FUJI ELECTRIC

FCX

FCX – AX SERIES FLOW TRANSMITTER

DATA SHEET

FHF···3

The FCX–AX flow transmitter accurately measures differential pressure generated by a primary element, and transmits a 4 to 20mA signal proportional to flow. The transmitter utilizes unique micromachined capacitance silicon sensor with state-of-the-art microprocessor technology to provide exceptional performance and functionality.

FEATURES

1. High accuracy
   0.07% accuracy for all calibrated spans is a standard feature for all models covering 0.1kPa{1mbar} draft range to 3000kPa{30bar} high differential. Fuji's micro-capacitance silicon sensor assures this accuracy.
2. Minimum environmental influence
   The "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. Application flexibility
   Various options that render the FCX–AX suitable for almost any process applications include:
   – Analog indicator at either the electronics side or terminal side
   – Full range of hazardous area approvals
   – Built-in RFI filter and lightning arrester
   – $4\frac{1}{2}$-digits LCD meter
   – Stainless steel electronics housing
   – Wide selection of materials

SPECIFICATIONS

Functional specifications

Service: Liquid, gas, or vapour

Static pressure, span, and range limit:

Type	Static pressure [MPa] {bar}	Span limit [kPa] {m bar}		Range limit [kPa] {m bar}
		Min.	Max.	
FHF□11	–0.1 to + 3.2	0.1	1	+/– 1
	{–1 to + 32}	{ 1}	{ 10}	{+/– 10}
FHF□22	–0.1 to + 10	0.6	6	+/– 6
	{–1 to + 100}	{ 6}	{ 60}	{+/– 60}
FHF□23	–0.1 to + 10	3.2	32	+/– 32
	{–1 to + 100}	{ 32}	{ 320}	{+/– 320}
FHF□25	–0.1 to + 10	13	130	+/– 130
	{–1 to + 100}	{ 130}	{ 1300}	{+/– 1300}
FHF□26	–0.1 to + 10	50	500	+/– 500
	{–1 to + 100}	{ 500}	{ 5000}	{+/– 5000}
FHF□33	–0.1 to + 16	3.2	32	+/– 32
	{–1 to + 160}	{ 32}	{ 320}	{+/– 320}
FHF□35	–0.1 to + 16	13	130	+/– 130
	{–1 to + 160}	{ 130}	{ 1300}	{+/– 1300}
FHF□36	–0.1 to + 16	50	500	+/– 500
	{–1 to + 160}	{ 500}	{ 5000}	{+/– 5000}
FHF□38	–0.1 to + 16	300	3000	+/– 3000
	{–1 to + 160}	{ 3000}	{ 30000}	{+/– 30000}
FHF□43	–0.1 to + 42	6.4	64	+/– 32
	{–1 to + 420}	{ 32}	{ 320}	{+/– 320}
FHF□44	–0.1 to + 42	6.4	64	+/– 64
	{–1 to + 420}	{ 64}	{ 640}	{+/– 640}
FHF□45	–0.1 to + 42	13	130	+/– 130
	{–1 to + 420}	{ 130}	{ 1300}	{+/– 1300}
FHF□46	–0.1 to + 42	50	500	+/– 500
	{–1 to + 420}	{ 500}	{ 5000}	{+/– 5000}
FHF□48	–0.1 to + 42	300	3000	+/– 3000
	{–1 to + 420}	{ 3000}	{ 30000}	{+/– 30000}

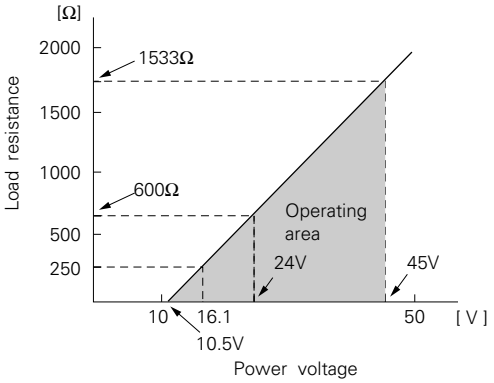
– Lower limit of static pressure (vacuum limit) ;
  Silicone fill sensor: See Fig. 1
  FHF□38 and FHF□48: –50kPa{–0.5kgf/cm^2}
  Fluorinated fill sensor: 66kPa abs (500mmHg abs) at temperature below 60°C.
– The maximum span of each sensor can be converted to different units using below factors.
  1MPa=10^{3}kPa=10bar=10.19716kgf/cm^2=145.0377psi
  1kPa=10mbar=101.9716mmH_2O=4.01463inH_2O

Overrange limit: To maximum static pressure limit

Output signal: 4 to 20mA DC
Square root of differential input pressure between 0.5% and 100% of input.
Linear or zero is selectable below 0.5% of input.

Power supply: Transmitter operates on 10.5V to 45V DC at transmitter terminals.
10.5V to 32V DC for the units with optional arrester.

Load limitations: see figure below



Hazardous locations: (Approval pending)

Authorities	Flameproof	Intrinsic safety	Type N Nonincendive
BASEEFA	Ex ds IIC T5, T6	EEx ia IIC T4, T5	Ex N II T5
Factory Mutual	Class I II III Div. 1 Groups B thru. G	Class I II III Div. 1 Groups A thru. F	Class I II III Div. 2 Groups A thru. G
CSA	Class I II III Div. 1 Groups C thru. G	Class I II III Div. 1 Groups A thru. G	Class I II III Div. 2 Groups A thru. G
RIIS	Ex ds IIB+H_2 T4	—	—
SAA	Ex d II C T5, T6 IP 66/67	Ex ia II C T5, T6 IP 66/67	Ex n II C T5, T6 IP 66/67

Zero/span adjustment:
Zero is adjustable from the external adjustment screw.
The adjustment screw can also function to adjust span when MODE SWITCH (located on the electronics unit) is in the span mode.
INHIBIT mode to disable the adjustable screw is also available.

Damping: Adjustable electrical damping.
The time constant is adjustable to 0, 0.3, 1.2, 4.8, or 19.2 seconds.

Zero elevation/suppression:
–100% to +100% of URL

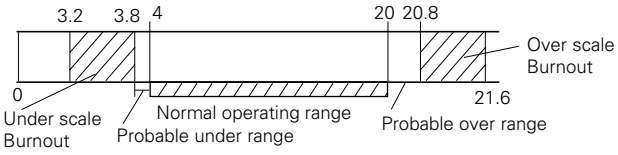
Normal/reverse action:
Selectable by moving a jumper pin located on the electronics unit.

Indication: Analog indicator or $4\frac{1}{2}$-digit LCD meter, as specified.

Burnout direction: If self-diagnostic detect transmitter failure, the analog signal will be driven to either "Output Hold", "Output Overscale" or "Output Underscale" modes.

Model FHF: Unless otherwise specified in the order, the transmitter will be shipped in "Output Hold" mode.
(Output signal just before failure happens is maintained.)

"Output Hold": Output signal is hold as the value just before failure happens.
"Output Overscale": Approx. 21.6mA
"Output Underscale": Approx. 3.8mA



Loop-check output:
Transmitter can output constant signal of 4mA, 12mA, or 20mA if MODE SWITCH is set to the loop check mode.

Temperature limit: Ambient: – 40 to + 85°C
(– 20 to + 80°C for LCD indicator)
(– 40 to + 60°C for arrester option)
(– 10 to + 60°C for fluorinated oil fill transmitter)
– 15 to +85°C for 6 digit code "8".
For explosionproof units (flameproof or intrinsic safety), ambient temperature must be within the limits specified in each standard.
Process: – 40 to +120°C for silicone fill sensor
– 20 to +80°C for fluorinated oil fill sensor
Storage: – 40 to +90°C

Humidity limit: 0 to 100% RH

Performance specifications

Accuracy rating: (Including linearity, hysteresis, and repeatability)

Max span above 32kPa model:
±0.07% of calibrated span for a range of 50% to 100% of flow.
(±0.175% for a range of 20% to 50% of flow)

Max span 1kPa, 6kPa model:
±0.1% of calibrated span for a range of 50% to 100% of flow.
(±0.25% for a range of 20% to 50% of flow)

Stability: ±0.1% of upper range limit (URL) for 24 months

Temperature effect:
Effects per 55°C change between the limits of – 40°C and +85°C

Range code (6th digit in "Code symbols")	Shift at 20% output (% of URL)
"1"/ 1kPa {10m bar} max. span "2"/ 6kPa {60m bar} max. span	$\pm\left(0.3+0.25\frac{\text{URL}}{\text{Span}}\right)$ %/28°C
"3"/ 32kPa {320m bar} max. span "4"/ 64kPa {640m bar} max. span "5"/ 130kPa {1300m bar} max. span "6"/ 500kPa {5000m bar} max. span "8"/ 3000kPa {30000m bar} max. span	$\pm\left(0.25+0.0625\frac{\text{URL}}{\text{Span}}\right)$ %/28°C

Static pressure effect:

Static pressure code (5th digit in "Code symbols")	Shift at 20% output (% of URL)
"1" /1kPa {10m bar} sensor "2" /6kPa {60m bar} sensor	±0.25%/1MPa{10bar} ±0.25%/3.2MPa{32bar}
"2" "3" "4"	±0.125%/10MPa{100bar}

Double the shift for material code (7th digit in Code symbols) "H", "M", "T", "B", "L" and "U".

Overrange effect: Shift at 20% output (% of URL)

Static pressure code (5th digit in "Code symbols")	Shift at 20% output (% of URL)
"1" / 1kPa {10m bar} sensor	±0.75% / 1MPa {10bar }
"2" / 6kPa {60m bar} sensor	±0.75% /3.2MPa {32bar }
"2"	±0.25% / 10MPa {100bar } *1
"3"	±0.25% / 16MPa {160bar } *1
"4"	±0.42% / 42MPa {420 bar} *1

Double the effects for material code "H", "M", "T", "B", "L" and "U".

*1) In case of 6th code "5".

Supply voltage effect:
Less than 0.05% of calibrated span per 10V

RFI effect: Less than 0.2% of URL for the frequencies of 20 to 1000MHz and field strength 30 V/m when electronics covers on.
(Classification: 2-abc: 0.2% span per SAMA PMC 33.1)

Step response: (without electrical damping)

Type	Time constant	Dead time
FHF□11	1.25 s	approx. 0.3 s
FHF□12	0.85 s	
FHF□□3	0.45 s	
FHF□4 to □8	0.2 s	

Mounting position effect:
Zero shift, less than 0.12kPa {1.2m bar} for a 10° tilt in any plane.
No effect on span.
This error can be corrected by adjusting Zero.
(Double the effect for fluorinated fill sensors)

Dielectric strength:
500V AC, 50/60Hz 1 min., between circuit and earth.

Insulation resistance:
More than 100MΩ at 500V DC.

Turn-on time: 4 sec.

Internal resistance for external field indicator:
12Ω or less

Physical specifications

Electrical connections:
G1/2, 1/2-14 NPT, Pg13.5, or M20 × 1.5 conduit, as specified.

Process connections:
1/4-18 NPT or Rc1/4 on 54mm centers, as specified.
Meets DIN 19213.

Process-wetted parts material:

Material code (7th figure in "Code symbols")	Process cover	Diaphragm	Wetted sensor body	Vent/drain
V	316 stainless steel(*1)	316L stainless steel	316 stainless steel	316 stainless steel
H	316 stainless steel(*1)	Hastelloy-C	Hastelloy-C lining	316 stainless steel
M	316 stainless steel(*1)	Monel	Monel lining	316 stainless steel
T	316 stainless steel(*1)	Tantalum	Tantalum lining	316 stainless steel
B	Hastelloy-C lining	Hastelloy-C	Hastelloy-C lining	Hastelloy-C
L	Monel lining	Monel	Monel lining	Monel
U	Tantalum lining	Tantalum	Tantalum lining	Tantalum

Notes: * (1) SCS14 per JIS G 5121
Remark: Sensor O-rings: Viton and teflon selectable.
Availability of above material design depends on ranges and static pressure. Refer to "Code symbols".

Non-wetted parts material:
Electronics housing: Low copper die-cast aluminum alloy (standard), finished with polyester coating, or 316 stainless steel (SCS14 per JIS G5121), as specified.
Bolts and nuts: Cr-Mo alloy (standard), 304 stainless steel (for static pressure code "1", "2", and "3" only), or 630 stainless steel (for static pressure code "4" only). Static pressure rating for code "3" with 304 stainless steel bolts is degraded to 10MPa{100bar}.
Fill fluid: Silicone oil (standard) or fluorinated oil (Daifloil)
Mounting bracket: Carbon steel with epoxy coating or 304 stainless steel, as specified

Environmental protection:
IEC IP67 and NEMA 4X

Mounting: On 60.5mm (JIS 50A) pipe using mounting bracket, direct wall mounting, or direct process mounting.

Mass{weight}: Transmitter approximately 4.4kg without options.
Add; 0.5kg for mounting bracket
0.8kg for indicator option
4.5kg for stainless steel housing option

Optional features

Indicator: A plug-in analog indicator (1.5% accuracy) can be housed in the electronics compartment or in the terminal box of the housing. An optional 4 digits LCD meter is also available.

Arrester: A built-in arrester protects the electronics from lightning surges.
Lightning surge immunity:
4KV (1.2 × 50μs)

Oxygen service: Special cleaning procedures are followed throughout the process to maintain all process wetted parts oil-free.
The fill fluid is fluorinated oil.

Chlorine service: Oil-free procedures as above. Includes fluorinated oil for fill.

Degreasing: Process-wetted parts are cleaned, but the fill fluid is standard silicone oil. Not for use on oxygen or chlorine measurement.

NACE specification:
Metallic materials for all pressure boundary parts comply with NACE MR-01-75. ASTM B7M or $\frac{1}{2}$L7M bolts and 2HM nuts (Class II) are available.
Static pressure rating for code "3" (160 bar) is degraded to 100 bar.

Vacuum service: Special silicone oil and filling procedure are applied.
See below figure.

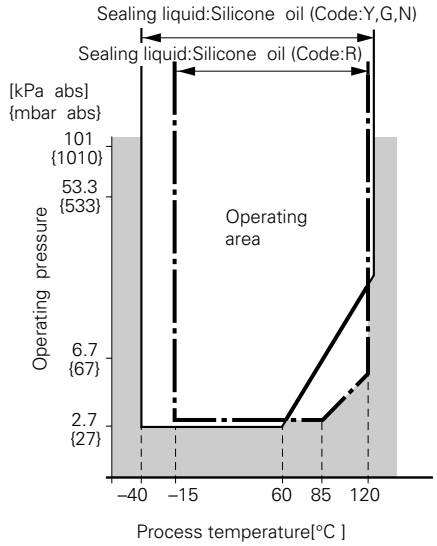


Fig. 1 Relation between process temperature and operating pressure

Customer tag: A stainless steel tag with customer tag data is wired to the transmitter.

Coating of cell: Cell's surface is finished with epoxy/polyuretane double coating.
Specify if environment is extremely corrosive.

ACCESSORIES

Oval flanges: (Model FFP, refer to Data Sheet No. EDS6-10)
Converts process connection to 1/2-14 NPT or to Rc1/2; in carbon steel or in 316 stainless steel.

Three-value manifolds:
(Model FFN, refer to Data Sheet No. EDS6-10)
Available in carbon steel or in 316 stainless steel and in pressure rating 16MPa {160bar} or 42MPa{420bar}.

The product conforms to the requirements of the Electromagnetic compatibility Directive 89/336/EEC as detailed within the technical construction file number TN510412. The applicable standards used to demonstrate compliance are :-

EMI (Emission) EN50081-1 : 1992

Test item	Frequency range	Basic standard
Applicable Electromagnetic Radiation Disturbance	30-1000MHz	EN55022 Class B

EMS (Immunity) EN50082-1 : 1992

No.	Test item	Test specification	Basic standard	Performance criteria
1	Electrostatic discharge	8kV (Air)	IEC 801-2:1984	B
2	Radio-frequency electromagnetic field.	27-500MHz 3V/m (Unmodulated)	IEC 801-3:1984	A
3	Fast transients common mode	0.5kV, 5/50 (Tr/Th) ns 5kHz Rep.	IEC 801-4:1988	B

"LVD - The transmitter is not covered by the requirements of the LVD standard."

CODE SYMBOLS

1	2	3	4	5	6	7	8	9	10	11	12	13		14	15
F	H	F					3						–		

Description

Connections

	Process connection	Oval flange screw	Conduit connection
S	Rc1/4	7/16-20UNF	G 1/2
T	1/4-18NPT	7/16-20UNF	1/2-14NPT
V	1/4-18NPT	M10 (or M12)*	Pg 13.5
W	1/4-18NPT	M10 (or M12)*	M20×1.5
X	1/4-18NPT	7/16-20UNF	Pg 13.5

Span and materials

	Static pressure [MPa] {bar}	Span limit (*2) [kPa] (m bar)	Process cover	Diaphragm	Wetted cell body
11V	–0.1 to +3.2 {–1 to +32}	0.1…1 {1…10}	316 stainless steel	316L stainless steel	316 stainless steel
11H			316 stainless steel	Hast. C	Hast. C lining
22V	–0.1 to +10 {–1 to 100}	0.6…6 {6…60}	316 stainless steel	316L stainless steel	316 stainless steel
22H			316 stainless steel	Hast. C	Hast. C lining
33V	–0.1 to +16 {–1 to +160}	3.2…32 {32…320}	316 stainless steel	316L stainless steel	316 stainless steel
33H			316 stainless steel	Hast. C	Hast. C lining
33M			316 stainless steel	Monel	Monel lining
33T			316 stainless steel	Tantalum	Tantalum lining
35V		13…130 {130…1300}	316 stainless steel	316L stainless steel	316 stainless steel
35H			316 stainless steel	Hast. C	Hast. C lining
35M			316 stainless steel	Monel	Monel lining
35T			316 stainless steel	Tantalum	Tantalum lining
36V		50…500 {500…5000}	316 stainless steel	316L stainless steel	316 stainless steel
36H			316 stainless steel	Hast. C	Hast. C lining
36M			316 stainless steel	Monel	Monel lining
36T			316 stainless steel	Tantalum	Tantalum lining
38V		300…3000 {3000…30000}	316 stainless steel	316L stainless steel	316 stainless steel
43V	–0.1 to +42 {–1 to +420}	3.2…32 {32…320}	316 stainless steel	316L stainless steel	316 stainless steel
43H			316 stainless steel	Hast. C	Hast. C lining
43M			316 stainless steel	Monel	Monel lining
45V		13…130 {130…1300}	316 stainless steel	316L stainless steel	316 stainless steel
45H			316 stainless steel	Hast. C	Hast. C lining
45M			316 stainless steel	Monel	Monel lining
46V		50…500 {500…5000}	316 stainless steel	316 stainless steel	316 stainless steel
46H			316 stainless steel	Hast. C	Hast. C lining
46M			316 stainless steel	Monel	Monel lining
48V		300…3000 {3000…30000}	316 stainless steel	316 stainless steel	316 stainless steel
23B	–0.1 to +10 {–1 to+100}	3.2…32 {32…320}	Hast. C lining	Hast. C	Hast. C lining
23L			Monel lining	Monel	Monel lining
23U			Tantalum lining	Tantalum	Tantalum lining
25B		13…130 {130…1300}	Hast. C lining	Hast. C	Hast. C lining
25L			Monel lining	Monel	Monel lining
25U			Tantalum lining	Tantalum	Tantalum lining
26B		50…500 {500…5000}	Hast. C lining	Hast. C	Hast. C lining
26L			Monel lining	Monel	Monel lining
26U			Tantalum lining	Tantalum	Tantalum lining

Note: * (1) The thread is M12, if 42MPa {420bar} static pressure is specified.

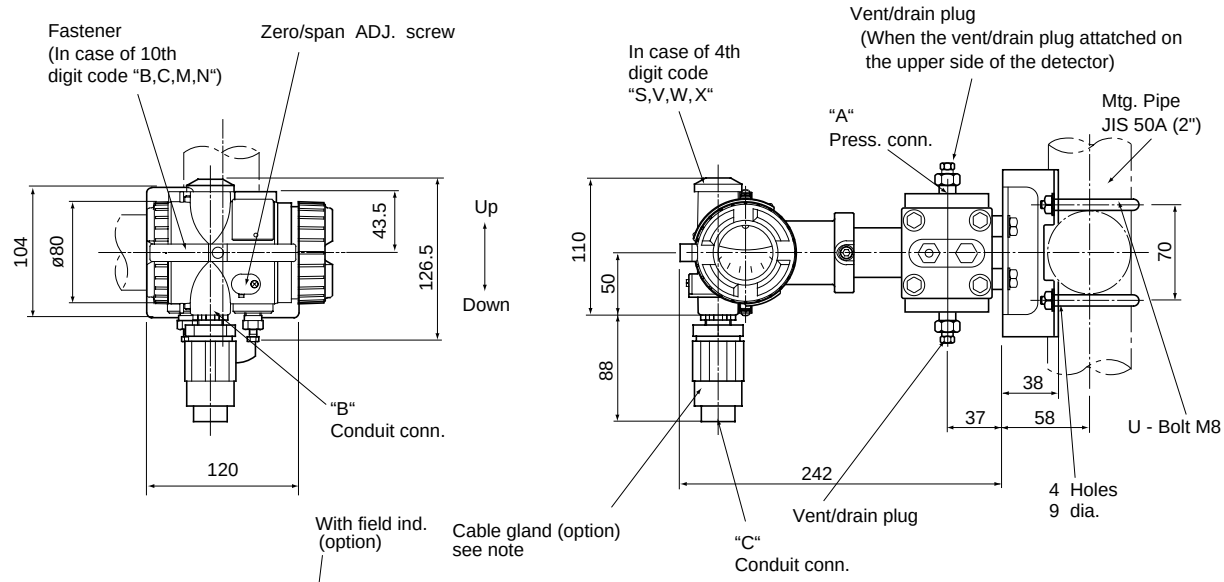
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

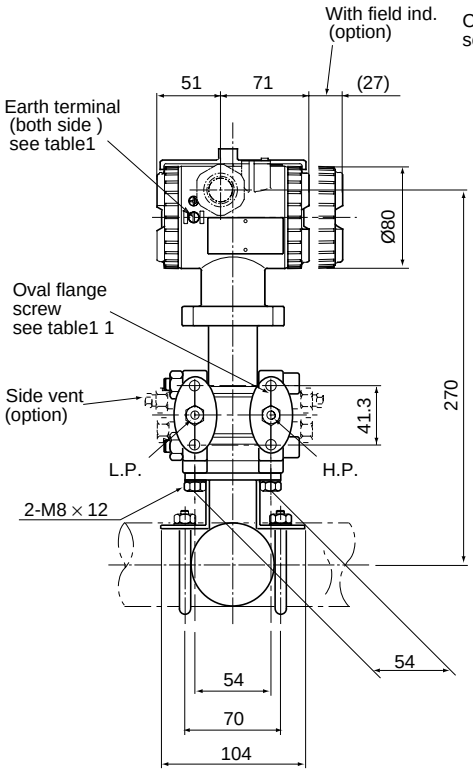
F H F □ □ □ □ 3 – □ □ □ □ □ – □ □

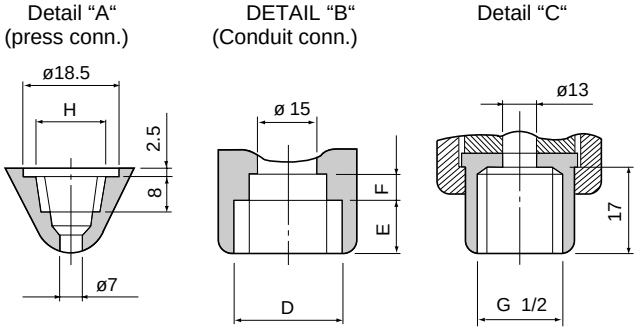
	Description
	Indicator and arrester
	Indicator / Arrester
A	None / None
B	Analog, 0 to 100% linear scale / None
D	Analog, custom scale / None
J	Analog, double scale / None
E	None / Yes
F	Analog, 0 to 100% linear scale / Yes
H	Analog, custom scale / Yes
K	Analog, double scale / Yes
L	Digital, 0 to 100% of flow / None
Q	Digital, 0 to 100% of flow / Yes
	Approvals for hazardous locations (Approval pending)
A	None (for ordinary locations)
B	JIS, Flameproof (Conduit seal) (Available for 4th digit code "S")
C	JIS, Flameproof (Cable gland seal) (Available for 4th digit code "S")
D	FM, Flameproof (or explosionproof) (Available for 4th digit code "T")
E	CSA, Flameproof (or explosionproof) (Available for 4th digit code "T")
M	BASEEFA, Flameproof (Conduit seal)
N	BASEEFA, Flameproof (Cable gland seal) (Conduit connection G 1/2 only)
H	FM, Intrinsic safety and nonincendive
J	CSA, Intrinsic safety and nonincendive
K	CENELEC, Intrinsic safety
P	CENELEC, Intrinsic safety and BASEEFA, Type N
R	SAA Flameproof (Conduit seal)(Available for 4th digit cord ("S,T,W)
T	SAA Intrinsic safety (Available for 4th digit cord ("S,T,W)
Q	SAA Type–N (non-sparking)(Available for 4th digit cord ("S,T,W)
	Side vent/ drain and mounting bracket
	Side vent/drain / Mounting bracket
A	None / None } Specify "A", "B", or "C" for the 7th digit code "B", "L", or "U"
B	None / Yes, carbon steel
C	None / Yes, stainless steel
D	Yes / None
E	Yes / Yes, carbon steel
F	Yes / Yes, stainless steel
	Stainless steel parts
	Stainless steel tag plate / Stainless steel elec, housing / Coating of cell
Y	None / None / None
B	Yes / None / None
C	None / Yes / None
E	Yes / Yes / None
M	None / None / Yes
N	Yes / None / Yes
P	None / Yes / Yes
Q	Yes / Yes / Yes
	Special applications and fill fluid
	Treatment / Fill fluid
Y	None (standard) / Silicone oil
W	None (standard) / Fluorinated oil
G	Degreasing / Silicone oil
A	Oxygen service / Fluorinated oil (Material code "W", "V")
D	Chlorine service / Fluorinated oil (Material code "H", "T", "B", "U")
N	NACE specification / Silicone oil (Not available for 7th digit code "T", "U" and 15th digit code "A", "B")
R	Vacuum service / Silicone oil for vacuum use
	Sensor O-ring
A	Viton
B	Teflon
	Bolt/nut
A	Cr-Mo alloy hexagon socket head cap screw/carbon steel nut
B	Cr-Mo alloy hexagon bolt/nut
C	NACE bolt/nut (ASTM A193 B7M/A194 2HM) } (*2)
D	NACE bolt/nut (ASTM A320 L7M/A194 2HM) } (*2)
E	304 stainless steel/304 stainless steel } (*3) } (*5)
F	630 stainless steel/304 stainless steel } (*4) } (*5)

Notes: (*2) Static pressure should be –0.1 to +10MPa{–1 to +100bar}.
(*3) Available for the 5th digit code "1", "2", "3". In case of stainless steel bolt with the 5th digit code "3", static pressure should be –0.1 to +10MPa {–1 to + 100bar}.
(*4) Available for the 5th digit code "3", "4".
(*5) In case of tropical use, select a stainless bolts and nuts.

OUTLINE DIAGRAM (Unit:mm)



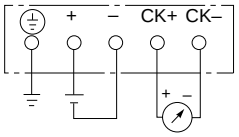




4th digit code	Conduit conn. D	E	F	Press. conn. H	Oval flange screw	Earth terminal
S	G1/2	17	8	Rc1/4	7/16-20UNF Screw depth13	M4
T	1/2 –14NPT	16	5	1/4–18NPT	7/16-20UNF Screw depth13	No. 8-32UNC
V	Pg13.5	8	4.5	1/4–18NPT	M10 Screw depth13	M4
W	M20 × 1.5	16	5	1/4–18NPT	7M10 Screw depth13	M4
X	Pg13.5	8	4.5	1/4–18NPT	7/16-20UNF Screw depth13	M4

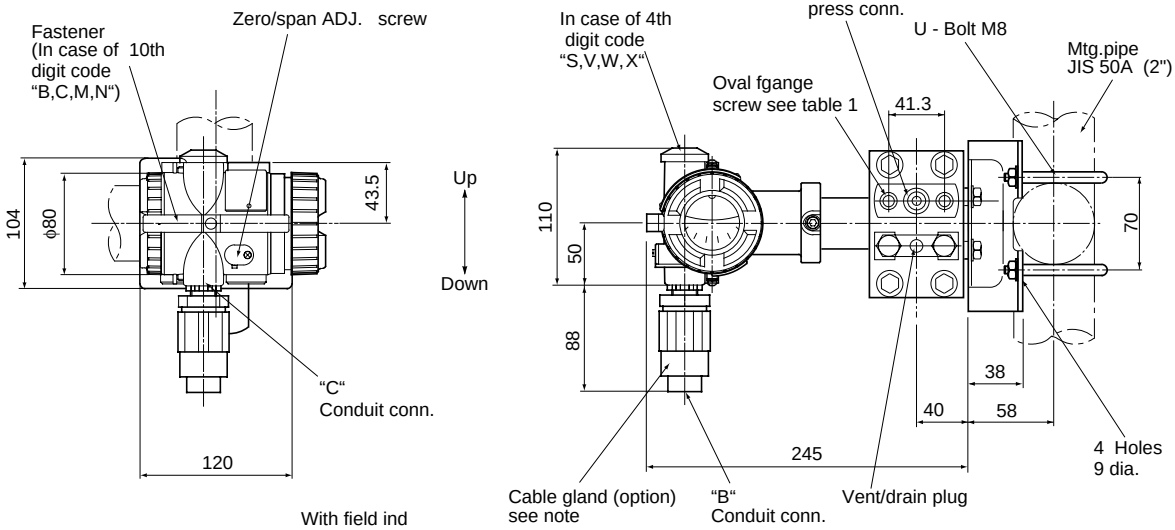
Table 1

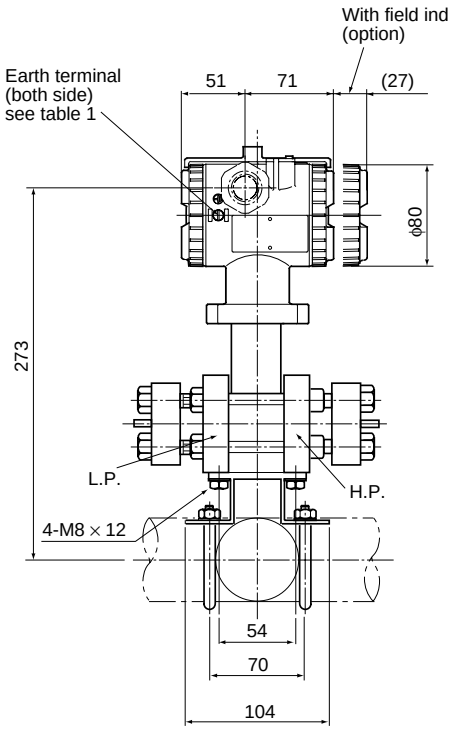
CONNECTION DIAGRAM

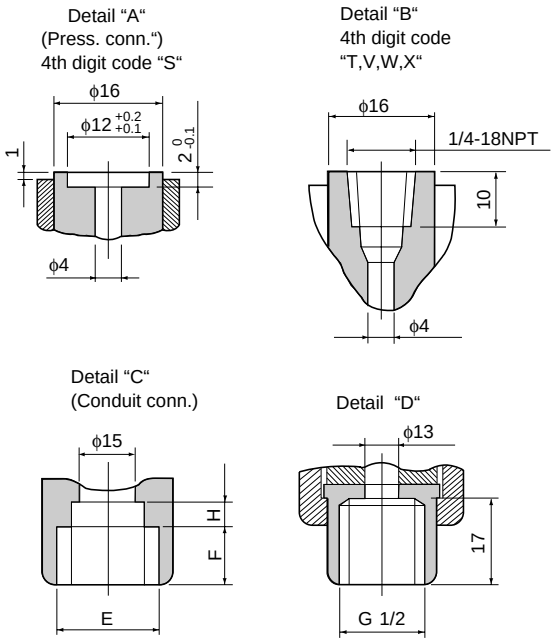


Note1) : Cable gland is supplied in case of flamproof packing type.
ø11 cable is suitable.

FHF S T V W X □□ W V H M T 3

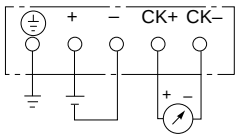






See table 1

CONNECTION DIAGRAM



FHF [S T V W X] 2 [ ] [B L U] 3

4th digit coode	Conduit conn.			Oval flange screw	Earth terminal
	E	F	H		
S	G1/2	17	8	7/16–20UNF Screw depth 13	M4
T	1/2 -14NPT	16	5	7/16–20UNF Screw depth 13	No. 8-32UNC
V	Pg13.5	8	4.5	M10 Screw depth 13	M4
W	M20 × 1.5	16	5	M10 Screw depth 13	M4
X	Pg13.5	8	4.5	7/16–20UNF Screw depth 13	M4

Table 1

Note) : Cable gland is supplied in case of flameproof packing type.
ϕ11 cable is suitable.

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