

DIAPHRAGM SEAL(S)

Diaphragm seals are used to measure accurately liquid level, density on open and closed tanks, or flow measurement in pipes. The use of the diaphragm seal(s) avoid(s) that the measuring cell is directly in contact with the process. The welded seal construction assures excellent reliability in high temperature and high corrosive, viscous, sticking, crystallizable and abrasive process conditions.

FEATURES

1- Construction

The diaphragm seals are mounted on differential, gauge and absolute pressure transmitters of FCX-All series. The seal can be rigid, (direct) mounted on the transmitter or with capillaries between the seal and the transmitter.

The construction is an all welded design without any gasket between the seal and the transmitter diaphragm and is filled with the suitable oil for your application.

2- Operating principle

The measuring pressure is applied on the diaphragm seal and transferred by the filling fluid through the capillary tube to the measuring cell of the pressure transmitter.

3- Parts materials

Wetted parts materials (diaphragm and gasket face) are in stainless steel, Tantalum, Hastelloy, Monel, Titanium, Zirconium, Nickel, depending on the application requirements. Other parts are in stainless steel: capillary tube, reduced volume flange, diaphragm seal body, direct mounting connection parts.

Standard filling fluid is silicone oil. Fluorinated oil, sanitary oil, high temperature oil and vacuum service filling are available through model selection.

4- Diaphragm seal types

According to the mounting and operating conditions different seal types can be useful :

Flush mounting design from DN40 to DN100.

Seals with extensions (50 to 200 mm).

Flanged, screwed or weld neck adaptors

Seals for sanitary applications according DIN, SMS or Tri-Clamp standards



SPECIFICATIONS

Functional specifications

Diaphragm seal application :

The seal(s) can be mounted direct or rigid on the transmitter (for example for liquid level measurement at the bottom of the tank) or capillary mounted to distance the measuring point away from the transmitter (for example in case of high process temperature). The rigid mounted seal can be assembled in a long design or in a short (compact) design according to the physical dimension requests of the customer (see outline dimensions drawings).

	Rigid mounting	Capillary mounting
F#B	short or long design	HP side
F#M	short or long design	HP side
F#D	see datasheet of level transmitter	HP and LP side HP side LP side

Capillary tube specifications :

Standard capillary lengths :

1,5 / 3 / 6 m (other upon request)

Inside diameter :

1 mm standard

2 mm for vacuum service, high process temperature applications, short response time requirements

Smallest bending radius of the capillary : 100 mm

Capillary tube sheald possibilities :

PVC sheald :

Temperature limit : -10 à 80°C

Stainless steel sheald :

Temperature limit : -40 à 400°C

Temperature limits :

Ambiant temperature : -40 to 85°C

Process temperature :

-40 to 150°C for rigid mounting,

-40 to 400°C for capillary design, and according the filling fluid limitations.



Pressure limits :

Working pressure :
 Limited by the static pressure or the working pressure of the transmitter or by the nominal flange rating of the diaphragm seal (PN). (Please take the smallest of both)
 Vacuum limit :
 Depending of the limit of the transmitter and the filling fluid of the seal.
 For a differential or gauge pressure transmitter the lowest vacuum is 20 Torr or 27 mbar abs.
 Only the absolute pressure transmitter can be used till absolute zero (FKM).
 For the utilization of vacuum service < 20 Torr (27 mbar abs.) the absolute pressure transmitter has to be used.

Process temperature effect : (mbar/10°C)

Seals	DN 50 / 2" SS diaphragm	DN 80 / 3" SS diaphragm	DN 80 / 3" Other diaphragm materials.	DN 100 / 4" SS diaphragm	Adaptor SS diaphragm
for transmitters					
FKB/FKM	1.24	0.17	0.73	0.08	0.17
FKD	0.5	0.09	0.22	0.05	0.09

Note : the indicated values are in mbar/10°C Static pressure effect for ΔP transmitter with stainless steel diaphragms (F#D transmitter with DN80 and DN100 seals) :

Zero shift :
 ± 0,2% of URL for flange rating, up to 40 bar or 300 lbs
 Span shift :
 - 0,2% +0,2%
 - 0,1% of calibrated span for flange rating pressure

Response time : (mean values)

Oil filling	Code digit 7	Density at 25°C	Response time	
			0 to 320 mbar	0 to 1.3 bar
Std silicone oil	Y, G	0,95	0,15	0,037
Fluorinated oil	W,A,D	1,84	0,17	0,04
Oil for vacuum or high temperature	V, T	1,07	0,25	0,065

The indicated values are in seconds per meter of capillary length with internal tube diameter Ø 1 mm.
 The indicated response time is based on a pressure change of 0 to 100% of the calibrated span at reference temperature of 20°C.
 The indicated values do not include the response time of the transmitter.

Performance specifications

To calculate the total performance, both the transmitter and the diaphragm seals performances have to be added.

Accuracy : (at reference conditions)

The assembling of 1 or 2 diaphragm seals on a transmitter increases the accuracy error at reference conditions of 0,1% of the span.

Ambiant temperature effect :

Effect when transmitter alone is corrected

Seal	DN 50 / 2" SS diaphragm	DN 80 / 3" SS diaphragm	DN 80 / 3" other diaphragm materials	DN 100 / 4" SS diaphragm	Adaptor SS diaphragm
Transmitters					
FKB/FKM - gauge /abs pressure capillary(m)	2.03	0.11	0.22	0.04	0.11
FKD - differential pressure capillary (m)	1.5	0.08	0.2	0.03	0.08
FKM - differential pressure capillary (m)	0.48	0.04	0.05	0.02	0.04
FKD - differential pressure capillary (m)	0.32	0.03	0.07	0.01	0.03

Note : the indicated values are in mbar/10°C for capillary length of 1m and internal capillary tube ø of 1 mm

Effect when transmitter **and the seal assembly** is corrected

The zero drift due to ambient temperature changes are improved (between 2 and 5 times) by an additional temperature correction operation of the complete transmitter unit (transmitter and seals) (see code B,C,L,M digit 11 of the codification FKB, FKD, FKM)

A thermal isolation or a heating of the capillaries minimises the ambient temperature effect.

Filling fluid of the diaphragm seals :

Code digit 7	Designation	Temperature resistance (°C)		Density (25°C)
		P abs ≥ 1 bar	P abs < 1 bar	
Y	Silicone oil	-40 to 180	-40 to 120	0,95
W	Fluorinated oil	-20 to 200	-20 to 120	1,84
F	Sanitary fill fluids	-10 to 250	-10 to 120	0,92
V	Silicone oil		20 to 200	1,07
T	Silicone oil	20 to 350	20 to 200	1,07

The indicated values and limits are indicated for the most common applications (standard filling fluids).
 Please ask Fuji Electric for special applications indicating your temperature, pressure and vacuum conditions (vacuum and temperature can occur together).
 Other filling fluids can be used for your applications.

CODE SYMBOLS - S

1 2 3 4 5 6 7 8								DESCRIPTION
S								Flanged axial diaphragm seal connection
A								Flanged radial diaphragm seal connection - Not possible with rigid mounting design digit 6 : code R
R								Wafer type - Not possible with rigid mounting design digit 6 : code R
W								
	4							(*1) Flanges RF (Flange size and rating)
								ANSI-150LB 3"-ISO PN 20 DN 80
	5							ANSI-150LB 4"-ISO PN 20 DN 100
	6							ANSI-300LB 3"-ISO PN 50 DN 80
	7							ANSI-300LB 4"-ISO PN 50 DN 100
	8							DIN PN40 DN80
	9							DIN PN16 DN100
	H							(*2) ANSI-150LB 2"-ISO PN 20 DN 50
	J							(*2) ANSI-300LB 2"-ISO PN 50 DN 50
	G							(*2) DIN PN40 DN50
	U							PN 25 / DN 50 - coupling nut DIN 11851 design material code "V" only
	V							PN 40 / DN 50 - coupling nut SMS material code "V" only
	W							PN 40 / DN 50 - seal only Clamp material code "V" only
	X							No dead volume Sanitary material code "V" only
	A							(*3) Flange adaptor PN 40 DN 25 material code "V" - others UR
	B							(*3) Flange adaptor ISO PN 20 DN 25 (1"-150 ANSI) material code "V" - others UR
	C							(*3) Flange adaptor ISO PN 50 DN 25 (1"-300 ANSI) material code "V" - others UR
	D							(*3) Flange adaptor PN 40 DN 40 material code "V" - others UR
	E							(*3) Flange adaptor ISO PN 20 DN 40 (1"1/2 - 150 ANSI) material code "V" - others UR
	F							(*3) Flange adaptor ISO PN 50 DN 40 (1"1/2 - 300 ANSI) material code "V" - others UR
	S							(*3) Screwed 1/2 NPTE material code "V" - others UR
	T							(*3) To be welded (pipe 2"1/2) material code "V" - others UR
								Diaphragm seal material
								Diaphragm Flange raised face Flange
	V							(*4) SS 316 L SS 316 L SS 316 L
	H							Hastelloy-C Hastelloy-C SS 316 L
	B							Monel Monel SS 316 L
	T							Tantalum Tantalum SS 316 L
	P							(*9) Titanium Titanium SS 316 L
	R							(*9) Zirconium Zirconium SS 316 L
	C							SS 316 L + gold coat SS 316 L SS 316 L
	K							(*10) SS 316 L + glued PTFE diaphragm SS 316 L + PTFE SS 316 L
	F							(*5) SS 316L + FEP lining SS 316 L + FEP lining SS 316 L
								Diaphragm seal design
								Flush mounting
	Y							(*6) Diaphragm extension 50 mm
	A							(*6) Diaphragm extension 100 mm material code "V" - digit 4
	B							(*6) Diaphragm extension 150 mm
	C							(*6) Diaphragm extension 200 mm
	D							(*6) Diaphragm extension 50 mm
	E							(*6) Diaphragm extension 100 mm material code "H" - digit 4
	F							(*6) Diaphragm extension 150 mm
	G							(*6) Diaphragm extension 200 mm
	H							(*6) Diaphragm extension 50 mm
	J							(*6) Diaphragm extension 100 mm material code "B" - digit 4
	K							(*6) Diaphragm extension 150 mm
	L							(*6) Diaphragm extension 200 mm
	M							(*6) Diaphragm extension 50 mm
	P							(*6) Diaphragm extension 100 mm material code "T" - digit 4
	R							(*6) Diaphragm extension 150 mm
	S							(*6) Diaphragm extension 200 mm
	T							(*6) Diaphragm extension 200 mm
								Transmission diaphragm seal to measuring cell
								Mounting design Capillary length Capillary design
	A							Capillary 1.5 m PVC protection
	B							Capillary 3 m PVC protection
	C							Capillary 6 m PVC protection
	D							Capillary Upon request PVC protection
	G							(*7) Capillary 1.5 m SS sheald
	H							(*7) Capillary 3 m SS sheald
	K							(*7) Capillary 6 m SS sheald
	L							(*7) Capillary Upon request SS sheald
	R							Rigid design - not possible with digit 2 = R, W - max. process temperature : 150°C
								Special applications and fill fluid for the diaphragm seal only
								Treatment Fill fluid
	Y							None (standard) Silicone oil
	W							None (standard) Fluorinated oil
	F							None (standard) Sanitary fill fluid
	D							Chlorine service Fluorinated oil
	G							Degreasing Silicone oil
	A							Oxygen service Fluorinated oil
	N							NACE Silicone oil
	V							(*8) Vacuum - max temperature 200°C Silicone oil
	T							(*8) Very high temperature (20 to 350°C) - No vacuum

Notes :

- 1* Different flange machinings (recess, groove, ...) upon request, standard flange machining = stock finish; except for digit 4 - material code H, B, T, P, R, F = smooth finish
- 2* Only available with span higher than : 0 to 0,5/5 bar - max process temperature : 150°C - or ask FUJI with operating conditions
- 3* Axial diaphragm seal connection - no extension possible
- 4* SS316L for DN 50, 80 & 100 & flange adaptors
- 5* Not possible with digit 7 : V, H, T
- 6* All wetted parts in the same material (diaphragm, extension, flange gasket area) : - Other flange designs are available - only available with flange size digit 3 code 4, 5, 6, 7, 8, 9, H, J, G
- 7* Recommended for Vacuum or High Temperature applications T > 120°C - (Capillary internal diameter = 2mm)
- 8* Consult FUJI for your application with the specific operating conditions
- 9* Max process temperature 150 °C
- 10* Process temperature limit 260°C if no vacuum and 180°C if vacuum



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