FUJI ELECTRIC
e-Front runners Fuji Electric France S.A.

FCX-AII

ABSOLUTE, DIFFERENTIAL AND GAUGE PRESSURE TRANSMITTER FOR REMOTE SEAL(S)

DATA SHEET

F#B, F#D, F#M

The FCX-AII series absolute, differential and gauge pressure transmitters accurately measures and transmits proportional 4 to 20mAdc signal. The transmitters utilize the unique micromachined capacitive silicon sensor with state-of-the-art microprocessor technology to provide exceptional performance and functionality.

FEATURES

1. Outstanding accuracy
0.07 % accuracy for all calibrated spans is the standard feature for all differential and gauge pressure models and 0.2 % accuracy for all absolute pressure models. The microcapacitance silicon sensor assures this feature for all elevated or suppressed calibration ranges without additional adjustment.

2- Minimum environment influence
The patented "advanced Floating Cell" design which protects the pressure sensor against changes in temperature, static pressure, and overpressure substantially reduces total measurement error in actual field applications.

3- FUJI/HART®, bilingual communication protocol and FOUNDATION™ Fieldbus and Profibus™ compatibility
FCX-AII series transmitter offers bilingual communications to speak both Fuji and Hart® protocol. Any Hart® compatible device can communicate with FCX-AII. Further, by upgrading electronics FOUNDATION™ Fieldbus and Profibus™ are also available.

4- Application flexibility
Example of options that render the FCX-AII suitable for almost any process applications includes :
- Analog indicator at either the electronics side or terminal side
- Full range of hazardous area approvals
- Built-in RFI filter and lightning arrester
- 5-digits LCD meter
- Stailess steel electronics housing
- Wide selection materials
- High temperatures and high vacuum seals

5- Burnout current flexibility (Under Scale : 3.2 to 3.8mA, Over Scale : 20.8 to 21.6mA)
Burnout signal level adjustable using Model FXW Hand Held Communicator (HHC) to comply with NAMUR NE43.

6. Dry calibration without reference pressure
Thanks to the best combination of unique construction of mechanical parts (Sensor unit) and high performance electronics circuit (Electronics unit), reliability of dry calibration reference pressure is at equal level as wet calibration.

SPECIFICATIONS

Functional specifications

Type:

- FKD : differential pres. transmitter with remote seal(s)
- FDD : FOUNDATION™ Fieldbus & Profibus™

- FKB : gauge pressure transmitter with remote seal
- FDB : FOUNDATION™ Fieldbus & Profibus™

- FKM : absolute pres. transmitter with remote seal
- FDM : FOUNDATION™ Fieldbus & Profibus™

Service:

Liquid, gas or vapour

Span and range limits :

Model			Range limits
Type	Minimum	Maximum	
	F#D		
	(mbar)	(mbar)	(mbar)
F□D□□3	3.2	320	± 320
F□D□□5	13	1300	± 1300
F□D□□6	50	5000	± 5000
F□D□□8	300	30000	± 30000
	F#B		
	(bar)	(bar)	(bar)
F□B□□1	0,013	1,3	-1 to + 1,3
F□B□□2	0,05	5	-1 to + 5
F□B□□3	0,3	30	-1 to + 30
F□B□□4	1	100	-1 to + 100
F□B□□5	5	500	-1 to + 500
	F#M		
	(bar abs.)	(bar abs.)	(bar abs.)
F□M□□1	0,016	0,16	0 to +0,16
F□M□□2	0,016	1,3	0 to +1,3
F□M□□3	0,05	5	0 to +5
F□M□□4	0,3	30	0 to +30

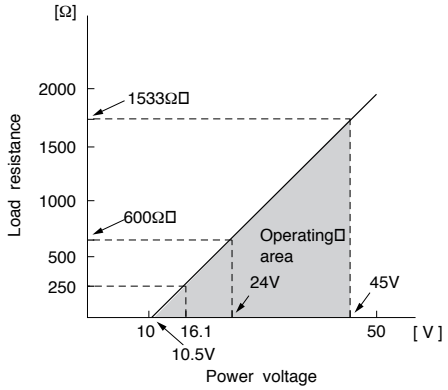
Note: To minimise environment influence, span should be greater than 1/10 of the max span in most applications.

Overrange limit :
To maximise static pressure limit.

Output signal :
4-20 mA dc with digital signal superimposed on the 4-20 mA signal.
Digital signal based on FOUNDATION™ Fieldbus or Profibus™.

Power supply :
Transmitter operates on 10,5 to 45V dc at transmitter terminals

Load limitations :



Note : digital communication with FXW/Hart® requires min 250Ω load resistance.

Hazardous locations :
Designed to meet international intrinsic safety and flameproof (explosionproof) standards.

Zero/Span adjustment :
Zero and span are adjustable by hand held communicator in Hart® or Fuji protocol.Local adjustment of zero are possible from outside screw on the electronic housing.

Damping : (adjustable from HHC)
A damping of the output signal is possible between 0 and 32 sec with the hand held communicator HHC.
Local adjustment possibilities with LCD indicator (refer to optional indicator).

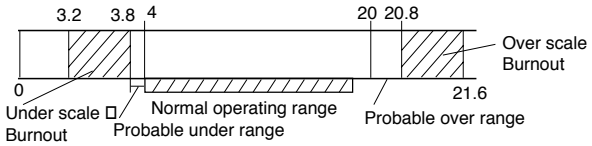
Zero elevation / Suppression :
Zero can be elevated or suppressed within the specified range limit of each sensor model.

Normal / reverse action :
Adjustable via HHC.

Indication :
A plug-in analog indicator can be mounted on the electronics unit or the terminal block.
The local LCD indicator (5 digits) is assembled on the electronics unit.
Additional local adjustment facilities are possible by the integrated switches in the LCD indicator :
- "Local/comm" switch gives the possibilities to make local adjustments of zero/span, damping or to configure the transmitter with a hand held communicator.
- The "mode" switch with 7 positions gives local adjustment possibilities for zero/span, 4/20mA, enable or inhibit the local adjustments.
- Local damping adjustment is possible via the "damp" switch.

Burnout direction : selectable from HHC
If self diagnostic detect transmitter failure, the analog signal will be driven to eighter "Output Hold" , "Output Overscale" or "Output Underscale" mode.

"Output Hold" :
Output signal is hold as the value just before failure happens.
"Output Overscale" :
Adjustable within the range 20,8mA to 21,6mA from the communicator HHC.
"Output Underscale" :
Adjustable within the range 3,2mA to 3,8mA from the communicator HHC.



Loop check output :
Transmitter can be configured via HHC to provide constant signal between 3,8 and 21,6mA.

Temperature limit :
Ambiant :
- 40 to + 85°C
- 20 to + 80°C (LCD indicator)
- 40 to + 60°C (arrester option)
- 10 to + 60°C (fluorinated oil filling of the cell)

For explosionproof units(flame proof or intrinsic safety), ambient temperature must be within the limits specified in each standard.
Process :
Check in the seal - datasheet with the specific temperature conditions.
Storage : - 40 to + 90°C

Humidity : 0 to 100% RH

Communication :
With HHC (Model FXW, consult Data Sheet No. EDS8-47), following information can be remotely displayed or reconfigured.
Note : HHC's version must be more than 6.0 (or FXW □□□□1- A3), for FCX-AII.

Items		HART® PROTOCOL		FUJI PROTOCOL	
		Display	Set	Display	Set
Tag n°		Yes	Yes	Yes	Yes
Model n°		_	_	Yes	Yes
Serial n°		Yes	_	Yes	_
Engeineering unit		Yes	Yes	Yes	Yes
Range limit		Yes	_	Yes	_
Measuring range		Yes	Yes	Yes	Yes
Damping		Yes	Yes	Yes	Yes
Output mode	Linear	Yes	_	Yes	_
	Square root	Yes	_	Yes	_
Burnout direction		Yes	Yes	Yes	Yes
Adjustment		Yes	Yes	Yes	Yes
Output adjust		_	Yes	_	Yes
Data		Yes	_	Yes	_
Self diagnoses		Yes	_	Yes	_
Printer		_	_	_	_
External switch lock		Yes	Yes	Yes	Yes
Transmitter display		Yes	Yes	Yes	Yes
Linearise		_	_	Yes	Yes
Rerange		Yes	Yes	Yes	Yes

Programmable output linearization function :
Output signal can be characterized with "14 points linear approximation function" from HHC.

Field Bus units :

Digital signal

Transmission technique : according to IEC61158-2

Power supply : 9VDC...32VDC

Base current : 15 ±2mA

Transmission rate : 31,25kbits/s

Profibus-PA : version 3.0, DPVI version 2.0

Foundation Fielbus : FF-890/891

Mounting position effect :

Zero shift : < 12 mm WC for 10° incline in any position.
This shift can be corrected with the zero adjustment.
This effect is doubled for fluorinated oil filling.
No influence on span adjustment.

Dielectric strength:

500 V ac 50/60Hz during 1 min. between circuit an earth.

Insulation resistance : > 100 MΩ at 500 V dc

Turn on time : 4 sec.

Internal resistance for external field indicator :

12 Ω maxi

Performance specifications

Accurancy rating :
(including linearity, hysteresis and repeatability)

For span greater than 1/10 of URL :
±0,07 % of calibrated span for F#B, F#D
±0,2 % of calibrated span for F#M

For span smaller than 1/10 of URL :
±(0,02 + 0,05 x 0,1x URL/span) % of span (F#B, F#D)
±(0,05+0,05 x 0,1x URL/span) % of span (F#M)

Linearity :
0,05% of calibrated span (F#B, F#D)
0,1% of calibrated span (F#M)

Stability for 3 years :
±0,1% of URL (F#B, F#D)
±0,2% of URL (F#M)

Temperature effect : (transmitter only)
Effect per 28°C change between - 40 and + 85°C.
Model F#M :
Zero shift : ±(0,125 +0,1URL/span) % of URL
Total effect : ±(0,125 +0,1URL/span) % f URL
Model F#B, F#D :
Zero shift : ±(0,1+0,025%URL/span) % of URL
Total effect : ±(0,125 +0,025URL/span) % of URL

Static pressure effect (F#D) :
Zero shift : ± 0,1% of URL for 100 bar
Span shift : -0,2% of URL for 100 bar

Overrange effect (F#B, F#M) :
Zero shift : 0,2% of URL, for any overrange pressures (limited to the max. overrange pressure)

Overrange effect (F#D) :
Zero shift : ±0,3% of URL / 100 bar

Supply voltage effect :
< 0,05% of calibrated span / 10 V.

RFI effect :
<0,2% of URL for the frequences of 20 to 1000 MHz and field strength of 10 V/m when electronic housing covers are on (Classification : 2-abc : 0,2% of span according SAMA PMC 33.1)

Step response: (without electrical damping)
Time constant : 0,45 sec (F#D span code "3")
Time constant : 0,2 sec (other spans and F#B, F#M)
Dead time : 0,3 sec
Response time = 5 x time constant + dead time
Time constant (τ) = 63 % output signal
Note : faster response time is available as option (maximum update rate : 25 times per second).

Physical specifications

Electrical connections :
1/2-14 NPT, Pg 13,5 or M20 x 1,5

Non wetted parts material :
Electronics housing :
Standard : low copper die cast aluminium alloy finished with epoxy / polyurethane double coating
Option : SS 316.
Bolts and nuts :
Standard : Cr-Mo alloy
Option : SS 316 (for working pressure ≤ 100 bar) or SS 630 (for working pressure > 100 bar)
Filling fluid :
Standard : silicone oil
Uppon request : fluorinated oil
Mountig bracket :
Standard : carbon steel with epoxy coating
Option : SS 304.

Environmental protection :
IEC IP 67 - NEMA 6/6P

Mounting :
On tube ø 50 mm (2") or direct wall mounting using mounting bracket

Weight :

Transmitter alone :	about 5 kg
add :	0,5 kg for the mounting bracket
	0,8 kg for indicator
	4,5 kg stainless steel housing (option)

Diaphragm seal(s) :
A comprehensive selection of seals can be chosen in accordance with the specific seal (see EDS6-02).

Optional features

Indicator :

A plug-in turnable analog indicator (1,5% accurancy) can be housed in the electronics compartment or in the terminal box of the housing.
A 5 digits LCD meter, which can be fitted on the electronics side is also available.

Arrester :

A built in arrestor protects the electronics from lightning surges.
Lightning surge immunity :
4KV (1,2 x 50μs)

NACE specifications :

Metallic materials for all pressure boundary parts comply with NACE MR 01-75.
ASTM or L7M bolts and 2HM nuts (class II) are available.
Maximum operating pressure is 100 bar for this option

Customer tag :

A stailess steel tag with customer tag data is wired to the transmitter

Vacuum service :

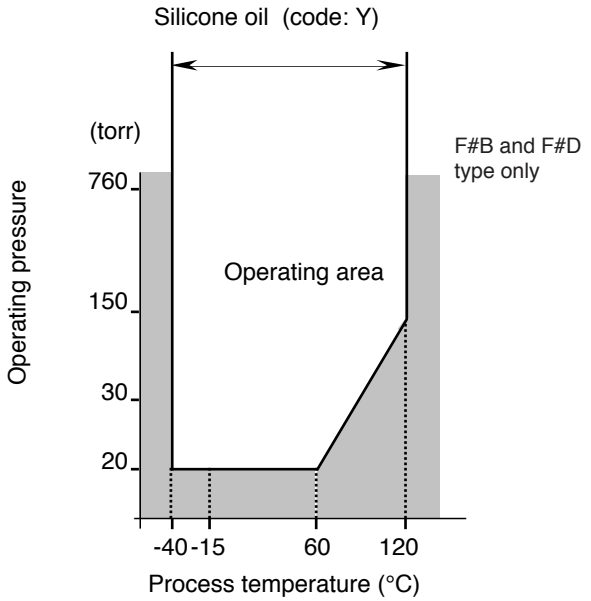


Fig. 1 Relation between max. temperature and operating pressure for transmitters only.

Accessories

Hand Held Communicator :

(refer to FXW datasheet EDS8-47)

The product conforms to the requirments of the Electromagnetic Compatibility Directive 89/336/EEC as detailed within the technical construction file number TN513035. The applicable standards used to demonstrate compliance are :

EMI (Emission) **EN61326 : 1997**

Class A (std for Industrial Location)

Frequency range MHz	Limits	Reference Standard
3 to 230	40dB (μV/m) quasi peak measured at 10m distance	CISPR16-1 and CISPR16-2
230 to 1000	47dB (μV/m) quasi peak, measured at 10m distance	

EMS (Immunity) **EN61326 : 1997**

Annex A (std for Industrial Location)

Phenomenon	Test value	Basic Standard	Performance criteria
Electrostatic discharge	4kV (Contact) 8kV (Air)	IEC61000-4-2	B
Electromagnetic field	80 to 1000MHz 10V/m 80%AM (1kHz)	IEC61000-4-3	A
Rated power frequency magnetic field	30A/m 50Hz	IEC61000-4-8	A
Burst	2kV 5kHz	IEC61000-4-4	B
Surge	1.2μs/50μs 1kV (Line to line) 2kV (line to ground)	IEC61000-4-5	B
Conducted RF	0.15 to 80MHz 3V, 80%AM (1kHz)	IEC61000-4-6	A

Note) Definition of performance criteria

A : During testing, normal performance within the specification limits

B : During testing, temporary degradation, or loss of function or performance which is self-recovering.

CODE SYMBOLS - F#D

1	2	3	4	5	6	7	8	9	10	11	12	13	Description
						V	E	-				Y	
												(*5)	**Type**
F	K	D											Differential pressure transmitter - Smart, 4-20 mAdc + Fuji/Hart® digital signal
F	D	D											FOUNDATION™ Fieldbus & Profibus™
													Conduit connection
			T										1/2"-14NPT
			V										Pg 13.5
			W										M 20x 1.5
													Diaphragm seal rating
				A									Without diaphragm seals - not possible with digit 11 code B & C
				2									PN 25
				4									PN 20 - 150 Lbs
				6									PN 50 - 300 Lbs
				8									PN 40
				9									PN 16
				L									PN 100 - 600Lbs
				M									PN 150
				N									PN 250
												(*1)	**Spans (bar)**
					3							(*2)	0 to 3.2/320
					5							(*2)	0 to 0.013/1.3
					6								0 to 0.05/5
					8								0 to 0.3/30
													Indicator and arrester

Initial setting		Indicator	Arrester
	V E - A	None	none
	V E - B	Analog, 0-100% linear scale	none
	V E - C	Analog, 0-100% √ scale	none
4-20mA DC	V E - D	Analog, custom scale	none
+	V E - J	Analog, double scale	none
HART/FUJI	V E - E	None	yes
digital signal	V E - F	Analog, 0-100% linear scale	yes
"SMART"	V E - G	Analog, 0-100% √ scale	yes
	V E - H	Analog, Custom scale	yes
	V E - K	Analog, double scale	yes
	V E - L	Digital, 0-100%	none
	V E - P	Digital, custom scale	none
	V E - M	Digital, 0-100% √ scale	none
	V E - Q	Digital, 0-100%	yes
	V E - S	Digital, custom scale	yes
	V E - N	Digital, 0-100% √ scale	yes
FF	V E - R	None	yes
FF	V E - T	Digital, custom scale	yes
Profibus	V E - V	None	yes
Profibus	V E - W	Digital, custom scale	yes

Approvals for hazardous locations (Approvals pending. Consult FUJI for status)

A	None (standard)
X	Flameproof housing ATEX ⟨Ex⟩ II 2 GD - EEx d IIC T5/T6
K	Intrinsic safety ATEX ⟨Ex⟩ II 1 GD - EEx ia IIC T4/T5
D	FM - Flameproof housing Class I, Division 1, Groupe B, C, D Dust ingnitionproof Class II/III, Division 1, Group E, F, G - (elec. conn. code "T" only)
E	CSA - Flameproof housing Class I, II, II, Division 1, Group C, D - Class II, Group E, F, G - Class III - (elec. conn. code "T" only)
H	FM - Intrinsic safety Class I, II, III, Division 1, Group A, B, C, D, E, F, G Nonincendive Class I,II,III, Division 2, Group A,B,C,D,F,G
J	CSA - Intrinsic safety & Nonincendive Class I, Group A,B,C,D - Class II, Group E,F,G Class III - Temp code T4 for all classes (electrical connection code "T" only)
P	ATEX type "n" ⟨Ex⟩ II 3 GD - EEx nL/nAL IIC T4/T5

			Mounting design (*3)	Ambiant temperature correction
	B	(*3)	Capillary on HP side	Transmitter and diaphragm seal assembly
	C		Capillary on HP & LP side	Transmitter and diaphragm seal assembly
(*6)	E		HP : rigid short design LP : capillary	Transmitter and diaphragm seal assembly
	G	(*3)	Capillary on HP side	Transmitter
	H		Capillary on HP & LP side	Transmitter

		Cell flange design	**SS parts**		
		Operating pressure	bolts/nuts	SS tag plate	SS housing
(*4)	1	p=50 bar	none	none	none
(*4)	2	p=50 bar	none	yes	none
(*4)	3	p=50 bar	none	none	yes
(*4)	4	p=50 bar	none	yes	yes
	Y	p > 50 bar	carbon steel	none	none
	B	p > 50 bar	carbon steel	yes	none
	C	p > 50 bar	carbon steel	none	yes
	E	p > 50 bar	carbon steel	yes	yes
	A	p = 100 bar	SS 316/SS 316	none	none
	D	p = 100 bar	SS 316/SS 316	yes	none
	F	p = 100 bar	SS 316/SS 316	none	yes
	G	p = 100 bar	SS 316/SS 316	yes	yes
	P	p> 100 bar	SS 630/SS 304	none	none
	R	p> 100 bar	SS 630/SS 304	yes	none
	S	p> 100 bar	SS 630/SS 304	none	yes
	T	p>100 bar	SS 630/SS 304	yes	yes

Note :
1- Turn down 100 : 1 is possible, but should be used at the span greater than 1/10 of the maximum span for better performance
2- For DN≤ 50 consult FUJI for your application with the specific operating conditions
3- Transmitter with capillary design has a standard mounting bracket - for rigid mounting design see F#E
4- Not possible with digit 12 : code 1, 2, 3, 4 even when p < 50 bar
5- Standard fill fluid of measuring cells : silicone oil - other fill fluids : upon request
6- Transmitter with different diaphragm seals or capillary lenghtes on HP and LP side must be temperature corrected- digit 12 code 1, 2, 3, 4 not possible

CODE SYMBOLS - F#B

1	2	3	4	5	6	7	8	9	10	11	12	13	Description
						V	E	-				Y	
												(*7)	**Type**
F	K	B											Gauge pressure transmitter - Traditional 4-20 mAdc + FUJI/Hart® digital signal
F	D	B											FOUNDATION™ Fieldbus & Profibus™
													Conduit connection
			T										1/2"-14 NPT
			V										Pg 13.5
			W										M 20x 1.5
													Diaphragm seal rating
				A									Without diaphragm seals - not possible with digit 11 code B, L, M
				2									PN 25
				4									PN 20 - 150 Lbs
				6									PN 50 - 300 Lbs
				8									PN 40
				9									PN 16
				L									PN 100 - 600Lbs
				M									PN 150
				N									PN 250
												(*1)	**Spans (bar)**
					1							(*2)	0 to 0.013/1.3
					2							(*3)	0 to 0.05/5
					3								0 to 0,3/30
					4							(*4)	0 to 1/100
					5							(*4)	0 to 5/500
													Indicator and arrester

				Initial setting	Indicator	Arrester
V	E	-	A	4-20mA DC + HART®/FUJI digital signal "SMART"	None	none
V	E	-	B		Analog, 0-100% linear scale	none
V	E	-	D		Analog, custom scale	none
V	E	-	J		Analog, double scale	none
V	E	-	E		None	yes
V	E	-	F		Analog, 0-100% linear scale	yes
V	E	-	H		Analog, custom scale	yes
V	E	-	K		Analog, double scale	yes
V	E	-	L		Digital, 0-100%	none
V	E	-	P		Digital, custom scale	none
V	E	-	Q		Digital, 0-100%	yes
V	E	-	S		Digital, custom scale	yes
V	E	-	R	FF	None	yes
V	E	-	T	FF	Digital, custom scale	yes
V	E	-	V	Profibus	None	yes
V	E	-	W	Profibus	Digital, custom scale	yes

													Approvals for hazardous locations (Approvals pending. Consult FUJI for status)
												A	None (standard)
												X	Flameproof housing ATEX ⟨Ex⟩ II 2 GD - EEx d IIC T5/T6
												K	Intrinsic safety ATEX ⟨Ex⟩ II 1 GD - EEx ia IIC T4/T5
												D	FM - Flameproof housing Class I, Division 1, Groupe B, C, D
													Dust ingnitionproof Class II/III, Division 1, Group E, F, G - (elec. conn. code "T" only)
												E	CSA - Flameproof housing Class I, II, II, Division 1, Group C, D -
													Class II, Group E, F, G - Class III - (elec. conn. code "T" only)
												H	FM - Intrinsic safety Class I, II, III, Division 1, Group A, B, C, D, E, F, G
													Nonincendive Class I,II,III, Division 2, Group A,B,C,D,F,G
												J	CSA - Intrinsic safety & Nonincendive Class I, Group A,B,C,D - Class II, Group E,F,G
													Class III - Temp code T4 for all classes (electrical connection code "T" only)
												P	ATEX type "n" ⟨Ex⟩ II 3 GD - EEx nL/nAL IIC T4/T5

													Mounting design (*5)	**Ambiant temperature correction**
												B	Capillary	Transmitter and diaphragm seal assembly
												L	Rigid - long design	Transmitter and diaphragm seal assembly
												M	Rigid - short design	Transmitter and diaphragm seal assembly
												G	Capillary	Transmitter
												S	Rigid - long design	Transmitter
												T	Rigid - short design	Transmitter

													Cell flange design	**SS parts**	
													Operating pressure	**bolts/nuts**	**SS tag plate**	**SS housing**
												(*6)	1	Y	p ≤ 50 bar	none (*7)	none	none
												(*6)	2	Y	p ≤ 50 bar	none (*7)	yes	none
												(*6)	3	Y	p ≤ 50 bar	none (*7)	none	yes
												(*6)	4	Y	p ≤ 50 bar	none (*7)	yes	yes
													Y	Y	p > 50 bar	carbon steel	none	none
													B	Y	p > 50 bar	carbon steel	yes	none
													C	Y	p > 50 bar	carbon steel	none	yes
													E	Y	p > 50 bar	carbon steel	yes	yes
													A	Y	p ≤ 100 bar	SS 316/SS 316	none	none
													D	Y	p ≤ 100 bar	SS 316/SS 316	yes	none
													F	Y	p ≤ 100 bar	SS 316/SS 316	none	yes
													G	Y	p ≤ 100 bar	SS 316/SS 316	yes	yes
													P	Y	p > 100 bar	SS 630/SS 304	none	none
													R	Y	p > 100 bar	SS 630/SS 304	yes	none
													S	Y	p > 100 bar	SS 630/SS 304	none	yes
													T	Y	p > 100 bar	SS 630/SS 304	yes	yes

Note* : 1- Turn down of 100 : 1 is possible, but should be used at the span greater than 1/10 of the maximum span for better performance.
2- Consult FUJI for your application with the specific operating conditions
3- For DN ≤ 50 consult FUJI for your application with the specific oper. conditions
4- Flange rating according max. operating pressure - for DN < 50 flange size and / or PN > 150 - consult FUJI
5- Transmitter with capillary design has a standard mounting bracket - rigid monting design are always without monting bracket
6- For rigid mounting design code 1, 2, 3, 4 not possible: codify Y, B, C, E for carbon steel bolts; A, D, F, G for SS bolts (PN ≤ 100 bar) and P, R, S, T for SS bolts (PN > 100 bar)
7- Standard fill fluid of measuring cells : silicone oil - other fill fluids : upon request

CODE SYMBOLS - F#M

1	2	3	4	5	6	7	8	-	9	10	11	12	13	Description
						V	E	-					Y	
														Type (*6)
F	K	M												Absolute pressure transmitter - Smart, 4-20 mAdc + Fuji/Hart® digital signal
F	D	M												FOUNDATION™ Fieldbus & Profibus™
														Conduit connection
			T											1/2"-14 NPT
			V											Pg 13.5
			W											M 20x 1.5
														Diaphragm seal rating
				A										Without diaphragm seals - not possible with digit 11 code B, L, M
				2										PN 25
				4										PN 20 - 150 Lbs
				6										PN 50 - 300 Lbs
				8										PN 40
				9										PN 16
													(*1)	**Spans (bar abs)**
					1								(*2)	0 to 0.016/0.16
					2								(*3)	0 to 0.016/1.3
					3									0 to 0.05/5
					4									0 to 0.3/30
														Indicator and arrester

								Initial setting	Indicator	Arrester
				V	E	-	A		None	none
				V	E	-	B		Analog, 0-100% linear scale	none
				V	E	-	D	4-20mA DC	Analog, custom scale	none
				V	E	-	J	+	Analog, double scale	none
				V	E	-	E	HART®/FUJI	None	yes
				V	E	-	F	digital signal	Analog, 0-100% linear scale	yes
				V	E	-	H	"SMART"	Analog, custom scale	yes
				V	E	-	K		Analog, double scale	yes
				V	E	-	L		Digital, 0-100%	none
				V	E	-	P		Digital, custom scale	none
				V	E	-	Q		Digital, 0-100%	yes
				V	E	-	S		Digital, custom scale	yes
				V	E	-	R	FF	None	yes
				V	E	-	T	FF	Digital, custom scale	yes
				V	E	-	V	Profibus	None	yes
				V	E	-	W	Profibus	Digital, custom scale	yes

				Approvals for hazardous locations (approvals pending. Consult FUJI for status)
			A	None (standard)
			X	Flameproof housing ATEX Ex II 2 GD - EEx d IIC T5/T6
			K	Intrinsic safety ATEX Ex II 1 GD - EEx ia IIC T4/T5
			D	FM - Flameproof housing Class I, Division 1, Groupe B, C, D
				Dust ingnitionproof Class II/III, Division 1, Group E, F, G - (elec. conn. code "T" only)
			E	CSA - Flameproof housing Class I, II, II, Division 1, Group C, D -
				Class II, Group E, F, G - Class III - (elec. conn. code "T" only)
			H	FM - Intrinsic safety Class I, II, III, Division 1, Group A, B, C, D, E, F, G
				Nonincendive Class I,II,III, Division 2, Group A,B,C,D,F,G
			J	CSA - Intrinsic safety & Nonincendive Class I, Group A,B,C,D - Class II, Group E,F,G
				Class III - Temp code T4 for all classes (electrical connection code "T" only)
			P	ATEX type "nL" Ex II 3 GD - EEx nL/nAL IIC T4/T5

			Mounting design (*4)	**Ambiant temperature correction**
		B	Capillary	Transmitter and diaphragm seal assembly
		L	Rigid - long design	Transmitter and diaphragm seal assembly
		M	Rigid - short design	Transmitter and diaphragm seal assembly
		G	Capillary	Transmitter
		S	Rigid - long design	Transmitter
		T	Rigid - short design	Transmitter

			Stainless steel parts		
			bolts/nuts	**SS tag plate**	**SS housing**
	1	*5)	None (capill. mount.)	none	none
	2	*5)	None (capill. mount.)	yes	none
	3	*5)	None (capill. mount.)	none	yes
	4	*5)	None (capill. mount.)	yes	yes
	Y		Carbon steel	none	none
	B		Carbon steel	yes	none
	C		Carbon steel	none	yes
	E		carbon steel	yes	yes
	A		SS 316/SS 316	none	none
	D		SS 316/SS 316	yes	none
	F		SS 316/SS 316	none	yes
	G		SS 316/SS 316	yes	yes

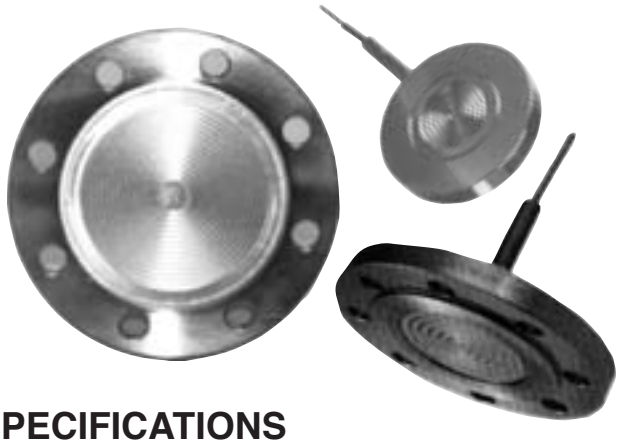
Note : 1- Turn down of 100 :1 is possible, but should be used at the span greater than 1/10 of the maximum span for better performance.
2- Consult FUJI for your application with the specific operating conditions
3- For DN < 50 consult FUJI for your application with the specific operating conditions
4- Transmitter with capilary design has a standard mounting bracket - rigid monting design are always without monting bracket
5- For rigid mounting design code 1, 2, 3, 4 not possible: codify Y, B, C, E for carbon steel bolts and A, D, F, G for SS bolts
6- Standard fill fluid of measuring cells : silicone oil - other fill fluids : upon request

DIAPHRAGM SEAL(S)

DATA SHEET

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 an 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-AII 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 stailess 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 for DN 50 to DN 125.
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 lengthes :
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
Maxi process pressure : 400 bar

Capillary tube sheald possibilities :

PVC sheald :
Temperature limit : -10 à 80°C
Stainless steel sheald :
Temperature limit : -40 à 400°C

Température 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 vaccum 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.

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 diaphr.	DN 80 / 3" SS diaphr.	DN 80 / 3" other diaph. materials	DN 100 / 4" SS diaphr.	Adaptor SS diaphr.
Transmitters					
F#B/F#M - gauge /abs pressure	2.03	0.11	0.22	0.04	0.11
capillary(m)	1.5	0.08	0.2	0.03	0.08
F#D - differential pressure	0.48	0.04	0.05	0.02	0.04
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 F#B, F#D, F#M)

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

Seal	DN 50 / 2" SS diaphr.	DN 80 / 3" SS diaphr.	DN 80 / 3" other diaph. materials.	DN 100 / 4" SS diaphr.	Adaptor SS diaphr.
for transmit.					
F#B/F#M	1.24	0.17	0.73	0.08	0. 17
F#D	0.5	0.09	0.22	0.05	0.09

Process temperature effect : (mbar/10°C)

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	Resp.time 0 to 320 mbar	Resp.time 0 to 640 mbar	Resp.time 0 to 1.3 bar
Std silicone oil	Y, G	0,934	0,15	0,08	0,037
Fluorinated oil	W,A,D	1,84	0,17	0,09	0,04
Oil for vaccum or high temperature	V, T	1,07	0,25	0,13	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.

Filling fluid of the diaphragm seals :

Code digit 7	Designation	Temperature resistance (°C)		Density (at 25°C)
		P abs ≥ 1 bar	P abs < 1 bar	
Y	Silicone oil	-40 to 180	-40 to 120	0,934
W	Fluorinated oil	-20 to 200	-20 to 120	1,84
F	Sanitary fill fluide	-10 to 250	-10 to 120	0,92
V	Silicone oil		-10 to 200	0,934
T	Silicone oil	-20 to 400	-10 to 200	0,934

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 occure together).
Other filling fluids can be used for your applications.

CODE SYMBOLS - S

1	2	3	4	5	6	7		8	
S							-		

	A								Flanged axial diaphragm seal connection	
	R								Flanged radial diaphragm seal connection - Not possible with rigid mounting design digit 6 : code R	
	W								Wafer type - Not possible with rigid mounting design digit 6 : code R	
							(*1)		**Flanges RF (Flange size and rating)**	
		4							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	
		K							G2" screwed seal	Only for direct mounting with F#P, F#H
		L							G 1" 1/2 screwed seal	Only for direct mounting with F#P, F#H
		U							PN 25 / DN 50 - coupling nut — DIN 11851 design	material code "V" only (digit 2 : "A" only)
		V							PN 40 / DN 50 - coupling nut — SMS	material code "V" only (digit 2 : "A" only)
		W							PN 40 / DN 50 - seal only — Clamp	material code "V" only (digit 2 : "A" only)
		A					(*2)	(*3)	Flange adaptor PN 40 DN 25	material code "V" - others upon request
		B					(*2)	(*3)	Flange adaptor ISO PN 20 DN 25 (1"-150 ANSI)	material code "V" - others upon request
		C					(*2)	(*3)	Flange adaptor ISO PN 50 DN 25 (1"- 300 ANSI)	material code "V" - others upon request
		D					(*2)	(*3)	Flange adaptor PN 40 DN 40	material code "V" - others upon request
		E					(*2)	(*3)	Flange adaptor ISO PN 20 DN 40 (1"1/2 - 150 ANSI)	material code "V" - others upon request
		F					(*2)	(*3)	Flange adaptor ISO PN 50 DN 40 (1"1/2 - 300 ANSI)	material code "V" - others upon request
		S					(*2)	(*3)	Screwed 1/2 NPTE	material code "V" - others upon request
		T					(*2)	(*3)	To be welded (pipe 2"1/2)	material code "V" - others upon request

Diaphragm seal material

				Diaphragm	Flange raised face	Flange
		V	(*4)	SS 316L	SS 316 L	SS 316 L
	(*8)	H		Hastelloy-C	Hastelloy-C	SS 316 L
	(*8)	B		Monel	Monel	SS 316 L
	(*8)	T		Tantalum	Tantalum	SS 316 L
	(*8)	P	(*2) (*9)	Titanium	Titanium	SS 316 L
	(*8)	R	(*2) (*9)	Zirconium	Zirconium	SS 316 L
	(*8)	C		SS 316 L + gold coat	SS 316 L	SS 316 L
	(*8)	F	(*2) (*5)	SS 316L + FEP lining	SS 316 L + FEP lining	SS 316 L

Diaphragm seal design

		Y		Flush mounting	
		A	(*6)	Diaphragm extension 50 mm	
		B	(*6)	Diaphragm extension 100 mm	material code "V" - digit 4
		C	(*6)	Diaphragm extension 150 mm	
		D	(*6)	Diaphragm extension 200 mm	
		E	(*6)	Diaphragm extension 50 mm	
		F	(*6)	Diaphragm extension 100 mm	material code "H" - digit 4
		G	(*6)	Diaphragm extension 150 mm	
		H	(*6)	Diaphragm extension 200 mm	
		J	(*6)	Diaphragm extension 50 mm	
		K	(*6)	Diaphragm extension 100 mm	material code "B" - digit 4
		L	(*6)	Diaphragm extension 150 mm	
		M	(*6)	Diaphragm extension 200 mm	
		P	(*6)	Diaphragm extension 50 mm	
		R	(*6)	Diaphragm extension 100 mm	material code "T" - digit 4
		S	(*6)	Diaphragm extension 150 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
	(*7)	G		Capillary	1,5 m	SS sheald (*9)
	(*7)	H		Capillary	3 m	SS sheald (*9)
	(*7)	K		Capillary	6 m	SS sheald (*9)
	(*7)	L		Capillary	Upon request	SS sheald (*9)
		R		rigid design - not possible with digit 2 = R, W - max. process temperature : 150°C (for F#D, F#M, F#B)		
		S		rigid design - not possible with digit 2 = R, W - max. process temperature : 150°C (for F#P, F#H)		

Special applications and fill fluid for the diaphragm seal only

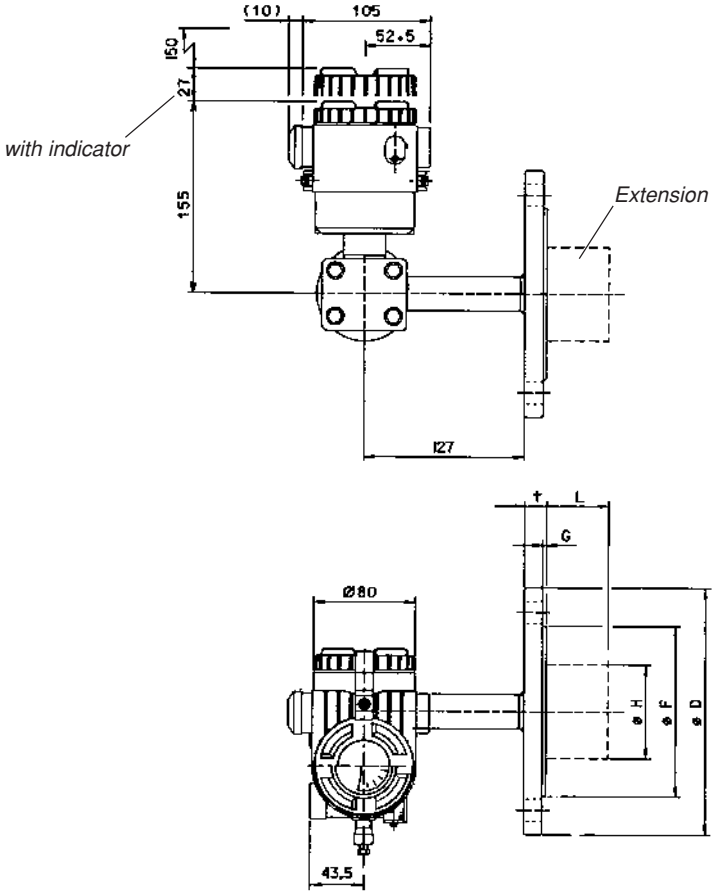
				Treatment	Fill fluid
		Y		None (standard)	Silicone oil
		W		None (standard)	Fluorinated oil
		F		None (standard)	Sanitary fill fluid
		D		Chlorine service	Fluorinated oil
		G		Degreasing	Silicone oil
		A		Oxygen service	Fluorinated oil
		N		NACE	Silicone oil
	(*8)	V		Vacuum - max temp 200°C	Silicone oil
	(*8)	T		Very high temp (- 20 to 400°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- Not possible with diaphragm extension - Only available with span higher than 0 to 0,5/5 bar - max process temperature : 150°C
3- Axial diaphragm seal connection - no extension possible
4- SS316 L for DN 50, 80 & 100 & flange adaptors
5- Not possible with digit 7 : V, T
6- All wetted parts in the same material (diaphragm, extension, flange gasket area)
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

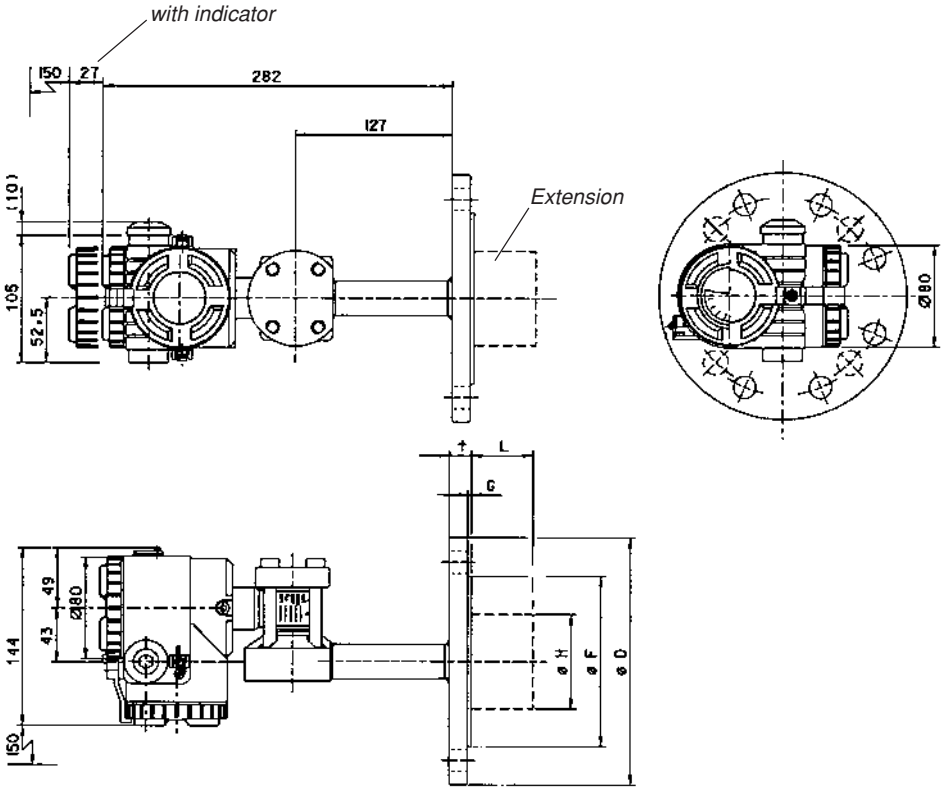
Outline dimensions for rigid mounted diaphragm seal on a gauge or an absolute pressure transmitter (units : mm)

Dimensions of the seal - refer to page 14, 15 and 16

Short mounting design



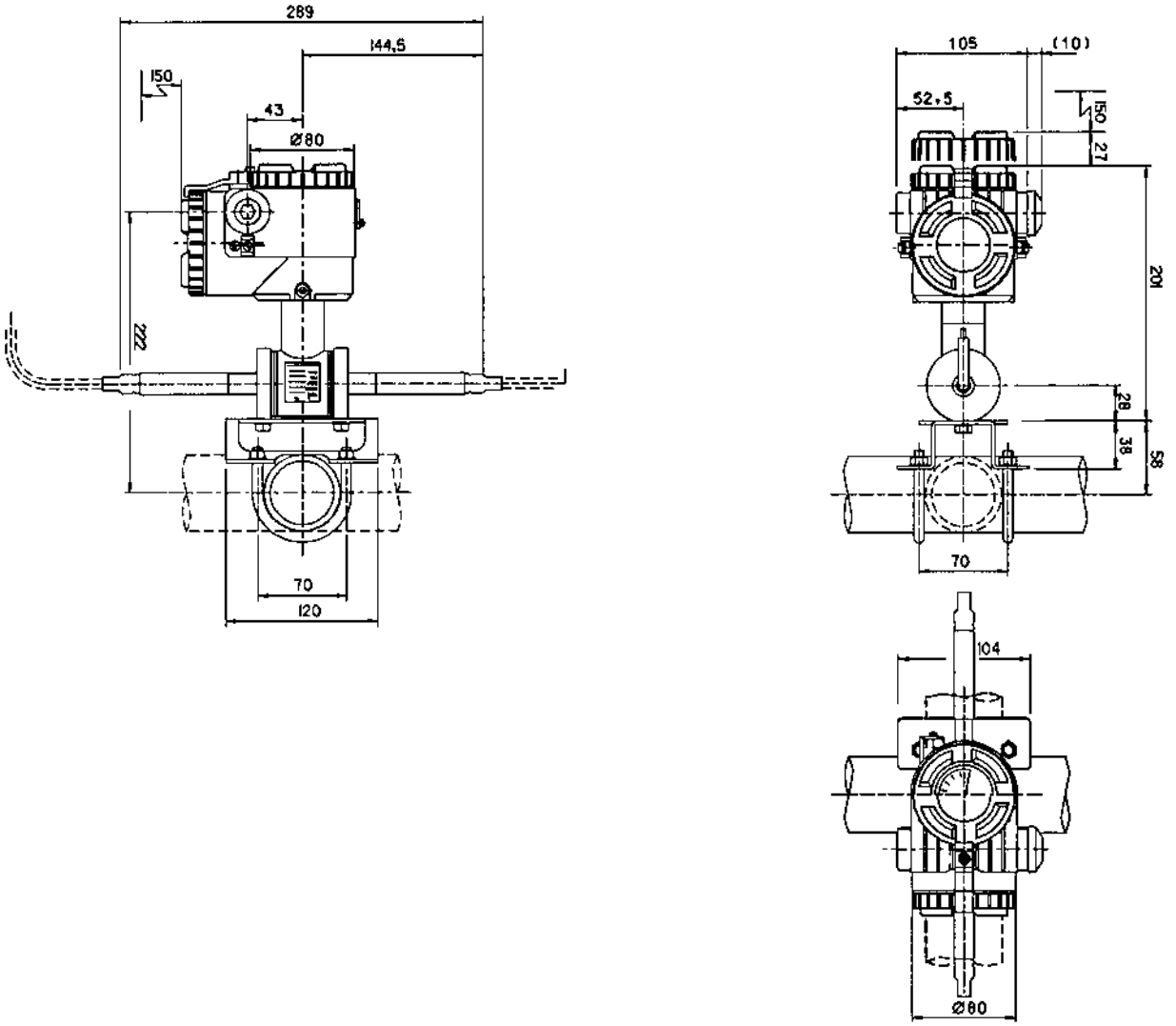
Long mounting design



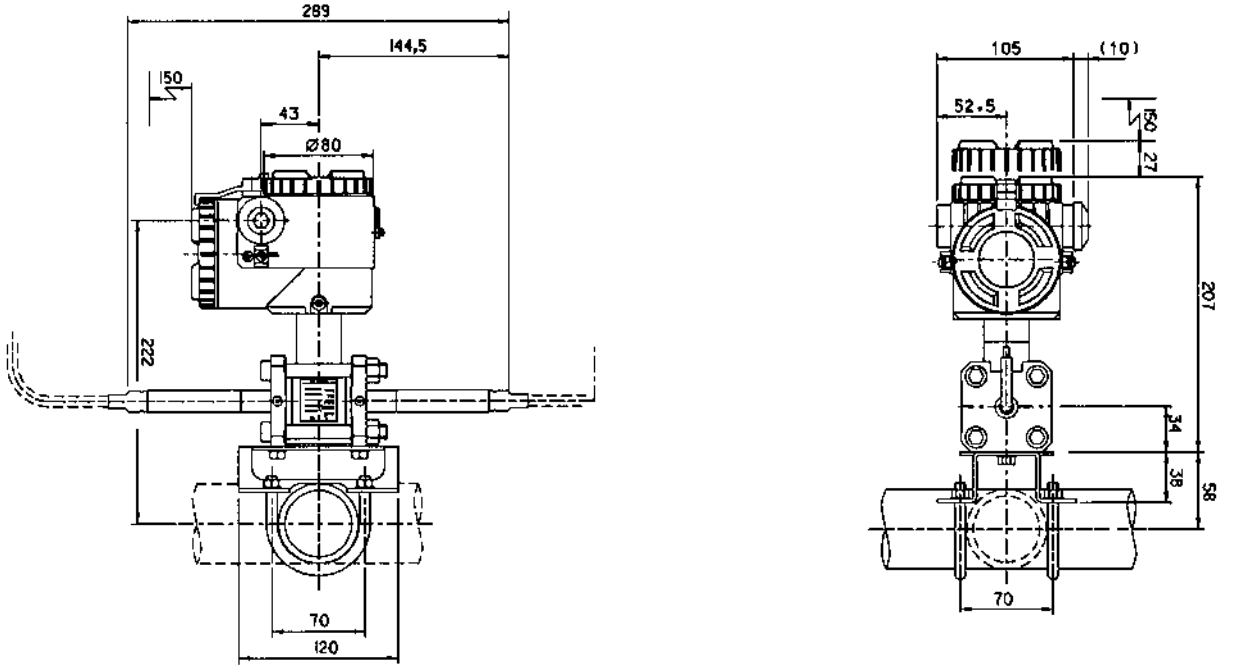
Outline dimensions for capillary mounted diaphragm seal(s) on a differential pressure transmitter (units : mm)

Dimensions of the seal - refer to page 14, 15 and 16

For PN ≤ 50bar : reduced volume flanges are welded on the measuring cell



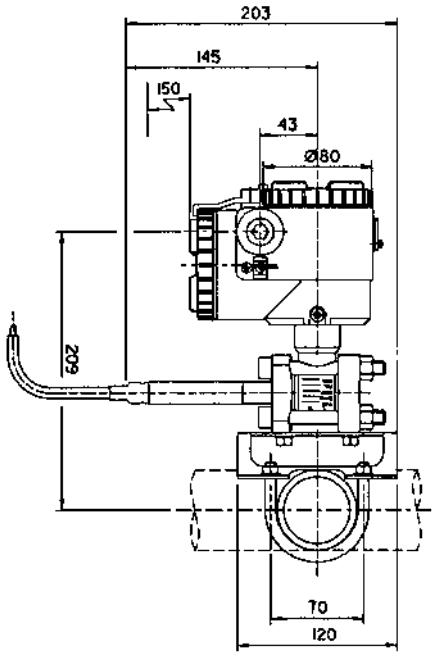
For PN>50bar : reduced volume flanges are welded and bolted on the measuring cell

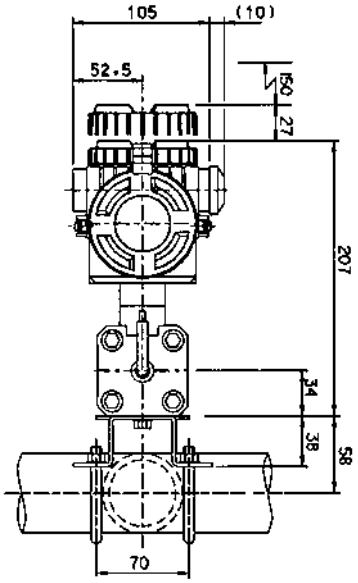


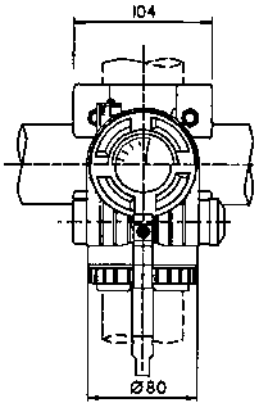
Outline dimensions for capillary mounted diaphragm seal(s) on a gauge or absolute pressure transmitter (units : mm)

Dimensions of the seal - refer to page 14, 15 and 16

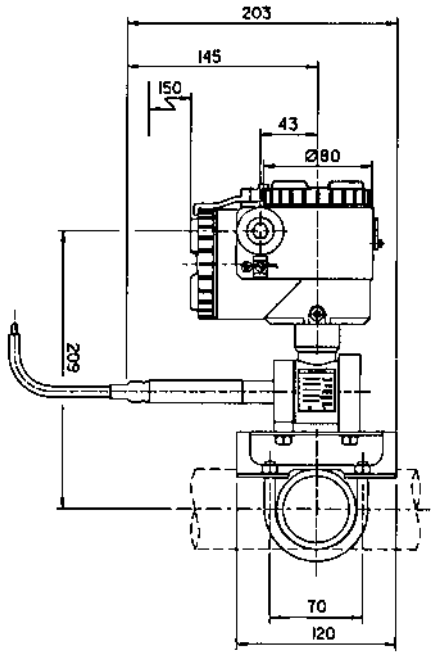
For PN ≤ 50bar : reduced volume flanges are welded on the measuring cell

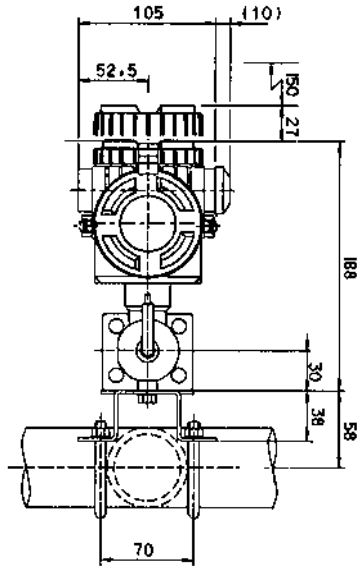






For PN>50bar : reduced volume flanges are welded and bolted on the measuring cell

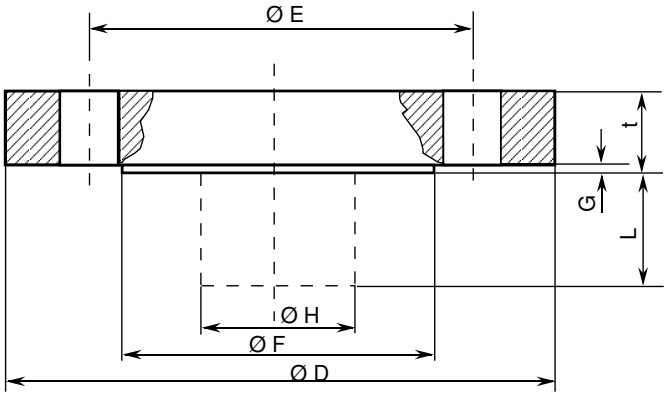




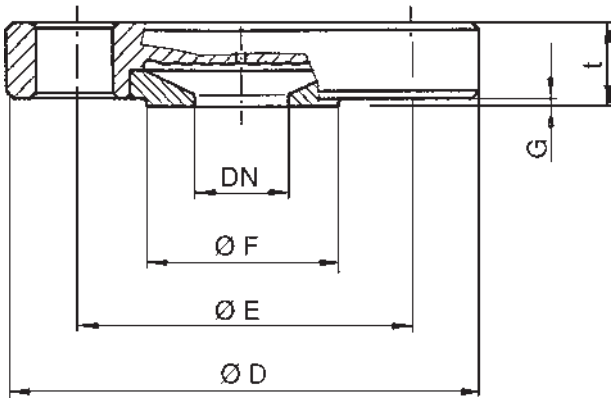
Outline dimensions of the standard diaphragm seals - Flush and extension

(units : mm)

DN 50, 80, 100



DN ≤ 25 ou 1“



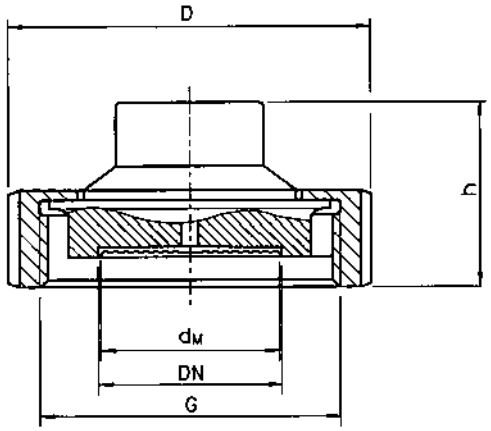
FLANGE DIMENSIONS ACCORDING DIN 2501 ET B16.5										
DIN / ISO		ANSI								
PN	DN	NP	NW	ØD	ØE	ØF	G	ØH	t	N x Øh
40	15			95	65	45	2		22	4 x 14
40	20			105	75	58	2		22	4 x 14
40	25			115	85	68	2		22	4 x 14
40	50			165	125	102	3	48	20	4 x 18
40	80			200	160	138	3	73	20	8 x 18
16	100			220	180	158	3	96	20	8 x 18
20	15	150 lbs	1/2”	95	60,5	35	2		22	4 x 16
20	20	150 lbs	3/4”	100	70	43	2		22	4 x 16
20	25	150 lbs	1”	110	79,5	51	2		22	4 x 16
50	15	300 lbs	1/2”	95	66,5	35	2		22	4 x 16
50	20	300 lbs	3/4”	120	82,5	43	2		22	4 x 20
50	25	300 lbs	1”	125	89	51	2		22	4 x 20
20	50	150 lbs	2”	150	120,5	92	1,6	48	20	4 x 20
20	80	150 lbs	3”	190	152,5	127	1,6	73	24	4 x 20
20	100	150 lbs	4”	230	190,5	158	1,6	96	24	8 x 20
50	50	300 lbs	2”	165	127	92	1,6	48	22,5	8 x 20
50	80	300 lbs	3”	210	168,5	127	1,6	73	29	8 x 22
50	100	300 lbs	4”	255	200	158	1,6	96	32	8 x 22

Outline dimensions of sanitary diaphragm (units : mm)

The seals for the sanitary and pharmaceutical applications are available DIN, SMS and Tri Clamp standards

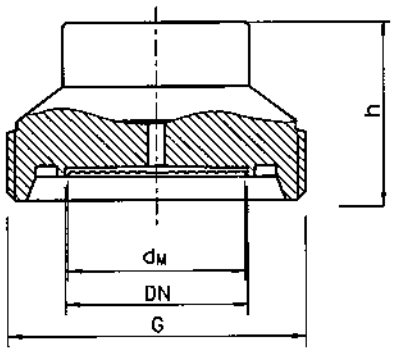
Seals according DIN 11851 and SMS standard
2 different designs exists for DIN 11851 and SMS :
(d_M = diamètre actif de la membrane)

Coupling nut design



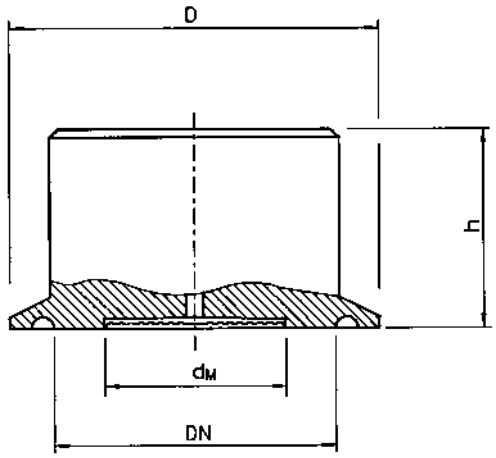
DIN 11851					
DN	PN (Max)	D	h	d_M	G
25	40	63	36	25	Rd 52 x 1/6
32	40	70	36	32	Rd 58 x 1/6
40	40	78	36	40	Rd 65 x 1/6
50	40	112	36	52	Rd 78 x 1/6
65	40	112	36	65	Rd 95 x 1/6
80	40	127	36	76	Rd 110 x 1/4

Male thread design



SMS					
DN	PN (Max)	D	h	d_M	G
25	40	51	38	25	Rd 40 x 1/6
32	40	60	38	32	Rd 48 x 1/6
38	40	74	38	40	Rd 60 x 1/6
51	40	84	38	52	Rd 70 x 1/6
63.5	40	100	38	65	Rd 85 x 1/6
76	40	114	38	76	Rd 98 x 1/6

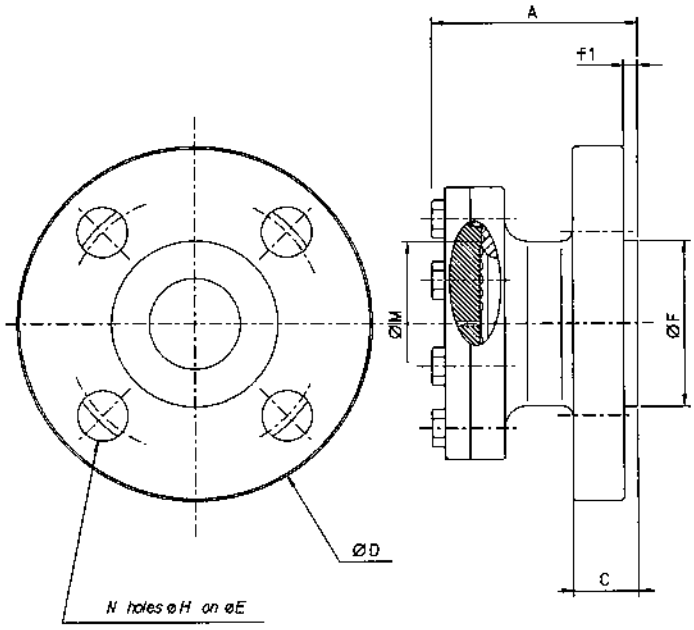
Tri Clamp design



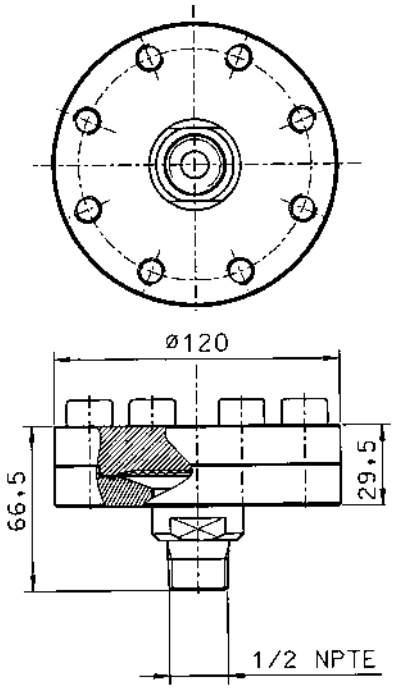
DN	PN (Max)	D	h	d_M
1 1/2"	40	50,5	35	32
2"	40	64	35	40
2 1/2"	40	77,5	35	50
3"	40	91	35	65

Outline dimensions of diaphragm seals with adaptors (units : mm)

Flange adaptor



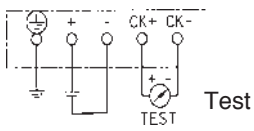
Screwed adaptor



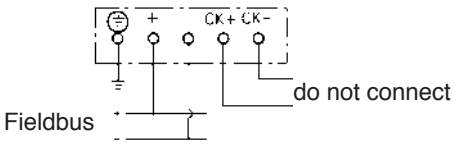
FLANGES DIMENSIONS												
DIN		AINSI		Ø D	ØE			ØF	Cmin	f1	A	ØM
PN	DN	Pe	DN			N	ØH					
40	25			115	85	4	14	68	17	2	83	72,2
20	25	150	1”	108	79,5	4	15,8	50,8	16	1,6	81	72,2
50	25	300	1”	124	88,9	4	19	50,8	17,5	1,6	86	72,2
40	40			150	110	4	18	88	17	3	85	72,2
20	40	150	1 1/2”	127	98,4	4	15,8	73	17,5	16	85	72,2
50	40	300	1 1/2”	156	114,3	4	22,2	20,6	73	1,6	91	72,2

CONNECTION DIAGRAM

FK# unit



FD# unit



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