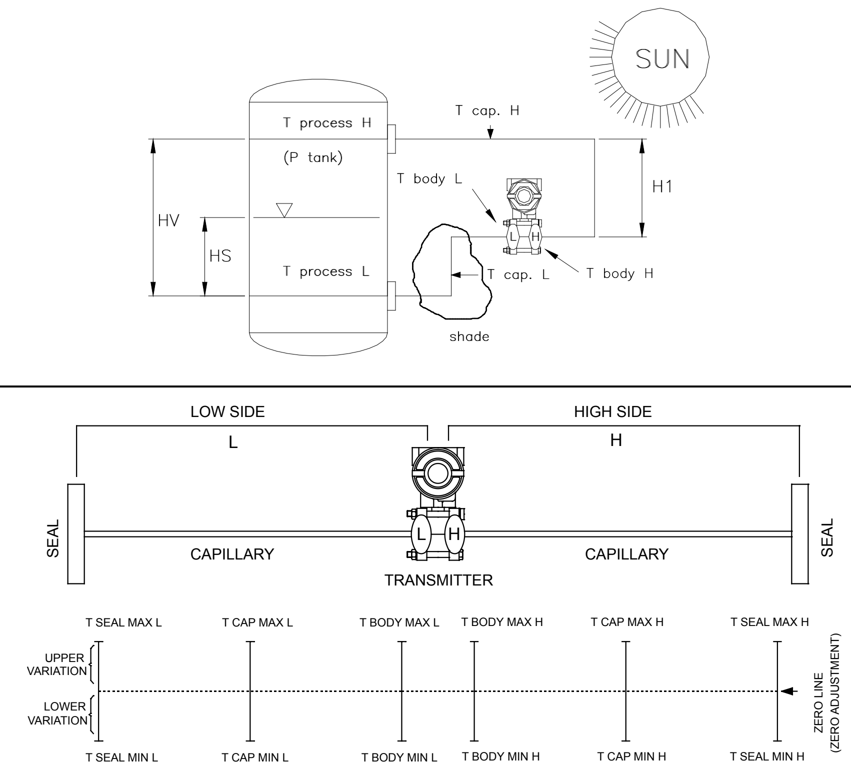


Table 5.3 – Assembly Scheme (Example 1)

D – PROCESS DATA	RESPONSE
D.1 – H Side	
1. T seal max H – Maximum Temperature in the H Side Seal (°C)	70
2. T seal min H – Minimum Temperature in the H Side Seal (°C)	60
3. T cap max H – Maximum Temperature in the H Side Capillary (°C)	60
4. T cap min H – Minimum Temperature in the H Side Capillary (°C)	-15
5. T body max H – Maximum Temperature in the H Side Body (°C)	60
6. T body min H – Minimum Temperature in the H Side Body (°C)	-15
D.2 – L Side	
1. T seal max L – Maximum Temperature in the Side Seal (°C)	120
2. T seal min L – Minimum Temperature in the L Side Seal (°C)	80
3. T cap max L – Maximum Temperature in the L Side Capillary (°C)	35
4. T cap min L – Minimum Temperature in the L Side Capillary (°C)	-5
5. T body max L – Maximum Temperature in the L Side Body (°C)	60
6. T body min L – Minimum Temperature in the L Side Body (°C)	-15
D.3 – Pressure	
1. Maximum Process Pressure (bar abs.)	5
2. Minimum Process Pressure (bar abs.)	2

Table 5.4 – Process Data (Example 1)

E – USER EXPECTANCY	RESPONSE
1. Global Error Requested by User (% Transmitter Calibration)	0.5%
2. Response Time Requested by the Mesh Control (seconds)	10

Table 5.5 – User Expectancy (Example 1)

Error Calculation by Temperature

Have:

1° – "Upper Variation of Temperature"

Seal H Side

$$\Delta T_{seal} = (70 - 25) = 45\,^{o}C$$
$$\Delta T_{cap} = (60 - 25) = 35^{o}C$$
$$\Delta T_{body} = (60 - 25) = 35\,^{o}C$$

Using the formulas on Chapter 2, item 2 we have:

$$\Delta V_{rdf} = 0.0508\ cm^{3}$$
$$\Delta V_{ext} = 0.0049\ cm^{3}$$
$$\Delta V_{cap} = 0.0843\ cm^{3}$$
$$\Delta V_{body} = 0.0432\ cm^{3}$$
$$V_{total} = \Delta V_{total} = 0.1823\ cm^{3}$$

Entering this value in Figure 2.6, we have:

$$Error = Error\,(Graphic\,).\ Fm$$

$$E_{H} = +25.9080\ mmH_{2}O$$

NOTE
If the diaphragm is equal to 0.1mm, enter with this value V_{total} on Figure 2.8 E_H = + 71.8080 mmH_2O.

Seal L Side

$$\Delta T_{seal} = (120 - 25) = 95\,^{o}C$$
$$\Delta T_{cap} = (35 - 25) = 10^{o}C$$
$$\Delta T_{body} = (60 - 25) = 35\,^{o}C$$

Using the formulas on Chapter 2, item 2 has:

$$\Delta V_{rdf} = 0.1073\ cm^{3}$$
$$\Delta V_{ext} = 0.0104\ cm^{3}$$
$$\Delta V_{cap} = 0.0433\ cm^{3}$$
$$\Delta V_{body} = 0.0432\ cm^{3}$$
$$V_{total} = \Delta V_{total} = 0.2042\ cm^{3}$$

Enter this value on Figure 2.6, have:

$$Error = Error\,(Graphic\,).\ Fm$$

$$E_L = +28.9000\ mmH_2O$$

NOTE
If the diaphragm is equal to 0.1mm enter this value V_{total} on Figure 2.8, E_L = + 80.2060 mmH_2O.

2º – "Temperature Lower Variation"

Seal H Side

$$\Delta T_{seal} = (60 - 25) = 35\ ^{o}C$$
$$\Delta T_{cap} = (-15 - 25) = -40^{o}C$$
$$\Delta T_{body} = (-15 - 25) = -40\ ^{o}C$$

Using the formulas on Chapter 2, item 2 we have:

$$\Delta V_{rdf} = 0.0395\ cm^3$$
$$\Delta V_{ext} = 0.0038\ cm^3$$
$$\Delta V_{cap} = -0.0963\ cm^3$$
$$\Delta V_{body} = -0.0494\ cm^3$$
$$V_{total} = \Delta V_{total} = -0.1024\ cm^3$$

Enter this value in the Figure 2.6, we have:

$$Error = Error\ (Graphic\ ).\ Fm$$

$$E_H = -14.4160\ mmH_2O$$

Enter this value in the Figure 2.8 it is not possible to find the Value for negative Error because there is a contraction in the diaphragm.

ATTENTION
The logarithmic graphs do not indicate negative errors. To resolve this problem and considering that the error is symmetrical, the V_{total} must be calculated, inverting the signals of the seal volume variation, of the extension and capillary and to add the negative signal to error: From Equations 2.8 and 2.9: $V_{Total} = \Delta V_{rdf} + \Delta V_{ext} + \Delta V_{cap} + \Delta V_{body}$ $V_{total} = (-0.0395) + (-0.0038) + (+0.0963) + (+0.0494) = 0.1024\ cm^3$ To enter this value in the Figure 2.6, obtain the Symmetric Error $E_H = +14.4160\ mmH_2O$ Inverting the signal: $E_H = -14.4160\ mmH_2O$ If the lamina equal 0.1mm enter with this value V_{total} in the Figure 2.8 $E_H = +39.8820\ mmH_2O$. Inverting the signal: $E_H = -39.8820\ mmH_2O$

Seal L Side

$$\Delta T_{seal} = (80 - 25) = 55\ {}^{o}C$$
$$\Delta T_{cap} = (-5 - 25) = -30^{o}C$$
$$\Delta T_{body} = (-15 - 25) = -40\ {}^{o}C$$

Using the formulas from Chapter 2, item 2:

$$\Delta V_{rdf} = 0.0620\ cm^3$$
$$\Delta V_{ext} = 0.0060\ cm^3$$
$$\Delta V_{cap} = -0.1300\ cm^3$$
$$\Delta V_{body} = -0.0494\ cm^3$$
$$V_{total} = \Delta V_{total} = -0.1113\ cm^3$$

Enter this value on Figure 2.6, have:

Error = *Error* (*Graphic*). *Fm*

$$E_L = -15.7080\ mmH_2O$$

Entering this value on Figure 2.8 it is not possible to find the Value for negative Error because there is a contraction in the diaphragm.

ATTENTION
The logarithmic graphs do not show negative errors. To solve this problem and considering that the error is symmetrical, the V_{total} must be calculated, by inverting the seal volume, the extension and the capillary variation signals and by adding the negative signal to the error, namely From Equations 2.8 and 2.9: $V_{Total} = \Delta V_{rdf} + \Delta V_{ext} + \Delta V_{cap} + \Delta V_{body}$ $V_{total} = (-0.062) + (-0.0060) + (+0.1300) + (+0.0494) = 0.1113cm^3$ By entering this value on Figure 2.6, one has the Symmetric Error $E_L = +15.7080\ mmH_2O$ Inverting the signal: $E_L = -15.7080\ mmH_2O$ If the diaphragm is equal to 0.1mm, enter with this value V_{total} on Figure 2.8 $E_L = +43.3840\ mmH_2O$ Inverting the signal: $E_L = -43.3840\ mmH_2O$

Calculation of Seal/Level Error

To calculate the Seals Error, verify the cases of symmetry. In this case, there is a Geometric Asymmetry and a Thermal Asymmetry, and therefore the Equation 2.13 on Chapter 2 must be used.

$$Es = \sqrt{(E_H)^2 + (E_L)^2}$$

1° – "Upper Temperature Variation"

$$Es1 = \sqrt{(25.9080)^2 + (28.9000)^2}$$

$$Es1 = 38.8128 \text{ mmH}_2\text{O}$$

2º – "Lower Temperature Variation"

$$Es2 = \sqrt{(-14.4160)^2 + (-15.7080)^2}$$

$$Es2 = 21.3205 \text{ mmH}_2\text{O}$$

Calculation of the Transmitter Accuracy with Seal/Level

NOTE
The transmitter accuracy is not significantly altered by the addition of seal/level. However, the measuring error resulting from the combination suffers significant increase due to physical and geometric parameters, in terms of temperature variation.

$$Accuracy = \frac{0.075}{100} \cdot 3400 = 2.55 \text{ mmH}_2\text{O}$$ *(See Transmitter's Manual)*

Calculation of the Global Error of Transmitter Assembling with Seals/Level

From Equation 2.14 the global error of the remote seal must be calculated:

$$E_{TpT\,\max} = \frac{0.175}{100} \cdot 3400 = 5.9500\ mmH_2O$$

$$E_{TpT\,\min} = \frac{0.195}{100} \cdot 3400 = 6.6300\ mmH_2O$$

$$E_{globalpTMax} = \sqrt{E_S{}^2 + E_T{}^2} = \sqrt{38.8128^2 + 5.9500^2}$$

$$E_{globalpTMax} = 39.2662\, mmH_2O$$

$$E_{globalpTMax} = 1.155\%$$ **of the calibrated Span**

$$E_{globalpTMin} = \sqrt{E_S{}^2 + E_T{}^2} = \sqrt{21.3205^2 + 6.6300^2}$$

$$E_{globalpTMin} = 22.3276\, mmH_2O$$

$$E_{globalpTMin} = 0.657\%$$ **of the calibrated Span**

The larger global error is:

$$E_{global} = 39.2662\, mmH_2O$$

$$E_{global} = 1.155\%$$ **of the calibrated Span**

Calculation of the Response Time

The response time is obtained through the Equation 2.14: $TR_S = TR_{listed} \cdot L$

Considering that the transmitter is range 2 type, the filling fluid is DC200/20.

However, the temperature to be used is closer to the Maximum value, because the temperature will not necessarily be kept on the maximum. So:

Maximum Temperature on the H Side Capillary = 60°C.

Maximum Temperature on the L Side Capillary, 35°C, from the Table 2.9:

$$TR_{listed} H = 0.455 \;\; s/m$$
$$TR_{listed} L = 0.698 \;\; s/m$$

Thus:

$$TR\,H = 0.455 \times 2.5 = 1.1375 \;\; s$$
$$TR\,L = 0.698 \times 4.5 = 3.1410 \;\; s$$

NOTE
Note that the response time between the sides is longer than 0.5 second and therefore this type of assembling is not recommended. It is advisable to reduce this difference.

$$TR_S = TR\,H + TR\,L = 4.2785 \sec$$

This response time refers only to the remote seal. To calculate the response time of the remote seal and transmitter set, add the time of both:

$$TR = TR_S + TR_T = 4.2785 + 0.1 = 4.3785 \sec$$

Checking the Capillary Length

To evaluate the maximum length of the capillary, three conditions on Chapter 2 must be met.

1º - Check if the dilated or contracted volume related to the initial volume of the seal diaphragm is in the Lower and Upper Limits (VCmin and VCmax) according to Equation 2.12.

$$VC_{\min} \le V_{total} \le VC_{\max}$$

Maximum Limit of the Transmitter: URL = 50Kpa = 5098.58 mmH_2O.

Thus, the process pressure conditioned to the transmitter URL will be:

$$\%VC_{\min} = \frac{MVP}{URL} \times 100$$

MVP=2400 mmH_2O (MVP: The larger value between the $|V.\sup|$ and $|V.\inf|$)

$$\%VC_{\min} = \frac{2400}{5098.58} \times 100 = 47.1\,\%$$

Table 2.18 shows the VC_{mim} value. Considering that the assembling was performed with a range 2 transmitter, the value relative to $\%VC_{\min}$ is obtained by the linear interpolation between 50% and 40%, whereby:

$$VC_{\min} = 2.76 \cdot (10^{-2} x \ cm^3)$$

VC_{max} is obtained on Table 2.10. Considering the # 0.05 mm Inox Steel diaphragm material, the family 7 diaphragm and the process ºC temperature, one has:

Maximum Temperature in the H Side Seal, 70°C.

Maximum Temperature in the L Side Seal, 120°C, on table 2.10, means:

$$VC_{\max} H = 93.7 \cdot (10^{-2} x \ cm^3)$$
$$VC_{\max} L = 85.9 \cdot (10^{-2} x \ cm^3)$$

From the calculation:

$V_{total} H1c = 0.1823 \ cm^3$ (*"Upper Temperature Variation"*)

$V_{total} L1c = 0.2042 \ cm^3$ (*"Upper Temperature Variation"*)

$\left|V_{total} H2c\right| = \left|-0.1024\right| = 0.1024 \ cm^3$ (*"Lower Temperature Variation"*)

$\left|V_{total} L2c\right| = \left|-0.1113\right| = 0.1113 \ cm^3$ (*"Lower Temperature Variation"*)

All the values are in their lower and upper limits according to equation 2.12, which makes the first condition acceptable.

2º - Check if the response time is compatible with the process variables, and if there is enough time for the pressure transmitted guarantees the application control limits.

Requested Client Time = 10 s
Calculated Time = 4.3785 s

Therefore, as a conclusion, the lengths satisfy the second condition.

3º - Check if the global assembling error is within client expectations.

Have:

Global Error Expected by User: 0.5% of the calibrated span
Global Assembling Error: 1.155% of the calibrated span

Thus, the Percent Error is greater than expected, so one concludes that the lengths do not meet the third condition.

Conclusion about the Capillary Length

As the third condition is not favorable, the remote seal assembled do not meet the application and user expectations.
It is worth remembering that the last condition do not depend only on the capillary length, hence it is possible to improve it and to make the application feasible using Table 2.2 of the Chapter 2.

Example 2

Combining Geometric Symmetry with Thermal Symmetry to minimize the Error.

A – TRANSMITTER DATA	RESPONSE
1. Type of Transmitter (Absolute, Gauge, Differential)	Differential
2. Range Superior Value (V.sup.) (mmH2O @ 4 ºC)	2400
3. Range Inferior Value (V. inf.) (mmH2O @ 4 ºC)	-1000
4. Transmitter Calibration (Span) (mmH2O @ 4 ºC)	3400
5. Transmitter Range (2,3,4,5)	2
6. Diaphragm Material/Fill Oil	316 SST/Sillicone
7. Maximum Ambient Temperature T Max. (ºC)	30
8. Minimum Ambient Temperature T Min. (ºC)	-5
9. Static Pressure Variation (Bar)	3
10. Pressure Transmitter Error to T Max. (Calibration percent)	0.078
11. Pressure Transmitter Error to T Min. (Calibration percent)	0.154
12. Transmitter Accuracy (Transmitter Calibration percent)	0.075
13. Stability/Time (Transmitter Calibration percent / months)	0.225 / 60
14. Transmitter Response Time (seconds)	0.1

Table 5.6 – Transmitter Data (Example2)

B – SEAL/LEVEL DATA	RESPONSE
1. Type of Connection (One Seal, Two Seals, One Level, Level/Seal)	Two Seals
2. Capillary Filling Fluid (Table 2.4)	Dc 200
3. Geometric Symmetry (Symmetric, Assymetric)	Symmetric
4. Thermic Symmetry (Symmetric, Assymetric)	Symmetric
5. Diaphragm Material (Steel, Hasteloy, Monel, Titanium, Tantalum and other)	Steel
6. Diaphragm Thickness	0.05 mm
B.1 – H Side	
1. H Side Model (SR301T, SR301E, SR301R, SR301S, SR301P, LD30XL, LD30XS)	SR301E
2. Side H Diameter Seal (N Inch, DN (mm))	3 Inch
3. H Side Diaphragm Family (Table 2.5)	7
4. Diaphragm Reservoir Volume – Vrdf (cm3) (Table 2.6)	105.6E-2
5. H Side Capillary Length (meters)	4.5
6. H Side Extension Length (meters)	0.10
B.2 – L Side	
1. L Side Model (SR301T, SR301E, SR301R, SR301S, SR301P, LD30XL, LD30XS)	SR301E
2. Side L Diameter Seal (N Inch, DN (mm))	3 Inch
3. L Side Diaphragm Family (Table 2.5)	7
4. Diaphragm Reservoir Volume – Vrdf (cm3) (Table 2.6)	105.6E-2
5. L Side Capillary Length (meters, N.A. – non applicable)	4.5
6. L Side Extension Length (meters)	0.10

Table 5.7 – Level/Seal Data (Example 2)

C – ASSEMBLY SCHEME

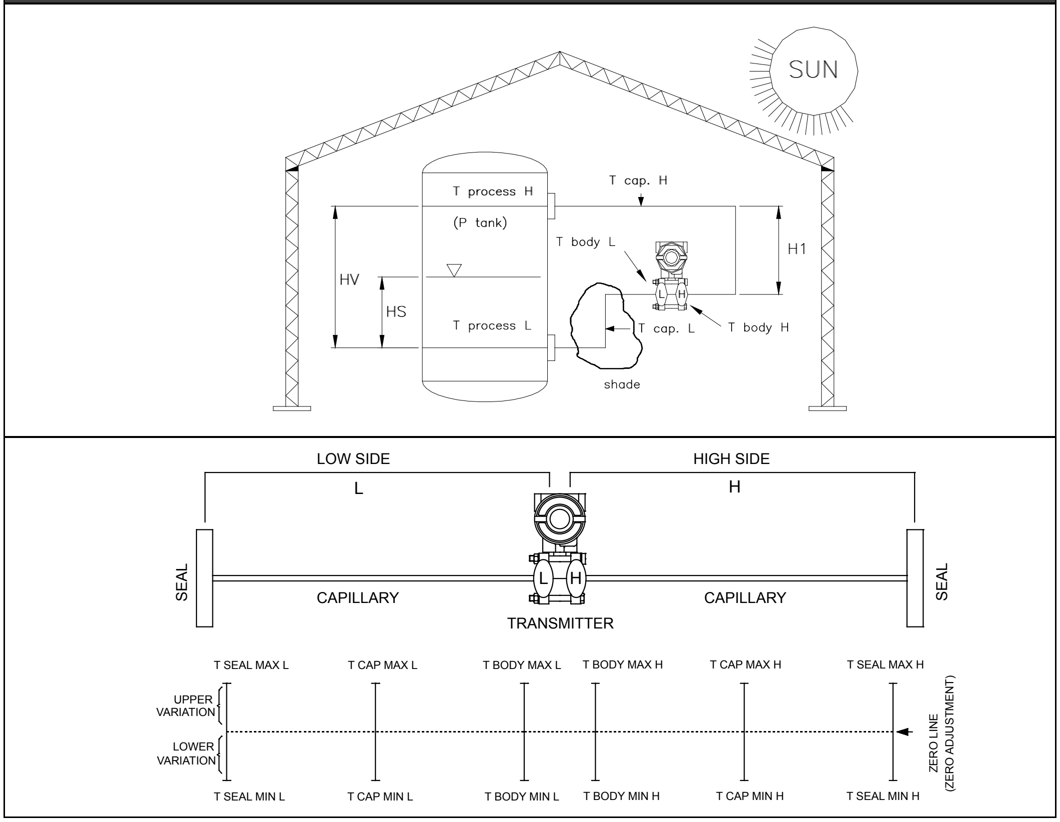


Table 5.8 – Assembly Scheme (Example 2)

D – PROCESS DATA	RESPONSE
D.1 – H Side	
1. T seal max H – Maximum Temperature in the H Side Seal (°C)	90
2. T seal min H – Minimum Temperature in the H Side Seal (°C)	80
3. T cap max H – Maximum Temperature in the H Side Capillary (°C)	30
4. T cap min H – Minimum Temperature in the H Side Capillary (°C)	-5
5. T body max H – Maximum Temperature in the H Side Body (°C)	30
6. T body min H – Minimum Temperature in the H Side Body (°C)	-5
D.2 – L Side	
1. T seal max L – Maximum Temperature in the L Side Seal (°C)	90
2. T seal min L – Minimum Temperature in the L Side Seal (°C)	80
3. T cap max L – Maximum Temperature in the L Side Capillary (°C)	30
4. T cap min L – Minimum Temperature in the L Side Capillary (°C)	-5
5. T body max L – Maximum Temperature in the L Side Body (°C)	30
6. T body min L – Minimum Temperature in the L Side Body (°C)	-5
D.3 – Pressure	
1. Maximum Process Pressure (bar abs.)	5
2. Minimum Process Pressure (bar abs.)	2

Table 5.9 – Process Data (Example 2)

E – USER EXPECTANCY	RESPONSE
1. Global Error Requested by User (% Transmitter Calibration)	0.5%
2. Response Time Requested by the Mesh Control (seconds)	10

Table 5.10 – User Expectancy (Example 2)

Error Calculation by Temperature

Have:

1º – "Upper Variation of Temperature"

Seal L and H Side

$$\Delta T_{seal} = (90 - 25) = 65\ ^{o}C$$
$$\Delta T_{cap} = (30 - 25) = 5^{o}C$$
$$\Delta T_{body} = (30 - 25) = 5\ ^{o}C$$
$$E_H = E_L = +15.2864\ mmH_2O$$

2º – "Temperature Lower Variation"

Seal L and H Side

$$\Delta T_{seal} = (80 - 25) = 55\ ^{o}C$$
$$\Delta T_{cap} = (-5 - 25) = -30^{o}C$$
$$\Delta T_{body} = (-5 - 25) = -30\ ^{o}C$$
$$E_H = E_L = -13.9468\ mmH_2O$$

Calculation of Seal/Level Error

To calculate the Seals Error, verify the cases of symmetry. In this case, there is a Geometric Asymmetry and a Thermal Symmetry, and therefore the Equation 2.12 on Chapter 2 must be used.

$$Es = \sqrt{(E_H)^2 + (E_L)^2} \times \left(\frac{1}{\sqrt{6}}\right)$$

1º – "Upper Temperature Variation"

$$Es1 = \sqrt{(15.2864)^2 + (15.2864)^2} \times \left(\frac{1}{\sqrt{6}}\right)$$

$Es1 = 8.8260$ mmH_2O

2º – "Lower Temperature Variation"

$$Es2 = \sqrt{(-13.9468)^2 + (-13.9468)^2} \times \left(\frac{1}{\sqrt{6}}\right)$$

$Es2 = 8.0520$ mmH_2O

Calculation of the Transmitter Accuracy with Seal/Level

NOTE
The transmitter accuracy is not significantly altered by the addition of seal/level. However, the measuring error resulting from the combination suffers significant increase due to physical and geometric parameters, in terms of temperature variation.

$Accuracy = \frac{0.075}{100} \cdot 3400 =$ 2.55 mmH₂O *(See Transmitter's Manual)*

Calculation of the Global Error of Transmitter Assembling with Seals/Level

From Equation 2.14 the global error of the remote seal must be calculated:

$$E_{TpT\,\max} = \frac{0.078}{100} \cdot 3400 = 2.6520\ mmH_2O$$

$$E_{TpT\,\min} = \frac{0.154}{100} \cdot 3400 = 5.2360\ mmH_2O$$

$$E_{globalpTMax} = \sqrt{E_S{}^2 + E_T{}^2} = \sqrt{8.8260^2 + 2.6520^2}$$

$$E_{globalpTMax} = 9.216\, mmH_2O$$

$E_{globalpTMax} = 0.271\%$ **of the calibrated Span**

$$E_{globalpTMin} = \sqrt{E_S{}^2 + E_T{}^2} = \sqrt{8.0520^2 + 5.2360^2}$$

$$E_{globalpTMin} = 9.605\, mmH_2O$$

$E_{globalpTMin} = 0.283\%$ **of the calibrated Span**

The larger global error is:

$$E_{global} = 9.605\, mmH_2O$$

$E_{global} = 0.283\%$ **of the calibrated Span**

Calculation of the Response Time

The response time is obtained through the Equation 2.14: $TR_S = TR_{listed} \cdot L$

Considering that the transmitter is range 2 type, the filling fluid is DC200/20.

However, the temperature to be used is closer to the Maximum value, because the temperature will not necessarily be kept on the maximum. So:

Maximum Temperature on the H Side Capillary, 30 ºC.

Maximum Temperature on the L Side Capillary, 30°C, from the Table 2.9:

$$TR_{listed}H = TR_{listed}L = 0.698\ \ s/m$$

Thus:

$$TR\,H = TR\,L = 0.698 \times 4.5 = 3.1410\ \ s$$

NOTE
Note that the response time between the sides is smaller than 0.5 second and therefore this type of assembling is recommended.

$$TR_S = TR\,H + TR\,L = 6.2820\,\text{sec}$$

This response time refers only to the remote seal. To calculate the response time of the remote seal and transmitter set, add the time of both:

$$TR = TR_S + TR_T = 6.2820 + 0.1000 = 6.3820\,\text{sec}$$

Checking the Capillary Length

To evaluate the maximum length of the capillary, three conditions on Chapter 2 must be met.

1º - Check if the dilated or contracted volume related to the initial volume of the seal diaphragm is in the Lower and Upper Limits (VCmin and VCmax) according to Equation 2.12.

$$VC_{\min} \le V_{total} \le VC_{\max}$$

Maximum Limit of the Transmitter: URL = 50Kpa = 5098.58 mmH_2O

Thus, the process pressure conditioned to the transmitter URL will be:

$$\%VC_{\min} = \frac{MVP}{URL} \times 100$$

MVP=2400 mmH_2O (MVP: The larger value between the $|V.\sup|$ and $|V.\inf|$)

$$\%VC_{\min} = \frac{2400}{5098.58} \times 100 = 47.1\%$$

Table 2.18 shows the VC_{mim} value. Considering that the assembling was performed with a range 2 transmitter, the value relative to $\%VC_{\min}$ is obtained by the linear interpolation between 50% and 40%, whereby:

$$VC_{\min} = 2.76 \cdot (10^{-2}{}_X\ cm^3)$$

VC_{max} is obtained on Table 2.10. Considering the # 0.05 mm Steel diaphragm material, the family 7 diaphragm and the process ºC temperature, one has:

Maximum Temperature in the H Side Seal, 90 ºC.

Maximum Temperature in the L Side Seal, 90°C, on table 2.10, means:

$$VC_{\max}H = VC_{\max}L = 85.9 \cdot (10^{-2} x \ cm^3)$$

From the calculation:

$$V_{total}H1c = V_{total}L1c = 0.108 \ cm^3$$ (*"Upper Temperature Variation"*)

$$V_{total}H2c = |V_{total}L2c| = |-0.099| = 0.099 \ cm^3$$ (*"Lower Temperature Variation"*)

All the values are in their lower and upper limits according to equation 2.12, which makes the first condition acceptable.

2º - Check if the response time is compatible with the process variables, and if there is enough time for the pressure transmitted guarantees the application control limits.

Requested Client Time = 10 s
Calculated Time = 6.3820 s

Therefore, as a conclusion, the lengths satisfy the second condition.

3º - Check if the global assembling error is within client expectations.

Have:

Global Error Expected by User: 0.5% of the calibrated span
Global Assembling Error: 0.283% of the calibrated span

Thus, the Percent Error is smaller than expected, so one concludes that the assembling meets the third condition.

Conclusion about the Capillary Length

As all the condition is favorable, the remote seal assembled do meet the application and user expectations.

TYPE OF SEAL AND ORDERING CODE

"T" Type Flanged Remote Seal - SR301T

Description

The **SR301T** is a flanged seal with welded diaphragm. It can be supplied with an optional flush connection and housing. The flush connection removes deposits of the diaphragm without disconnecting the seal. If installed correctly, the seal flange does not get wet in contact with the process fluid during normal operation. However, the diaphragm and housing are wetted.

Bolts and nuts are not supplied with the seal.

For Dimensions Models and Pressure Limits see respectively the pages 6.14, 6.15 and pages 6.7 to 6.9.

MODEL SR301T — "T" TYPE FLANGED REMOTE SEAL

COD.	Process Connection	COD.	Process Connection
1	1" ASME B-16.5	8	DN 50 DIN EN1092-1
2	1 1/2" ASME B-16.5	9	DN 80 DIN EN1092-1
3	2" ASME B-16.5	A	DN 100 DIN EN1092-1
4	3" ASME B-16.5	C	40 A JIS B2220
5	4" ASME B-16.5	D	50 A JIS B2220
6	DN 25 DIN EN1092-1	E	80 A JIS B2220
7	DN 40 DIN EN1092-1	F	100 A JIS B2220
		Z	Special – See notes

COD.	Pressure **Class**	COD.	Pressure **Class**
1	150 # ASME B-16.5	C	PN25/40 DIN EN1092-1
2	300 # ASME B-16.5	D	PN63/100 DIN EN1092-1
3	600 # ASME B-16.5	E	PN63/160 DIN EN1092-1
4	1500 # ASME B-16.5 **(4)**	F	10K JIS B2220
5	2500 # ASME B-16.5	G	20K JIS B2220
6	PN63 DIN EN1092-1	H	40K JIS B2220
7	PN100 DIN EN1092-1	Z	Special – See notes
8	PN160 DIN EN1092-1		
9	PN250 DIN EN1092-1		
A	PN10/16 DIN EN1092-1		
B	PN10/40 DIN EN1092-1 **(3)**		

COD.	Capillary Length	COD.	Capillary Length
1	500 mm	8	6000 mm
2	1000 mm	9	8000 mm
3	1500 mm	B	9000 mm
4	2000 mm	A	10000 mm
5	3000 mm	C	11000 mm
6	4000 mm	D	12000 mm
7	5000 mm	E	7000 mm

COD.	Diaphragm Material	COD.	Diaphragm Material
I	316L SST	A	316L SST with Teflon Lining
H	Hastelloy C276	G	316L SST Gold Plated
M	Monel 400 **(10)**	L	316L SST with Halar Lining **(9)**
T	Tantalum **(10)**	C	Hastelloy with Teflon Lining
U	Titanium **(10)**	D	304L SST

COD.	Fill Fluid
S	DC 200 – silicone oil
D	DC 704 – silicone oil
F	Fluorolube MO-10 **(1)**
T	Syltherm 800
N	Neobee M20
G	Glycerin + Water **(7)**
B	Fomblim 06/06
K	Krytox 1506
H	Halocarbon 4.2

COD.	Lower Housing Material	COD.	Lower Housing Material
0	Without Lower Housing **(2)**	4	Duplex (UNS 31803) **(7)**
1	316 SST	5	304L SST **(7)**
2	Hastelloy C276 **(7)**	M	Monel
3	Super Duplex (UNS 32750) **(7)**		

COD.	Gasket Material
0	Without Gasket
T	Teflon (Ptfe)
G	Grafoil (Flexible Grafoil)
I	316L SST **(6)**

COD.	Optional Items *
ZZ	Special Options – Specify

SR301T – 4 2 3 – H S – 1 T / *

* Leave it blank if there are not optional items.

OPTIONAL ITEMS	
Shield Material	A1 - 316 Stainless Steel A3 - 316 Stainless Steel with PVC Lining
Material / Flange Type	F0 - 316L Stainless Steel (Integral Flange) F1 - C276 Hastelloy (Integral Flange) **(7)** F2 - 304L Stainless Steel (Integral Flange) **(7)** F3 - Super Duplex (UNS 32750) (Integral Flange) **(7)** F4 - Duplex (UNS 31803) (Integral Flange) **(7)**
Lower Housing Connection	G0 - With Flush Connection of ¼" NPT (If Supplied with Lower Housing) G1 - With Two Flush Connections of ¼" NPT at 180° G3 - With Two Connections of ½" – 14 NPT at 180° (With Lid) G4 - Without Flush Connection G5 - With Flush Connection of 1/2" NPT
Face (8)	H0 - Raised Face (ASME, DIN, JIS) H1 - Flat Face (ASME, DIN) H2 - Flat Face with Sealing Channel – RTJ (ASME B 16.20) **(5)**
Special Procedures	P1 - Degrease Cleaning (Oxygen or Chlorine Service) P5 - Mounting according to NACE Standard

Notes – SR301T:

(1) Fluorolube Filling Fluid is not available with Monel Diaphragm.
(2) Supplied Without Gasket.
(3) Standard DIN EN 1092-1 subdivides DN80 into PN16 (c=20) and PN40 (c=24), Smar provides only PN40 (c=24), external diameter and holes coincide.
(4) Also fits the #900 class.
(5) Only the gasket code available I (Stainless 316).
(6) Only RTJ.
(7) Item by inquiry.
(8) Finishing of the flange faces according to specific standards.
(9) Applicable only for:
- Diameters/Capillary Length:
  - 2" ASME B 16.5, DN 50 DIN, JIS 50 A, for seals up to 3 meters of capillary and level models (by inquiry).
  - 3" ASME B 16.5, DN 80 DIN, JIS 80 A, for seals up to 5 meters of capillary and level models.
  - 4" ASME B 16.5, DN 100 DIN, JIS 100 A, for seals up to 8 meters of capillary and level models.
- Faces: RF and FF.
- Temperature Limits:
  - +10 to 100°C;
  - +101 to 150°C (by inquiry).
- Not applicable for use with lower housing.
- Performance with Halar see page 6.12.

(10) Diaphragms of Titanium, Tantalum, and Monel available only in 0.1 mm.

Flanged Remote Seal with Extension - SR301E

Description

The **SR301E** is a flanged seal with welded diaphragm. The diaphragm is extended from the seal flange and welded to the extension. Differently from Model SR301T, it is not supplied with housing, because the diaphragm coincides with the internal wall of the tank.

Bolts and nuts are not supplied with the seal.

For Dimensions Models and Pressure Limits see respectively the pages 6.14, 6.15 and pages 6.7 to 6.9.

MODEL	FLANGED REMOTE SEAL WITH EXTENSION
SR301E	

CODE		Process Connection, Range and Standard
2	1	1.1/2" 150 # ASME B-16.5
2	2	1.1/2" 300 # ASME B-16.5
2	3	1.1/2" 600 # ASME B-16.5
3	1	2" 150 # ASME B-16.5
3	2	2" 300 # ASME B-16.5
3	3	2" 600 # ASME B-16.5
4	1	3" 150 # ASME B-16.5
4	2	3" 300 # ASME B-16.5
4	3	3" 600 # ASME B-16.5
5	1	4" 150 # ASME B-16.5
5	2	4" 300 # ASME B-16.5
5	3	4" 600 # ASME B-16.5
7	B	DN 40 PN10/40 DIN EN1092-1
8	B	DN 50 PN10/40 DIN EN1092-1
9	C	DN 80 PN10/40 DIN EN1092-1
A	A	DN 100 PN10/16 DIN EN1092-1
A	C	DN 100 PN25/40 DIN EN1092-1

CODE	Capillary Length
1	500 mm
2	1000 mm
3	1500 mm
4	2000 mm
5	3000 mm
6	4000 mm
7	5000 mm
8	6000 mm
9	8000 mm
B	9000 mm
A	10000 mm
C	11000 mm

CODE	Diaphragm Material
I	316L Stainless Steel
H	Hastelloy C276
M	Monel 400
T	Tantalum
U	Titanium
A	316L Stainless Steel with Teflon Lining
G	316L Gold Plated Stainless Steel
L	316L Stainless Steel with Halar Lining **(6)**
C	Hastelloy with Teflon Lining

CODE	Filling Fluid
S	DC 200 – silicone oil
D	DC 704 – silicone oil
F	Fluorolube MO-10 **(1)**
T	Syltherm 800
N	Neobee M20
B	Fomblim 06/06
K	Krytox 1506
H	Halocarbom 4.2

CODE	Extension Length (2)
1	50 mm (2")
2	100 mm (4")
3	150 mm (6")
4	200 mm (8")

CODE	Optional Items*
ZZ	Special Options – Specify

SR301E – 4 2 3 – H S – 1 / *

* Leave it blank when there are not optional items.

OPTIONAL ITEMS	
Shield Material	A1 - 316 Stainless Steel A3 - 316 Stainless Steel with PVC Lining
Material / Flange Type	F0 - 316L Stainless Steel (Integral Flange) F1 - C276 Hastelloy (Integral Flange) (3) F2 - 304L Stainless Steel (Integral Flange) **(3)** F3 - Super Duplex (UNS 32750) (Integral Flange) **(3)** F4 - Duplex (UNS 31803) (Integral Flange) **(3)**
Face (5)	H0 - Raised Face (ASME, DIN, JIS)
Extension Material	J0 - 316 Stainless Steel J1 - C276 Hastelloy **(3)**
Special Procedures	P1 - Degrease Cleaning (Oxygen or Chlorine Service) P5 - Mounting according to NACE Standard

Notes – SR301E:

(1) Fluorolube Filling Fluid Is Not Available with Monel Diaphragm.
(2) Standard DIN EN 1092-1 subdivides DN80 into PN16 (c=20) and PN40 (c=24), Smar provides only PN40 (c=24), external diameter and holes coincide.
(3) Item by inquiry.
(4) Diaphragms of Titanium, Tantalum, and Monel available only in 0.1 mm.
(5) Finishing of the flange faces according to specific standards.
(6) Applicable only for:
- Diameters/Capillary Length:
  - 2" ASME B 16.5, DN 50 DIN, JIS 50 A, for seals up to 3 meters of capillary and level models (by inquiry).
  - 3" ASME B 16.5, DN 80 DIN, JIS 80 A, for seals up to 5 meters of capillary and level models.
  - 4" ASME B 16.5, DN 100 DIN, JIS 100 A, for seals up to 8 meters of capillary and level models.
- Faces: RF and FF.
- Temperature Limits:
  - +10 to 100°C;
  - +101 to 150°C (by inquiry).
- Performance with Halar see page 6.12.

Threaded Remote Seal – SR301R

Description

The **SR301R** is a threaded connection seal. The diaphragm is welded to the flange. This model is always supplied with housing because the process thread is located in this part. The (optional) flush connection in the housing enables to remove deposits on the diaphragm without disconnecting the seal. The parts are bolted together and sealed with a gasket.

This model is supplied with bolts and nuts in Stainless Steel 316.

For Dimension Models and Pressure Limits see page 6.16 and pages 6.7 to 6.9.

MODEL SR301R	THREADED REMOTE SEAL

CODE	Process Connection
1	1/4 NPT
2	3/8 NPT
3	½ NPT
4	3/4 NPT
5	1 NPT
6	1 ½ NPT
7	1/2“ BSP
8	1” BSP

CODE	Pressure Limit
2	2000 psi (138 bar)
3	5800 psi (400 bar)

CODE	Capillary Length
1	500 mm
2	1000 mm
3	1500 mm
4	2000 mm
5	3000 mm
6	4000 mm
7	5000 mm
8	6000 mm
E	7000 mm
9	8000 mm
B	9000 mm
A	10000 mm

CODE	Diaphragm Material
I	316L Stainless Steel
H	Hastelloy C276
M	Monel 400 **(3)**
T	Tantalum **(3)**
U	Titanium **(3)**
A	316L Stainless Steel with Teflon Lining
G	316L Gold Plated Stainless Steel
C	Hastelloy with Teflon Lining

CODE	Filling Fluid
S	DC 200 – silicone oil
D	DC 704 – silicone oil
F	Fluorolube MO-10 **(1)**
T	Syltherm 800
N	Neobee M20
B	Fomblim 06/06
K	Krytox 1506
H	Halocarbom 4.2

CODE	Lower Housing
I	316L Stainless Steel
H	Hastelloy C276
S	Super Duplex (UNS 32750) **(4)**
D	Duplex (UNS 31803) **(4)**
A	304L Stainless Steel **(4)**
M	Monel

CODE	Gasket Material
T	Teflon (Ptfe)
G	Grafoil (Flexible Grafoil)

CODE	Flush Connection
0	Without Flush Connection
1	With Flush Connection **(2)**

CODE	Optional Items*
ZZ	Special Options – Specify

SR301R – 4 1 3 – H A I T 0 / *

* Leave it blank when there are not optional items.

OPTIONAL ITEMS	
Shield Material	A1 - 316 Stainless Steel A3 - 316 Stainless Steel with PVC Lining
Flange Material	F0 - 316 Stainless Steel
Lower Housing Connection	G0 - With Flush Connection of ¼” NPT (If Supplied with Housing) G4 - Without Flush Connection
Special Procedures	P1 - Degrease Cleaning (Oxygen or Chlorine Service)

Notes – SR301R:

(1) Fluorolube Filling Fluid Is Not Available with Monel Diaphragm.
(2) Flush connection not available for process connection 1½” NPT.
(3) Diaphragms of Titanium, Tantalum, and Monel available only in 0.1 mm.
(4) Item by inquiry.

Sanitary Remote Seal – SR301S

Description

The **SR301S** is a seal for food and other applications where the sanitary connections are necessary. The diaphragm is welded to the connection face, which can be Threaded type or Tri-Clamp, allowing an easy and fast connection/disconnection of the process equipment.

For Dimensions see pages 6.19, 6.20 and 6.21 and Pressure Limits pages 6.7, 6.8 and 6.9.

MODEL SR301S – SANITARY REMOTE SEAL

COD.	Process Connection (1)	COD.	Process Connection (1)
T	Tri-Clamp DN50 – without extension	M	Threaded SMS – 3" - with extension **(2)**
A	Tri-Clamp DN50 – with extension	1	Threaded SMS – 3" - without extension **(2)**
F	Tri-Clamp – 1.1/2" - without extension	C	Threaded RJT – 2" - without extension **(2)**
D	Tri-Clamp – 2" - without extension	5	Threaded RJT – 2" - with extension **(2)**
6	Tri-Clamp – 2" - with extension	L	Threaded RJT – 3" - with extension **(2)**
G	Tri-Clamp – 3" - without extension	2	Threaded RJT – 3" - without extension **(2)**
I	Tri-Clamp – 3" - with extension	B	Threaded IDF – 2" - without extension **(2)**
8	Threaded DN25 – DIN 11851 – with extension **(2)**	4	Threaded IDF – 2" - with extension **(2)**
H	Threaded DN40 – DIN 11851 – without extension **(2)**	K	Threaded IDF – 3" - with extension **(2)**
9	Threaded DN40 – DIN 11851 – with extension **(2)**	3	Threaded IDF – 3" - without extension **(2)**
U	Threaded DN50 – DIN 11851 – without extension **(2)**	Y	As per special option
V	Threaded DN50 – DIN 11851 – with extension **(2)**		
W	Threaded DN80 – DIN 11851 – without extension **(2)**		
X	Threaded DN80 – DIN 11851 – with extension **(2)**		
S	Threaded SMS – 1.1/2" - without extension **(2)**		
E	Threaded SMS – 2" - without extension **(2)**		
7	Threaded SMS – 2" - with extension **(2)**		

COD.	Pressure Class
1	Normal pressure
2	High pressure
Z	Special (see notes)

COD.	Capillary Length	COD.	Capillary Length
1	500 mm	7	5000 mm
2	1000 mm	8	6000 mm
3	1500 mm	9	8000 mm
4	2000 mm	B	9000 mm
5	3000 mm	A	10000 mm
6	4000 mm	E	7000 mm

COD.	Diaphragm Material
H	Hastelloy C276
I	316L SST

COD.	Fill Fluid
S	DC 200 – silicone oil
D	DC 704 – silicone oil
F	Fluorolube MO-10
T	Syltherm 800
N	Neobee M20

COD.	Wet O-ring
0	Without O-ring
T	Teflon
B	Buna-N
V	Viton

COD.	Tank Adapter
0	Without Tank Adapter
3	With Tank Adapter in 316L SST **(3)**

COD.	Tri Clamp
0	Without Tri-Clamp
2	With Tri-Clamp in 304 SST

COD.	Optional Items**
ZZ	Special Options – Specify

SR301S	4	1	3	I	S	T	0	0	*	TYPICAL MODEL

* Leave it blank when there are not optional items.

OPTIONAL ITEMS	
Shield Material	A1 - 316 Stainless Steel A3 - 316 Stainless Steel with PVC Lining
Special Procedures	P1 - Degrease Cleaning (Oxygen or Chlorine Service)
Process Connection Material	K0 – Without process connection and special material K1 – Tri-Clamp 2" DIN11864-3 without extension/ 316L SST K2 – Varivent 68

Notes – SR301S:

(1) Extension Material in 316 Stainless Steel and wet part with diaphragm material.
(2) Not available for Tri-clamp in 304 stainless steel.
(3) Not available for without O-Ring option.
(4) HP – High Pressure.

Pancake Remote Seal - SR301P

Description

The **SR301P** is a seal with welded diaphragm, whose assembly requests blind flanges. This model is supplied with housing and flush connection (optional). The flush connection removes deposits on the diaphragm without disconnecting the seal. The seal diaphragm and the housing are wetted (in contact with the process fluid). However, the blind flange does not get wet.

Bolts, nuts, and blind flange are not supplied with the seal.

The pressure limits are established by pressure class of the blind flange.

For Dimensions see page 6.17 and for Pressure Limits see pages 6.7 to 6.9.

MODEL	
SR301P	PANCAKE REMOTE SEAL

CODE	Process Connection, Pressure Class / Standard		
1	1 1/2"	150...2500 #	ASME B-16.5
2	2"	150...2500 #	ASME B-16.5
3	3"	150...2500 #	ASME B-16.5
4	4"	150...2500 #	ASME B-16.5
5	DN 40	PN10...100	DIN EN1092-1
6	DN 50	PN10...100	DIN EN1092-1
7	DN 80	PN10...100	DIN EN1092-1
8	DN 100	PN10...100	DIN EN1092-1

CODE	Capillary Length	CODE	Capillary Length
1	500 mm	8	6000 mm
2	1000 mm	9	8000 mm
3	1500 mm	B	9000 mm
4	2000 mm	A	10000 mm
5	3000 mm	D	12000 mm
6	4000 mm	E	7000 mm
7	5000 mm		

CODE	Diaphragm Material	CODE	Diaphragm Material
I	316L Stainless Steel	A	316L Stainless Steel with Teflon Lining
H	Hastelloy C276	B	Tantalum with Teflon Lining
M	Monel 400 **(6)**	G	316L Stainless Steel Gold Plated
T	Tantalum **(6)**	C	Hastelloy with Teflon Lining
U	Titanium **(6)**	8	Monel 400 Gold Plated **(3)**

CODE	Fill Fluid
S	DC 200 – silicone oil
D	DC 704 – silicone oil
F	Fluorolube MO-10 **(1)**
T	Syltherm 800
N	Neobee M20
G	Glycerin + Water
B	Fomblim 06/06
K	Krytox 1506
H	Halocarbon 4.2

CODE	Lower Housing
0	Without Lower Housing **(2)**
1	316 Stainless Steel
2	Hastelloy C276
3	Super Duplex (UNS 32750) **(3)**
4	Duplex (UNS 31803) **(3)**

CODE	Gasket Material
0	Without Gasket
T	Teflon (Ptfe)
G	Grafoil (Flexible Grafoil)

CODE	Optional Items*
ZZ	Special Options – Specify

SR301P - 2 | 3 - I | S - 1 | 0 / *

OPTIONAL ITEMS	
Shield Material	A1 - 316 Stainless Steel A3 - 316 Stainless Steel with PVC Lining
Flange Material	F0 - 316L Stainless Steel
Lower Housing Connection	G0 - With Flush Connection of ¼” NPT (If Supplied with Housing) G1 - With Two Flush Connections of ¼” NPT at 180° G3 - With Two Connections of ½” – 14 NPT at 180° (With Lid) G5 - With Flush Connection of 1/2” NPT
Face (5)	H0 - Face (ASME, DIN, JIS) **(4)**
Special Procedure	P1 - Degrease Cleaning (Oxygen or Chlorine Service)

Notes – SR301P:

(1) Fluorolube filling fluid is not available with Monel diaphragm.
(2) Supplied without gasket.
(3) Item by inquiry.
(4) This face does not cause interference when mounted with counter-flanges with Flat Face (FF) or Raised Face (RF).
(5) Finishing of the flange faces according to specific standards.
(6) Diaphragms of Titanium, Tantalum, and Monel available only in 0.1 mm.

Technical Data

The calibration maximum limit of the remote seal or level transmitter should be the smallest value between the connection pressure limit (see following tables) and the upper range limit of the transmitter (URL). See transmitter's manual.

PRESSURES TABLE FOR SEAL AND LEVEL FLANGES ASME B16.5 2017 STANDARD

Material Group	Pressure Class	Maximum Temperature Allowed								
		-29 to 38	50	100	150	200	250	300	325	350
		Maximum Pressure Allowed (bar)								
Hastelloy C276	150	20	19.5	17.7	15.8	13.8	12.1	10.2	9.3	8.4
	300	51.7	51.7	51.5	50.3	48.3	46.3	42.9	41.4	40.3
	600	103.4	103.4	103	100.3	96.7	92.7	85.7	82.6	80.4
	1500	258.6	258.6	257.6	250.8	241.7	231.8	214.4	206.6	201.1
	2500	430.9	430.9	429.4	418.2	402.8	386.2	357.1	344.3	335.3

Material Group	Pressure Class	Maximum Temperature Allowed								
		-29 to 38	50	100	150	200	250	300	325	350
		Maximum Pressure Allowed (bar)								
S31803 Duplex S32750 Super Duplex	150	20	19.5	17.7	15.8	13.8	12.1	10.2	9.3	8.4
	300	51.7	51.7	50.7	45.9	42.7	40.5	38.9	38.2	37.6
	600	103.4	103.4	101.3	91.9	85.3	80.9	77.7	76.3	75.3
	1500	258.6	258.6	253.3	229.6	213.3	202.3	194.3	190.8	188.2
	2500	430.9	430.9	422.2	382.7	355.4	337.2	323.8	318	313.7

Material Group	Pressure Class	Maximum Temperature Allowed								
		-29 to 38	50	100	150	200	250	300	325	350
		Maximum Pressure Allowed (bar)								
AISI316L	150	15.9	15.3	13.3	12	11.2	10.5	10	9.3	8.4
	300	41.4	40	34.8	31.4	29.2	27.5	26.1	25.5	25.1
	600	82.7	80	69.6	62.8	58.3	54.9	52.1	51	50.1
	1500	206.8	200.1	173.9	157	145.8	137.3	130.3	127.4	125.4
	2500	344.7	333.5	289.9	261.6	243	228.9	217.2	212.3	208.9

Material Group	Pressure Class	Maximum Temperature Allowed								
		-29 to 38	50	100	150	200	250	300	325	350
		Maximum Pressure Allowed (bar)								
AISI316	150	19	18.4	16.2	14.8	13.7	12.1	10.2	9.3	8.4
	300	49.6	48.1	42.2	38.5	35.7	33.4	31.6	30.9	30.3
	600	99.3	96.2	84.4	77	71.3	66.8	63.2	61.8	60.7
	1500	248.2	240.6	211	192.5	178.3	166.9	158.1	154.4	151.6
	2500	413.7	400.9	351.6	320.8	297.2	278.1	263.5	257.4	252.7

PRESSURES TABLE FOR SEAL AND LEVEL FLANGES DIN EN 1092-1 2008 STANDARD

Material Group	Pressure Class	Maximum Temperature Allowed						
		RT*	100	150	200	250	300	350
		Maximum Pressure Allowed (bar)						
10E0 AISI 304/304L	PN 16	16	13.7	12.3	11.2	10.4	9,6	9.2
	PN 25	25	21.5	19.2	17.5	16.3	15.1	14.4
	PN 40	40	34.4	30.8	28	26	24.1	23
	PN 63	63	54,3	48,6	44,1	41,1	38,1	36,3
	PN 100	100	86.1	77.1	70	65.2	60.4	57.6
	PN 160	160	137.9	123.4	112	104.3	96.7	92.1
	PN 250	250	215.4	192.8	175	163	151.1	144

Material Group	Pressure Class	Maximum Temperature Allowed						
		RT*	100	150	200	250	300	350
		Maximum Pressure Allowed (bar)						
14E0 AISI 316/316L	PN 16	16	16	14.5	13.4	12.7	11.8	11.4
	PN 25	25	25	22.7	21	19.8	18.5	17.8
	PN 40	40	40	36.3	33.7	31.8	29.7	28.5
	PN 63	63	63	57.3	53.1	50.1	46.8	45
	PN 100	100	100	90.9	84.2	79.5	74.2	71.4
	PN 160	160	160	145.5	134.8	127.2	118.8	114.2
	PN 250	250	250	227.3	210.7	198.8	185.7	178.5

Material Group	Pressure Class	Maximum Temperature Allowed						
		RT*	100	150	200	250	300	350
		Maximum Pressure Allowed (bar)						
16E0 1.4410 Super Duplex 1.4462 Duplex	PN 16	16	16	16	16	16	-	-
	PN 25	25	25	25	25	25	-	-
	PN 40	40	40	40	40	40	-	-
	PN 63	63	63	63	63	63	-	-
	PN 100	100	100	100	100	100	-	-
	PN 160	160	160	160	160	160	-	-
	PN 250	250	250	250	250	250	-	-

***RT = Reference Temperature (-10 to 50 ºC)*

PRESSURES TABLE FOR SEAL AND LEVEL FLANGES JIS 2220 – 2012 STANDARD

Material Group	Pressure Class	Maximum Temperature Allowed			
		Tamb at 120º	220º	300º	350º
		Maximum Pressure Allowed (bar)			
AISI316L	10k	14	12	10	--
	20k	34	31	29	26
	40k	68	62	57	52

Notes

- The Tables are based on the standards and are subject to modifications. For more details consult the corresponding standards;
- It is necessary verify the application limits of the sealing gasket, because the limits can do unviable the tables above;
- The temperature limits of the fill fluid limit this tables. See Table 2.5, Section2.

Pressure Limit Tri-Clamp (TC) (Bar) – Table 1				
DN	Normal Pressure		High Pressure (HP)	
	20°C (68ºF)	120°C (248ºF)	20°C (68ºF)	120°C (248ºF)
1.1/2"	34	20	100	60
2" / DN50	28	17	70	42
3"	22	13	70	42

Pressure Limit for Thread (Bar) – NP – Table 2				
DN	RJT	IDF	SMS	DIN
	120°C (248ºF)	120°C (248ºF)	120°C (248ºF)	140°C (284ºF)
DN25	10	16	40	40
1.1/2" / DN40	10	16	40	40
2" / DN50	10	16	25	25
3" / DN80	10	10	25	25

O'Ring Application Guide – Table 3				
Ring Material	Resistance to Temperature in Continuous Service		Application – Recommended Use and Specification	
	Minimum Temperature º C (ºF)	Maximum Temperature º C (ºF)	Recommended	Not Recommended
Teflon® (PTFE)	-23 (-10)	232 (450)	General Applications, Excellent resistance to acids, bases, water, and amines	To avoid solvents and aromatic fuels.
Viton	-29 (-20)	205 (400)	Products of Petroleum, Silicone Fluids, Diester Fluids.	Amines, Cetone, Hot Water/Vapor Brake Fluids.
Buna N	-35 (-31)	135 (275)	General Applications, Products of Petroleum, Silicone Fluids, Fluids to Ethylene Glycol	Acids, Brake Fluids, Ozone, Cetones.

O'Ring Materials Guide – Table 4			
Ambient	**Teflon® (PTFE)**	**Viton**	**Buna N**
Acetic Acid, 30%	S.I.	++	+++
Acetone	-	-	-
Air, below 93 ºC (200° F)	++++	++++	++++
Ammonia Gas, Cold	++++	-	++++
Ammonia Gas, Hot	+++	-	-
Ammonia, Liquid	++	-	+++
Carbon Dioxide, Dry	++++	+++	++++
Carbon Dioxide, Wet	++++	+++	++++
Carbon Monoxide	++++	++++	++++
Caustic Soda	++++	-	+++
Chloro Dioxide	++	+++	-
Citric Acid	++++	++++	++++
Corn Oil	++++	++++	++++
Cottonseed Oil	++++	++++	++++
Diesel Oil	++++	++++	++++
Ethyl Alcohol (Ethanol)	++++	++	++++
Glycol Ethylene	++++	++++	++++
Fish Oil	S.I.	++++	++++
Gasoline	+++	++++	++++
Glucose	++++	++++	++++
Hydrogen	S.I.	++++	++++
Kerosene	+++	++++	++++
Methane	+++	++++	++++
Milk	++++	++++	++++
Mineral Oil	++++	++++	++++
Olive Oil	++++	++++	++++
Oxygen, Gas (Hot)	-	++	-
Oxygen, Liquid	-	-	-
Ozone	++++	++++	-
Propane	++++	++++	++++
Propylene Glycol	++++	++++	++++
Sodium Bicarbonate	++++	++++	++++
Vapour < 149 ºC (300 ºF)	+++	+++	-
Vapour > 149 ºC (300 ºF)	++	-	-
Vegetable Oils	++++	++++	++++
Vinegar	S.I.	+++	+++
Water	++++	++++	++++
(++++) Recommended; (+++) Satisfactory; (++) TrASMEtory; (-) Not Recommended; (S. I.) Without Information			

Diaphragm Hydrogen Migration

The hydrogen in H2 form does not have penetration danger in the diaphragm. However if the hydrogen separates forming ions of hydrogen (H+), the penetration can happen, therefore the spaces between the molecules of the diaphragm material can be larger than the size of the ion.

Inside of the diaphragm, this ion in contact with filling fluid (silicone oils) can be return the H2 form and to be arrested (inflating the diaphragm), causing damages the measurement.

Steps to Facilitate the Migration

- In High Temperatures or High Pressures, the H_2 molecules are excited, generating its break, favoring the migration of the ion (H+);

- Processes of spontaneous generation of electric current for potential difference between flanges;

- Corrosion of the pipe material due to the process fluid, liberating ion (H+); and

- Vapor to the High Temperature can generate corrosion of the diaphragm metal and to liberate ions (H+).

Form to Inhibit the Hydrogen Migration

- Kit of electric insulator, inhibit the galvanic current between flanges; and

- Stainless Steel diaphragms gold plated can aid in the hydrogen migration due to the size of the molecular space to be smaller than the ion space.

Gold Plated Stainless Steel Diaphragm

Resistance to Diaphragm Hydrogen Migration

Diaphragm Material	AISI 316 Gold Plated	AISI 316	Hastelloy C
Hydrogen Penetration	+++	++	+
(+++) Excellent Performance, (++) Good Performance, (+) Low Performance.			

Application with Halar for Seals and Levels

Technical Specification

Halar® is chemically one of the most resistant fluoropolymers. It is a thermoplastic of the melting process manufactured by Solvay Solexis, Inc. For its chemical structure, a 1:1 alternating ethylene copolymer and chlorinetrifluoroethylene, Halar® ***(ECTFE)*** offers an only combination of useful properties.

The diaphragms in 316L Stainless Steel covered with Halar®, are ideal for applications in contact with aggressive liquids. They offer excellent resistance to the chemic and abrasion with a wide temperature range. Halar® does not contaminate liquids of high purity and it is not affected by most of corrosive chemists, usually found in the industries, including strong minerals, oxidant acids, alkalis, liquid oxygen and some organic solvents.

Halar® is trademark of *Solvay Solexis, Inc*.

Performance Specification

For the performance specification see the equation below:

[1% SPAN x (URL/SPAN)] - Included temperature error*****

Diameters/Capillary Length:

- 2” ASME B 16.5, DN 50 DIN, JIS 50 A, for seals up to 3 meters of capillary and level models (by inquiry).
- 3” ASME B 16.5, DN 80 DIN, JIS 80 A, for seals up to 5 meters of capillary and level models.
- 4” ASME B 16.5, DN 100 DIN, JIS 100 A, for seals up to 8 meters of capillary and level models.

*****Temperature Limits:
+10 to 100°C;
+101 to 150°C (by inquiry).

TPE – Total Probable Error (Software)

Software to calculate the assembly error of the Pressure Transmitters with the possible connections to the process.

TPE was developed to a fast and effective aid of the products related the pressure measurement. The users are the Applications Engineer and Commercial Areas. The customer can request a report of performance estimate to Smar.

This product allows doing simulations of possible assemblies, verifying important data as the error estimates of the response time, of capillary length analysis and mechanical resistance of diaphragms with temperature variation. See an example in the Figure 6.1.

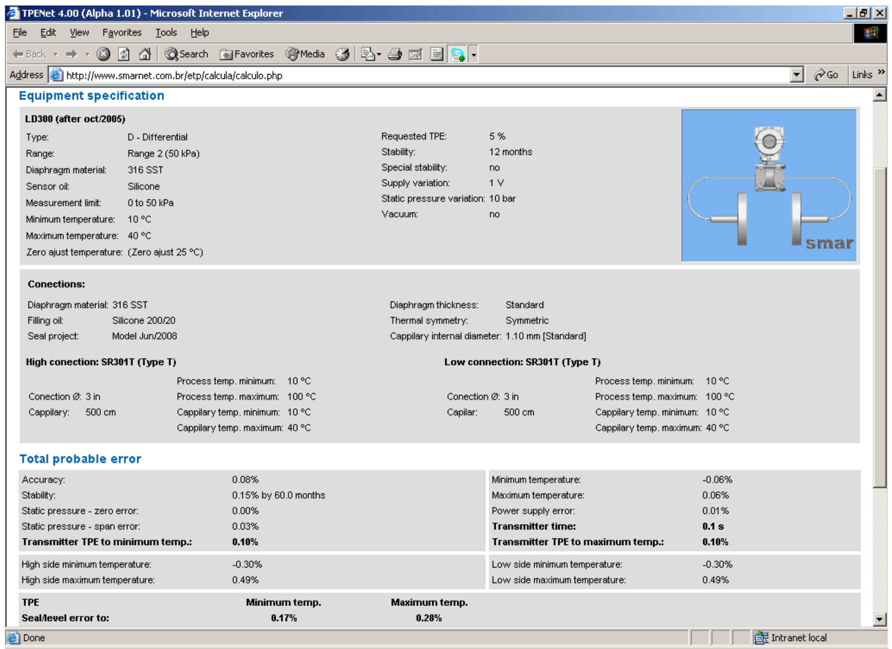
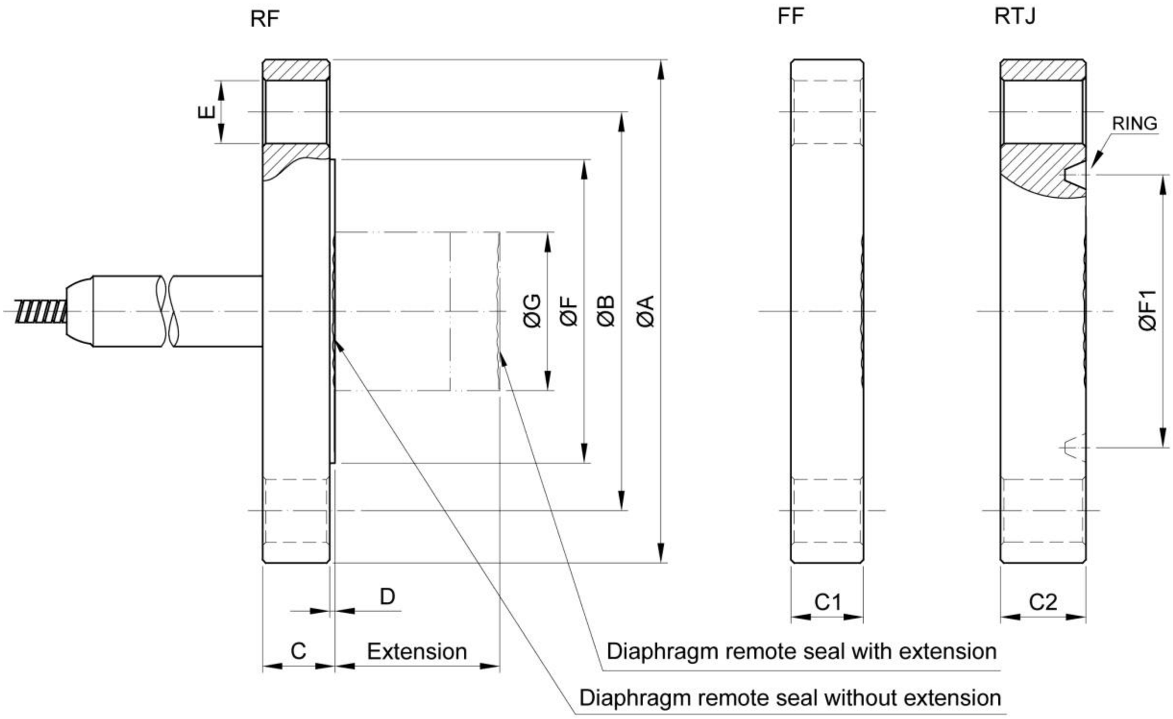


Figure 6.1 – TPE Software Screen

Dimensions

SR301T (RF/FF/RTJ) - "T" Type Flanged Remote Seal and SR301E (RF/FF/RTJ) - Flanged Remote Seal with Extension (Integral Flange)



DIMENSIONS IN mm (INCHES)
EXTENSION LENGHTS: 0 , 50 , 100 , 150 or 200
EXTENSIONS ONLY AVAILABLE IN RF FLANGES

ASME-B 16.5 - 2017 DIMENSIONS

DN	CLASS	A	B	C	C1 (FF)	C2 (RTJ)	D	E	F	F1 (RTJ)	RTJ RING	G	HOLES
1"	150	110 (4.33)	79,2 (3.12)	17 (0.67)	17 (0.67)	21 (0.83)	2 (0.06)	16 (0.63)	50,8 (2)	47,6 (1.87)	R15		4
	300	125 (4.92)	88,9 (3.50)	19 (0.75)	19 (0.75)	25 (0.98)	2 (0.06)	19 (0.75)	50,8 (2)	50,8 (2)	R16		4
	600	125 (4.92)	88,9 (3.50)	25 (0.96)		25 (0.98)	7 (0.25)	19 (0.75)	50,8 (2)	50,8 (2)	R16		4
	1500	150 (5.90)	101,6 (4)	35,6 (1.40)		35 (1.38)	7 (0.25)	25 (0.98)	50,8 (2)	50,8 (2)	R16		4
	2500	160 (6.30)	108 (4.25)	42 (1.65)		41,4 (1.63)	7 (0.25)	25 (0.98)	50,8 (2)	60,3 (2.37)	R18		4
1.1/2"	150	125 (4.92)	98,6 (3.88)	20 (0.78)	20 (0.79)	24,4 (0.96)	2 (0.06)	16 (0.63)	73,2 (2.88)	65,1 (2.56)	R19	40 (1.57)	4
	300	155 (6.10)	114,3 (4.5)	21 (0.83)	20 (0.79)	28,7 (1.13)	2 (0.06)	22 (0.87)	73,2 (2.88)	68,3 (2.68)	R20	40 (1.57)	4
	600	155 (6.10)	114,3 (4.5)	29,3 (1.15)		28,7 (1.13)	7 (0.25)	22 (0.87)	73,2 (2.88)	68,3 (2.68)	R20	40 (1.57)	4
	1500	180 (7.09)	124 (4.88)	38,8 (1.53)		38,2 (1.52)	7 (0.25)	28 (1.10)	73,2 (2.88)	68,3 (2.68)	R20	40 (1.57)	4
	2500	205 (8.07)	146 (5.75)	51,5 (2.03)		52,4 (2.06)	7 (0.25)	32 (1.26)	73,2 (2.88)	82,6 (3.25)	R23	40 (1.57)	4
2"	150	150 (5.90)	120,7 (4.75)	20 (0.79)	20 (0.79)	23,9 (0.94)	2 (0.06)	19 (0.75)	92 (3.62)	82,6 (3.25)	R22	48 (1.89)	4
	300	165 (6.50)	127 (5)	22,7 (0.89)	20,7 (0.81)	28,6 (1.13)	2 (0.06)	19 (0.75)	92 (3.62)	82,6 (3.25)	R23	48 (1.89)	8
	600	165 (6.50)	127 (5)	32,3 (1.27)		33,3 (1.31)	7 (0.25)	19 (0.75)	92 (3.62)	82,6 (3.25)	R23	48 (1.89)	8
	1500	215 (8.46)	165 (6.50)	45 (1.77)		46 (1.81)	7 (0.25)	25 (0.98)	92 (3.62)	95,3 (3.75)	R24	48 (1.89)	8
	2500	235 (9.25)	171,5 (6.75)	58 (2.27)		58,8 (2.31)	7 (0.25)	28 (1.10)	92 (3.62)	101,6 (4)	R26	48 (1.89)	8
3"	150	190 (7.48)	152,4 (6)	24,3 (0.96)	22,3 (0.88)	28,7 (1.13)	2 (0.06)	19 (0.75)	127 (5)	114,3 (4.5)	R29	73 (2.87)	4
	300	210 (8.27)	168,1 (6.62)	29 (1.14)	27 (1.06)	34,9 (1.37)	2 (0.06)	22 (0.87)	127 (5)	123,8 (4.87)	R31	73 (2.87)	8
	600	210 (8.27)	168,1 (6.62)	38,8 (1.53)		39,7 (1.56)	7 (0.25)	22 (0.87)	127 (5)	123,8 (4.87)	R31	73 (2.87)	8
4"	150	228,6 (9)	190,5 (7.5)	24,3 (0.96)	22,3 (0.88)	28,7 (1.13)	2 (0.06)	19 (0.75)	157 (6.19)	149,2 (5.87)	R36	89 (3.50)	8
	300	255 (10)	200 (7.87)	32,2 (1.27)	30,2 (1.19)	38,1 (1.50)	2 (0.06)	22 (0.87)	157 (6.19)	149,2 (5.87)	R37	89 (3.50)	8
	600	275 (10.83)	215,9 (8.5)	45,1 (1.77)		46 (1.81)	7 (0.25)	25 (1)	157 (6.19)	149,2 (5.87)	R37	89 (3.50)	8

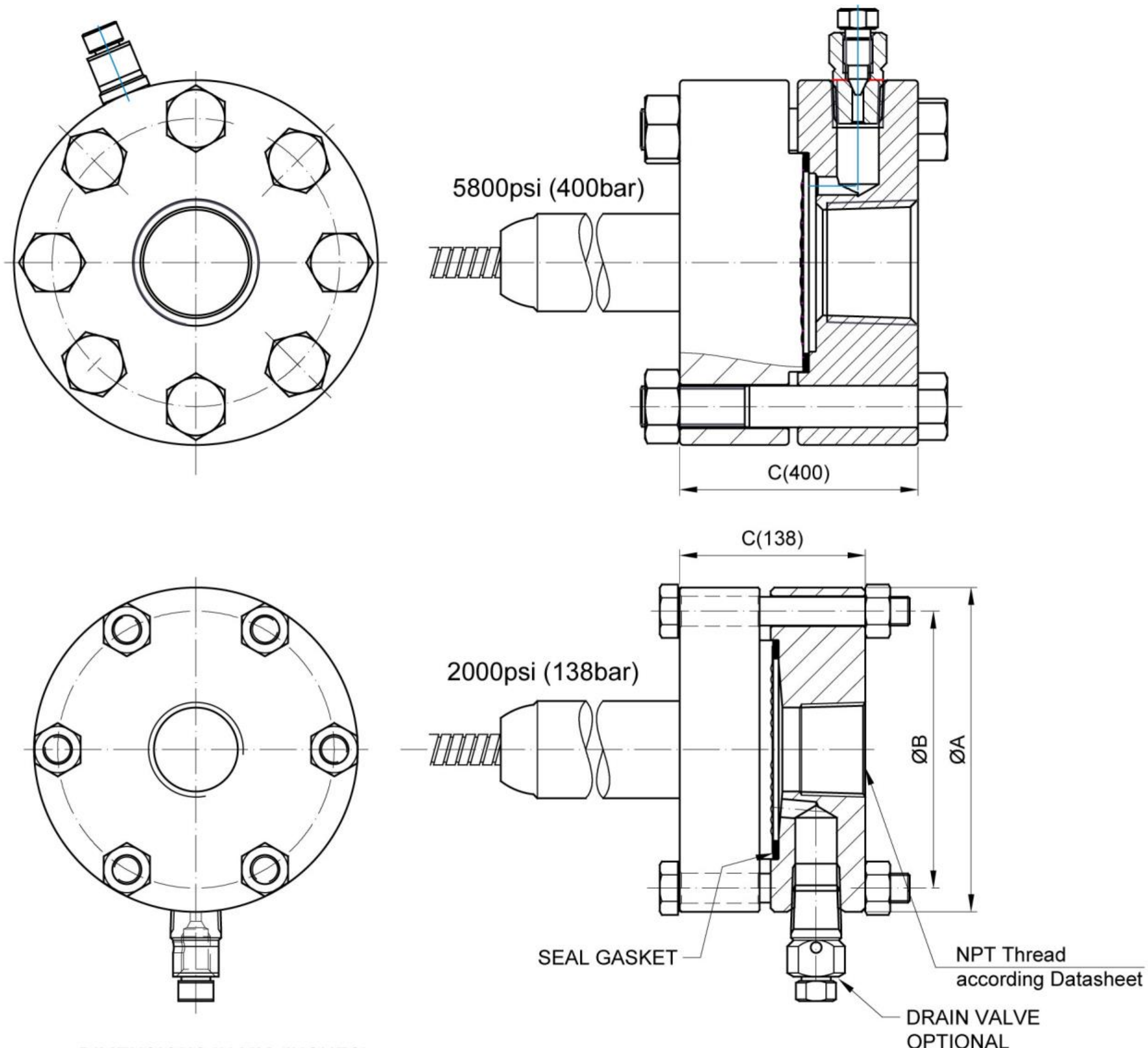
EN 1092-1-2008 DIMENSIONS

DN	PN	A	B	C	C1 (FF)		D	E	F		G	HOLES
25	10/40	115 (4.53)	85 (3.35)	19 (0.75)	19 (0.75)		2 (0.08)	14 (0.55)	68 (2.67)			4
	63/160	140 (5.51)	100 (3.94)	24 (0.95)			2 (0.08)	18 (0.71)	68 (2.67)			4
	250	150 (5.91)	105 (4.13)	28 (1.10)			2 (0.08)	22 (0.87)	68 (2.67)			4
40	10/40	150 (5.91)	110 (4.33)	20 (0.78)	20 (0.78)		3 (0.12)	18 (0.71)	88 (3.46)		40 (1.57)	4
	63/160	170 (6.69)	125 (4.92)	28 (1.10)			3 (0.12)	22 (0.87)	88 (3.46)		40 (1.57)	4
	250	185 (7.28)	135 (5.31)	34 (1.34)			3 (0.12)	26 (1.02)	88 (3.46)		40 (1.57)	4
50	10/40	165 (6.50)	125 (4.92)	20 (0.78)	20 (0.78)		3 (0.12)	18 (0.71)	102 (4.01)		48 (1.89)	4
	63	180 (7.09)	135 (5.31)	26 (1.02)			3 (0.12)	22 (0.87)	102 (4.01)		48 (1.89)	4
	100/160	195 (7.68)	145 (5.71)	30 (1.18)			3 (0.12)	26 (1.02)	102 (4.01)		48 (1.89)	4
	250	200 (7.87)	150 (5.91)	38 (1.50)			3 (0.12)	26 (1.02)	102 (4.01)		48 (1.89)	8
80	10/40	200 (7.87)	160 (6.3)	24 (0.95)	24 (0.95)		3 (0.12)	18 (0.71)	138 (5.43)		73 (2.87)	8
	63	215 (8.46)	170 (6.69)	28 (1.12)			3 (0.12)	22 (0.87)	138 (5.43)		73 (2.87)	8
	100/160	230 (9.06)	180 (7.09)	36 (1.42)			3 (0.12)	26 (1.02)	138 (5.43)		73 (2.87)	8
100	10/16	220 (8.67)	180 (7.08)	20 (0.78)			3 (0.12)	18 (0.71)	158 (6.22)		89 (3.50)	8
	25/40	235 (9.25)	190 (7.5)	24 (0.95)			3 (0.12)	22 (0.87)	162 (6.38)		89 (3.50)	8

JIS B 2220 DIMENSIONS

	CLASSE	A	B	C		D	E	F		G	HOLES
40A	20K	140 (5.5)	105 (4.13)	20 (0.78)		2 (0.08)	19 (0.75)	81 (3.2)		40 (1.57)	4
50A	10K	155 (6.1)	120 (4.72)	20 (0.78)		2 (0.08)	15 (0.59)	96 (3.78)		48 (1.89)	4
	20K	155 (6.1)	120 (4.72)	20 (0.78)		2 (0.08)	19 (0.75)	96 (3.78)		48 (1.89)	8
	40K	165 (6.5)	130 (5.12)	26 (1.02)		2 (0.08)	19 (0.75)	105 (4.13)		48 (1.89)	8
80A	10K	185 (7.28)	150 (5.9)	22 (0.87)		2 (0.08)	19 (0.75)	126 (4.96)		73 (2.87)	8
	20K	200 (7.87)	160 (6.3)	22 (0.87)		2 (0.08)	19 (0.75)	132 (5.2)		73 (2.87)	8
100A	10K	210 (8.27)	175 (6.89)	20 (0.78)		2 (0.08)	19 (0.75)	151 (5.95)		89 (3.50)	8

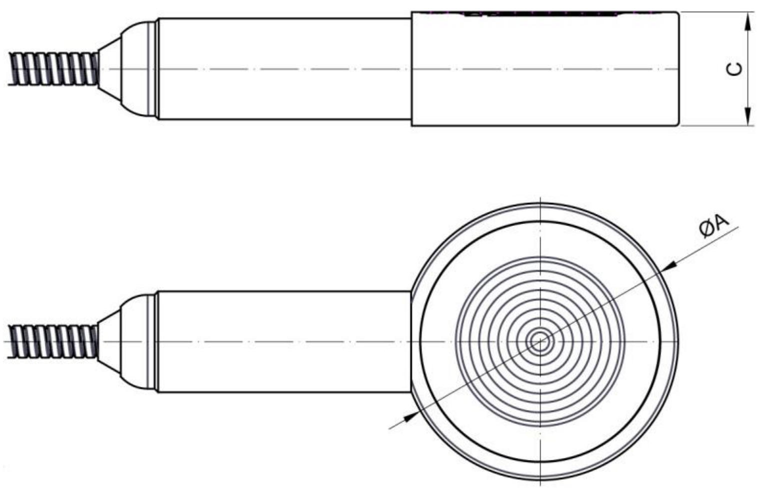
SR301R – Threaded Remote Seal



DIMENSIONS IN MM (INCHES)
DRAIN VALVE NOT ALAILABLE TO 1.1/2"NPT

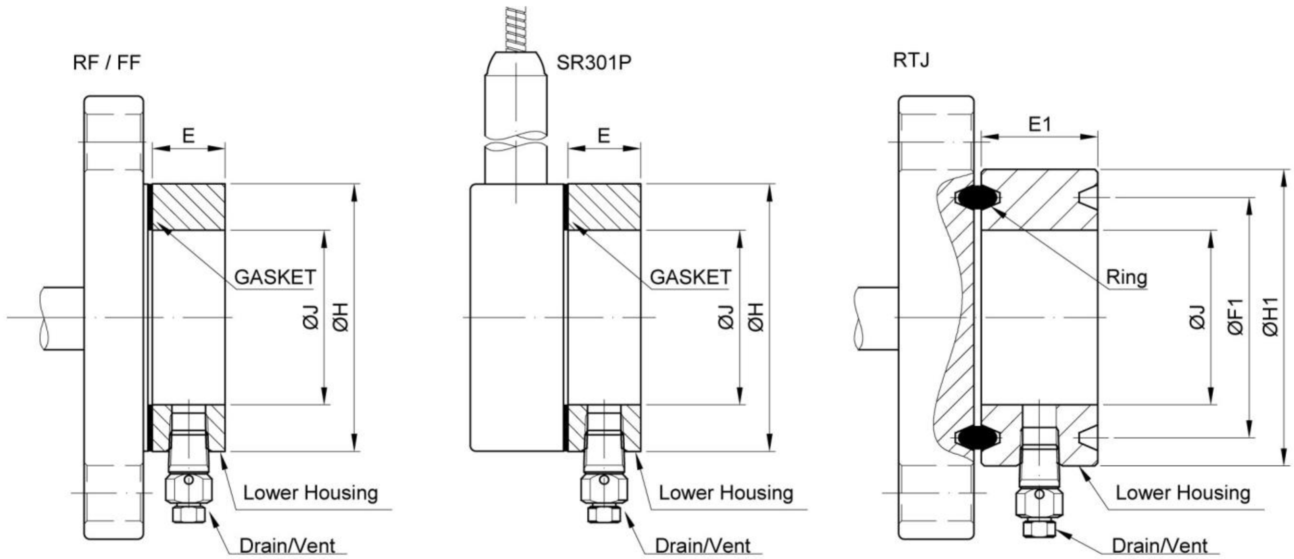
LIMIT	A	B	C	HOLES	BOLTS
2000psi (138bar)	89 (3.50)	76 (2.99)	51 (2.01)	6	5/16-24UNF
5800psi (400bar)	100 (3.93)	79 (3.11)	65,5 (2.58)	8	7/16-20UNF

SR301P – Pancake Remote Seal without Extension



ASME-B 16.5 DIMENSIONS			
DN	CLASS	C	ØA
1.1/2"	150....2500	30 (1.18)	73,2 (2.88)
2"	150....2500	30 (1.18)	92 (3.62)
3"	150....2500	30 (1.18)	127 (5)
4"	150....2500	30 (1.18)	157,2 (6.19)
DIN EN 1092-1 DIMENSIONS			
DN	PN	C	ØA
40	10....250	30 (1.18)	88 (3.46)
50	10....250	30 (1.18)	101,6 (4)
80	10....250	30 (1.18)	138 (5.43)
100	10....250	30 (1.18)	162 (6.38)

Lower Housing

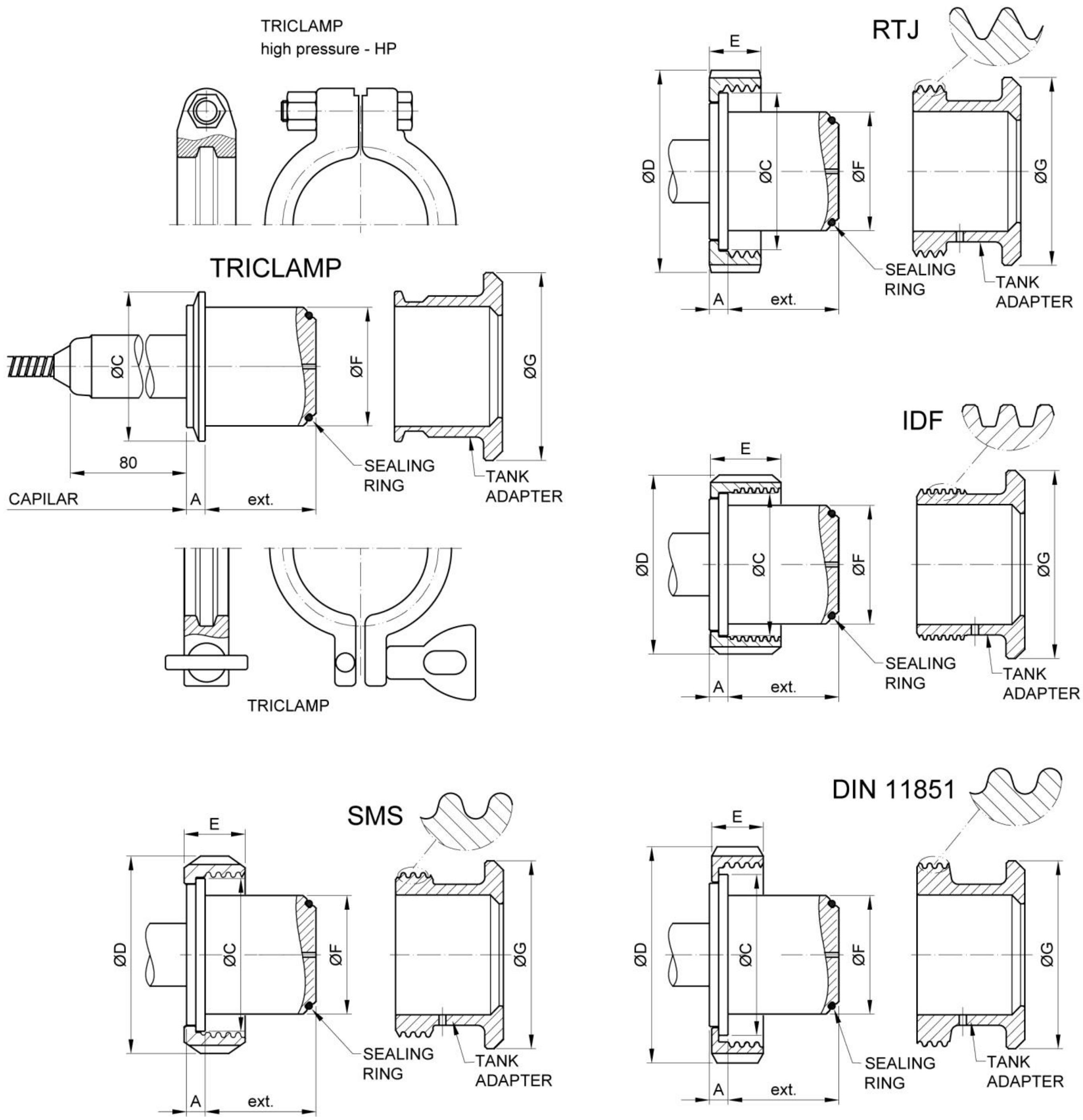


DIMENSIONS - RF / FF - mm (inch)						
STANDARD	DN	CLASS	H	J	E	
					1/4"NPT	1/2"NPT
ASME B16.5	1"	ALL	50,8 (2,00)	35 (1,38)	25	
	1.1/2"		73,2 (2,88)	48 (1,89)	25	35
	2"		91,9 (3,62)	60 (2,36)	25	35
	3"		127 (5,00)	89 (3,50)	25	35
	4"		158 (6,22)	115 (4,53)	25	35
DIN EN 1092-1	25	ALL	68 (2,68)	35 (1,38)	25	35
	40		88 (3,46)	48 (1,89)	25	35
	50		102 (4,02)	60 (2,36)	25	35
	80		138 (5,43)	89 (3,50)	25	35
	100		158 (6,22)	115 (4,53)	25	35
JIS B 2220	40A	20K	81 (3,19)	48 (1,89)	25	35
	50A	10K	96 (3,78)	60 (1,36)	25	35
		40K	105 (4,13)	60 (1,36)	25	35
	80A	10K	126 (4,96)	89 (3,50)	25	35
		20K	132 (5,20)	89 (3,50)	25	35
	100A	10K	151 (5,94)	115 (4,53)	25	35

DIMENSIONS - RTJ - mm (inch) - ASME B16.5							
DN	CLASS	F1	RING	H1	J	E1	
						1/4"NPT	1/2"NPT
1"	150	47,6 (1,87)	R15	63,5 (2,50)	35 (1,38)	40	45
	300	50,8 (2,00)	R16	70 (2,75)	35 (1,38)	40	45
	600	50,8 (2,00)	R16	70 (2,75)	35 (1,38)	40	45
	1500	50,8 (2,00)	R16	71,5 (2,81)	35 (1,38)	40	45
	2500	60,3 (2,37)	R18	73 (2,88)	35 (1,38)	40	45
1.1/2"	150	65,1 (2,56)	R19	82,5 (3,25)	48 (1,89)	40	45
	300	68,3 (2,69)	R20	90,5 (3,56)	48 (1,89)	40	45
	600	68,3 (2,69)	R20	90,5 (3,56)	48 (1,89)	40	45
	1500	68,3 (2,69)	R20	92 (3,62)	48 (1,89)	40	45
	2500	82,6 (3,25)	R23	114 (4,50)	48 (1,89)	40	45
2"	150	82,6 (3,25)	R22	102 (4,00)	60 (2,36)	40	45
	300	82,6 (3,25)	R23	108 (4,25)	60 (2,36)	40	45
	600	82,6 (3,25)	R23	108 (4,25)	60 (2,36)	40	45
	1500	95,3 (3,75)	R24	124 (4,88)	60 (2,36)	40	45
	2500	101,6 (4,00)	R26	133 (5,25)	60 (2,36)	40	45
3"	150	114,3 (4,50)	R29	133 (5,25)	89 (3,50)	40	45
	300	123,8 (4,87)	R31	146 (5,75)	89 (3,50)	40	45
	600	123,8 (4,87)	R31	146 (5,75)	89 (3,50)	40	45
4"	150	149,2 (5,87)	R36	171 (6,75)	115 (4,53)	40	45
	300	149,2 (5,87)	R37	175 (6,88)	115 (4,53)	40	45
	600	149,2 (5,87)	R37	175 (6,88)	115 (4,53)	40	45

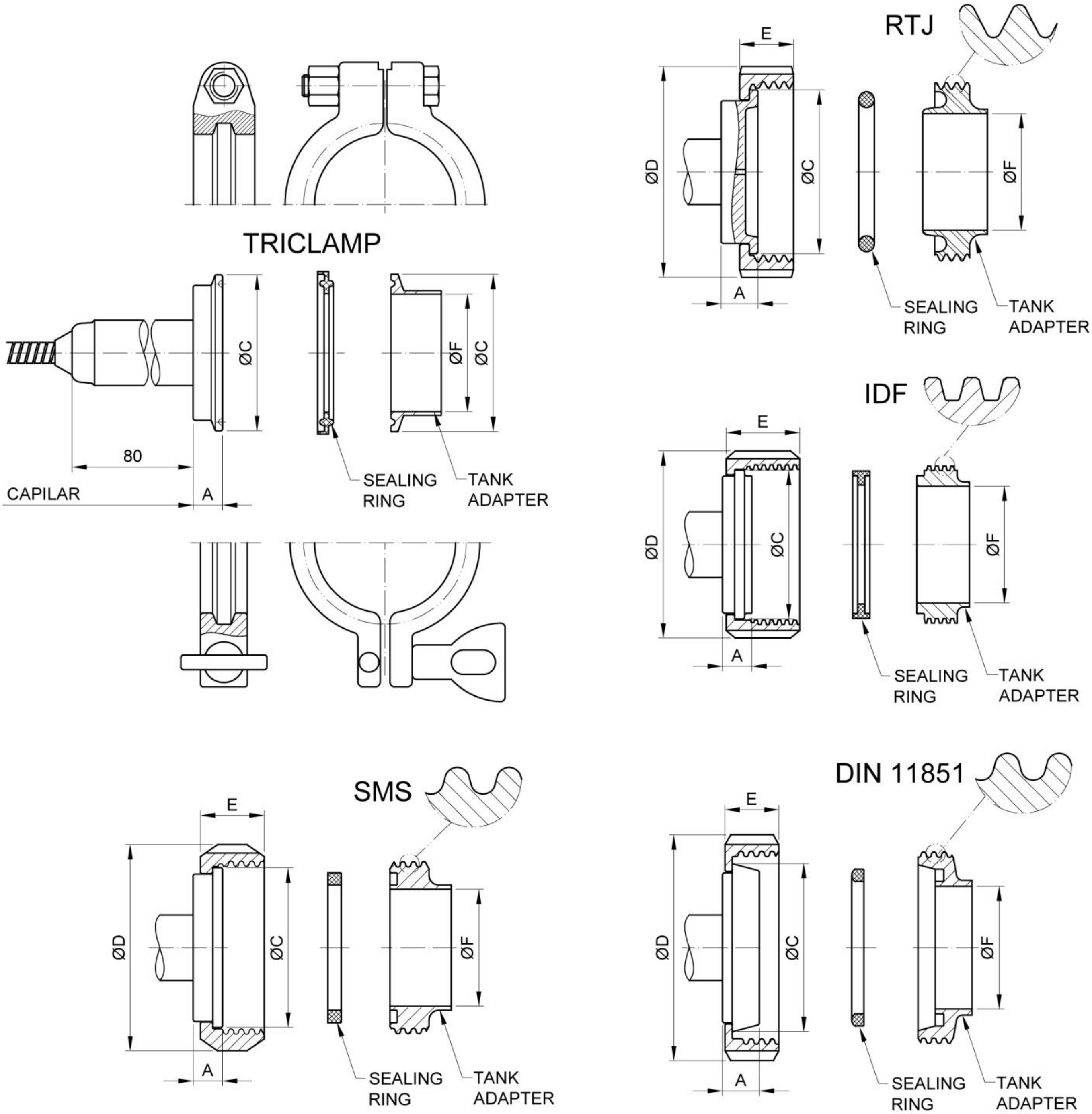
LOWER HOUSING 1/2NPT SUPPLIED WITH PLASTIC PROTECTION
NOT LOWER HOUSING 1/2 NPT FOR 1 INCH

SR301S – Sanitary Remote Seal with Extension



Dimensions see Table 5

SR301S – Sanitary Remote Seal without Extension



Dimensions see Table 5

Table 5: Dimensions relative to pages 6.19 and 6.20.

SR301S / LD30XS / LD400S							
CONNECTIONS WITH EXTENSION	Dimensions in mm (inch)						
	A	ØC	ØD	E	ØF	ØG	EXT.
Tri-Clamp DN50 - with extension	8 (0.315)	64 (2.52)	---	---	50,5 (1.99)	80 (3.15)	48 (1.89)
Tri-Clamp DN50 HP - with extension	8 (0.315)	64 (2.52)	---	---	50,5 (1.99)	80 (3.15)	48 (1.89)
Tri-Clamp - 2" - with extension	8 (0.315)	64 (2.52)	---	---	50,5 (1.99)	80 (3.15)	48 (1.89)
Tri-Clamp - 2" HP -with extension	8 (0.315)	64 (2.52)	---	---	50,5 (1.99)	80 (3.15)	48 (1.89)
Tri-Clamp - 3" - with extension	8 (0.315)	91 (3.58)	---	---	72,5 (2.85)	100 (3.94)	50 (1.96)
Tri-Clamp - 3" HP - with extension	8 (0.315)	91 (3.58)	---	---	72,5 (2.85)	100 (3.94)	50 (1.96)
Thread DN25 - DIN 11851 - with extension	6 (0.24)	47,5 (1.87)	63 (2.48)	21 (0.83)	43,2 (1.7)	80 (3.15)	26,3 (1.03)
Thread DN40 - DIN 11851 - with extension	8 (0.315)	56 (2.2)	78 (3.07)	21 (0.83)	50,5 (1.99)	80 (3.15)	48 (1.89)
Thread DN50 - DIN 11851 - with extension	8 (0.315)	68,5 (2.7)	92 (3.62)	22 (0.86)	50,5 (1.99)	80 (3.15)	48 (1.89)
Thread DN80 - DIN 11851 - with extension	8 (0.315)	100 (3.94)	127 (5)	29 (1.14)	72,5 (2.85)	100 (3.94)	50 (1.96)
Thread SMS - 2" - with extension	8 (0.315)	65 (2.56)	84 (3.3)	26 (1.02)	50,5 (1.99)	80 (3.15)	48 (1.89)
Thread SMS - 3" - with extension	8 (0.315)	93 (3.66)	113 (4.45)	32 (1.26)	72,5 (2.85)	100 (3.94)	50 (1.96)
Thread RJT - 2" - with extension	8 (0.315)	66,7 (2.63)	86 (3.38)	22 (0.86)	50,5 (1.99)	80 (3.15)	48 (1.89)
Thread RJT - 3" - with extension	8 (0.315)	92 (3.62)	112 (4.41)	22,2 (0.87)	72,5 (2.85)	100 (3.94)	50 (1.96)
Thread IDF - 2" - with extension	8 (0.315)	60.5 (2.38)	76,2 (3)	30 (1.18)	50,5 (1.99)	80 (3.15)	48 (1.89)
Thread IDF - 3" - with extension	8 (0.315)	87,5 (3.44)	101,6 (4)	30 (1.18)	72,5 (2.85)	100 (3.94)	50 (1.96)

SR301S / LD30xS / LD400S							
CONNECTIONS WITHOUT EXTENSION	Dimensions in mm (inch)						
	A	ØC	ØD	E	ØF	ØG	EXT.
Tri-Clamp - 1 1/2" - without extension	12 (0.47)	50 (1.96)	---	---	35 (1.38)	---	---
Tri-Clamp - 1 1/2" HP - without extension	12 (0.47)	50 (1.96)	---	---	35 (1.38)	---	---
Tri-Clamp - 2" - without extension	12 (0.47)	63,5 (2.5)	---	---	47,6 (1.87)	---	---
Tri-Clamp - 2" HP - without extension	12 (0.47)	63,5 (2.5)	---	---	47,6 (1.87)	---	---
Tri-Clamp - 3" - without extension	12 (0.47)	91 (3.58)	---	---	72 (2.83)	---	---
Tri-Clamp - 3" HP - without extension	12 (0.47)	91 (3.58)	---	---	72 (2.83)	---	---
Thread DN40 - DIN 11851 - without extension	13 (0.51)	56 (2.2)	78 (3.07)	21 (0.83)	38 (1.5)	---	---
Thread DN50 - DIN 11851 - without extension	15 (0.59)	68,5 (2.7)	92 (3.62)	22 (0.86)	50 (1.96)	---	---
Thread DN80 - DIN 11851 - without extension	16 (0.63)	100 (3.94)	127 (5)	29 (1.14)	81 (3.19)	---	---
Thread SMS - 1 1/2" - without extension	12 (0.47)	55 (2.16)	74 (2.91)	25 (0.98)	35 (1.38)	---	---
Thread SMS - 2" - without extension	12 (0.47)	65 (2.56)	84 (3.3)	26 (1.02)	48,6 (1.91)	---	---
Thread SMS - 3" - without extension	12 (0.47)	93 (3.66)	113 (4.45)	32 (1.26)	73 (2.87)	---	---
Thread RJT - 2" - without extension	15 (0.59)	66,7 (2.63)	86 (3.38)	22 (0.86)	47,6 (1.87)	---	---
Thread RJT - 3" - without extension	15 (0.59)	92 (3.62)	112 (4.41)	22,2 (0.87)	73 (2.87)	---	---
Thread IDF - 2" - without extension	12 (0.47)	60.5 (2.38)	76 (2.99)	30 (1.18)	47,6 (1.87)	---	---
Thread IDF - 3" - without extension	12 (0.47)	87,5 (3.44)	101,6 (4)	30 (1.18)	73 (2.87)	---	---

smar	SRF – Service Request Form Remote Seals	Proposal No.:
Company:	**Unit:**	**Invoice:**

COMMERCIAL CONTACT	TECHNICAL CONTACT
Full Name:	**Full Name:**
Function:	**Function:**
Phone: **Extension:**	**Phone:** **Extension:**
Fax:	**Fax:**
Email:	**Email:**

EQUIPMENT DATA		
Model:	**Serial Number:**	**Sensor Number:**

PROCESS DATA							
Process Fluid:							
Calibration Range		**Ambient Temperature (ºC)**		**Process Temperature (ºC)**		**Process Pressure**	
Min:	**Max:**	**Min:**	**Max:**	**Min:**	**Max:**	**Min:**	**Max:**

Static Pressure		**Vacuum**	
Min:	**Max:**	**Min:**	**Max:**
Normal Operation Time:		**Failure Date:**	

FAILURE DESCRIPTION
(Please, describe the failure. Can the error be reproduced? Is it repetitive?)

OBSERVATIONS

USER INFORMATION

Company:

Contact: Title: Section:

Phone: Extension: E-mail:

Date: Signature:

For warranty or non-warranty repair, please contact your representative. Further information about address and contacts can be found on https://www.smar.com/en/support